

Domestic Interconnection Arrangements for Datel Services

J.G. Williams



U.S. DEPARTMENT OF COMMERCE
Malcolm Baldrige, Secretary

Dale N. Hatfield, Acting Assistant Secretary
for Communications and Information

March 1981



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DOMESTIC INTERCONNECTION ARRANGEMENTS FOR DATEL SERVICES

EXECUTIVE SUMMARY

The Interconnection Issue

The International Record Carriers (IRCs) have, for a number of years, provided a switched, overseas voiceband data service called Datal. As currently implemented, IRC customers in the United States call through the Bell/Independent domestic message telephone service (MTS) network in the usual fashion in order to reach a Datal switch or an IRC operator. The call is then placed over conditioned IRC and overseas correspondent transmission facilities in order to reach the country of call destination. Finally, the overseas domestic telephone network is used to complete the call to the desired party in the foreign country. Service in the opposite direction, from other countries into the United States, is also available.

This report is concerned with the changes proposed in the Bell/Independent domestic MTS network to provide a more advanced form of interconnection to the IRCs. Examples of such changes include several types of arrangements for a better quality of transmission between the IRC customer and the IRC switch and the capability for the customer to dial the called number using the same number of digits used for overseas MTS calls.

There has been a history of debate between the IRCs and AT&T concerning the issue of interconnection. This history is considered in detail in Section 2 of this report. Various interconnection plans have been placed before the FCC by the IRCs. AT&T, in Commission filings, has generally argued against these proposals. Section 214 applications have been filed by AT&T for the use of international MTS for data (by the FCC 1964 TAT-4 Decision) and by the IRCs for enhanced overseas Datal offerings. Petitions have been placed before the Commission by AT&T to deny the IRCs' requests, and, likewise, the IRCs have petitioned the Commission to deny AT&T until they obtain a "suitable" interconnection. Thus, the issue of IRC interconnection for Datal has been a principal point of contention.

In orders released on February 11, 1980, and February 14, 1980, respectively, the Commission granted the AT&T Section 214 application, while also relaxing the conditions under which the IRCs could offer Datal. The Section 214 applications of the IRCs were not granted in full. Specifically, their exact interconnection requests were not granted. However, the Commission retained jurisdiction over this matter pending the outcome of the MTS-WATS Market Structure Inquiry, the Docket 19660 proceedings, and this study.

This study was originally initiated by the National Telecommunications and Information Administration (NTIA) in August 1979 in the belief that the sanctioned use of international MTS for data, improved Datel¹ offerings by the IRCs, and increased competition in international telecommunications in general would all be in the public interest. Since the forum of filings before the Commission had not broken the impasse over the interconnection issue, NTIA believed that an independent study would be useful to the Commission. As the study has evolved, it appears that its principal use can be to provide a framework so that more productive discussion can transpire between the affected carriers.

Study Methodology

In discussing interconnection, it is extremely helpful to factor the problem into eight specific operational and technical areas, namely:

- o Point of Interconnection
- o Numbering Plan
- o Signaling
- o Operator Procedures
- o Customer Billing
- o Maintenance and Testing
- o Financial Arrangements
- o Network Planning.

This categorization is used extensively throughout this report. In Section 2 it provides a common denominator for considering the claims and proposals made by the various carriers. In Sections 3 and 4 it provides a framework for the further analysis of the interconnection issue.

Several months after this study was initiated, the ENFIA II meetings commenced. ENFIA II was concerned with the technical and operational issues related to the domestic OCCs' use of the Bell/Independent switched intraexchanged network for local distribution. Although this interconnection problem is not the same² as that facing the IRCs for Datel, there are many similarities. The study reported here was therefore

¹ Certain commercial equipment, instruments, materials, or services are identified in this paper to specify adequately the analysis procedures. In no case does such identification imply recommendation or endorsement by NTIA, nor does it imply that the material or equipment identified is necessarily the best available for the purpose.

² One future problem raised by the IRCs which is not included in the above categorization, and which is distinctly different from the concerns of the domestic OCCs, is that of double satellite hops. With the increasing use of domestic satellites in the MTS network, the potential for double hop transmission will grow.

refocused to take advantage of the information developed in ENFIA II. Much of this information might not have been available otherwise, so the occurrence of ENFIA II was fortunate. Section 3 of this report contains an analysis of the Datel interconnection problem as it relates to ENFIA II, while Section 4 is concerned with other aspects of the interconnection issue.

Study Results

Having factored the interconnection problem into technical and operational areas, in Section 5 we recombine these aspects in order to discuss the problem as a whole. Three different outlooks for improved Datel interconnection are considered as a function of the timeframe over which implementation is likely to occur.

There are several reasons why more ambitious interconnection arrangements will take longer to implement. First, such arrangements will require changes throughout the Bell/Independent MTS network. Unless extraordinary expenses are incurred, such changes must be incorporated into ongoing plans to modernize this network. Such long-term modernization plans, for example the introduction of electronic switching, require a number of years to complete. Second, the introduction of more advanced interconnection arrangements for the IRCs must be coordinated with the introduction of similar arrangements required to accommodate other carriers, such as the domestic OCCs. This is required for economic reasons and to avoid the conflict which might otherwise result from the piecemeal introduction of change.

These three categories of solutions, long-term, medium-term, and short-term, are discussed below. This categorization assumes that the IRCs will pay for the changes which they require. To assume otherwise, for example to assume that such costs should be borne by the MTS ratepayers as an overall social good, would operate against the goal of cost-based telecommunications services.

Bounds upon reasonable interconnection plans imply bounds upon the financial resources dedicated to implementing them. Of course, NTIA is not privy to the financial plans of the IRCs, nor would it be appropriate to be so. For this reason, the inclusion of a solution to a given aspect of interconnection into a particular category should be taken as illustrative of what seems reasonable. The ultimate agreement on such details must be left to the carriers involved.

Long-Term Outcome: Parity

The IRCs have often requested that they be provided parity of interconnection with AT&T. In their view, parity means that an IRC's Datel service would bear exactly the same technical and operational relationship to the Bell/Independent domestic MTS

network as does AT&T Long Lines for its overseas MTS service. Each of the eight technical and operational areas listed above is one dimension of interconnection. Parity can be viewed as an advanced arrangement in each of these eight dimensions.

In all of the controversy over interconnection, there has never been an attempt to relate the cost of achieving parity for Datel to the revenue from Datel which presumably must support such change. Such an analysis would indicate that there is a considerable disparity. Industry-wide Datel revenue simply is not capable of supporting the changes in the Bell/Independent domestic MTS network necessary to achieve parity of interconnection for Datel.

The annual Datel revenue for all of the IRCs combined is about one million dollars (\$1 M), and accounts for only a tiny fraction of the overall IRC industry revenue of almost \$450 M annually. As a data service, Datel is based upon older circuit-switched concepts and technologies. An IRC would have to evaluate Datel against newer packet-switched systems in order to decide what to back with facilities and promote in the marketplace. Given these realities, it is not clear how much of its growth capital an IRC would direct towards the improvement of Datel, but it is reasonable to assume that it would be related to Datel's current and projected future revenues.

AT&T has estimated that to make some of the changes necessary to implement Datel parity would involve an initial expenditure of \$169 M and an annual expense of \$20 M. While these figures were not substantiated by AT&T and hence cannot be readily evaluated, they cannot be dismissed out of hand, considering the magnitude of the Bell/Independent domestic network and the changes which would be required to achieve parity. We believe it difficult to justify significant changes to this network in order to accommodate Datel service alone, which generates a very low level of demand diffusely across the entire nation.

We believe parity for Datel must rest on a broader economic base, such as that which would be provided by a coordinated national plan designed to evolve the public switched voiceband network into a significantly more competitive configuration. It is not clear that such a comprehensive effort will be undertaken at this time. At present, the process begun in ENFIA II offers the best hope for beginning to work in this direction.

Medium-Term Outcome: Relating to the Problems of the OCCs

The ENFIA II meetings were concerned with enhanced interconnection arrangements for domestic OCC-switched voiceband services. Examples of such services, as currently offered, are the MCI "Execunet" and the SPCC "Sprint V."

There are significant differences between the IRCs' and the OCCs' interconnection problems. At the most macroscopic level of description, the OCCs use the Bell/Independent intraexchange network at both ends of their own interexchange networks, while the IRCs use the Bell/Independent intraexchange and interexchange networks at one end of their international networks, with the other end supplied by their foreign correspondents.

Even so, there are a considerable number of similarities between the two problems. Both problems raise issues concerning point of interconnection, numbering plans, signaling, etc.--in other words, the eight technical and operational areas of interconnection used throughout this report. Further, the complexity of the OCCs' and the IRCs' interconnections with the Bell/Independent network are similar. Both must receive calls and signaling information from the Bell/Independent network; both must send calls and signaling to this network.

It is significant that in the ENFIA II meetings parity was not a primary issue. As a practical matter, the OCCs apparently realized that their revenues and their time scales for planning and deployment were simply not commensurate with the changes which would be required in the Bell/Independent plant to implement parity. This is relevant to our concern here. By any measure, such as revenue, number of trunk connections, etc., the OCCs' domestic switched voiceband business is about 100 times larger than is the IRCs' Datel at this time.

The ENFIA II meetings, which only reached the stage of initial negotiations, have been terminated. ENFIA II was more concerned with problem definition, the suggestion of tentative solutions, and mutual education. In this sense, however, ENFIA II set the stage for a process which is now continuing.

The continuation of this process has been manifest in AT&T's response to the FCC in Docket 78-72, as filed on March 3, 1980. Here, AT&T has suggested certain interconnection plans which are an outgrowth of the work in ENFIA II. Bell also proposed that a technical committee be formed, with Commission and industry participation, to consider this matter further.

Although the administrative and institutional details are unclear at this time, a process is going forward which should eventually result in an enhanced form of interconnection for the OCCs. Because of the similarities between the OCCs' and IRCs' problems, and because of the much greater economic impetus behind the OCC issue, NTIA believes that the IRCs' interconnection problems should be folded into this ongoing process. It is also imperative that this be accomplished soon, so that the Datel interconnection issue is not considered as an afterthought.

Short-Term Outlook: Considering the IRC Problem Alone

If Datel is considered in isolation, then an arrangement which appears commensurate with Datel revenue involves an IRC customer reaching an IRC's Datel switch using the Bell/Independent domestic MTS network in the usual fashion. Further information, such as the calling party's identification and the station to be called, would then be conveyed over the built-up connection using some inband means such as Touch Tone multifrequency signaling. This arrangement closely parallels that currently employed in the Datel services and by the domestic OCCs for switched voiceband services such as Execunet and Sprint V.

Through enhancement of the currently employed approach, the IRCs should be able to obtain some of the enhancements of interconnection which they have requested. Because all of the IRC switches are currently located in New York City, it should be possible to connect them all into the Bell/Independent domestic MTS network through one Bell System switch. This one switch might be especially modified without incurring great expense.

We note that answer supervision is already offered on this basis. Other attributes of four-wire transmission including a four-wire path through the connecting switch, not currently available to the IRCs, may also be attainable. Of course, those attributes of interconnection requiring changes which are diffuse throughout the entire Bell/Independent MTS network, such as dialing parity, could not be accomplished by this means.

DOMESTIC INTERCONNECTION ARRANGEMENTS FOR DATEL SERVICES

J. G. Williams*

The International Record Carriers have, for a number of years, provided a switched, overseas, voiceband data service called Datal. This report examines changes required in the Bell/Independent domestic MTS network to provide a more advanced form of interconnection for Datal than is presently available. The report examines Datal interconnection in terms of eight specific operational and technical areas: point of interconnection, numbering plan, signaling, operator procedures, customer billing, maintenance and testing, financial arrangements, and network planning. Three categories of solutions to the interconnection problem are discussed: short-, medium-, and long-term.

Key words: Datal interconnection; international record carriers; switched voiceband data service

1. INTRODUCTION

Datal is a switched, voiceband communication service provided by the International Record Carriers (IRCs) in the United States in conjunction with the telecommunication administrations of certain foreign countries. As currently configured, Datal customers in the United States place calls in the conventional manner over the Bell/Independent MTS network (and, to a certain extent, over similar facilities of Western Union) in order to reach an IRC switching center. All such centers are currently located in New York City.

At such a switching center a call is terminated at an IRC automatic switch or at a manual switchboard. The customer then provides calling and called party information. The call is then carried over conditioned international voiceband transmission facilities in order to reach a switching center in the country of call destination. Typically, these transmission facilities are owned jointly by the IRC and the foreign administration. The call is then routed by the switched voiceband network of the foreign administration to the called station. Service from other countries to the United States is also available, with routing performed in the opposite direction but otherwise as described above.

The IRCs cannot afford, either singly or collectively, to deploy and operate a private network¹ in order to reach their Datal customers in the United States.

*The author, now with the FCC in Washington, D.C., was formerly with the Institute for Telecommunication Sciences, National Telecommunications and Information Administration, U.S. Department of Commerce, Boulder, CO 80303.

¹The parent company of two of the IRCs, ITT and RCA, also has initiated domestic long-haul operations. These networks are too fragmentary to provide the domestic Datal sections and further, the FCC has until very recently prohibited interconnection of these international and domestic networks.

The means by which an IRC is interconnected into the Bell/Independent MTS network for domestic access and egress therefore becomes critical.

This report is concerned with the changes required in the Bell/Independent domestic MTS network in order to provide a more advanced form of interconnection to the IRCs. Examples of such changes include arrangements for a better quality of transmission between the IRC customer and the IRC switch and arrangements for a customer-dialed service equivalent to that employed for international MTS.

There has been a long history of debate between the IRCs and AT&T concerning the issue of interconnection. Various interconnection plans have been placed before the FCC by the IRCs. AT&T, in Commission filings, has generally argued against these proposals. Section 214 applications have been filed by AT&T for the international use of MTS data and by the IRCs for enhanced overseas Datel offerings. Petitions have been placed before the commission by AT&T to deny the IRCs' requests, and, likewise, the IRCs have petitioned the Commission to deny AT&T. The issue of IRC interconnection for Datel has been a principal point of contention.

In orders released on February 11, 1980, and February 14, 1980, respectively, the Commission granted the AT&T Section 214 application, while also relaxing the conditions under which the IRCs could offer Datel. The Section 214 applications of the IRCs were not granted in full. Specifically, their interconnection requests were not granted. However, the Commission retained jurisdiction over this matter pending the outcome of the MTS-WATS Market Structure Inquiry, the Docket 19660 proceedings, and this study.

This study was initiated by the National Telecommunications and Information Administration in the belief that the sanctioned use of international MTS for data, increased Datel offerings by the IRCs, and increased competition in international telecommunications in general would all be in the public interest. Since the forum of filings before the Commission had not broken the impasse over the interconnection issue, NTIA believed that an independent study would be useful to the FCC. The purpose of this study is to provide a framework so that more productive discussion can take place among the affected carriers. It is not appropriate for NTIA to make detailed recommendations concerning interconnection. The resolution of details is best left to the carriers involved.

Although NTIA held informal meetings with AT&T and the IRCs, during which many views and much helpful background information was obtained, this document is based upon information which is in the public record. This constraint does not appear to have limited the study in any important way, and it produces a document which provides references.

The focus of this study is on calls from the United States to other countries and not the converse. This is also the focus of the contention between AT&T and the IRCs. In terms of interconnection, the difficult technical and operational problems arise in the country of call origination. The termination of U.S.-generated Datel traffic into another country's public switched voiceband network is straightforward. If standard signaling and transmission formats are used, then no changes are required in the terminating network.

There have been discussions between some IRCs and foreign administrations regarding enhanced interconnection for Datel traffic which originates overseas and is destined for the United States. The inbound (to the United States) traffic is obviously an important aspect of the overall service and involves complex technical and institutional problems not under U.S. control. However, it should be noted that in making international arrangements, if conventions regarding issues such as numbering plans are not broken, then such arrangements would have no effect upon the operation of the Bell/Independent domestic MTS network. (Some of the numbering plans discussed in ENFIA II could influence a uniform approach to this problem by overseas administrations.)

Interconnection cannot be discussed as a simple issue. Rather, it is a concept which involves a number of different operational and technical considerations. It is extremely helpful to factor the interconnection problem into eight such specific areas. These areas are used throughout this report. They provide a common denominator for considering the claims and proposals made by the various carriers, as well as providing a framework for our further analysis of the interconnection issue.

The Point of Interconnection is the first of these eight areas. Issues considered here include the type of transmission facility which will be used between an IRC switching center and the connecting Bell/Independent MTS network switch (e.g., two-wire vs. four-wire) and the nature of the connecting Bell/Independent switch itself (e.g., two-wire vs. four-wire connectivity through the switch). Related issues, such as the location of the Bell/Independent connecting switch(es) with respect to the IRC switches, and hence the routing of Datel calls in the Bell/Independent network, are also considered here.

Issues involving the Numbering Plan constitute the second operational and technical area. Considered here is the manner in which a Datel customer conveys information to the Bell/Independent MTS network in order to be routed to the IRC switch, and the manner in which further information is conveyed to the IRC switch in order to route the call to the station of call destination. From the calling customer's standpoint, the numbering plan is perhaps the most visible aspect of interconnection, since it determines the number of digits which are dialed in order to

complete a call. The numbering plan is an important aspect of interconnection. Depending upon the plan chosen, no changes may be required in the Bell/Independent MTS network or substantial changes may be called for.

Related to the numbering plan is the technical and operational area of Signaling, which is concerned with the manner in which customer-dialed information, and other information which may be generated internal to the Bell/Independent network, is passed to the IRC switch.

The area of Operator Procedures is concerned with the special functions which the Bell and Independent operators may have to perform on behalf of the IRCs. Again, no special functions may be required or considerable extra effort may be incurred, depending upon the plan chosen. If special functions are performed, then new operator equipment arrangements, procedures, and training will be required, as will new routing and billing tables and associated software modifications. Extra costs will be incurred for all such changes, as well as for the ongoing operator activity itself.

From the standpoint of interconnection, the area of Customer Billing is concerned with the manner in which calling customer information is conveyed from the Bell/Independent network to an IRC. Obviously, an IRC must determine the calling customer or station identity in order to bill for a call. The calling station identity is generated internal to the Bell/Independent network for its own billing purposes, but this information is not normally available for external use. With modification, the Bell/Independent network could pass this information to the IRC switch at the time of call set-up.

If special interconnection arrangements are instituted between the Bell/Independent and IRC networks, then corresponding Maintenance and Testing procedures must also be devised. It is important to isolate equipment problems to the network in question so that maintenance responsibility can rapidly and unambiguously be determined.

The area of Financial Arrangements is concerned with the manner in which the IRCs will compensate Bell and the Independents for the use of the MTS network. Included here are periodic (e.g., monthly) payments which may be incurred as a function of actual network use. Separate from this is the issue of compensation for the development and deployment of special network arrangements which may be required for enhanced Data1 interconnection. To the extent that the market for

Datel is speculative, the mechanism for bearing the risk for such developments must also be considered.

Finally, the area of Network Planning is concerned with the manner in which IRC projections for the growth of Datel interconnection arrangements are factored into the planning process for the growth of the Bell/Independent MTS network. Although there is a legitimate need for the exchange of planning information, the design of such procedures must carefully balance this need against the potential for anti-competitive abuse.

The remainder of this report is structured as follows. Section 2, titled "Background," discusses the history of the debate between the IRCs and AT&T concerning the issue of interconnection for Datel. The eight technical and operational areas are used extensively to trace the details of the various proposals placed before the Commission and to document the current position of each of the affected carriers. Section 2 is intended as a normative description of what transpired. Our own critical remarks and analyses are excluded.

Section 3 relates the IRCs' problems of interconnection for Datel to the interconnection problems facing the domestic Other Common Carriers (OCCs). A short time after this study was initiated, the ENFIA II meetings commenced. ENFIA II was concerned with the technical and operational issues related to the domestic OCCs' use of the Bell/Independent switched intraexchange network for local distribution. Although this problem is not the same as that facing the IRCs for Datel, there are many similarities. This study was therefore refocused to take advantage of the information developed in ENFIA II. Much of this information might not have been available otherwise, so the occurrence of ENFIA II was fortunate.

ENFIA II did not address all the issues related to domestic interconnection for Datel services. Section 4 considers some of the issues which were not addressed in ENFIA II.

Unlike the previous sections of this report, where the interconnection problem is factored into technical and operational areas, Section 5 recombines these aspects in order to consider the problem as a whole. Three different categories of solutions are discussed, as a function of the timeframe over which implementation is likely to occur. The solutions discussed in Section 5 should be taken as examples or prototypes, indicative of what seems reasonable to us, and not as NTIA recommendations. This is consistent with the purpose of this study, which, as we have said, is to provide a framework of understanding so that more productive discussions can take place among the affected carriers.

2. BACKGROUND

This section discusses the history of the International Record Carriers' requests for interconnection with the AT&T domestic MTS network, starting with the FCC Report and Order of January 1976 and going through the FCC Orders released in February 1980. Events before the FCC prior to 1976 will not be discussed, since they are not directly relevant to the current issues of interconnection. Likewise, court proceedings will not be mentioned, because very little of engineering interest was discussed in that forum.

To provide context, the situation prior to 1976 must first be reviewed. Unlike the domestic MTS network, AT&T's overseas facilities were restricted to voice-only applications. International Dataphone services (i.e., the ability to send data, facsimile or record communication alternately with voice at usage-sensitive rates) were restricted by AT&T's tariff. AT&T's overseas MTS facilities were fully interconnected with the domestic MTS network on a manual, operator-intervention basis; and with the introduction of IDDD, the evolution to an automatic, customer-controlled means of interconnection was well under way.

A service somewhat similar to international Dataphone was provided by the International Record Carriers. This service, called Datel, permitted data, facsimile and record communication, while restricting voice to queuing and control. Switched connections between the IRC customers in the United States and the Datel operating centers were achieved via the AT&T domestic MTS network, and to a lesser extent, via a Western Union voice-band dialed access service. Circuits from the Datel operating centers to the AT&T network terminated on the line (customer) side of class 5 (local) switching offices. In this sense, AT&T treated the IRCs like any other local telephone customer.

With this arrangement, an operator in the Datel operating center was required to establish manually the connection between the IRC customer in the United States and the foreign administration's customer. For a call originating in the U.S., the IRC customer would dial the Datel operating center via the domestic MTS network in the usual manner, and then, with the assistance of the Datel operator, establish the call to the foreign party.

From as early as 1965 the IRCs had at various times attempted to obtain an enhanced means of interconnection with the AT&T domestic MTS network, primarily to provide a direct-dialed service which would eliminate the need for always using the Datel operator. However, prior to 1976, no such arrangement had been established.

2.1 FCC Report and Order of January 1976

The FCC (1976) Report and Order of January 19, 1976, concluded that the restriction of overseas MTS to voice-only was no longer in the public interest. Accordingly, the chief of the Common Carrier Bureau was instructed to accept Section 214 applications from AT&T to add Dataphone services to overseas MTS offerings.

The Report and Order further found ". . . it to be in the public interest for the IRCs to expand their switched record services, such as Datel, and to interconnect their facilities with AT&T's domestic MTS network for this purpose." In a section which is highly relevant to our interests here, the FCC also noted that:

"WUI has indicated strongly that it has had some difficulty obtaining interconnection with AT&T's domestic switched telephone network. It further asserts that such interconnection is necessary if the company is to serve customers outside of the gateway cities and thereby compete effectively with AT&T's international dataphone service. Although we are hopeful that appropriate agreements for interconnection can be reached, pursuant to our policies established for domestic common carrier, we shall entertain pleadings from the international carrier regarding what facilities and interconnections, not presently provided, are necessary for their proposed services."

In an effort to determine the type of interconnection "not presently provided," AT&T requested a meeting with the IRCs, which was held on February 4, 1976. Subsequent meetings were held on February 13, February 27, and March 9 of the same year. The results of the meetings were inconclusive, and no further meetings were held.

2.2 IRCs' Requests for Interconnection of April 1976

Pursuant to the FCC Report and Order, AT&T on April 9, 1976, filed a Section 214 application to provide overseas Dataphone service. Pursuant to the same Report and Order, ITT World Communications, Inc., on April 8, 1976 filed a "Petition for Interconnection" document with the FCC (ITT, 1976); while on April 9, 1976, RCA Global Communications, Inc. (RCA, 1976), TRT Telecommunications Corporation (TRT, 1976) and Western Union International, Inc. (WUI, 1976), filed similar documents.

These four documents contained details of the IRCs' interconnection requests. The Appendix of this document, which is organized by technical and operational areas and by IRC, provides details of these requests. As the Appendix shows, there was a reasonable consistency among the various IRCs. A summary, composite view will therefore be presented here.

The General interconnection requests were all the same; that the IRCs should bear the same technical and operational relationship to the Bell System domestic MTS network as does AT&T Long Lines. This arrangement has come to be known as parity. We now look at the specifics of the IRCs requests, in order to see what parity would mean.

In terms of the Point of Interconnection, ITT, RCA, and WUI required a four-wire circuit from their switch to the connecting AT&T switch, which they also required to be four wire. This four-wire connectivity, from the IRC switch all the way into the MTS network, was stated by the IRC's to be necessary in order to provide enhanced signalling and to reduce degradation caused by conversions between two-wire and four-wire modes of operation.

WUI explicitly required that "the number of transmission sections (circuits between AT&T exchanges) required for a domestic subscriber to reach WUI (or vice versa) shall be equivalent to the number of sections required by a subscriber to reach an international transit exchange serving the AT&T system." ITT and TRT were willing to allow at most one extra section.

A Numbering Plan was required such that a subscriber could reach an overseas party via an IRC by dialing the same number of digits as would be required for routing via AT&T Long Lines. Although not required by this constraint, the IRCs all suggested variations on the IDDD numbering plan for their use. For example, where a 011 prefix is used for international routing via AT&T Long Lines, a 01X prefix was suggested, where the 'X' specifies a particular IRC. RCA went to some length in discussing this, as shown in Section 3.2 of the Appendix.

With regard to the Signaling required from the AT&T MTS network to the IRC switch, both ITT and RCA required the same information and format as is now used to signal an AT&T International Switching center. WUI's request was somewhat more general: they asked for all calling-customer information dialed after the IRC access prefix, with the format unspecified.

In the area of Operator Procedures the IRCs requested that AT&T operators honor calling customers' requests for routing via an IRC. ITT further requested that unspecified international Dataphone/Datel calls be distributed according to some predetermined allocation scheme.

In terms of Customer Billing, ITT requested parity. Specifically, they required as a minimum: (a) the called party's telephone number, (b) the calling party's telephone number, (c) the date of the call, (d) the time of the call, and (e) the duration of the call. When technically possible, they requested that this information be made available in real-time; otherwise, that it be made available in an off-line, machine-readable form. WUI was less specific: they requested

that the calling party's identification be made available in real-time, or "such comparable arrangement satisfactory to WUI."

With respect to Maintenance and Testing little was said in detail, other than that some cooperative arrangement would be required such that IRC access facilities would be maintained to Bell System standards. ITT did request "operational access to AT&T's Data Test Centers."

It was asserted that the Financial Arrangements by which AT&T would be compensated for the IRCs' use of the domestic MTS network should be uniform and non-discriminatory. Again, the concept of parity was introduced: the IRCs should pay no more than the AT&T Long Lines. Recognizing this as a murky area, RCA and WUI suggested initial use of an arrangement similar to that for overseas TWX/Telex prior to AT&T's divestiture of TWX.

In terms of Network Planning, ITT requested consideration of the IRCs' needs as a part of the Bell System's normal planning process, and mentioned some specific area where attention was needed. RCA requested some specific planning information from AT&T, and volunteered a projection of Datel volume. TRT raised the specific issue of the avoidance of domestic satellite routing (one of the specifics raised by ITT), while WUI made some general remarks.

At the risk of considerable simplification, Table 1 presents a summary of the above discussion. It should be taken as such, and only used in this context, and in the context of the Appendix.

On April 26, 1976, AT&T (1976) filed a Reply to the IRCs' interconnection proposals. This reply was short and contained no technical analysis. AT&T asserted that the interconnection proposals, together with the IRCs' request for removal of the voice restriction on Datel (See for example, RCA, 1976, p. 81), amounted to an attempt to "integrate the IRCs' facilities into the overseas MTS network." AT&T further said that it was "not prepared to discuss any (such) 'parity' demands."

On July 23, 1976, ITT, RCA, and WUI all filed Petitions to Deny the AT&T Section 214 application for overseas Dataphone. On August 12, 1976, AT&T filed an Opposition to these Petitions to Deny. On August 31, 1976, ITT, RCA and WUI all filed Replies to this Opposition. None of these documents contained substantive technical discussions as relates to the issue of interconnection.

Section 214 applications were filed with the FCC by WUI on June 20, 1977, followed by RCA on June 30, 1977, and ITT on October 6, 1977. These applications requested permission to offer an enhanced Datel or "Dataphone-like" service. In such a service, the existing Datel restriction limiting voice to queuing and control would be expanded to allow "alternate voice/data". Further, some form of

Table 1. Summary of the IRC's April 1976 Requests for Interconnection

	ITT	RCA	TRT	WUI
General	Parity	Parity	Parity	Parity
Point of Inter-connection	Four-Wire Link to Four-Wire AT&T Switch, Routing Parity (or Near Parity) With AT&T LL	Four-Wire Link to Four-Wire AT&T Switch, Routing Parity With AT&T LL Implied	Transmission Parity & Routing Parity (or Near Parity) With AT&T LL	Four-Wire Link to Four-Wire AT&T Switch, Routing Parity With AT&T LL
Numbering Plan	Dialing Parity With IDDD	Dialing Parity With IDDD	Dialing Parity With IDDD	Dialing Parity With IDDD
Signalling	Parity With Info. Passed to AT&T International Switching Centers (ISCs)	Parity With Info. Passed to AT&T ISCs	No Specifics	IRC to Receive All Customer Dialed Info. In Real-Time
Operator Procedures	AT&T Operators Route to IRCs On Request, Unspecified Calls Allocated	No Specifics	AT&T Operators Route to IRCs On Request	AT&T Operators Route to IRCs On Request
Customer Billing	Parity	No Specifics	No Specifics	Calling Party ID in Real-Time
Maintenance & Testing	Co-operative Arrangements Required	IRC Access Trunks Maintained To Bell Std's.	No Specifics	No Specifics
Financial Arrangements	No Specifics	Bell Charges To IRCs At Parity With AT&T LL	No Specifics	Bell Charges To IRCs At Parity With AT&T LL
Network Planning	Near Parity	General Remarks	General Remarks	General Remarks

"full" or "parity" interconnection, along the lines previously requested by the IRCs (ITT, 1976; RCA, 1976; WUI, 1976), would be implemented. It was argued that approval of these applications was necessary if the IRCs were to be competitive with the proposed AT&T overseas Dataphone service.

2.3 AT&T's Petitions to Deny of July-November 1977

On July 27, 1977, AT&T (1977a) filed a Petition to Deny the WUI Section 214 application. In this document AT&T discussed the WUI interconnection proposed. This discussion was far short of a full technical analysis, but it nevertheless asserted that the requested interconnection was not feasible. This AT&T position is outlined below, using the technical and operational areas as developed above.

The General assertion of AT&T was again that the interconnection request, together with the request to allow "alternate voice/data," was "...tantamount to a demand that the structure of domestic public switched telephone network be altered, at great expense and without promise of tangible public benefits, to permit WUI to offer overseas MTS."

AT&T further asserted that:

"The authorization of additional carriers in the provision of MTS will cause existing economies of scale in switching and transmission facilities and billing arrangements to be sacrificed. It would result in inefficiencies and duplication of facilities and would also impose an unreasonable burden on foreign administrations. The public interest has been well-served by the Commission's recognition of MTS' natural monopoly characteristics. Any change in this policy will come at great expense and without any tangible benefit to the telephone subscriber."

With regard to an analysis of WUI's interconnection request, AT&T stated that:

"WUI's proposal would mandate more far-reaching and costly network modifications than can reasonably be explored, even on a broad basis, in a pleading of this nature. Indeed, the detailed technical study required just to identify all of the modifications (and other ramifications) associated with WUI's interconnection demand in the Bell System, is in itself, a substantial and costly undertaking. Accordingly, AT&T will not address in this pleading the modifications required to implement WUI's demands for connection over four-wire facilities through a four-wire switch, participation in Division of Revenues, or identical testing and billing arrangements."

This suggests that most of AT&T's specific remarks were in the area of Numbering Plans, which indeed they were.

AT&T asserted that to implement dialing parity it would be necessary to "change the existing international access code for operator assisted call to be routed via AT&T's overseas facilities from '01' to a three-digit code such as '001'."

Further, all domestic telephone companies would be required to:

". . . allocate, for routing via the IRCs' overseas facilities, all of the 18 remaining codes in the 01X and 00X series, where 'X' is any digit.

"In this way, WUI might be assigned '012' for a direct-dialed call and '002' for operator assisted calls. A second IRC might be assigned '013' and '003', etc. Inasmuch as there are only 18 customer dialable access codes not presently in use, this technique is only feasible if the total number of IRCs will never exceed nine. The current switching systems, even with the modifications hereinafter discussed, cannot accommodate additional customer access codes."

Because the Caribbean and Hawaii are part of the North American Numbering Plan, and can be dialed without an IDDD prefix in the domestic MTS network, but because there are overseas points to the IRCs, it would further be necessary to:

"... allocate for routing of calls originating in the continental United States via the IRCs' overseas facilities, a Numbering Plan Area (NPA) code for each IRC serving countries or territories now within the 809 NPA (most of the islands in the Caribbean area), and an NPA code for each IRC serving the State of Hawaii."

Further, the North American Numbering Plan

". . . is now designed for maximum of 152 NPA codes, and all but 20 of these are now in use. These 20 codes are expected to be required for telephone growth within about the next 20 years. Since telephone network switching systems would require major modifications to permit the use of additional codes as NPA codes, the demands of WUI and the other IRCs would force a premature advance of these expensive modifications by not only Bell Companies and domestic independent telephone companies, but also by many of the 22 foreign administrations within the NANP."

From a technological standpoint, AT&T asserted that to implement these changes ". . . would require a major development and design effort for modifications to our #1 Electronic Switching System (ESS), #1A ESS, #2 ESS, #2B ESS, #3 ESS, Traffic Service Position System (TSPS) and #5 Cross Bar Systems."

Expanding on this point, AT&T explained that:

"International Direct Distance Dialing (IDDD) is currently provided through #1 ESS, #1A ESS, TSPS, and #5 Cross Bar Systems. Development of IDDD capability in #2 ESS and #2B ESS is now underway, with feature availability planned for early

1978. IDDD capability in #3 ESS is planned for 1980. The costs to modify the nine #5 Cross Bar machines already equipped for IDDD in New York would be so prohibitive that AT&T would be forced to consider discontinuing IDDD service from these machines rather than make the extensive modifications required."

It was further alleged that:

". . . installations of the modifications into over 830 #1 ESSs, two #1As, and 114 TSPSs would require extraordinary effort. In addition, each of the approximate 8,5000 TSPS operator positions would require physical modification. Moreover, routing logic additions would be required in each of the domestic toll switching systems that would handle IRC destined traffic. Such an addition would be required for each country served by each IRC and for each IRC serving Hawaii and/or the Caribbean area." (Emphasis in original.)

AT&T suggested an alternative numbering plan for IRC use. In this scheme:

". . . calls originating in the public switched domestic telephone network could be dialed as a normal domestic seven or ten digit call, and would be completed to the IRCs at their respective gateways. The called address in the foreign network would be contained within the data message, together with information relating to the special treatment desired, such as store and forward, data speed and/or code change, modulation type change, or even the insertion of a data regeneration device. A simplified version of this arrangement might use customer operated Touch-Tone frequency signals to transmit message handling instructions to the IRC gateways, including called party network address and any special instructions. The initial IRC gateway address on the telephone network can be dialed with a one button automatic dialer to simplify the dialing procedure."

This plan requires no changes to the domestic MTS network, and hence no special arrangements with AT&T. A call is simply placed to the IRC in the normal fashion, and then further information is conveyed over the built-up connection. Of course, this is not "dialing parity," in the sense that more information must be customer conveyed to the AT&T and IRC switches, taken together, than would be conveyed to AT&T alone for an IDDD call. However, an arrangement such as this is currently used by the domestic OCCs, including MCI and SPC for their "Execunet" and "Sprint Y" MTS-like dialed access voice services.

In terms of the Point of Interconnection, AT&T offered a four-wire path from an IRC's switch to (but not through) the connecting AT&T MTS network switch. Specifically, AT&T stated that it was:

"... prepared to offer an interconnection arrangement to the IRCs that is both consistent with the policies established for domestic common carriers and would enhance their abilities to provide specialized data services. AT&T's proposal is to modify the OCC facility tariffs, introduced with the Settlement Agreement in Docket No. 20099, to give the IRCs four-wire voice grade central office connecting facilities between the IRCs' gateways and the serving central offices of the telephone company. This interconnection arrangement would provide a significant transmission improvement over the two-wire arrangement being used today by the IRCs for interconnection of their Datel services with the domestic public switched telephone network, and it would put the IRCs, most of whom were signatories to the Settlement Agreement in Docket No. 20099, in the same position with respect to interconnection with the public switched telephone network as the other OCCs."

The relatively few remarks which AT&T made with respect to Operator Procedures, Customer Billing and Financial Arrangements will now be reviewed.

In the area of Operator Procedures, it was asserted that:

"... the additional operator work time with this type of interconnection will necessitate the requirement for a large number of additional operators in the Bell System in 1977 alone. The initial training of Bell System operators in the new procedures necessitated by this type of interconnection has been estimated at several hundred thousand labor hours."

With regard to Customer Billing, AT&T alleged that:

"... computer program changes would have to be developed for over one hundred Regional Accounting Offices (RAO). Some of the computer programs will vary among RAOs to further complicate this task. Of course, all RAO personnel would have to be re-trained."

AT&T made no specific remarks on how Financial Arrangements might be implemented between itself and the IRCs. Rather, it chose to cast the question as a public interest issue. According to AT&T:

"... it is impossible to quantify the total cost to the public for this type of interconnection with the domestic public switched telephone network. Aside from the question of who will bear this cost (i.e., the MTS user? the overseas MTS user?), AT&T submits that this cost will increase as time goes on, in terms of lost flexibility in the nation's telephone network, delay in implementing new technology, inefficient use of resources, and increased labor hour requirements. The Commission must recognize that there will not only be 'one time' costs associated with this type of interconnection with domestic public switched telephone network, but also significant and substantial recurring costs that the public must pay."

In the technical and operational areas of Signaling, Maintenance and Testing and Network Planning, AT&T had no comments of substance.

On August 10, 1977, AT&T (1977b) filed a Petition to Deny the RCA Section 214 application of June 30, 1977. In this document AT&T advanced no new arguments concerning interconnection. AT&T argued that the RCA and WUI applications and requests for interconnection were very similar. The earlier analysis, contained in the AT&T Petition to Deny WUI as discussed above, was simply cited.

On November 16, 1977, AT&T (1977c) filed a Petition to Deny the ITT Section 214 application of October 6, 1977. In this document AT&T did develop some further analysis of interconnection.

As before, the General argument of AT&T was that the interconnection request, coupled with the request for alternate voice/data, was tantamount to a request to offer overseas MTS. AT&T further asserted that this would not be to the public good, since the FCC had "historically recognized the public interest benefits of only one carrier providing MTS to a particular geographic location."

For the first time, AT&T offered an estimate of the cost of meeting some of the IRCs' parity of interconnection requests. This estimate was:

- a capital investment of approximately \$126 million;
- nonrecurring expenses of approximately \$43 million;
- recurring expenses of \$20 million per year.

According to AT&T, the costs associated with the following item were not included in this estimate:

- point of interconnection arrangements which provide transmission parity,
- customer education, including the revision of "Call Guides" in telephone directories,
- training and equipping Bell System Repair Service Bureau personnel,
- ongoing activities related to IRC rate changes, relocation or addition of IRC gateways, rerouting of IRC traffic, etc.,
- economic penalties associated with the diversion of Bell System resources from other currently planned developments,

- costs associated with the otherwise unanticipated need to convert to four-digit NPA codes throughout the North American Network.

In stressing that the above costs were only rough estimates, AT&T asserted that:

"... the costs and development intervals quoted were developed in informal studies conducted in various Bell System companies specifically for purposes of responding to ITT's allegations regarding full interconnection. As such, these estimates are preliminary and to the extent noted, incomplete. A detailed multi-company formal study (involving nearly every department in AT&T, Bell Telephone Laboratories, the Western Electric Company and each Bell System Operating Telephone Company) would be required to confirm the costs estimates shown and to assign economic values to some of the nontangible penalties associated with interconnection of the type demanded by the IRC.

"We estimate that a study of this scope, based on a specific interconnection proposal, would require some 20 man-years of effort at a cost of approximately \$1.0 million."

The specific technical and operational areas addressed by AT&T will now be considered. In terms of the Point of Interconnection, AT&T stated that:

"A major IRC interconnection demand, identified as 'transmission parity,' requires the connection of IRC gateway offices to the domestic MTS network over four-wire facilities through four-wire switches and limits the number of switched links in the total connection (i.e., from the IRC gateway office to the toll office serving the subscriber) to the same number of switched links involved in an overseas telephone call.

"The provision of transmission parity would require that direct circuits be established from a great number of toll centers (i.e., Class '4' offices or higher in the domestic MTS network hierarchy), throughout the U.S., to each IRC gateway. These circuit groups, which would parallel existing groups, would be inefficient because of the light traffic loads expected to be routed over them. The number, size and cost of these additional groups would depend on the traffic expected by the IRCs, the geographical distribution of such calls, and the location of the IRCs' gateway offices. Costs cannot be estimated without this information.

"Without such new circuit groups, at least one additional switched link would be required in a toll office to IRC gateway connection."

The AT&T analysis of the Numbering Plan implication of ITT's interconnection request was a slight elaboration of the remarks made in the Petition to Deny WUI. Numbering plan issues were treated more thoroughly than any other area in this earlier Petition, and were consequently outlined in detail earlier in this document. This discussion will not be repeated here.

In this response to ITT, AT&T did develop some new arguments against parity of interconnection in the area of Operator Procedures. To quote again:

"Provision of access parity would necessitate TSPS² hardware and software modifications and would require additional operators. Significant TSPS development would be required as follows:

- Digit reception routines would have to be modified to recognize new prefix arrangements, to store carrier designation digits and to recognize unassigned carrier destination digits and handle accordingly.
- Outpulsing preparation routines would require modification to handle a new digit format for the first stage of outpulsing.
- Separate rating tables would be required to allow for variations among the carriers.
- AMA Recording would have to accommodate additional data entry to record carrier designation.
- Recent Change and Verification procedures would have to provide for adding, deleting, changing and verifying carrier associated rating tables.
- Service Observing program changes would be required to transmit the carrier designation digit along with the Country Code and National Number.
- Hardware and software changes associated with position displays on TSPS consoles would be required to permit displaying carrier designation digits."

"Additional toll operators would be required to provide parity for the IRCs. Call handling time would increase since the operator must determine whether a voice or data call is desired and, for data calls, determine which carriers serve the foreign country, quote rates for the serving carriers, determine which carrier the customer desires to use and route the call accordingly. Each new operator would require initial training while all others would require supplemental training."

²Traffic Service Position System (TSPS). A stored-program-control system based upon electronic switching technology which provides an enhanced function operator's console. Now in common use, replacing manual switchboards. (Our footnote.)

AT&T also raised some new objections in the area of Customer Billing. We quote these objections here:

"Methodology modifications required to provide billing parity for the IRCs would include:

- Acceptance of modified message recording formats from #1 ESS and TSPS, incorporating IRC identification data in AMA records.
- Acceptance of revised Operator Mark Sense and Optical Character Reader documents used to provide IRC identification capability in operator prepared call records.
- Development of Revenue Accounting Office programs to properly handle IRC routed call records in rating, division of revenues, settlements with Independent Telephone Companies, and billing of tariff charges.
- Development of administrative procedures required to introduce tariff modifications, provide necessary customer billing inquiry procedures, tracking procedures to assure ongoing validity of separations methods for costs between Bell System Operating Telephone Companies, Long Lines and the IRCs, and development of new billing formats.

"There are in excess of 100 Revenue Accounting Offices currently involved in overseas billing activities. Each of these offices would have to introduce the administrative and methods changes described above.

Other costs would include:

- Computer utilization for testing programs and format changes, and to trial the evolved total procedure.
- Modification of Centralized Message Data System programs and edit procedures to accommodate IRC routed call data identification.
- Ongoing record processing and billing."

In areas of Signaling, Maintenance and Testing, Financial Arrangements and Network Planning, AT&T said little in the Petition to Deny. These areas were also undeveloped in the earlier AT&T Petitions against WUI and RCA.

2.4 IRCs' Oppositions of August 1977 - January 1978

On August 17, 1977, WUI (1977) filed an Opposition to the AT&T (1977a) Petition to Deny its Section 214 application. In this document WUI did not modify their earlier interconnect request. WUI asserted that AT&T's claim that

the interconnection would mean "substantial and costly modification" was not established. Further, WUI asserted that the burden of proof was on AT&T, since only AT&T possessed the relevant technical information concerning MTS network operation. WUI characterized the AT&T offer of a four-wire circuit from the IRC operating center to (but not through) the connecting AT&T switch as "wholly inadequate," since, according to WUI, it would simply move the hybrid (two-wire to four-wire conversion device) from the IRC to the AT&T premises and would hence "appear technically indistinguishable" from the existing arrangement.

On September 9, 1977, RCA (1977) filed an Opposition to the AT&T (1977b) Petition to Deny its Section 214 application. With respect to the technological issues of interconnection, this document was very similar to the earlier opposition filed by WUI (1977). RCA did not modify their earlier interconnect request. They asserted that the AT&T claims as to the cost of interconnection were unsupported, that the four-wire path between the IRC operating center and the AT&T switch was inadequate, and that the numbering plan advanced by AT&T was unacceptable.

On January 20, 1978, RCA (1978) filed comments in opposition to the AT&T (1977c) Petition to Deny the ITT Section 214 application. RCA justified filing in the ITT case on the grounds that AT&T developed its most complete technical analysis of interconnection in opposition to ITT, and that AT&T had treated the interconnection requests of the IRCs in common in its own filings.

In this document RCA took a new approach to the interconnection problem. Without prejudice to their earlier arguments that AT&T was under obligation to provide parity of interconnection, RCA proposed a compromise, interim interconnection plan. This plan was presented in a somewhat more philosophical manner, without explicit reference to all of the technical and operational areas involved. The basic underpinning for this "higher grade of interconnection" was the belief, expressed by RCA, that "much of what AT&T is claiming it would have to provide for our use at great expense to it we may very well be in a position to do for ourselves."

With respect to the Point of Interconnection with the AT&T domestic network, RCA suggested that

"....(For) calls originating in the U.S., customers could use WATS lines, local central office lines, foreign exchange (FX) lines, private tielines, or any combination thereof, to reach the voice/record carriers' ISCs³.

³International Switching Center. (Our note.)

Outbound WATS lines or any of the other types of facilities discussed above could be used to deliver overseas data calls from the IRCs to domestic telephone subscribers. To improve transmission characteristics and minimize degradation, interconnection where WATS is used should be to a 4-wire serving WATS office."

Although RCA was silent as to the suggested Numbering Plan, the above discussion of the point of interconnection implies that customers would dial an IRC operating center through Bell facilities in the normal fashion, and then convey further information directly to the IRC switch by other means. This, of course, would require no modification to the Bell network, and is essentially the plan suggested by AT&T (1977a) in their Petition to Deny WUI.

In connection with Operator Procedures, RCA expressed the view, consistent with its general philosophy, that

"... we would not envision using AT&T operators in connection with our proposed service, except to the extent those operators might be required to advise a customer of the number to be dialed to access our facilities."

RCA made no explicit remarks concerning Signaling, Maintenance and Testing, Financial Arrangements, or Network Planning. Implicit in the proposed Point of Interconnection plan, these technical and operational areas should present fewer problems than under full parity of interconnection. Presumably, this is consistent with RCA's philosophy of increased self-reliance.

On January 27, 1978, ITT (1978) filed an Opposition to the AT&T (1977c) Petition to Deny its Section 214 application. In this document ITT advanced what it characterized as a compromise plan which would "substantially reduce the cost to AT&T for implementation."

In terms of Point of Interconnection the new plan suggested that:

"The electrical connection between AT&T and ITT Worldcom can be established using 4-wire trunk-type interconnections to AT&T's ISCs. Since there are 7 ISC locations, the interconnection facilities would be minimized. Thus, the interconnection would consist of 7 groups of circuits, one group per ISC."

With respect to Numbering Plans, ITT advanced the following:

"The customer dialing procedures used to place the overseas Dataphone-type calls should be such that the same number of digits be utilized to complete a call when directed to ITT Worldcom overseas facilities as for a similar call routed via AT&T's Long Lines Division. The

existing direct-dialed code 011 can be changed to 01X where X represents digits 1-9. Since there are only 6 international carriers potentially involved in providing the service in question here (AT&T, ITT Worldcom, RCA Global Communications, TRT Telecommunications, Western Union International, and French Cable), a single digit designator would cover all IRC and AT&T access requirements. The change in the last digit would not disturb the existing NPA arrangement where the second digit is either 0 or 1.

"It is also noted that two locations fall outside the continental United States geographic area and, while they are considered to be International points, they are still handled under North American Numbering Plan (NANP). The locations in question are:

808 NPA - Hawaii

809 NPA - Caribbean Area.

The existing NPA system is limited inasmuch as the first and the third digit can have the numerical assignments 2 to 9 and 0 to 9 respectively, while the second digit is limited to 0 or 1. Therefore, 154 NPA codes can be derived, of which AT&T represents that only 20 remain unused.

"For outbound calls to these areas, a maximum of 10 additional codes would have to be assigned to handle the two locations for IRC access (2 per IRC). This will still leave 10 codes available for AT&T's expansion."

Consistent with the proposal to use the existing IDDD arrangements for customer dialing, ITT proposed the following with respect to Signaling:

"... since the number of digits required for international calls exceeds the local system register capacity, the local office or TSPS outpulses a six digit code to the toll office as the first stage of outpulsing. The international call routing code (01X) plus a code identifying the country would constitute the six digits transmitted. Since 01 identified the international call and the last 3 digits the country, the toll offices can route a call to the ISC via the MTS system hierarchy the same way as the call was handled by AT&T's ISC. At the ISC point the third digit could be recognized and an additional tandem link (AT&T - ITT Worldcom) would be switched into the MTS connection. The ITT Worldcom switch would then be considered as an ISC point which would request the rest of the digits."

As relates to Operator Procedures, it was asserted that:

"As far as the operator assisted connections are concerned (code 010) ITT Worldcom will agree to the initial handling of the subscriber's call by an AT&T

operator, who would then either route the call through ITT Worldcom facilities directly or reroute the call to an ITT Worldcom operator for a subscriber who indicates a preference to complete his overseas interconnection via Worldcom facilities."

To provide for Customer Billing, ITT advanced the following plan:

"To simplify billing and message accounting procedures and to simplify the modifications in the TSPS and AMA tapes, it is suggested that AT&T would bill the subscriber directly for overseas calls as they now do and the accounting between AT&T and ITT Worldcom would be done on toll division basis. While the ITT Worldcom switch will not have the calling subscribers number or geographic location, it will store other pertinent information such as the called number, time and day of call, disposition of call, and length of call which would provide all the information required for toll-division between AT&T and ITT Worldcom."

These remarks, of course, also relate to the Financial Arrangements which ITT proposes to exist between itself and AT&T. At another point, ITT amplifies on these remarks, and specifically suggests joint through service:

"The 'problems' suggested by AT&T are really not significantly different from those encountered in any jointly provided through service, and therefore should be readily subject to negotiation among the carriers involved based on principles and practices established in prior arrangements among such carriers for such joint through service."

In the area of Maintenance and Testing, it was asserted that:

"Trouble encountered on international calls routed via ITT Worldcom could be reported to a Bell System repair service bureau. However, as in the past for other services, ITT Worldcom would instruct those subscribers using its services to call ITT Worldcom directly if troubles are encountered. Therefore, in most cases it would be ITT Worldcom that would arrange for circuit testing, trouble sectionalization, and maintaining an appropriate contact with the customer. Since the choice of IRC is made by the customer, he or she would know which IRC was used for the international call and the Bell System repair service bureau should direct the customer to call the appropriate IRC directly."

ITT had nothing specific to say about Network Planning, except as it relates to the general remarks about joint through service.

2.5 AT&T's Reply of February 1978

On February 23, 1978, AT&T (1978) replied to the opposition of ITT (1978) and to the related comments filed by RCA (1978). In general, AT&T contended that neither ITT nor RCA had refuted the analysis of interconnection contained in the earlier AT&T (1977c) Petition to Deny ITT. AT&T further asserted that ITT's new interconnection proposal "... compromised very little," while the RCA proposal was "... a significant compromise from its earlier interconnection demand."

We will now consider AT&T's specific remarks by technical and operational area, starting with RCA.

With respect to the Point of Interconnection, AT&T said the following concerning the RCA proposal:

"RCA proposes to use WATS, local central office lines, FX lines, private tie-lines, or any combination thereof, between their ISC and domestic telephone subscribers. Such an arrangement could minimize the number of 'links' in the connection between the customer and the ISC.

"RCA also proposes that interconnection, where WATS is used should be to a four-wire serving WATS office. This plan implies that the WATS connecting facility would also be four-wire. The goal apparently is to minimize overall transmission loss, as well as the implied degradation resulting from conversation from four-wire to two-wire and back to four-wire.

"WATS is now provided from two-wire serving offices. AT&T does not have a four-wire WATS offering under its service tariff.

"Only two⁴ types of Bell System switching systems (#1 ESS HILO EPSCS⁴ and four-wire #5 Crossbar) are capable of applying to four-wire terminations the required ringing, screening and other functions normally performed for two-wire line type terminations. Preliminary investigation indicates that these systems could terminate four-wire WATS. Additional development would be required in non-EPSCS #1 ESS HILO systems to ensure proper operation of the ringing, continuity test, answer supervision, etc., functions with terminating four-wire Inward WATS. Development and initial application of this feature for non EPSCS #1 ESS HILO offices would take at least two years.

⁴A #1 ESS switching system equipped with the HI-LO network and the Enhanced Private Switched Communications Service feature package.

"Because #1 ESS HILO or four-wire #5 Crossbar switching systems may not be available where four-wire WATS capability is required, it may be necessary to modify existing two-wire switching systems to provide four-wire WATS terminations. Adding the four-wire HILO network without the EPSCS feature to an existing two-wire #1 ESS office would cost approximately \$400,000 per office. The cost to add a small capacity four-wire switching capability to an existing two-wire #5 Crossbar office would be somewhat less per office than for #1 ESS."

As regards Numbering Plans, AT&T observed that:

"It would not be necessary to change dialing procedures for domestic telephone subscribers under the RCA proposal. Customers could access the desired IRC's overseas facilities by using the standard dialing formats established for WATS, etc., rather than having to dial a new '01X' or '00X' prefix."

This, of course, also has implications with respect to Signaling:

"The RCA proposal would essentially eliminate the need for switching⁵ system modifications described in our earlier Appendix A. These modifications would not be necessary because customer dialed '01X' or '00X' prefixes and network routing codes for each IRC would not be necessary."

In the area of Operator Procedures, AT&T responded as follows:

"RCA indicates that AT&T operators would not be used except to inform customers of the number to be dialed to access the desired IRC's overseas facilities. This statement implies that the customer would request the telephone number for a specific IRC. The directory assistance operator would then provide only the requested number and would not need to query the customer to determine the desired international carrier."

"We assume that under this plan all operator assisted ('01+') and operator handled ('0-') calls would be routed via AT&T facilities. This would eliminate the need for toll operators to determine whether a voice or data call is desired and, for data calls, determine which carriers serve the foreign country, quote rates for the serving carriers, determine which carrier the customer desires to use and to route the call accordingly. Therefore, additional toll operators and the associated training would not be required."

⁵Appendix A of the AT&T (1977c) Petition to Deny, which contained details of AT&T's technical and operational analysis of interconnection. (Our note.)

"TSPS hardware and software modifications outlined in our earlier Appendix A would not be required under this proposal since there would be no change in dialing or routing procedures."

Related to the issue of Billing, AT&T stated that:

"It is not clear from RCA's discussion what type of billing arrangement is intended since we have no details regarding its current billing procedures for interconnected telex calls with Western Union."

In the area of Maintenance and Testing it was asserted that:

"Although RCA proposes to handle problems encountered on international calls directly with its customers without the need for AT&T intervention, it is unlikely that the responsibility for resolving such problems could be totally removed from AT&T. Assuming that the IRCs' efforts to have their customers report all troubles directly to them were effective, there would still remain an incremental cost to AT&T associated with new testing and maintenance procedures."

RCA made no mention of the nature of the desired Financial Arrangements with AT&T, and AT&T made no further comment on the subject either. Likewise, neither carrier raised Network Planning issues.

We now turn to the remarks which AT&T made with respect to the ITT proposal.

With respect to the Point of Interconnection, AT&T asserted that:

"ITT's modified interconnection demand, based on its willingness to accept one link more than an overseas MTS call would otherwise traverse, is for interconnection of ITT's international switch with each of the seven AT&T International Switching Centers (ISCs). While this arrangement is obviously less costly than the "full transmission parity" arrangement, it is not free from problems. It would result in inefficient traffic routing due to considerable backhaul. For example, an MTS call originated in the continental U.S. and destined for the Far East would be routed to an AT&T ISC on the West Coast. If an ITT customer initiated the call, it would be routed from AT&T's ISC to the ITT switch in New York, then back across the country and on to the Far East. If the number of ITT gateway switches increases, the number of long haul, inefficient, dedicated trunk groups required between AT&T's ISCs and the gateway switches would increase."

The Numbering Plan proposed by ITT (1978) (i.e., the use of a 01X preface similar to the existing IDDD numbering scheme) in the Opposition was essentially the same as that originally proposed by ITT (1976) in their Petition for Interconnection. AT&T (1977c) had dealt with this suggestion at some length in its

earlier Petition to Deny and although AT&T (1978) repeated some of these arguments in this Reply, we will not repeat them here.

With respect to calls from the U.S. to Hawaii and the Caribbean, AT&T stated that:

"ITT's modified interconnection plan would still require, for outgoing calls from the continental U.S., the assignment of one NPA code for each of the four IRCs presently serving the Caribbean area ('809' NPA) and one NPA code for each of the three IRCs presently serving Hawaii--an initial total of seven NPA codes.

"As outlined in our earlier Appendix A, there are only 20 remaining unassigned NPA codes, all of which will be required for anticipated telephone growth within about the next 25 years. While NPA code requirements under the ITT Worldcom modified interconnection proposal (assuming ITT's use of 'designators') would not force immediate modification of all common control switching offices within the NANP to interchangeable NPA codes, this conversion would be advanced by approximately eight years from the date presently planned. There would be a major cost penalty associated with such an advance, although the penalty would be less than that associated with making this conversion immediately. Moreover, implementation of such an arrangement would be in contravention of the worldwide accepted principle of 'destination code routing,' which prescribes that each station in a network, indeed in the world, be identified by a single and unique address."

With respect to Signaling, AT&T advanced the following:

"As recognized by ITT Worldcom, changes in local switching systems would be required to permit acceptance of the customer dialed '01X' prefixes and to transmit the appropriate IRC routing code forward. The cost for these switching system modifications would be slightly decreased under the new ITT interconnection proposal because '00X' codes are not required, but the additional operator services expense would likely erase any switching systems savings."

"ITT correctly points out that the local office or TSPS outpulses a six digit code to the toll switching offices at the first stage of outpulsing. The six digit code is comprised of a three digit network routing code and a three digit code identifying the called country.

⁶This, of course, does not consider the possibility that additional carriers may be authorized to provide service to these offshore points.

In ITT's view, the first two digits (01) could signal an international call and the last three digits would still designate the called country. Toll offices could then supposedly route a call to the ISC via the MTS hierarchy the same way as for an AT&T handled call. Thus, according to ITT, only the seven AT&T ISCs would have to be modified so as to route the call at that point, based on the third (X) digit, on a direct trunk group to the international carrier designated by the customer. ITT's modified interconnection plan and alleged cost savings apparently are based on the incorrect assumption that toll switching systems in the domestic network could route calls to the proper AT&T ISC essentially on the basis of five digits (01 plus the country code) without changing the existing translations.

"Routing as suggested by ITT would still require six digit translation. All toll switching offices in the domestic network would require the same translations as assumed in Appendix A in order to route international calls to the proper AT&T ISC for a given country code regardless of the carrier designated. The cost and extent of work required to accomplish routing on this basis would, therefore, be the same as set out in AT&T Appendix A."

With respect to Operator Procedures, AT&T responded to ITT as follows:

"ITT proposes a slight change from the 'full customer dialing parity' requirements. ITT continues to demand that prefixes in the '01X' series be used to identify the international carrier for customer dialed calls. ITT indicates, however, that it would not be necessary to use a three digit code, such as '001,' to identify the international carrier on customer dialed operator assisted calls. Rather, ITT suggests that a 'reasonable compromise' would be for all subscribers to use the '010' code for operator assisted calls and have all calls, including MTS calls presently dialed on a '01+' basis, processed, at least initially, by an AT&T operator.

"From the ITT proposal, it is unclear whether '010' is intended to be a stand alone code to signal the operator (similar to '0-') or a prefix dialed by the customer, in addition to the country code and national number, that would signal the operator that some assistance is needed. If the former, ITT is suggesting doing away with all overseas customer dialed operator-assisted calls--a giant step backward and an expensive degradation of an established service. It would be the death knell of the '01+' overseas call. If the latter, ITT would significantly increase the call handling time of AT&T operators for all '010+' calls, inasmuch as the operator would then have to determine whether a voice or data call was desired, the overseas carrier to be used, etc.

"ITT's 'compromise' would, we believe, result in a higher cost than implementation of the full customer dialing parity approach outlined in Appendix A. First, since all local switching offices with IDDD capability and virtually every toll switching office in the country would have to be modified to accommodate the '01X' customer dialing parity demand, there would be relatively little additional cost to, at the same time, modify these offices to recognize and route a '00X' customer dialed prefix. Second, implementation of the 'compromise' would place a greater burden on AT&T operators and would result in a degradation in the level of service presently provided to the MTS customer due to the longer time interval required for an operator to process a call manually.

"The proposed elimination of '00X' codes would result in minor reductions in TSPS program modifications previously cited in Appendix A. However, additional modifications would be required to permit the TSPS operator to add the appropriate carrier designation on operator assisted calls ('010+CC+NN), if that is the dialing procedure intended by ITT. In addition, routing procedures and associated toll switching system translations would be required to allow the AT&T operator to route a call either directly to the IRC switch for completion or to an IRC operator for assistance."

In the area of Customer Billing, AT&T replied that:

"The billing procedures outlined by ITT are essentially those assumed for preparation of AT&T's Appendix A. No attempt has been made to quantify costs associated with toll division procedures which would include the IRCs since a specific proposal has not been presented and there would be a need to involve foreign administrations and independent telephone companies in such efforts."

With respect to Maintenance and Testing, AT&T responded as follows:

"ITT Worldcom proposes that customers report trouble encountered on international calls directly to the carrier selected for that call. The selected international carrier would then arrange for circuit testing and trouble sectionalization, and would maintain contact with the customer. This implies that the IRCs would assume responsibility for educating their customers regarding proper trouble reporting procedures. Assuming that their efforts would be effective, there would still remain an incremental cost to AT&T associated with new testing and maintenance procedures."

Since the customers who would report such troubles are also customers of the locally franchised telephone companies, it seems unlikely that the responsibility for handling trouble reports related to IRC facilities could be totally removed from AT&T."

As relates to Financial Arrangements, it is curious that AT&T did not respond to ITT's suggestion for joint through service between AT&T and the IRCs.

ITT had said nothing really specific about Network Planning. AT&T was silent on this issue also.

Table 2 provides a composite view of AT&T's and the IRC's current positions with respect to the issue of interconnection. This table was compiled by working backwards from the last clear position statement in the public record by each of the carriers in each of the technical and operational areas. This table is, by necessity, a simplification, and should be taken in the context of the above discussion.

2.6 FCC Orders of February 1980

On February 11, 1980, the FCC (1980a) released an Opinion, Order and Authorization with respect to the AT&T Section 214 application to provide overseas Dataphone service. The AT&T application was granted, conditioned "... on AT&T first making available to any and all international record carriers for their international services interconnection with AT&T's domestic network equivalent to the interconnection afforded domestic OCC's including any interconnection required for the IRCs to obtain foreign exchange (FX) service." Further, jurisdiction was retained "... over any and all aspects of this authorization to further condition this authorization on the availability to the IRCs of additional, or different, kinds of interconnection as may be deemed to be required in furtherance of the present or future public interest." The availability of this report was mentioned as one reason for retaining jurisdiction.

In a companion Opinion, Order and Authorization released on February 14, 1980, the FCC (1980b) acted upon the Section 214 application of the IRCs to provide enhanced Datel or "Dataphone-like" service. The requests of the IRCs were granted in part. The previous voice limitation was removed, allowing voice to be used over Datel circuits on a permissive basis. Twenty-one major cities in the United States, all different from the five current gateway cities, were defined as "operating areas". Within these areas the IRCs were given permission to offer their customers free direct access, meaning that charges for the domestic portion of the Datel circuit (between the IRC customer and the IRC

Table 2. Summary of AT&T's and the IRCs' Current Positions
with Respect to Interconnection

	<u>ITT</u>	
	<u>ITT</u> <u>POSITION</u>	<u>AT&T</u> <u>POSITION</u>
General	Close to Parity	Strongly opposed
Point of Inter-Connection	Four-wire link to AT&T ISC. Implies one more trunk to IRC than to AT&T LL.	Can be implemented, but would result in considerable, inefficient backhauling of traffic.
Numbering Plan	Dialing parity with IDDD for customer-direct-dialed calls without operator assistance (i.e. '01X Plan').	Would require major development and design efforts to change #1ESS, #1AESS, #2ESS, #2BESS, #3ESS, TSPS, and #5XBAR.
	Continental U.S. to 808 and 809 NPA calls require two new NPA's to be assigned per IRC.	Would advance conversion of NANP to interchangeable codes by approximately 8 years.
Signaling	Routing can be accomplished on 91X preface, using existing IDDD mechanisms.	All toll switches in domestic network would acquire translation changes, at great expense.
Operator Procedures	Initial handling of operator-assisted calls by AT&T.	Unclear on details of ITT proposal. Generally opposed. Cites costs and difficulties under various interpretations of ITT's requests.
Customer Billing	AT&T bills customer. ITT compensated on a toll-division basis.	Costs associated with toll division not quantified.

Table 2. (Cont'd.)

	<u>ITT</u> <u>POSITION</u>	<u>AT&T</u> <u>POSITION</u>
Maintenance And Testing	Asserts that customer will know to contact IRC, so that Bell involvement will be minimal.	Asserts that AT&T will still be heavily involved.
Financial Arrangements	Joint through service.	Curiously silent. Presumably strongly opposed.
Network Planning	Near parity.	No clear statement.

RCARCA*
POSITIONAT&T
POSITION

General	Significant compromise from parity.	Generally favorable, with some reservations.
Point of Inter-connection	Combination of WATS, Local CO, FX and private tielines. WATS connection on four-wire basis at serving office.	Suggested facilities currently available under tariff, except four-wire serving WATS office, which would require development, even at EPSCS #1ESS HI-LO switches.
Numbering Plan	Customer dials IRC switch through MTS network in normal fashion. Other information conveyed by other means (e.g., further touch-tone digits).	No objection. Other carriers (e.g., domestic OCCs) already use network in this way. No changes required by AT&T.
Signaling	No special requirements. Uses domestic MTS network in normal manner.	No objection.
Operator Procedure	AT&T operators used only for normal directory assistance.	No objection.
Customer Billing	Suggests arrangement similar to that used with Western Union for interconnected TELEX calls.	No comment. Not familiar with arrangements between RCA and Western Union.
Maintenance And Testing	No specifics on customer interactions. IRC access circuits maintained to Bell standards.	Asserts that AT&T will be involved with IRC customers. IRC access circuits would be maintained, since they are already a tariffed offering.
Financial Arrangements	Bell charges to IRC's at parity with AT&T LL.	No specifics.
Network Planning	No clear position.	No clear position.

*The compromise put forth by RCA was indicated to an interim solution. RCA continued to require 'parity' as a long-term solution.

WUI

WUI
POSITION

AT&T
POSITION

General	Parity.	Strongly opposed.
Point of Inter-connection	Four-wire link to four-wire AT&T switch Routing parity with AT&T LL.	Opposed. A large number of inefficient trunk groups would be required for routing parity.
Numbering Plan	Dialing parity with IDD.	Would require major development and design efforts to change #1ESS, #1AESS, #2ESS, #2BESS, #3ESS, TSPS and #5XBAR. Solution of 808 and 809 NPA problem would advance conversion to interchangeable codes by approximately 8 years.
Signaling	IRC to receive all customer-dialed information in real time.	No clear statement.
Operator Procedures	AT&T operators route to IRCs on request.	Opposed. Additional operators and operator training would be required.
Customer Billing	Calling party ID in real-time.	No clear statement.
Maintenance and Testing	No specifics	-
Financial Arrangements	Bell charges to IRCs at parity with AT&T LL.	No specifics.
Network Planning	No clear position.	No clear position.

switch) can be included in the IRCs overall charge, rather than being billed separately to the IRC customer by the domestic carrier.

Specific to the interconnection issue, the Commission characterized the IRCs request for parity as going "... far beyond what we envisioned or intended in Docket 19558. Such request cannot be supported by bootstrapping the limited public interest findings made on the record of that proceeding which addressed itself only to the expanded offering of enhanced dataphone-type service there considered, such as Datel." The Commission did recognize however, that the expansion of Datel to the newly created operating areas "... may be implemented by interconnection with AT&T's domestic network equivalent to the interconnection afforded domestic OCCs including any interconnection necessary to obtain foreign exchange (FX) service, as well as in any other manner consistent with our Gateway order, also being acted upon this day (FCC 79-841)". Finally, the Commission retained jurisdiction over this matter pending (1) the outcome of the MTS-WATS Market Structure Inquiry, (2) actions pursuant to the Gateway order and (3) the results of this study.

In these Orders, the Commission appeared to be giving the IRCs additional interconnection capability and flexibility. However, the IRCs already had been authorized by the Commission to have their customers use the MTS network, at the IRCs expense, throughout the United States without limitation. An excerpt from a typical Datel tariff states:

"Subscribers in the Message Telephone Service of the American Telephone and Telegraph Company in the continental United States may obtain Datel Service in the following manner:

- a) An outbound Datel Service call may be made by placing a domestic telephone service call, at the Company's expense, to the Company's terminal in New York, NY.
- b) An inbound Datel Service call to telephone subscribers in the continental United States will be completed by a telephone service call from the Company's terminal in New York, NY or San Francisco, CA to the called party at the company's expense."

The IRCs have implemented this authority by means of accepting collect calls and the use of INWATS. Thus, in requiring AT&T to offer the IRCs FX service and interconnection equal to domestic OCCs at twenty-one new operating areas, the Commission appeared to be giving the IRCs less than that which they already had.

3. ENFIA II AND ITS RELEVANCE

Certain domestic Other Common Carriers (OCCs), such as MCI Telecommunications Corporation (MCI) and Southern Pacific Communications Corporation (SPC) offer services (called "Execunet" and "Sprint V", respectively) which are in some sense competitive with the switched voiceband message telephone services (MTS) offered by Bell and the Independents. Other OCCs, including International Telephone and Telegraph (ITT) and Western Union (WU) are just entering this market.

In these services, the OCCs provide the interexchange or long-haul facilities and use Bell or Independent facilities for local distribution at each end. In the current arrangement an OCC customer dials a local telephone number using the Bell/Independent network and thus accesses the OCC switch. This switch in effect answers the call and provides a second dial tone. The customer then conveys further information, including his own identification and the number he wishes to reach, using Touch-Tone signaling. The call is then placed over the OCC facilities to the OCC switch in the distant city. At this point the call re-enters the Bell/Independent network, the called number is passed to the local telephone company switch and the corresponding telephone is rung.

In this arrangement the OCC switches are connected to the line side of local (class 5) offices. From the standpoint of network interconnection, the OCCs are thus treated like any other local telephone customer. Initially, the OCCs were also charged business line rates. The original ENFIA (Exchange Network Facilities for Interstate Access) meetings, held under FCC auspices, were concerned with changes to this tariff. In December 1978 an interim settlement was reached which modified the way in which the OCCs would compensate Bell and the Independents for network utilization. The technical arrangements for interconnection were not changed.

The ENFIA II meetings, which commenced in October 1979, were initiated by OCC requests for an enhanced means of interconnection between their networks and the Bell/Independent network. For anyone who has read the previous section of this report, the issues raised in these meetings would seem familiar. The OCCs were also interested in a "parity" of interconnection. More specific issues, such as point of interconnection, numbering plan, and customer billing,

were discussed at length. Five such meetings were held⁷. The problem was defined, AT&T suggested various possible solutions in some detail, tariffs were proposed, there was negotiation concerning these tariffs, but no agreement was reached. It is possible that these meetings may continue, but no such plan exist as of this writing.

These discussions between AT&T and the OCCs were the type of meetings which the IRCs have repeatedly requested, but never succeeded in obtaining⁸. AT&T had previously asserted that a full study of the IRC interconnection problem would cost one million dollars⁹. Although AT&T obviously spent a considerable sum on the studies in support of ENFIA II, we have no basis upon which to assess the actual cost. In any case, much of the material developed for ENFIA II is relevant to the IRCs' problem, and is really the only such material available.

It should be noted, of course, that while there are significant similarities, there are also differences between the IRCs' and OCCs' problems. At the most macroscopic level of description, the OCCs use the Bell/Independent intraexchange network at both ends of their interexchange network; while the IRCs use the Bell/Independent intraexchange and interexchange network at one end of their international network, with the other end supplied by their foreign correspondent. Even so, the complexity of the OCCs' and IRCs' interconnection with the Bell/Independent network is similar. Both must receive calls and signaling information from the Bell/Independent network; both must send calls and signaling information to this network.

Rather than continue to explore differences and similarities in a general way, we turn now to specific technical and operational areas.

⁷The five meetings were held on October 2, 1979; October 31-November 1, 1979; November 13-14, 1979; January 15-16, 1980, and January 29, 1980. For an account of these meetings, see Telecommunications Reports, Vol. 45, No. 40, pp. 7-9; Vol. 45, No.44, pp. 10-11; Vol. 45, No. 46, pp.7-8; Vol. 46, No. 3, pp. 13-14, and Vol.46, No. 5, pp. 8-9. AT&T also distributed considerable documentation. This is in the public record, but may be more difficult to obtain.

⁸Most recently, see the September 25, 1979 letter from Robert E. Conn, Executive Vice President, WUI, to Philip L. Verveer, Chief, Common Carrier Bureau, FCC. Such requests have also been contained in previous IRC filings with the FCC. See, for example, WUI (1977), pp. 8-9.

⁹AT&T (1977c), page 25, second footnote.

3.1 Point of Interconnection

In ENFIA II, two plans were discussed which are relevant to the IRC point of interconnection issue. The first, applicable only to local #1 ESS and #1A ESS machines, is called "Trunk with Line Treatment". In this arrangement the software of the ESS machine is modified in order to give line features to a trunk. In particular, it is modified so that billing information is accumulated in the normal fashion, for a call placed through this facility into the Bell/Independent network. When the called telephone goes off-hook, answer supervision is returned, as it would be in the case of a trunk, to notify the OCC or IRC switch that the called party has answered.

This arrangement, as suggested in ENFIA II for OCC use, is similar to a tariffed offering which is already available to and used by the IRCs. It is implemented on one modified ESS Class 5 machine in New York City, and is arranged with a four-wire path from the IRC to (but not through) the Bell switch.

The second terminating plan, suggested by AT&T for possible OCC use, is called "Four Wire Trunk Connection To Toll Switch". The name is descriptive. A four-wire transmission facility would be provided from the OCC switch to the Bell toll switch, which might be a class 2, 3, or 4 machine. If the Bell switch were itself four-wire¹⁰, then the entire path, from the OCC switch, through the connecting toll office and hence into the Bell/Independent network, would be four-wire also. Since this is a trunk connection, answer supervision would be provided.

In the IRC context, this arrangement could be used to receive calls from the Bell/Independent network to the IRC switch. In the opposite direction, however, there would be a billing problem.

In the Bell/Independent network, billing information is accumulated in conjunction with local switching, and there is no means to obtain this information for calls which enter the network at toll machines. Other than obtaining the information from the IRC itself, the Bell/Independent network would require modification to obtain the billing information for an inbound international call which is placed from the IRC switch, through the Bell toll machine, into the national Bell/Independent network to a terminating telephone. This function could be provided, but it might be difficult if calls were billed according to normal tariffs, which take into account the distance and intrastate/interstate nature of the call.

¹⁰Not all such switches are four wire. See Section 4 of this report.

This billing problem has no analog in the OCC context, since calls would only be placed into the Bell/Independent network for intraexchange completion, and payment to Bell and the Independents could be handled by a modified ENFIA tariff.

3.2 Numbering Plans and Signaling

Numbering plans are concerned with the methods in which a customer may convey information to the Bell/Independent and other carrier networks. Signaling is concerned with the ways in which this information, and other information which may be generated internally, will be passed through these networks to influence the routing and billing of the call. In Section 2 of this report it was convenient to consider these issues separately. Here, within the context of specific proposals, it is more convenient to combine these subjects.

Three different numbering plans were suggested for study in ENFIA II. All of these plans require that the OCC (or IRC) switch connect to a Bell/Independent toll switch. For this reason, none of these numbering plans will work in conjunction with the "Trunk with Line Treatment" point of interconnection plan discussed above, since this scheme involves OCC (or IRC) interconnection to a local switch. Therefore, to use any of these proposed numbering plans, either the "Trunk with Line Treatment" scheme must be further modified, or the Four Wire Connection to Toll Switch" scheme, as previously discussed, must be employed.

In the discussion above, recall that the "Four Wire Connection to Toll Switch" plan would require further modification of the billing means in order for an IRC to originate calls into the Bell/Independent network. Thus, as presented in ENFIA II, and assuming no further modifications, the Trunk with Line Treatment" point of interconnection plan would be better suited for placing calls from an IRC switch into the Bell/Independent network; the "Four Wire Connection to Toll Switch" point of interconnection plan, better suited for calls from the Bell/Independent network to the IRC switch.

We now discuss the three numbering plans, one at a time, along with their corresponding signaling and routing implications.

3.2.1 Dedicated Office Code Plan

In this plan there would be one NNX, within a given NPA, which all customers would dial to reach the OCCs. Thus a customer would dial, in the usual manner:

$$\text{NNX } X_1X_2X_3X_4$$

where

NNX would be the common access code assigned to all OCCs within the NPA,

X_1X_2 would be the two-digit identifier assigned to a particular OCC,

X_3X_4 would be free for an OCC to assign as desired.

In the operation of the toll hierarchy, the terminating OCC switch would receive at least the X_3X_4 digits. Since X_3X_4 would not be enough information to both identify the calling customer and the number he wished to call, the OCC would have to return a second dial tone and receive further information from the calling customer over the built-up connection, using some means such as Touch Tone signaling. These same remarks would apply to an IRC.

This plan assumes that the calling customer and the OCC switch are located in the same NPA. As we have seen, this is a reasonable assumption for an OCC, but not for an IRC.

Assuming that an IRC switch were located in New York City (NPA = 212), then this plan would work for calling customers within this area. To obtain service from other NPAs, it would be necessary for the customer-dialed

$$\text{NNX } X_1X_2X_3X_4$$

to be translated to

$$212 \text{ N}'\text{N}'\text{X}' \text{ } X_1X_2X_3X_4' //$$

(where N'N'X' might not be the same as NNX), before the call was routed beyond the NPA of origin.

Most Bell/Independent switching systems should be able to perform this function¹¹, but, again, this was not discussed in ENFIA II.

The code space of X_1X_2 (i.e., 100 possible identifiers) should be adequate to accommodate both the OCCs and IRCs.

¹¹See AT&T (1975), Section 4, Tables 2 and 3.

In conjunction with the Dedicated Office Code plan, a variation, called "Dedicated Office Code with ANI" was also studied. ANI stands for "Automatic Number Identification." It refers to an arrangement, provided in conjunction with a local switching machine, for identifying a calling station and forwarding this information along with the call to a connecting toll machine. It is usually used in conjunction with Automatic Message Accounting (i.e., billing).

If the calling party identification were forwarded to an OCC in real-time, then fewer digits would have to be dialed by the calling customer. Further, the OCC would be afforded a greater measure of security, since it would know which station was calling. An IRC would be interested in these same benefits.

To implement this scheme in the OCC context the local switch, to which the calling customer is connected, must be connected to the toll switch by a CAMA-type trunk group (Centralized Automatic Message Accounting). The calling party identification, and the call itself, is then placed over a trunk in this group. This arrangement requires that the OCC switch be connected directly to the toll machine, and that the toll machine be modified to pass the CAMA information through to the OCC.

This arrangement is feasible for an OCC. But for an IRC the CAMA information would generally have to pass through the nationwide Bell/Independent network, in order to reach the IRC switch in one location (e.g., New York City), or, at most, perhaps in a few locations (e.g., New York City and San Francisco). This might be accomplished by forwarding the information, from the CAMA-equipped toll switch, through the built-up connection, to the IRC switch. Further, the originating NPA would have to be added to the information transferred. Again, this was not discussed in ENFIA II, and it is not clear exactly how this function would best be performed.

3.2.2 Dedicated NPA Plan

In this scheme there would be one NPA (Numbering Plan Area - i.e., Area Code), within the North American Numbering Plan, which all customers would dial to reach the OCCs. Then a customer would dial, in the usual manner:

NPA NNX₀ X₁X₂X₃X₄

where

NPA would be the common area code assigned to all OCCs within the North American Numbering Plan,

NN would be the two-digit identifier assigned to a particular OCC,

X₀X₁X₂X₃X₄ would be free for an OCC to assign as desired.

In the normal operation of the toll hierarchy it would be possible for the OCC switch to receive the $X_0X_1X_2X_3X_4$ digits, which would reduce the number of digits the calling customer would have to dial after reaching the OCC. Since these five digits, in themselves, would not be adequate to specify a station in the North American Numbering Plan, the OCC switch would still have to return a second dial tone, and receive further information from the calling customer as discussed above.

This plan would work in the IRC context, since it is capable of routing a call out of the NPA of origin. The code space of NN (i.e., $8 \times 8 = 64$ combinations) should be adequate for OCC and IRC use. If not, however, then it would be possible to designate:

NNX_0 as the three-digit identifier assigned to a particular OCC or IRC,

$X_1X_2X_3X_4$ as free for the OCC or IRC to assign as desired.

This arrangement may be preferable or even necessary, since it would permit full six-digit routing (i.e., NPA NNX_0) for calls through the national Bell/Independent network to the IRC switch.

Since an IRC might receive either four ($X_1X_2X_3X_4$) or five ($X_0X_1X_2X_3X_4$) digits, it would be possible for the IRC switch to perform a translation from this code into a pre-registered foreign station number, and hence complete the call with no second dial tone or further digits received from the calling customer. This assumes, of course, that the IRC decided that this scheme afforded adequate security against unauthorized use.

In effect, both the called and calling stations' identifications, together with invalid codes to provide for security, would have to be implicit within the four or five digits. This concept, called pre-subscription, would require a prior arrangement between an IRC and its customers as to the foreign stations which could be reached. Further, the product of the number of IRC customers and the number of stations reachable would probably be limited to about 10^3 or 10^4 , allowing for invalid codes. This is, of course, a fundamentally different definition of the IRC's business from one in which any Bell/Independent customer might reach any foreign telephone station.

A "Dedicated NPA with ANI" plan was also discussed in ENFIA II. In the IRC context, this plan would present the same difficulties as discussed in Section 3.2.1 above.

3.2.3 IDDD Plan

In this scheme the existing International Direct Distance Dialing (IDDD) arrangement would be adapted for OCC use. The previous two numbering plans, at least in their non-AMA form, could function in conjunction with any local switching machine. This arrangement, however, was only offered for OCC originating customers served by #1 ESS and #1A ESS local switches.

In the normal IDDD application, a customer would place an unassisted station-to-station call by dialing

011 + CC + NN

where

- 011 is the international prefix,
- CC is the country code, either one, two, or three digits,
- NN is the national number of the station desired, with length limited such that $CC + NN \leq 12$ digits.

In the normal IDDD applications, the #1 ESS or #1A ESS would output a first stage of information consisting of

011 + XXX where

- XXX is a routing code to connect the #1 ESS or #1A ESS with the appropriate AT&T International Switching Center.

After the built-up connection was established, the #1 ESS or #1A ESS would output the second stage of information consisting of

CC + NN

directly to the International Switching Center¹².

As suggested by AT&T for OCC use, the customer would dial

011 YY NPA NNX XXXX

where

- 011 is the international prefix,
- YY is the "pseudo country code" used to identify an OCC,
- NPA NNX XXXX is a full ten-digit North American Numbering Plan station number.

This is consistent with the IDD scheme, since $YY + NPA NNX XXXX = 12$ digits; the maximum limitation of $CC + NN$.

A signaling arrangement, analogous to that discussed above, would then be used to connect the #1 ESS or #1A ESS local switch with the OCC switch during the first stage of outputting, and to convey the NPA NNX XXX to the OCC switch during the second stage.

¹²This explanation is somewhat simplified, but adequate for our purposes here. For more details, see, for example, AT&T (1975), Section 10.

Relative to the other numbering plans discussed in ENFIA II, this arrangement has the advantage of conveying the most information to the OCC switch during the normal operation of the Bell/Independent network. An OCC switch would still need to return a second dial tone, and receive further customer-dialed information, in order to learn the identity of the calling customer or station in real-time.

If this plan were to be used by an IRC, only 10 digits (analogous to NPA NNX XXXX) could be received by the IRC switch without resorting to the second dial tone procedure. Again, this is more digits than an IRC would receive under either of the other numbering plans proposed in ENFIA II, but it is not adequate to identify uniquely an arbitrary foreign station number. To do so would require up to 12 digits, i.e., the CC + NN dialed in the existing Bell/Independent IDDD plan.

Note that this possible IRC use of the IDDD plan proposed in ENFIA II is not the same as the use of the IDDD mechanism initially proposed by the IRCs, as discussed in Section 2.2 of this report. This previously discussed IRC proposal would convey the entire Country Code + National Number (CC + NN) of up to 12 digits, without using a mechanism such as second dial tone or pre-subscription. However, recall that AT&T strenuously objected to this plan (Section 2.3, above), and RCA later suggested another alternative, at least as an interim solution (Section 2.4, above), while the other IRCs did not.

A signaling arrangement, analogous to that discussed above, would then be used to connect the #1 ESS or #1A ESS local switch with the OCC switch during the first stage of outpulsing, and to convey the NPA NNX XXXX to the OCC switch during the second stage.

Returning to the possible OCC and IRC use of the IDDD plan as suggested in ENFIA II, we note an interesting point with respect to the pseudo country code. Assignment of these codes, for normal IDDD use, is by international agreement, administered by the CCITT. There is no technical problem in employing unused codes for internal U.S. use, provided that they are not claimed for their original international application. Both uses, of course, cannot co-exist. It is not clear exactly what approval, if any, would be required to employ domestically the unused country codes as pseudo country codes, how this approval would be obtained, who would be responsible for administration, etc.

One advantage of the IDDD plan should be mentioned in closing. The IRCs have expressed concern about domestic satellite routing of their calls in the Bell/Independent network (see the Appendix, Sections 9.1 and 9.3). Since IDDD calls to an International Switching Center are not presently routed over domestic satellites in the Bell/Independent network, this problem would not exist.

3.3 Customer Billing

In the OCC context considered in ENFIA II, a calling customer usually reaches the OCC switch through the Bell/Independent intraexchange network. Charges are incurred in the usual manner. From a Bell/Independent billing standpoint these calls will usually be local or perhaps extended calling area calls. If a calling customer must incur a toll charge in order to reach the nearest OCC switch, then this is his prerogative.

This is not analogous to the IRC situation. Each IRC can be expected to have a switch in only one or perhaps at most a few locations. The IRC originating customer in the United States must often use the Bell/Independent toll facility to reach this point. Further, the IRCs would prefer that this toll call not appear on the calling customer's Bell/Independent bill, just as the domestic portion of an IDDD call would not appear as a separate item. This particular problem will be discussed in more detail in a later section of this report.

In any case, the technical problems faced by an IRC in obtaining information with which to bill for the portion of the call which uses its own facilities are similar to the problems faced by an OCC in this regard. The particulars of this billing problem are a function of the numbering plan under consideration.

Recall that in the Dedicated Office Code Plan an IRC would receive two digits (X_3X_4) as a part of the operation of the Bell/Independent network, while in the Dedicated NPA Plan an IRC might receive four ($X_1X_2X_3X_4$) or five ($X_0X_1X_2X_3X_4$).

Two digits are clearly not enough information for a pre-subscription scheme to identify both the calling and called stations, so a second dial tone procedure would have to be employed. With four or five digits pre-subscription might be possible, as discussed above.

Assuming a second dial tone procedure without pre-subscription, the IRC switch would expect to receive the calling party's identification, which might be in either the form of a special preassigned code or the actual North American Numbering Plan calling station number. In either case, the IRC switch might also be expected to receive a security code, to verify that the calling party was indeed an IRC customer. Further, the IRC would be expected to maintain files which associate the calling party identification with a name and address, in order to perform billing. Since the IRC could time the use of its own facilities, a bill for this use could be generated.

Another variation of this arrangement, which would not require a security code, might be possible if the IRC were to receive the North American Numbering Plan calling station number as the calling party identification. In this case,

it would be assumed that any Bell/Independent customer was, by definition, an IRC customer, and that any call was valid. Billing would require cooperation between the IRC and Bell and the Independents, at least to associate the calling number with a name and address. Although this plan, which we will call customer base parity, is technically feasible, it obviously is a different definition of the IRC's Datel business, and has legal implications well beyond the scope of this report.

If the ANI version of either the Dedicated Office Code or Dedicated NPA Plan were available for IRC use, then the full ten-digit North American Numbering Plan number of the calling station would be conveyed to the IRC switch in real time. This number could be matched against a list of valid IRC customers by the IRC switch. Alternatively, a customer base parity scheme could be implemented.

When the IDDD numbering plan was discussed in ENFIA II, an associated billing arrangement was considered in which the OCCs would receive AMA (Automatic Message Accounting) tapes on a periodic basis. For each OCC call, this tape would contain the calling and called number and the time of connection and disconnection.

If employed by an IRC, this tape would contain the calling number, the ten digits (analogous to NPA NNX XXXX) received by the IRC switch, and the time of connection and disconnection. From a technical standpoint, this information would be adequate for an IRC to implement a customer base parity scheme, since it could be matched with information maintained in files by the IRC. Of course, an alternative arrangement is possible, in which the IDDD numbering plan is used without customer base parity.

3.4 Financial Arrangements and Network Planning

The tariff arrangement proposed by AT&T in ENFIA II consisted of several different types of charges, each of which was related to a different type of expense involved in providing interconnection to the OCCs. Network planning issues were implicit in these financial arrangements, so these two areas will be discussed together.

As a result of the ENFIA I meetings the tariffs were based both upon actual costs, and upon an agreement negotiated between AT&T and the OCCs. In ENFIA II the tariffs were only to be cost-based, with AT&T earning its authorized rate of return. As of this writing the ENFIA II meetings have been terminated, and no agreement was reached. One source of disagreement centered around the validation of the tariffs. Many detailed factors were involved in the tariff development. Perhaps a relatively large meeting, such as ENFIA II, is simply not the appropriate forum in which to explain and justify such a complex structure.

Philosophically, some of the most interesting concepts introduced in the ENFIA II tariff structure related to network planning. The original ENFIA circuits were connected to the line side of local switches, in the same manner as an ordinary telephone customer. Line terminations are normally provisioned so that customer demand for new service can be satisfied rapidly. State Public Utility Commissions usually monitor held orders. The rapid availability of telephone service is considered a public-interest objective.

The ENFIA II discussions included connections to be made to the trunk side of the connecting switches. Trunk termination and facility availability has previously been considered an internal Bell/Independent network planning issue. Because of the fixed costs associated with the installation of new equipment, such facilities are normally added only at periodic intervals which are relatively far apart in time. Thus a "growth job" might only take place on a switching system every 2 years. Because of the complexity of these changes, they must be planned and scheduled well in advance. Thus there are planning cycles, which require forecasts of need prior to installation and availability. In the past, of course, these forecasts have only been concerned with Bell/Independent requirements.

In ENFIA II AT&T suggested a procedure in which each OCC which was interconnected to a particular switching machine would order additional facilities at the appropriate time in the switch's planning cycle. Each OCC would determine its needs based upon its own forecasts, business plans, etc. If an OCC requested facilities which were subsequently found to be unneeded, then a "reserved capacity" charge would be imposed. This charge would continue until either the OCC used the facility or until the next planning interval.

This concept leaves a number of interesting questions unresolved - for example, how can an OCC verify that "reserved capacity" is indeed still reserved, should there be a secondary market in reserved capacity, etc. Nevertheless, the general philosophy of insulating the Bell/Independent and OCC planning processes from one another seems quite important. Without such insulation, antitrust problems become more difficult, joint planning meetings with FCC oversight become more frequent, and the possibility for true competition is reduced.

Because the OCCs did not wish to wait up to 2 years for the next planning cycle, a special "advanced availability" study was conducted in 10 cities selected by the OCCs. On a case-by-case basis, AT&T examined the possibility of changing existing plans in order to accommodate these initial OCC requests. One-time charges were developed for this accommodation.

The more usual types of tariff items were also developed in ENFIA II. A monthly, recurrent charge per ENFIA II circuit was proposed. The form of this tariff was similar to that developed in ENFIA I, but the actual charges were higher, presumably because they were cost based.

There were also charges proposed for installing an ENFIA II circuit and for changing the status of a circuit - for example, changing an ENFIA I circuit or a reserved capacity termination to an active ENFIA II circuit.

In connection with the numbering plan, there were charges for changing the translation in the switching machines to recognize the new customer-dialed digits. These charges were relatively modest, and seem to reflect the actual administrative expense of implementing the changes.

With respect to the Dedicated NPA plan, there was no charge proposed for advancing the date at which the North American Numbering Plan would be filled, and some new arrangement, such as interchangeable NPA codes, would have to be instituted.

Because of the differences in the ways in which the OCCs and the IRCs would use the Bell/Independent network, the details of the ENFIA II financial arrangement do not have a great relevance to the IRCs problem.

Issues of forecasting, network planning, and trunk termination availability should be much easier to resolve in the IRC context, because far fewer trunks are involved. This is demonstrated by Table 3. In this table the IRC figures were obtained in an indirect way, using the RCA projections, which are the only available in the public record. Even with this approximation, however, it is clear that the IRC demand for termination with the Bell/Independent network is roughly two orders of magnitude less than that of the OCCs.

The concept of advanced availability is not as relevant in the IRC context. The somewhat heroic efforts suggested by AT&T in order to meet OCC requests would hardly be justified. It should be much easier to satisfy the modest IRC requests within the constraints of existing plant. If they cannot be completely satisfied, then some simpler plan for advanced availability should still be possible. The general principle of insulating Bell/Independent and IRC forecasts from one another is still valid. As a practical matter, of course, any planning error would be far less harmful in absolute impact.

An IRC would use both the Bell/Independent intraexchange and interexchange plant. In principle the tariff structure could be even more complex than that found in ENFIA II. This would make the validation of the tariff even more difficult. But again, as a practical matter, the far fewer circuits involved might argue for a simpler tariff structure.

Table 3. Comparison of QCC and IRC
Termination Forecasts

	All QCCs ¹³	RCA ¹⁴	All IRCs ¹⁵
	<u>Total</u>	<u>Globcom</u>	<u>Total</u>
1980	26,356	150	255
1981	41,662	200	340

3.5 Other Issues and Concluding Remarks

The issue of operator procedures was not really discussed in ENFIA II. The general expectation was that the Bell/Independent operator procedures would not change significantly. The issue of maintenance and testing was not discussed at any length either. There would have been a need to resolve these issues eventually, of course, had the discussions continued.

At the most general level, ENFIA II demonstrated that technical plans for the interconnection of other carriers with the Bell/Independent network can be devised, explained, and understood. Unfortunately, ENFIA II also demonstrated the extreme difficulty of constructing cost-based tariffs which can be verified. Any improvement in this art would be an important contribution, and would likely become even more important in the future.

4. FURTHER CONSIDERATION OF ISSUES

ENFIA II did not address all of the issues related to domestic interconnection for Datal services. Some of the issues not addressed will be considered in this section.

4.1 Point of Interconnection

The IRCs have requested (1) that the transmission path from their switch to the connecting Bell/Independent switch be four-wire, (2) that the connecting switch itself be four-wire so that there is four-wire connectivity from the IRC

¹³From data given to AT&T by the QCCs (i.e., ITT, MCI, SPC and WU) at the November 13-14, 1979, ENFIA II meeting.

¹⁴From the Appendix, Section 9.2.

¹⁵Scaled from the RCA data by multiplying the previous column by the factor (present Datal revenue for all IRCs/present Datal revenue for RCA), Data for factor obtained from IRCs.

through the Bell/Independent switch, and (3) that the number of links in the switched circuit from an IRC to a domestic customer be no more (or, at most, one more) than the number from a Bell International Switching Center. In this section we will discuss the necessity of such arrangements and the problems involved in implementing them.

A transmission path may be two-wire, which means that transmission may occur simultaneously in both directions over a single pair of wires; or it may be four-wire, in which case each of the two directions of transmission is carried on a separate wire pair. Carrier transmission systems (analog or digital) are inherently four-wire, as are digital switching systems (more precisely, switches with digital networks). The device which converts between the two-wire and the four-wire modes of operation is called a hybrid.

Figure 1a shows diagrammatically what will be called a two-wire section, consisting of a two-wire transmission path with a hybrid at the right end. Note that this transmission path might not be a simple circuit. In general it is a series of two-wire transmission circuits with two-wire switches interposed, providing that two-wire connectivity is maintained from one end of the circuit to the other.

Likewise, Figure 1b shows a four-wire section, consisting of a four-wire transmission path with a hybrid at the right end. Again, the transmission path may consist of an arbitrary number of four-wire circuits with four-wire switching points interposed.

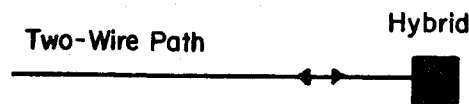


Figure 1A
Two-Wire Section

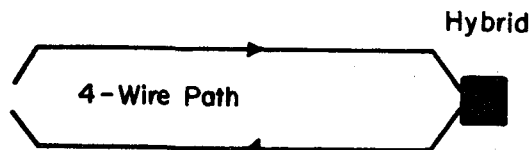


Figure 1B
Four-Wire Section

With this notation any transmission path can be represented as a series of two-wire sections and four-wire sections, which, by definition, must alternate.

A central problem which the IRCs are attempting to mitigate by reducing the number of two-wire to/from four-wire conversions relates to echo. In principle no echo will occur if the impedance of the hybrid is equal to the impedance of the connecting two-wire circuit. If the hybrid impedance is not matched, then some of the energy in one side of the connecting four-wire circuit will be reflected into the other side, causing echo.

This is illustrated in Figure 2. The original signal enters hybrid A, and is placed on the upper leg of the four-wire circuit. At hybrid B an impedance mismatch is assumed to occur. Some of the energy from the signal will pass through hybrid B into transmission path C, but some will be reflected at the hybrid and directed back along the lower leg of the four-wire circuit to hybrid A. At hybrid A we might also assume an impedance mismatch, resulting in some of the echo energy being directed back towards the original signal as "talker's echo", and some of the energy (the echo's echo) being reflected back again to cause "listener's echo" along transmission path C. The nomenclature, of course, is from voice telephony.

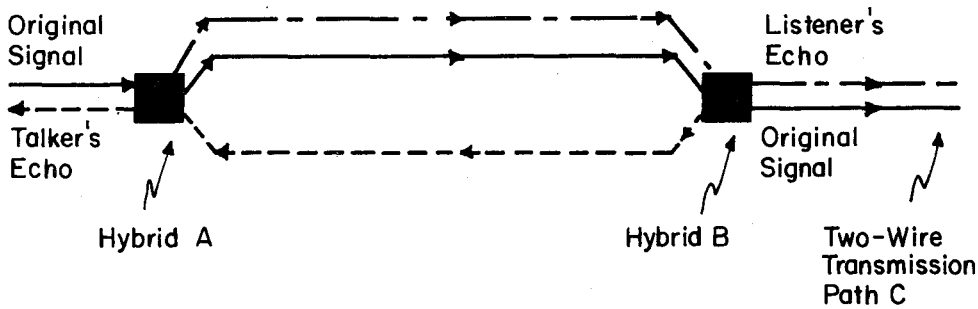


Figure 2
Echo Paths in 2 to/from 4 Wire Conversion

If the connecting two-wire circuit has a known, constant impedance, then the impedance of the hybrid can be closely matched and echo can be minimized. Assume, however, that transmission path C in Figure 2 includes a local loop. Then hybrid B might be in the toll connecting trunk of a local switch, or it might be deeper in the MTS network. In any case, hybrid B will be switched to different local loops with different impedances on different occasions, and hence the impedance of the hybrid must be adjusted to a compromise value. In modern switched telephone networks this is the major source of echo, and exists at both ends of the built-up connection. Since this problem affects the extremities of the connection, it is beyond the control of any interconnection plan which can be proposed by the IRCs.

In data communication these echos can cause various difficulties depending upon such factors as (1) whether transmission is full duplex or half duplex, (2) the data rate employed, (3) the path delay and (4) the signal-to-noise ratios of the receivers in the modems at both ends of the connection.¹⁶

Using the two-wire section/four-wire section diagrammatic notation, Figure 3 shows the entire circuit path for a Datel call under the current arrangement. Note that M and N are independent random variables. In general they both vary from call to call, as a function of the path established through the PTT and Bell/Independent networks. Further, the statistical distribution of M is a function of PTT policy for its own domestic network, and is beyond direct control of a U.S. carrier.

Each hybrid produces both listener's and talker's echo. The resultant echo at each end of the path is a complex function of these individual echos. We would expect the greatest components of echo to be generated at hybrids A and B, for the reasons discussed above.

The IRC point of interconnection plan proposes to change link C to a four-wire path, which would also eliminate the hybrids at both ends of this link. Figure 4 shows the result of implementing this plan. The random variable M is the same as in Figure 3, since the operation of the PTT network would not be affected. The random variable N' of Figure 4 is different from N of Figure 3 since this is a different network arrangement.

Note that N' will not always be equal to zero. In (other) words, even with the proposed IRC point of interconnection plan, there is still the possibility of two-wire to/from four-wire conversions in the Bell/Independent path

¹⁶For more detail, see, for example, AT&T (1977), Telecommunication Transmission Engineering, Volume 1, p. 491.

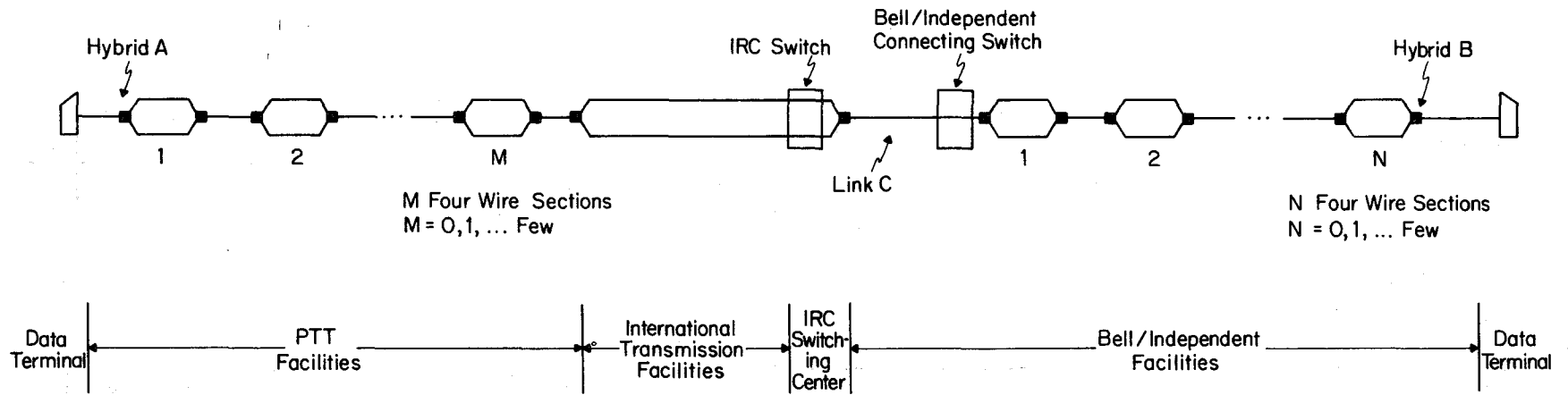


Figure 3
Present Datel Circuit Path

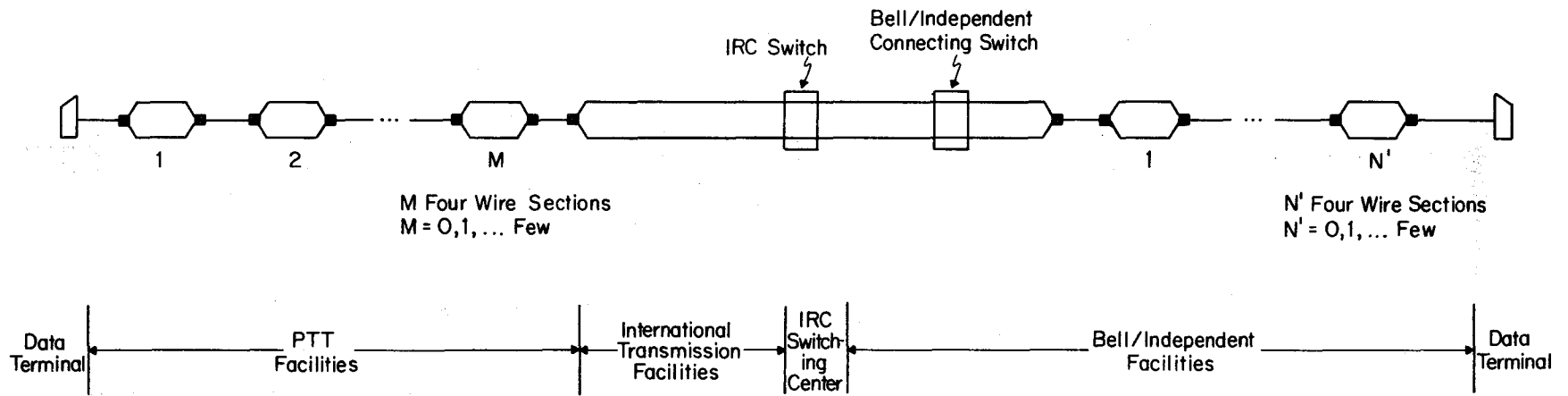


Figure 4
DATEL CIRCUIT PATH
UNDER IRC PROPOSAL

between the IRC switch and the local switching office serving the IRC customer in the United States.

To understand this, we first note that not all Bell/Independent switches in the MTS toll hierarchy are four wire. This is shown in Table 4. Using data from Table 4, Figure 5 shows the relationship of an IRC switch to the Bell/Independent toll hierarchy in the proposed IRC plan.

Table 4. Number of Bell and Independent Switches In The MTS Toll Hierarchy For All 50 States at the End of 1978¹⁷

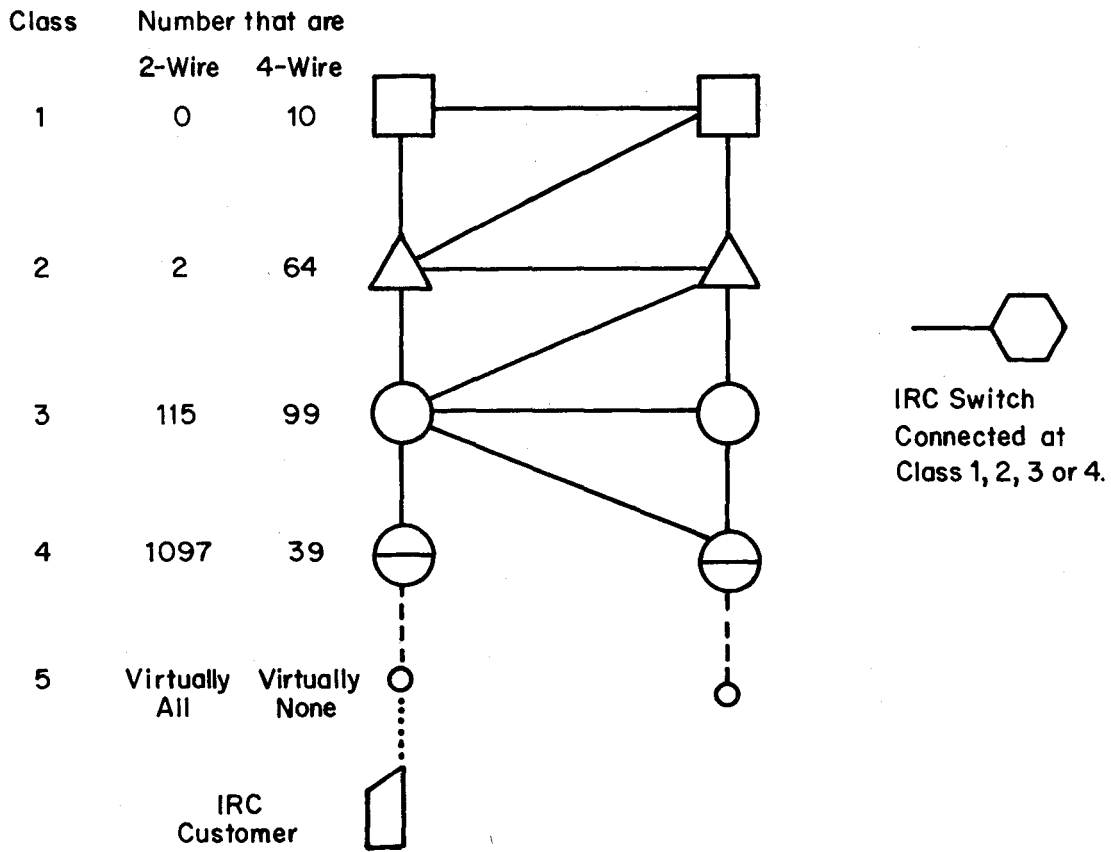
SYSTEM TYPE	CLASS			
	1	2	3	4
No. 4 Electronic Switching System (4ESS). All are four-wire.	2	7	7	5
No. 4 Crossbar (4XB). All are four-wire.	8	55	86	27
No. 1 and No. 1A Electronic Switching System (1/1A ESS). Four-wire Version.	0	2	6	7
No. 1 and No. 1A Electronic Switching Systems (1/1A ESS). Two-wire version.	0	0	9	67
Crossbar Tandem (XBT). All are two-wire.	0	2	69	144
No. 5 Crossbar (5XB). All are two-wire.	0	0	34	351
Step-by-Step (SXS). All are two-wire.	0	0	3	535

From a study of Figure 5 it can be seen that N' of Figure 4 will not always be equal to zero, but rather will vary from call to call according to the particular path established through the Bell/Independent hierarchy.

Returning now to a comparison of Figures 3 and 4, there is no doubt that the arrangement suggested in Figure 4 would result in some improvement in transmission. The quantitative characterization of this improvement would be a

¹⁷ Excluded are 10 non-Bell No. 1 or No. 1A ESS machines for which information was not available. Compiled from AT&T (1979) Distance Dialing Coordinating Handbook.

Figure 5
Relationship of IRC Switch to Bell/Independent Toll
Hierarchy in the IRC Proposed Point of Interconnection Plan



- Local loops. Virtually all 2-wire
- Toll connecting trunks. Some 2-wire, some 4-wire.
- Intertoll trunks. Mostly 4-wire. (Not all possible trunk connections shown on diagram.)

substantial study in its own right. Complicating factors include the statistical nature of the connection at both ends of the path (i.e., M, N, and N' are all random variables) and the fact that the PTT path may be through different national networks in different countries on different calls. To the author's knowledge, no such analysis is available. AT&T would be in the best position to perform such a study, but, they have had no reason to do so since the international use of Dataphone had not been allowed until recently.

Another question concerning point of interconnection involves the number of links in the path from an IRC customer to the IRC switch. WUI has requested routing parity with AT&T long lines, meaning that the number of links in the WUI path would be no more than the number of links required for the same customer to reach an AT&T Long Lines International Switching Center. ITT has suggested that, at most, one additional link could be allowed.¹⁸

The difficulty with these proposals is as follows. In the Bell/Independent toll hierarchy trunks may be justified from a number of toll switches directly to International Switching Centers not to improve transmission quality, but rather on the basis of traffic alone. The use of a direct rather than an alternative route is justified by the well-known traffic engineering concept of "economic CCS". But Bell/Independent international MTS traffic is much larger than Datel traffic.¹⁹ The equivalent direct groups to IRC switches may not be justified.

This particular IRC request illustrates a problem which has permeated the entire point of interconnection issue. It would be extremely helpful if exactly what the IRCs want could be quantified, independent of how it is to be accomplished. As AT&T and the IRCs have developed their arguments over the years, these issues have become confounded. In the area of transmission quality, the improvements which the IRCs seek should be quantified using well-known transmission performance parameters. As we have seen, translating this into a specific point of interconnection plan may be difficult, but it would improve the potential for meaningful discussions.

4.2 Numbering Plans and Signaling

This section considers numbering plans and their related signaling implication. In the previous chapter on ENFIA II the Dedicated Office Code Plan, the Dedicated NPA Plan and the ENFIA II IDDD Plan were examined in Sections

¹⁸Appendix Sections 2.1 and 2.4.

¹⁹Current annual revenues: Bell/Independent, about \$1,370 M; Datel, about \$1 M. Sources: AT&T and the IRCs, respectively.

3.2.1, 3.2.2, and 3.2.3, respectively. None of these plans provide dialing parity with the Bell/Independent IDDD numbering plan. Dialing parity would imply that any station in the U.S. MTS network could call a station in a foreign country via an IRC, dialing no more digits than would be required to reach the station via the international facilities of AT&T Long Lines.

This section considers the proposed IRC IDDD plan, using the same format as Section 3. This plan is different from the three mentioned above in that it does provide dialing parity.

As discussed in Section 2.2 and summarized in Table 1, all of the IRCs initially requested dialing parity. This also implies that the IRC switch would receive all of the information received by an AT&T International Switching Center as the call progressed. As summarized in Table 2 of Section 2, ITT and WUI have continued to request dialing parity, while RCA has suggested a compromise, at least in the interim.

In the present AT&T IDDD numbering plan, an unassisted station-to-station call is established by dialing

011 + CC + NN,

while an operator-assisted call requires the dialing of

01 + CC + NN.

In both cases

CC is the country code, either one, two, or three digits,

NN is the national number of the station desired, with length limited such that $CC + NN \leq 12$ digits.

In all cases the local switching office serving the calling customer must have the capacity to handle IDDD calls. For operator-assisted calls the local office is connected to a TSPS system. The customer-dialed "01 + CC + NN" is passed, in slightly modified form, to the TSPS. The TSPS performs operator functions, as well as the function of digit analysis, route translation, AMA recording and two-stage outpulsing. In the first stage, the TSPS outpulses a six digit code consisting of

011 + XXX

where

XXX is a routing code.

This six-digit code is routed through the toll hierarchy in the normal fashion, establishing a connection between the TSPS and the appropriate International Switching Center. After this built-up connection is established, the TSPS outpulses the second stage of information consisting of

CC + NN.

In the case of Step-by-Step, most #5 Crossbar, #2 ESS, #2B ESS and #3 ESS local switching offices, unassisted station-to-station calls are also routed through TSPS, which performs all of the functions described above, except, of course, operator services. Since one TSPS can serve many local switching offices, this arrangement presumably reduces the cost of more extensive modification at each local switch to provide IDDD.

In the case of #1 ESS, #1A ESS, and nine especially modified #5 Crossbar offices in New York City, unassisted station-to-station calls are handled directly by the local switches, which perform the functions noted above to interface directly with the International Switching Centers.

Three different variations of the IRC IDDD plan have been suggested. The first will be called the IRC O1X Prefix Proposal. In their original requests for interconnection ITT (1976), TRT (1976), and WUI (1976) all suggested this plan in a general way, while RCA (1976) made the suggestion more explicitly. These requests are all summarized in Section 3 of the Appendix. This proposal has been consistently advanced in later IRC documents, and will therefore be considered as the primary IRC proposal.

In the IRC O1X prefix proposal an IRC customer would dial

O1X + CC + NN

where

X is a single digit assigned to a particular IRC,

CC is the country code and

NN the national number, as described above.

Since X = 1 is already in use by AT&T, there would be code space for 9 IRCs under this plan.

The two-stage signaling mechanism described above would be used (1) to establish a connection from the local servicing switch or TSPS to the IRC switch (instead of the AT&T International Switching Center), and (2) to convey the CC + NN to the IRC switch. This arrangement is described in detail by RCA in Section 4.2 of the Appendix.

In this numbering plan there is no way for an IRC customer to both (1) dial the full CC + NN and (2) signal the IRC switch that operator assistance is desired. The IRCs have not been explicit as to how operator services would be handled.

Operator assisted calls could be customer-dialed in the IRC 00X Prefix Proposal, as advanced by RCA (1976) and summarized in Section 3.2 of the Appendix.

In this proposal an IRC customer would dial

OOX + CC + NN
where X = 2N-2 for an unassisted station-to-station call to IRC N,
X = 2N-1 for a call to IRC N with assistance by an IRC operator,
N = 1, 2, 3, 4, 5.
CC is the country code and
NN the national number, as described above.

As indicated, there would be code space for only five IRCs. Assuming this plan were used by the four existing IRCs, only one new carrier could be accommodated. Competitive entry into this market would be severely restricted. From a policy standpoint this limitation must count very heavily against this plan.

The two-stage outpulsing mechanism could be used for signaling. Means would be required to differentiate a station-to-station from an operator assisted call at the IRC switch. RCA (the Appendix, Section 4.2) has suggested that a pseudo country code be substituted for the actual country code during second stage outpulsing for operator assisted calls. The pseudo code would imply (1) the actual country code and (2) the fact that an IRC operator was required. The code space of real country codes is more than half filled, but the subset of countries served by a particular IRC may not be. If not, then this plan might be implemented. Otherwise, it might be possible to imbed an operator required indicator in the 6 digit routing code used for first stage outpulsing. In either case, there would be direct and indirect costs to the domestic MTS network.

The third numbering plan advanced, called here the IRC Suffix Proposal, was also suggested by RCA (1976) and is also summarized in Section 3.2 of the Appendix. This plan would only be implemented for subscribers with Touch

Tone signaling capability. An end of dialing code, such as "*N#" or "N#" would be required after the normal IDDD dialing sequence, indicating carrier N. For dialing parity, AT&T would be assigned one of these codes. Presumably this scheme could indicate operator assistance, requiring a sequence such as "01 + CC + NN + *N#". The signaling implications of this proposal are as described for the IRC 00X prefix proposal.

4.3 Customer Billing and Financial Arrangements

Customer billing parity for Datel with AT&T Long Lines implies that the domestic (Bell/Independent network) segment of an international call is tarified on a postalized basis and not as a function of the location of call origination in the United States. Further, the charge for the domestic segment of the call would be included in the bill from the IRC, and not made a part of the bill from Bell or the Independent as normally received by the IRC customer. Such an arrangement is called free direct access.

Billing for customers of the Bell/Independent toll network is normally performed by equipment associated with the switching office originating the call. A signal, called reverse battery, is generated by the terminating office when the called party answers. This signal is then returned to the originating office. If this signal is not received, then timing for billing purposes is not initiated by the originating office, even though the call may have been completed.

On a call from an IRC customer in the United States through the Bell/Independent network to the IRC switch, it should technically be possible to inhibit Bell/Independent billing to the IRC customer. This might be accomplished by modifying the terminating Bell/Independent switch(es) which connect to the IRC switching centers. An IRC call would be sensed, and the return of the reverse battery signal would be inhibited.

Provisions for billing the IRC for the domestic segment of the call could be implemented by further modification to the terminating Bell/Independent switch(es). Assuming that Bell and the Independents offer domestic interconnection to the IRCs on a distance-sensitive basis, the technical arrangements might be similar to those used to implement 800 Service (Inward Wats). Tariffs for the interconnection services might be based upon Wats bands, since technical arrangements have been developed to forward originating Wats band information to the Bell/Independent terminating switch. Otherwise, it is not clear how the terminating switch would determine the domestic originating location of the call.

The above discussion assumes that an IRC offers free direct access to Datel customers located anywhere in the United States, which they have done for some years, in accordance with Commission approved tariffs. Some confusion on this subject arose due to recent FCC (1980a and b) Orders. (See Section 2.6.)

4.4 Double Satellite Hop Problem

Geosynchronous satellites have been used for international telecommunications, including Datel, for many years. The lengthy propagation time (about 1/4 second) caused by the path length to the geosynchronous orbit and back to earth, initially caused problems for data communications systems. However, most users have found solutions to this delay.

In the early stages of the Datel interconnection dispute, AT&T's use of satellites for domestic transmission was very low. Therefore, the potential difficulties of double satellite hops for Datel was not addressed by any of the protagonists in the dispute. Recently, however, AT&T has publicly indicated that they intend to increase their utilization of domestic satellites in the MTS network. The IRC's have indicated to us in private conversations their concern about the potential detrimental effects of double-hop transmissions. The IRC's claim that AT&T has already implemented techniques that prevent double-satellite-hop transmission in international MTS. The IRCs then state that unless AT&T provides them with some indication of the type of domestic transmission techniques used (terrestrial or satellite) to bring the link to their gateway switch, they will be at a competitive disadvantage vis-a-vis AT&T's international dataphone type services.

Obviously, this satellite double-hop problem was almost nonexistent in the past but we cannot dismiss its importance in the future.

5. STEPS TOWARDS RESOLVING THE PROBLEM

In the previous sections of this report the Datel interconnection problem was factored into specific operational and technical areas. In this section the problem is considered as a whole. The outlooks for three different categories of potential solutions are discussed: short-term, medium-term, and longterm.

Such categories assume that financial resources are limited, since, otherwise, the implementation of the most elaborate long-term plan could begin immediately. This assumption may seem obvious, but there has been a tendency

to discuss improved interconnection for Datel as a "right", without adequate consideration of who would pay.

It has been argued that improved Datel interconnection is in the public interest, and hence costs should be borne by the MTS ratepayer as an overall social good. This is a policy question which must be addressed by the FCC. In this study we have assumed the principle adopted in ENFIA II and therefore have assumed that the IRCs will pay for the changes which they require in the Bell/Independent MTS network in order to implement improved interconnection for Datel.

Since NTIA is not privy to the financial plans of the IRCs, it is not clear how much of its growth capital an IRC would direct towards the improvement of Datel. However, it seems reasonable to assume that it would not be highly disproportionate with respect to Datel's current and projected future revenues. The Datel annual revenue of about one million dollars (\$1M) accounts for only a tiny fraction of the overall IRC industry revenue of almost \$450M annually.²⁰ As a data service, Datel is based upon older circuit-switched concepts and technologies. An IRC would have to evaluate Datel and any potential service "off-shoots" against newer packet-switched systems in order to decide what to back with facilities and promote in the marketplace. Given these realities, it seems reasonable that improvements to Datel must be financed from Datel's \$1M annual industry-wide revenue base.

There are several reasons why more ambitious interconnection arrangements will probably take longer to implement. First, such arrangements are more likely to require changes throughout the Bell/Independent MTS network. Unless extraordinary expenses are incurred, such changes must be incorporated into the ongoing plans to modernize this network. Such long-term modernization plans, for example, the introduction of electronic switching, require a decade or more to complete. Second, in order to be economically feasible, the introduction of more advanced interconnection arrangements for the IRCs will probably require coordination with the introduction of similar arrangements to accommodate other carriers, such as the domestic QCCs.

Shorter term solutions should be viewed as interim steps, to be taken until the longer term processes can be worked through. For this reason, attention should be given to anything in a shorter term solution which might economically penalize or otherwise prejudice a longer term solution.

²⁰IRC supplied figures.

The inclusion of a solution to a given aspect of interconnection into a particular category should be taken as illustrative of what seems reasonable to us, and not as an NTIA recommendation. In general, the agreement on such details should be left to the carriers involved.

5.1 Long-Term Outlook: Parity

Parity of interconnection for Datel would imply that Datel bears exactly the same operational and technical relationship to the Bell/Independent domestic network as does AT&T Long Lines for overseas MTS service. Each of the eight technical and operational areas used throughout this report is one dimension of interconnection. Parity can be represented as a relatively advanced arrangement in each of these eight dimensions.

The experiences of the OCCs during ENFIA II, when lengthy discussions were held with AT&T regarding the issue of interconnection, are relevant to the issue of the feasibility of parity of interconnection for Datel. We noted in Section 3 that the ICRs' interconnection problems are similar in kind and complexity to the problems facing the OCCs. It is significant that in the ENFIA II meetings the OCCs did not attempt to obtain parity. As a practical matter, the OCCs seem to have realized that their revenues and their time scales for planning and deployment simply were not commensurate with the extensive changes which would be required in the Bell/Independent plant to implement parity.

This is relevant to our concerns here. The current annual revenue for all IRCs combined from Datel is about one million dollars (\$1M), while the current annual combined OCC revenue from switched voiceband services is about \$75M.²¹ Further, as shown in Table 3, the number of OCC trunk connections with the Bell/Independent network for switched services is about 100 times larger than the number of IRC trunk connections for Datel. Thus, by several measures, the OCC switched voiceband business is about two orders of magnitude larger than is the IRCs' business in Datel. If parity of interconnection is not economically feasible at this time for the OCCs, then this suggests that it is even less feasible for Datel.

At issue here is the economic base provided by Datel, which we assume must support the changes necessary in the Bell/Independent network to implement Datel parity. There are various ways to relate Datel's annual revenue base of

²¹ Composite figures from information supplied by the OCCs and IRCs.

about \$1M to the cost of modifying the Bell/Independent network. As a very simple example, suppose that \$100,000 of the \$1 M was available to implement Datal parity. Numbering plan parity alone would eventually require charges to each Bell and Independent local switching office. There are about 20,000 such offices. The $\$100,000/20,000 = \5 available annually per office is clearly inadequate.

Recall that AT&T (1977c) developed estimates for part of the cost of implementing Datal parity. These figures, as discussed in Section 2.3 above, were:

- a capital investment of approximately \$126M,
- nonrecurring expenses of approximately \$43M,
- recurring expenses of \$20M per year.

These figures can be summarized as:

- an initial expenditure of \$126M and \$43M = \$169M,
- an annual expense of \$20M.

AT&T has not substantiated these figures in detail, and hence they cannot be audited. But they cannot be dismissed out of hand, considering the magnitude of the Bell/Independent domestic MTS network and the changes which would be required to achieve parity. Further, a few simple calculations indicate that the figures are not intuitively unreasonable.

The current Bell System MTS network plant investment is about \$110 Billion. Removing land, buildings, trunks, loops and station equipment, the central office portion of this investment is about \$45 Billion. The annual operating expenses are about \$29 Billion (All figures are extrapolated from Bell System Data at year end 1978.).

Since Bell excluded the cost of point of interconnection arrangements from their figures, most of the initial expenditures for Datal parity would presumably be related to central office equipment. Writing the ratio of this initial expenditure to the Bell central office investment, we obtain

$$\frac{\$169\text{M}}{\$45,000\text{M}} = 0.4\%$$

This figure is conservative with respect to Datal parity, since including more of the Bell plant investment in the denominator would reduce the 0.4%.

We also write the ratio of annual expense for Datal parity to total Bell System annual expense

$$\frac{\$20\text{M}}{\$29,000\text{M}} = 0.07\%$$

It is not surprising that a system which was never designed for customer selectivity among carriers at parity would require an expenditure of about 0.4% of its present invested worth in order to be so modified, nor that it would require an annual expense of about 0.07% of its total annual expense in order to be so maintained. This certainly does not validate the AT&T figures, but it does suggest that they are not intuitively unreasonable.

Comparing the estimate of \$169M initial expenditure and \$20M annual expense to implement Datel parity with the \$1M Datel annual industry-wide revenue base, the considerable disparity must be noted. Datel revenue simply seems inadequate to support the changes necessary to implement Datel parity. The disparity is wide. It is not necessary to accept the AT&T estimate, since orders of magnitude changes in these figures would still not alter this conclusion. It seems very difficult to justify significant changes to the Bell/Independent domestic MTS network in order to accommodate a service like Datel which generates a very low level of demand diffusely across the entire nation.

This insight suggests several approaches, any of which might be useful in obtaining Datel parity, or something closer to it than is presently available. First, improved interconnection arrangements might be implemented in certain selected geographic sections of the country where the IRCs have their greatest concentration of Datel customers. Second, attributes of interconnection requiring changes which are diffuse throughout the entire Bell/Independent network, such as dialing parity, are much more expensive to implement than changes which are localized to one place, such as the point of interconnection between an IRC switch and the MTS network. Each attribute of parity should therefore be analyzed on a cost/benefit basis. Third, Datel parity might be considered as a part of a longer range and more comprehensive plan which would also address the interconnection concerns of other carriers who wish to use the Bell/Independent network. This would place Datel parity on a much broader economic base. It is not clear that such a comprehensive effort will be undertaken at this time. At present, the process begun in ENFIA II offers the best hope for beginning to work in this direction.

5.2 Medium-Term Outlook: Relating to the Problems of the OCCs

Section 3 of this report considered some of the ways in which the concepts developed in ENFIA II might be applied to the problem of Datel interconnection. While the IRC and OCC problems are not the same, it was noted that they have many similarities which might profitably be explored.

Using the concepts developed in ENFIA II many specific OCC interconnection plans could be devised. The ENFIA II meetings only reached the stage of initial

negotiation. Convergence towards a unique solution was not achieved. It is therefore not particularly useful to select one of the many OCC interconnection plans which might follow from ENFIA II and elaborate upon its adaptation for IRC use.

For the future, the primary importance of ENFIA II is the process which it set into motion. The continuation of this process has been manifest in the AT&T (1980) response to the FCC in the MTS/WATS Market Structure Inquiry. Here, AT&T has suggested certain interconnection plans which are an outgrowth of the work in ENFIA II. Bell also proposed that a technical committee be formed, with Commission and industry participation, to consider this matter further.

Although the administrative and institutional details are unclear at this time, a process is going forward which should eventually result in an enhanced form of interconnection for the OCCs. Because of the similarities between the OCCs' and IRCs' problems, and because of the much greater economic impetus behind the OCC issue, NTIA believes that the IRCs' interconnection problems should be folded into this ongoing process. It is imperative that this be accomplished soon, so that the Datel interconnection issue is not considered as an afterthought.

5.3 Short-Term Outlook: Considering the IRC Problem Alone

If an interconnection plan is devised for Datel only, then Datel revenue suggests that the current structure of the Bell/Independent MTS network must be used to the fullest extent possible. Changes to only a few network nodes (e.g., the points of interconnection to the IRC switches) might be contemplated, but changes to the entire Bell/Independent MTS network, consisting of about 20,000 local and 1,000 toll switching offices, seems beyond question.

One short-term solution would require an IRC customer in the United States to establish connection with an IRC switch by using the domestic MTS network in the usual fashion. The IRC customers would dial NNX XXXX or NPA NNX XXXX, causing the call to be routed to the IRC switch. After a stable connection was established, other information would be conveyed over the built-up path. This information would include the identification of the calling party or station and the number to be called in the foreign country. This information would permit the IRC to complete the call and to bill the calling customer for at least the international and PTT segments of the facilities used.

Information sent over the built-up connection might also include a password or security code and an indication when operator assistance was required. All such information might be conveyed by Touch Tone signaling or in the header

of the first data block transmitted. A repertory dialer, or equivalent means in a data terminal, might be used to generate such sequences and hence reduce manual intervention. No new operator procedures would be required within the Bell/Independent MTS network, since all additional operator functions would be handled exclusively by the IRCs.

This arrangement is similar to that currently employed by the domestic OCCs for switched voiceband services such as Execunet and Sprint V.

All of the IRC switches are currently located in New York City. It should be possible to connect them all into the Bell/Independent domestic MTS network through one Bell System switch. This one switch might be especially modified without incurring great expense. There is already a service available under tariff to the IRCs which provides four-wire circuits between the IRC switching centers and the line side of an especially modified class 5 (i.e., local) MTS network switching office. This switch, a No. 1 ESS, is located in New York City. It has been modified to provide answer supervision, normally a trunk function, to the line-side IRC circuits. On calls from a foreign administration through the IRC switching center into the Bell/Independent MTS network, answer supervision allows the IRC switch to detect that the called station in the United States has answered. Four-wire connectivity through the connecting Bell/Independent switch, one of the requests of the IRCs, is not provided by this plan.

One means to satisfy the IRCs point of interconnection requests might²² build upon the modifications which have already been developed for the No. 1 ESS to implement EPSCS (Enhanced Private Switched Communications Service). EPSCS is a private network service recently developed for large corporate and government customers. The No. 1 ESS trunk link network has been modified for

²²A description of the implementation of EPSCS on the No. 1 ESS is provided in: Lewis G. Anderson and Peter F. Lambert, "Modifying No. 1 ESS for Enhanced Private Network Service," Bell Laboratories Record, Vol. 57, No.2, pp. 46-52. EPSCS is not a capability of 1AESS; development would be required to make it available.

four-wire operations using the so-called HI-LO technique. Line-side features, such as dial tone and ringing, are also available to circuits connected to this trunk network. A No. 1 ESS providing EPSCS also normally provides Bell/Independent MTS network functions as well.

Although further software modifications would probably be required, a No. 1 ESS modified for EPSCS would seem the closest available equipment configuration which could supply the IRC point of interconnection requests, including four-wire connectivity through the switch into the Bell/Independent MTS network, trunk-side features such as answer supervision and line-side features such as dial tone and ringing.

6. ACKNOWLEDGEMENTS

The author extends grateful thanks to Messrs. Joseph Hull, Melvin Barmat, Charles Elmendorf, and Dr. Harvey Gates for their helpful reviews of the manuscript and for their encouragement in the development of the report.

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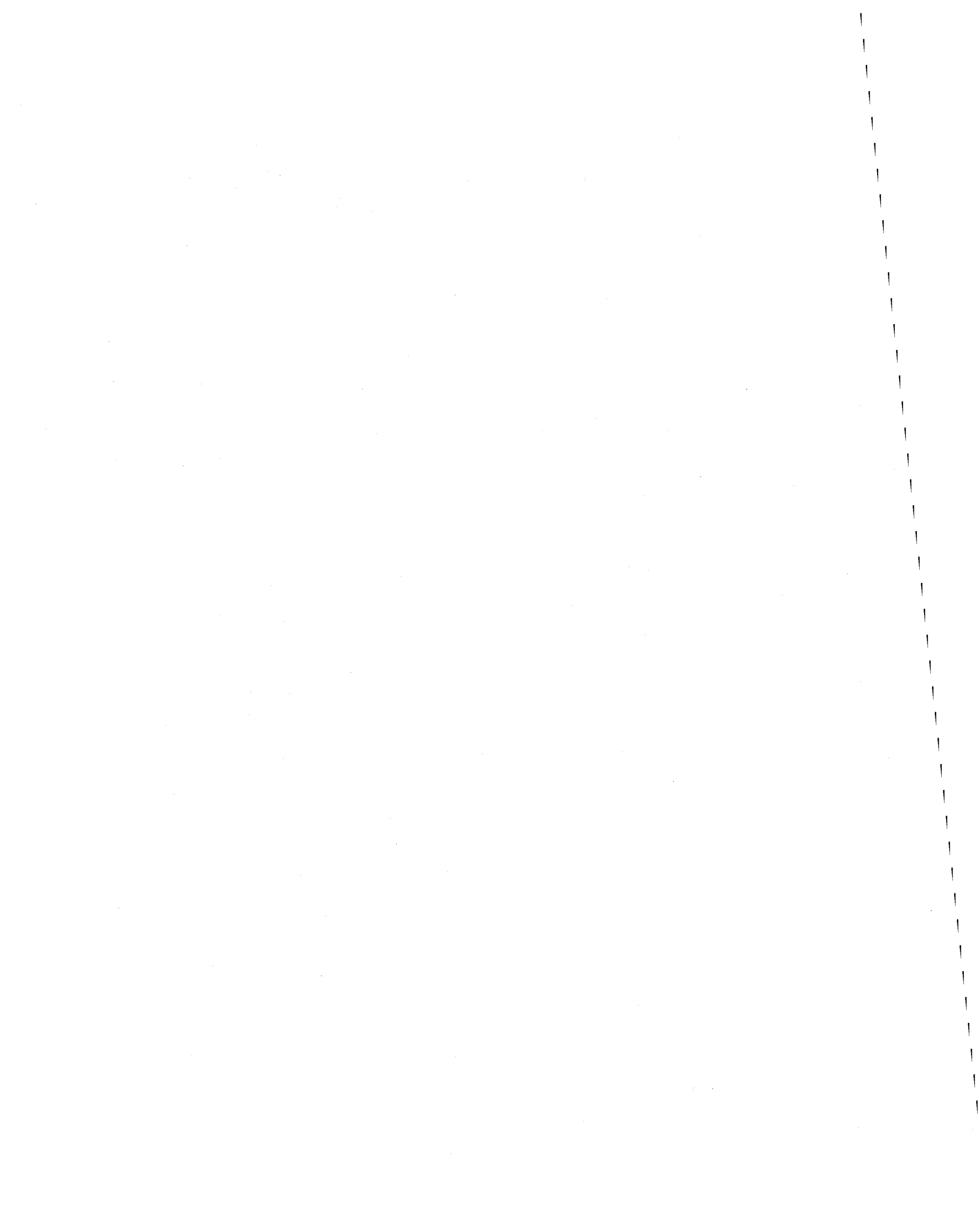
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APPENDIX

Details of the IRCs' April 1976 Requests for Interconnection

This appendix provides pertinent quotations from the requests filed with the FCC by ITT(1976), RCA(1976), TRT(1976) and WUI(1976) for interconnection with the AT&T domestic MTS network. Requests are classified into technical and operational areas. Within each area, quotes are by specific IRC.

1. General

- 1.1 ITT "...access to the domestic network of the Bell System on the same basis as AT&T Long Lines..."
- 1.2 RCA "...access arrangements must be provided in such a way as to insure that the public finds it as convenient to use the public switched telephone network to reach RCA Globcom's facilities both for existing overseas Datel service and for more specialized switched voice/data, data-only and facsimile services as it is to reach facilities provided by the AT&T Long Lines Department for overseas service. Furthermore, the quality of the facilities provided to RCA Globcom must equal those AT&T provides for its own overseas service..."
- 1.3 TRT "...fair competition between AT&T and the IRCs will not be possible unless interconnection arrangements are provided between the AT&T domestic network and the IRCs comparable to those available with AT&T's overseas MTS..."
- 1.4 WUI "Unless the IRCs can reach the domestic telephones on a parity with Long Lines, they will be competitively disadvantaged in reaching overseas present and future dataphone users..."

2. Point of Interconnection

2.1 ITT "...ITT Worldcom hereby requests that it be permitted by AT&T to interface on a four-wire basis to a four-wire switch at a suitable level in the hierarchy of the Bell System." Such a level implies "...that calls placed via ITT Worldcom would have a domestic routing equivalent to international Dataphone calls placed via AT&T. At the very least, such calls should not have more than one additional link depending upon their point of access to the Bell System."

2.2 RCA "The interconnection between the voice/record carriers' and AT&T's facilities should be on a four-wire trunk basis rather than a two-wire station termination as at present. Domestic trunk facilities provided to the voice/record carriers should be equivalent both operationally and electrically to the facilities currently interconnecting AT&T's existing seven international switching centers with the domestic telephone network." "Interconnection on a four-wire basis is necessary to improve overall data transmission performance by eliminating degradation which can occur in the transition from 4-wire to 2-wire and then back to 4-wire operation."

2.3 TRT "The call to the IRC's network must be routed in the most efficient manner, i.e., it should not take an appreciably longer time to access an IRC than to access an AT&T gateway switch." "The facilities used to connect the calling party to the IRC must be equal in quality to that provided to AT&T's gateways and should not include more than one section above the number of sections required to access the AT&T gateway switch."

2.4 WUI "There shall be a 4-wire transmission path interconnection into the AT&T MTS network at a Bell System 4-wire switching exchange. Such a plan will ensure the existence of a through transmission whereby the conversion from the basic 2-wire telephone subscriber line to the basic 4-wire long distance network will occur only once -- and will remain at 4-wire until the overseas network brings it down to 2-wire at the overseas subscriber's line. The foregoing configuration will help to

alleviate the existing serious impairment in transmission quality on WUI's existing switched data service caused by excessive conversions between 2-wire and 4-wire transmission facilities and will enable WUI's switched data system to 'see' the AT&T domestic network as that network is 'seen' by an AT&T international gateway switching exchange.

"The number of transmission sections (circuits between AT&T exchanges) required for a domestic subscriber to reach WUI (or vice versa) shall be equivalent to the number of sections required by a subscriber to reach an international transit exchange serving the AT&T system."

3. Numbering Plan

3.1 ITT

"...each such subscriber should be able to reach his called party via ITT Worldcom by dialing the same number of digits as he would for routing via AT&T Longlines. ITT Worldcom would therefore have to be assigned a 3 digit code comparable to AT&T's 011 to prefix the national code to the called party's number for IDDD calls."

3.2 RCA

"Three-digit access will be provided to users by AT&T using the existing IDDD numbering plan. Clearly, for the voice/record carriers to participate in the international switched voice/data market, access to the international services provided by either AT&T or the voice/record carriers must be on an equivalent basis. RCA Globcom believes a numbering plan with three-digit access to the voice/record carriers is technically realizable."

"Under the present AT&T numbering plan for international calls:

(1) A Dataphone subscriber, when placing an international call, dials the international prefix either:

- 01 (Person-to-Person, Credit Card or Special Call) or
- 011 (Station-to-Station)

Plus in either case the country code (1, 2 or 3 digits) and the national [significant] number. (The country code and the national [significant] number are limited to a maximum of twelve (12) digits.)

- (2) Typical dialing sequences are as follows:
- (a) PPCS Calls (Person-to-Person, Credit Card or Special Call) : 01 + CC + NN
 - (b) S-S Calls (Station-to-Station) : 011 + CC + NN
- Where CC : Country Code
 NN : National [Significant] Number."

"We propose that the numbering plan be modified so that the subscriber can have access either to AT&T or a voice/record carrier (VRC) as follows:

01X + CC + NN

Where X : Denotes a single-digit number
 assigned to a VRC

CC : Country Code.

"An alternative proposal would be to use 00X as the international prefix, where the second zero would indicate an overseas call routed via a voice/record carrier and the third digit the identity of the voice/record carrier and whether the call is station-to-station (S-S) or person-to-person, credit card, etc. (PPCS). The following is a sample assignment plan:

001	VRC A	S-S
002	"	PPCS
003	VRC B	S-S
004	"	PPCS
005	VRC C	S-S
006	"	PPCS
007	VRC D	S-S
008	"	PPCS
009	VRC E	S-S
000	"	PPCS.

"A third access proposal for those subscribers equipped with touch-tone multi-frequency (TTF) signalling capability is described below:

- (1) RCA Globcom proposes that a Dataphone TTF subscriber, when placing an international call, dial an "End of Dialing" code to indicate selection of either AT&T or a particular voice/record carrier to provide the international switching and transmission facilities.

(2) Two options for the "End of Dialing" code are proposed as follows:

(a) Option 1 would require the use of the *(Star) and #(Square) pushbuttons on the TTMF keypad, as follows:

Carrier	A	*1 #
"	B	*2 #
"	C	*3 #
"	D	*4 #
"	E	*5 #
"	F	*6 #
Spares		*(7-9) #

(b) Option 2 would require the use of the #(Square) pushbutton on the TTMF keypad, as follows:

Carrier	A	1#
"	B	2#
"	C	3#
"	D	4#
"	E	5#
"	F	6#
Spares		(7-9)# ."

3.3 TRT

"AT&T must provide access numbers (such as 012) from its domestic MTS network comparable to those utilized for overseas MTS calls, which will permit the IRC's to interface with the domestic MTS network in a manner similar to AT&T's international gateway switching centers for MTS service."

"Such access must be provided in a manner so that the dialing in accessing an IRC is no more complex than in making an MTS call."

3.4 WUI

"A telephone subscriber wishing to place a call via WUI should not be required to dial any more digits than he does when he calls via AT&T. Therefore the subscriber should be enabled to dial

AAA XXX YYYYYY

where

AAA A 3 digit access code to be equivalent to the 011 used by subscribers using AT&T and that would identify the IRC for that call,

XXX 1, 2 or 3 digit country code in accordance with the 'World numbering plan,'

YYYYYY Subscriber (national network) number in called country including the equivalent of an area code should one exist (may be up to 9 digits)".

4. Signaling

4.1 ITT

"Bell System centers would have to set up automatic international calls via ITT Worldcom in the same manner as they presently do by AT&T international switching centers (ISC), using 2-stage outpulsing with a 6-digit code to describe the IRC operating center and the destination country".

4.2 RCA

"Presently, the local office outpulsing format is:

 KP + 1 + CC + NN + ST*

RCA Globcom proposes that the local office outpulsing format should be modified to the following:

 KP + 1X + CC + NN + ST*

Where X is assigned as follows:

 AT&T 1

 VRC A 2

 " B 3

 " C 4

 " D 5

 " E 6

 Spares 7-9.

"... 'Two Stage Outpulsing' from an Electronic Switching System (ESS) or Traffic Service Position System (TSPS) is presently used to switch the international call to the ISC.

First stage outpulsing is:

 KP + 011 + XXX + ST

Where XXX : Country Code

The first stage of outpulsing provides for either a 3 or 6 digit routing code. The 3 digit code uniquely specifies a particular ISC for which the call is destined. The ISC, upon seizure after first stage outpulsing, returns a 'wink' signal (minimum duration: 220 MS) and then followed by a high tone (480 Hz). After receiving the wink signal, second stage outpulsing is as follows:

KP + CC/CC' + NN + ST

Where: CC' - Substitute Country Code (if call requires operator assist at ISC)

'Two Stage Outpulsing' as described will be used to switch the international call to a particular voice/record carrier operating office via four-wire facilities. The voice/record carrier will receive the digits and automatically switch the call to the terminating country, using C.C.I.T.T. Signalling System No. 5 or No. 6."

4.3 TRT No specific remarks.

4.4 WUI "The control signalling access plan requires that the appropriate AT&T exchange or switching office pass to the WUI exchange all customer dialed information after the designated WUI access code or prefix."

5. Operator Procedures

5.1 ITT "Operator-assist procedures would have to be formulated to permit present Bell System subscribers to specify routing via AT&T, ITT Worldcom or any other international record carrier. In the absence of specification as to routing, international dataphone calls should be distributed on a mutually agreed to allocation basis."

5.2 RCA No specific remarks.

5.3 TRT "On operator assist calls, AT&T should arrange procedures for the operator to inquire of the calling party:

- a) If the call is to be a dataphone call;
- b) If yes, whether the calling party wishes to route via AT&T or one of the IRC's;
- c) If the calling party selects one of the IRC's this routing should be honored by the operator."

5.4 WUI "Additionally, calls handled manually by AT&T operators should have equal access, upon customer request, to all carriers providing international dataphone-type service."

6. Customer Billing

6.1 ITT "ITT Worldcom requests that AT&T be required to provide ITT Worldcom with billing and accounting information similar to that exchanged between components of the Bell System.

"In order to properly bill for international dataphone-type calls, ITT Worldcom will require as a minimum: (a) the called party's telephone number, (b) the calling party's telephone number, (c) the date of the call, (d) the time of the call, and (e) the duration of the call.

"In the Bell System the called and calling party's number are pulsed from the originating end office to automatic message accounting equipment in a toll tandem switch or Traffic Service Position System. Where possible this information should alternately be pulsed to an international record carrier for billing in connection with dataphone-type calls. In cases where an international record carrier switch interfaces the Bell System hierarchy at a level above which this information is available, the billing tapes or other records made by AT&T should be provided to the international record carrier for accounting and settlement purposes".

6.2 RCA No specific remarks.

6.3 TRT No specific remarks.

6.4 WUI "AT&T should provide subscriber identification on outbound calls by forward pulsing of the subscriber's

telephone number to the WUI exchange, or such comparable arrangements satisfactory to WUI.

"Billing information generated on calls via WUI must be kept confidential from AT&T's sales or marketing force."

7. Maintenance and Testing

7.1 ITT "...reliable international dataphone-type service requires the agreement of the Bell System to engage in cooperative maintenance and equipment testing with the international record carriers...

"In order to provide responsiveness and reliable service to its customers, ITT Worldcom must have operational access to AT&T's Data Test Centers. This entails cooperative testing arrangements between these centers and ITT Worldcom's Operating Center."

7.2 RCA "Trunk access facilities provided to RCA Globcom should be maintained under the same standards and engineering practices followed by the Bell System."

7.3 TRT No specific remarks.

7.4 WUI No specific remarks.

8. Financial arrangements

8.1 ITT No specific remarks.

8.2 RCA "...care must be taken that any arrangements made for the sharing, or the division, of tolls between the voice/record carriers and AT&T for handling switched voice/data, data and facsimile services should reflect both the letter and spirit of the Commission's requirements for uniform and nondiscriminatory treatment. Thus, if Commission policy is to be implemented the voice/record carriers must be accorded pricing, divisions and service treatment as favorable as, for example, the local telephone companies afford the Long Lines Company which will provide the overseas service in competition with the voice/record carriers."

"Since there is no body of experience upon which to base divisions, it is suggested that pending agreement and the development of the necessary data, the Commission encourage or direct the interested parties to negotiate an agreement following the general concepts and ratios between payouts and tariff rates which obtained with respect to TWX/overseas telex interconnection prior to the time when AT&T divested itself of TWX to Western Union. Following such a course would permit prompt formulation of the necessary arrangements and insure the implementation of service pursuant to terms approximating those negotiated between the carriers with respect to another service (TWX/overseas telex) under relatively similar conditions."

8.3 TRT No specific remarks.

8.4 WUI "AT&T and WUI must establish financial arrangements no less favorable to WUI than the arrangements between AT&T's Long Lines Department and the independent telephone companies for international calls. Considerations of competition, equity and non-discrimination dictate that, in any event, such arrangements not be based upon two discrete charges to the subscriber, specifically (i) the cost of reaching WUI and (ii) the cost of the international portion. Total charges for a WUI dataphone-type call to a given overseas location from any place in the United States should be uniform and should be divided in accordance with a reasonable formula to be agreed upon by WUI and AT&T. Consideration can be given, for example, to a carrier-to-carrier arrangement similar to that formerly prevailing with respect to TWX calls interconnected to the IRCs' overseas telex networks, involving a cost-related carrier discount."

9. Network Planning

9.1 ITT "Consideration of international record carrier operation and of the international record carrier's international service offerings must be given by the Bell System both in its own

network planning and in planning negotiations carried on with foreign administrations regarding the development of the international switched telecommunications systems. The need for considerations of the international record carriers' role is particularly acute in the following areas:

- common channel interoffice signalling (CCIS)
- multiple satellite path routing precautions
- digital network evolution
- digital network signalling and interconnection
- interconnection with overseas networks
- future access and numbering plan schemes."

9.2 RCA

"RCA Globcom believes that to enable the voice/record carriers to compete for the overseas traffic generated by the installed base of domestic dial-up data users, AT&T should be required to provide the voice/record carriers with the following information concerning all Dataphone and DAA installations within the Bell System:

- A. The name and address of the user;
 - B. The telephone number associated with the station;
 - C. The type of DAA and station equipment;
 - D. The type of data modem and, if provided by the Bell System, the model and speed."
1. Initially, RCA Globcom will require the following estimated number of trunk circuits to the toll network:
 - (a) Terminating at New York: 30 Trunks
 - (b) Terminating at San Francisco: 30 Trunks
 2. RCA Globcom projects an annual growth rate of approximately 20-25 percent for international switched voice/data services. Based on this estimate, the following 5-year trunk requirements are projected:

NUMBER OF REQUIRED TRUNK CIRCUITS
TO TOLL NETWORK

<u>Year</u>	<u>New York</u>	<u>San Francisco</u>
1977	30	30
1978	40	40
1979	50	50
1980	75	75
1981	100	100

3. The above projections may be revised to more accurately reflect actual needs as the market for international switched voice/data service develops."

9.3 TRT

"With the advent of domestic satellite facilities, AT&T is establishing procedures and equipment to detect when a domestic call is routed via satellite so that the international segment may be routed over cable rather than satellite facilities in order to prevent double satellite hops. Procedures should also be established to automatically notify the IRC in a similar fashion of domestic satellite routings."

9.4 WUI

"WUI will initially require the physical interconnection between its own switched data exchange and the AT&T domestic telephone network to be made at WUI's exchange in New York City. Of course, as the service develops and grows, WUI may require interconnection at other points within the AT&T domestic telephone network. Such interconnection would be data quality voice-grade circuits with AT&T and WUI providing compatible inband signalling equipment at their respective locations."

BIBLIOGRAPHIC DATA SHEET

1. PUBLICATION NO. NTIA Report 81-67		2. Gov't Accession No.	3. Recipient's Accession No.
4. TITLE AND SUBTITLE Domestic Interconnection Arrangements for Datel Services			5. Publication Date March 1981
			6. Performing Organization Code
7. AUTHOR(S) John G. Williams			9. Project/Task/Work Unit No.
8. PERFORMING ORGANIZATION NAME AND ADDRESS U.S. Department of Commerce, National Telecommunications and Information Administration, Institute for Telecommunication Sciences, 325 Broadway, Boulder, CO 80303			10. Contract/Grant No.
11. Sponsoring Organization Name and Address U.S. Department of Commerce, National Telecommunications and Information Administration			12. Type of Report and Period Covered NTIA Technical Report
			13.
14. SUPPLEMENTARY NOTES			
15. ABSTRACT (A 200-word or less factual summary of most significant information. If document includes a significant bibliography or literature survey, mention it here.) The International Record Carriers have, for a number of years, provided a switched, overseas, voiceband data service called Datel. This report examines changes required in the Bell/Independent domestic MTS network to provide a more advanced form of interconnection for Datel than is presently available. The report examines Datel interconnection in terms of eight specific operational and technical areas: point of interconnection, numbering plan, signaling, operator procedures, customer billing, maintenance and testing, financial arrangements, and network planning. Three categories of solutions to the interconnection problem are discussed: short-, medium-, and long-term.			
16. Key Words (Alphabetical order, separated by semicolons) Datel interconnection, international record carriers, switched voiceband data service.			
17. AVAILABILITY STATEMENT <input checked="" type="checkbox"/> UNLIMITED. <input type="checkbox"/> FOR OFFICIAL DISTRIBUTION.		18. Security Class. (This report) Unclassified	20. Number of pages 82
		19. Security Class. (This page) Unclassified	21. Price:



