ORBCOMM Messaging Application:

Mobile Asset Tracking

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U.S. Dept of Commerce, Boulder Laboratories

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Systems Engineering

Orbcomm Global, Dulles, VA

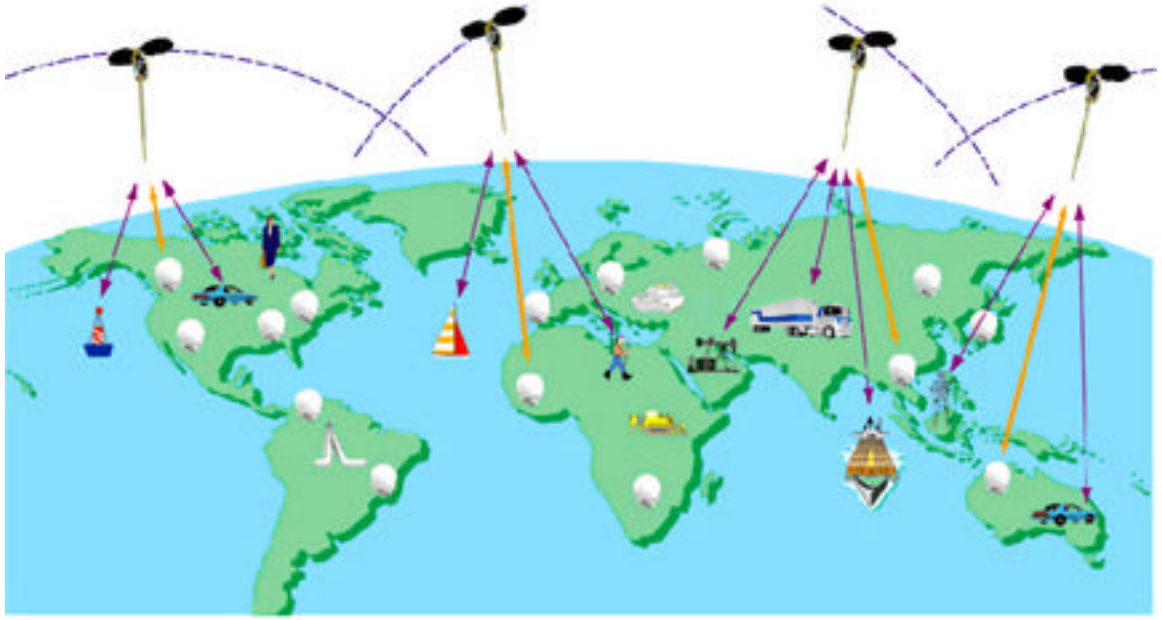
Roadmap

- Orbcomm System Overview
  - Satellites
  - Ground Network
  - Services
  - Markets

- Mobile Asset Tracking
  - Market
  - Products
  - Potentials

ORBCOMM System Overview

ORBCOMM System Overview



Satellites
(28 in 5 Orbital Planes)

Subscriber Links

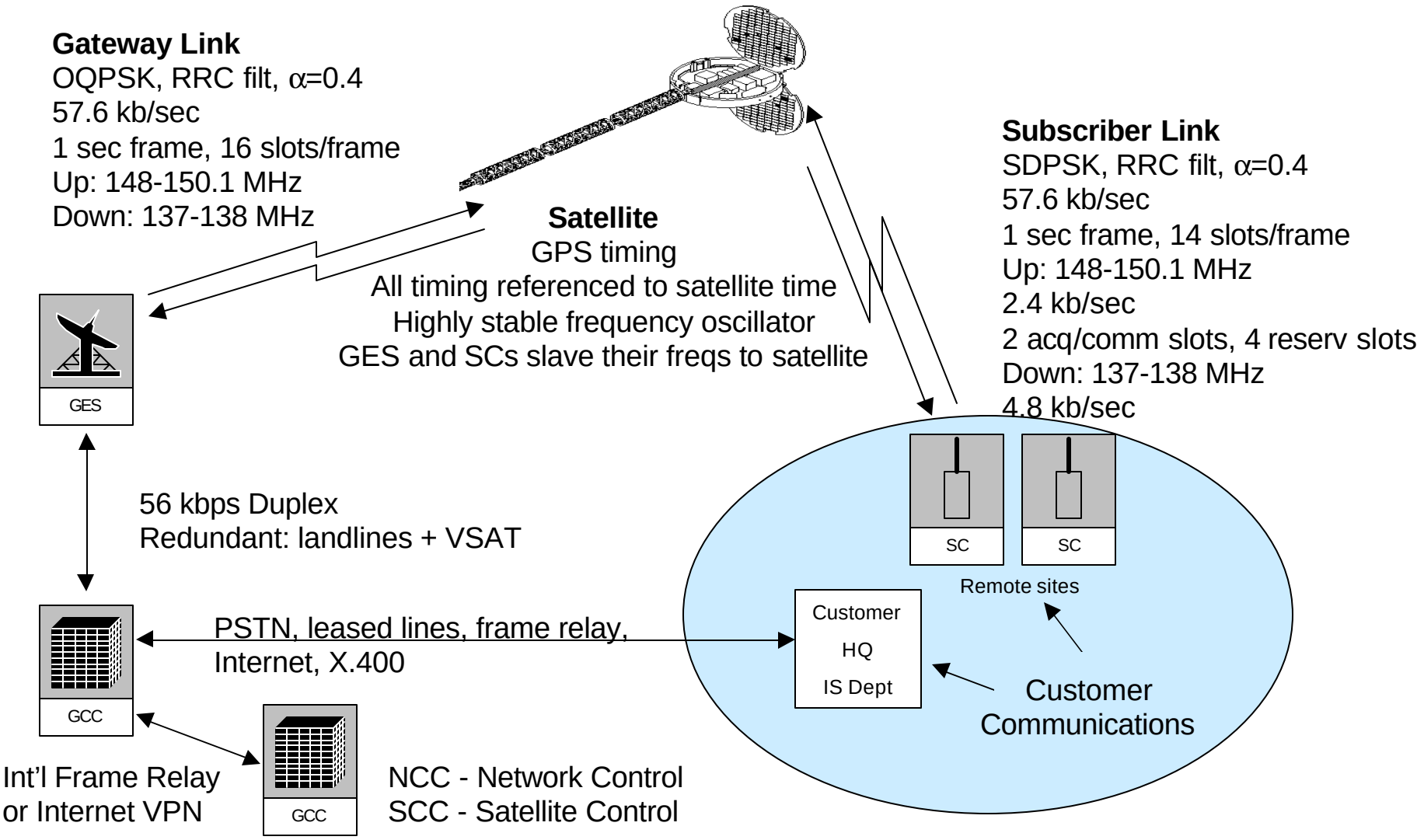
Uplink	Downlink
VHF	VHF
148-150 MHz	137-138 MHz
2,400 bps	4,800/9,600 bps

Gateway Links

Uplink	Downlink
VHF	VHF
148 MHz	137 MHz
56 Kbps	56 Kbps

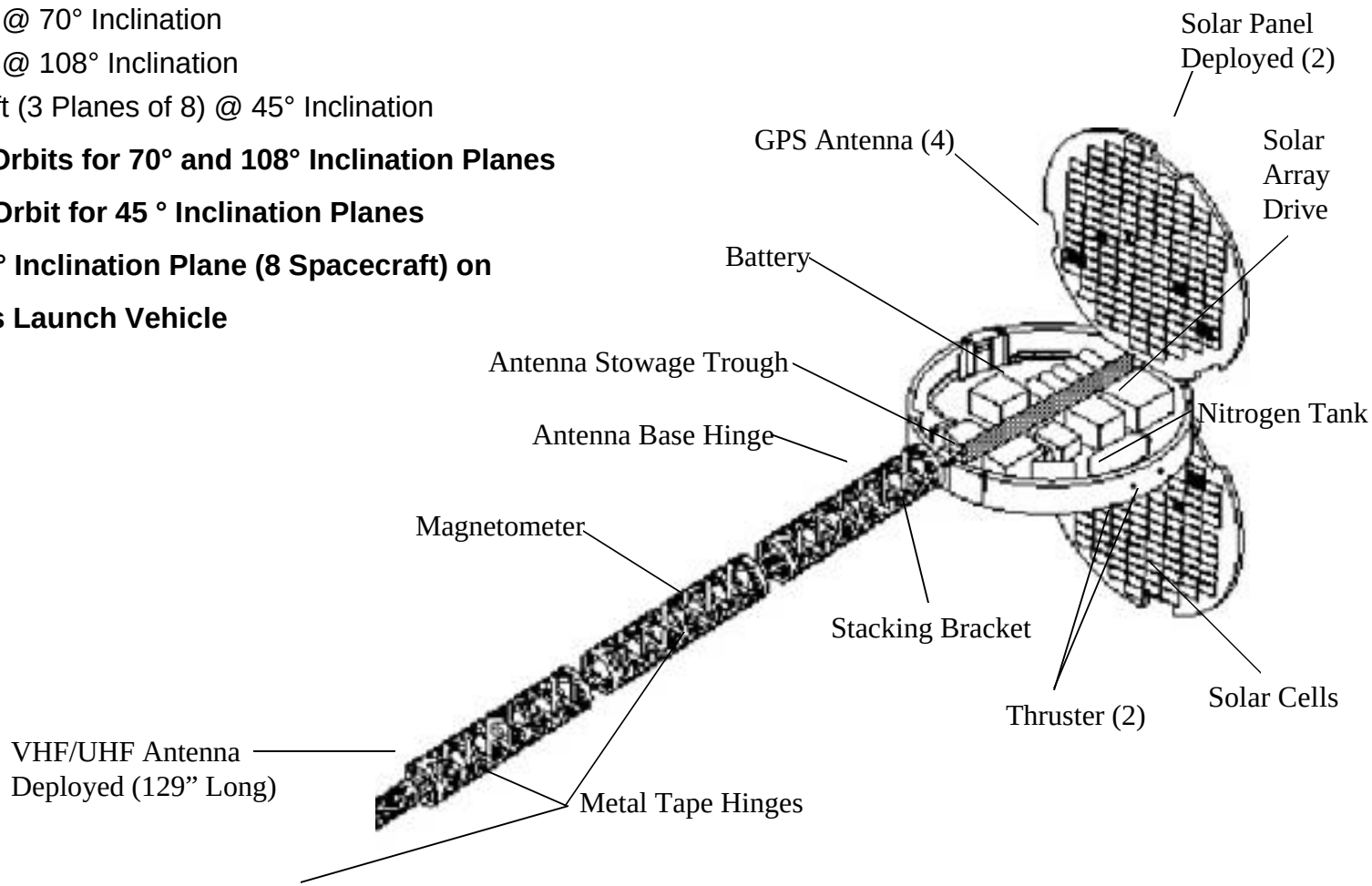
Gateway Earth Stations
(24+)

ORBCOMM System Overview (cont.)



Space Segment (Satellite)

- **28 Satellites in Five Orbital Planes (To be expanded to 36)**
  - 2 Spacecraft @ 70° Inclination
  - 2 Spacecraft @ 108° Inclination
  - 24 Spacecraft (3 Planes of 8) @ 45° Inclination
- **740 and 830 km Orbits for 70° and 108° Inclination Planes**
- **820 km Circular Orbit for 45 ° Inclination Planes**
- **Launch Each 45 ° Inclination Plane (8 Spacecraft) on a Single Pegasus Launch Vehicle**



Operational Ground Segment

Gateway Earth Station

Network Control Center

- 15 Gateway Earth Stations installed/under construction on 5 continents
- Network Control Center
  Dulles, VA
  24 x 7
- Redundant backup communications, including C-band VSAT, frame relay, and DDS circuits

Low Cost, Versatile Subscriber Units

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MAGELLAN

Personal Communicator

OEM Module

Scientific Atlanta

Meter Reading Unit

QUAKE WIRELESS

Data Communicator

Panasonic
Industrial Company

Data Communicator

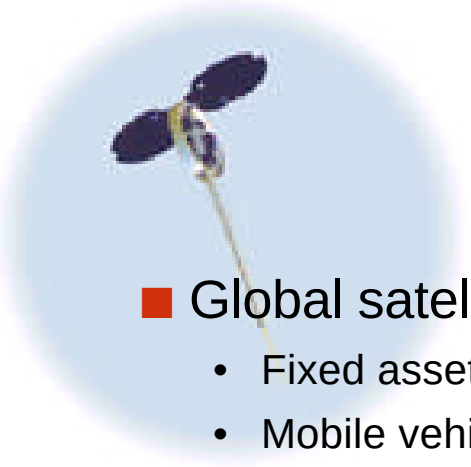
Data Communicator

Simply Everywhere

Overall Business Status

- Basic satellite network completed
  - 28 satellites launched on 5 rockets
  - Additional satellites planned for better coverage
- Ground network and distribution partners expanded
  - 15 gateways installed or under construction on 5 continents
  - 190 countries/dependent territories covered by 17 service providers
  - 90 domestic and international VARs
- Subscriber equipment and applications software products available
  - 16 product types from 5 manufacturers from $150 to $995
  - 25 completed applications ready for easy IT integration
  - Second/third-generation products, more applications on the way in 1999

ORBCOMM Services Overview



- Global satellite-based two-way data communications network
  - Fixed asset monitoring
  - Mobile vehicle tracking
  - Messaging/wireless e-mail
- Addressable market >150 million subscribers in 8-10 market segments
- Competitive position based on first-to-market advantages, low cost structure, worldwide distribution network and strong strategic partners

Large, Diversified Addressable Market

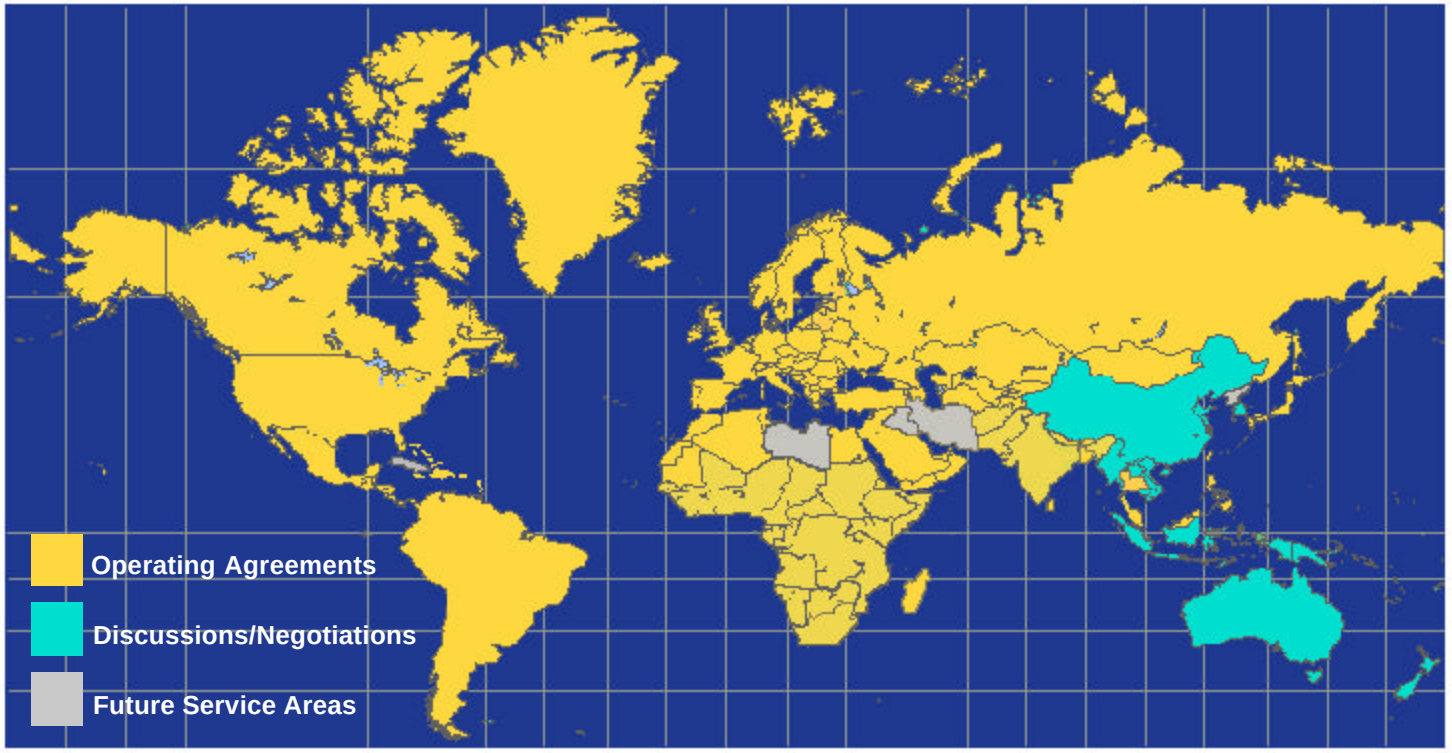
Mobile Asset Tracking Market

- Existing Methods
  - Yard checks or driver call-ins
  - Terrestrial wireless
  - GEO satellite
- Benefits
  - Increased productivity
  - Reduced losses
  - Reduced maintenance costs
  - New/improved service

Fixed Asset Monitoring Market

- Existing Methods
  - Physical site visit
  - Terrestrial wireless
  - GEO satellite
- Benefits
  - Reduced costs
  - Faster response time
  - More accurate data
  - Better decisions

ORBCOMM Has 17 Service Distribution Partners Covering 190 Countries



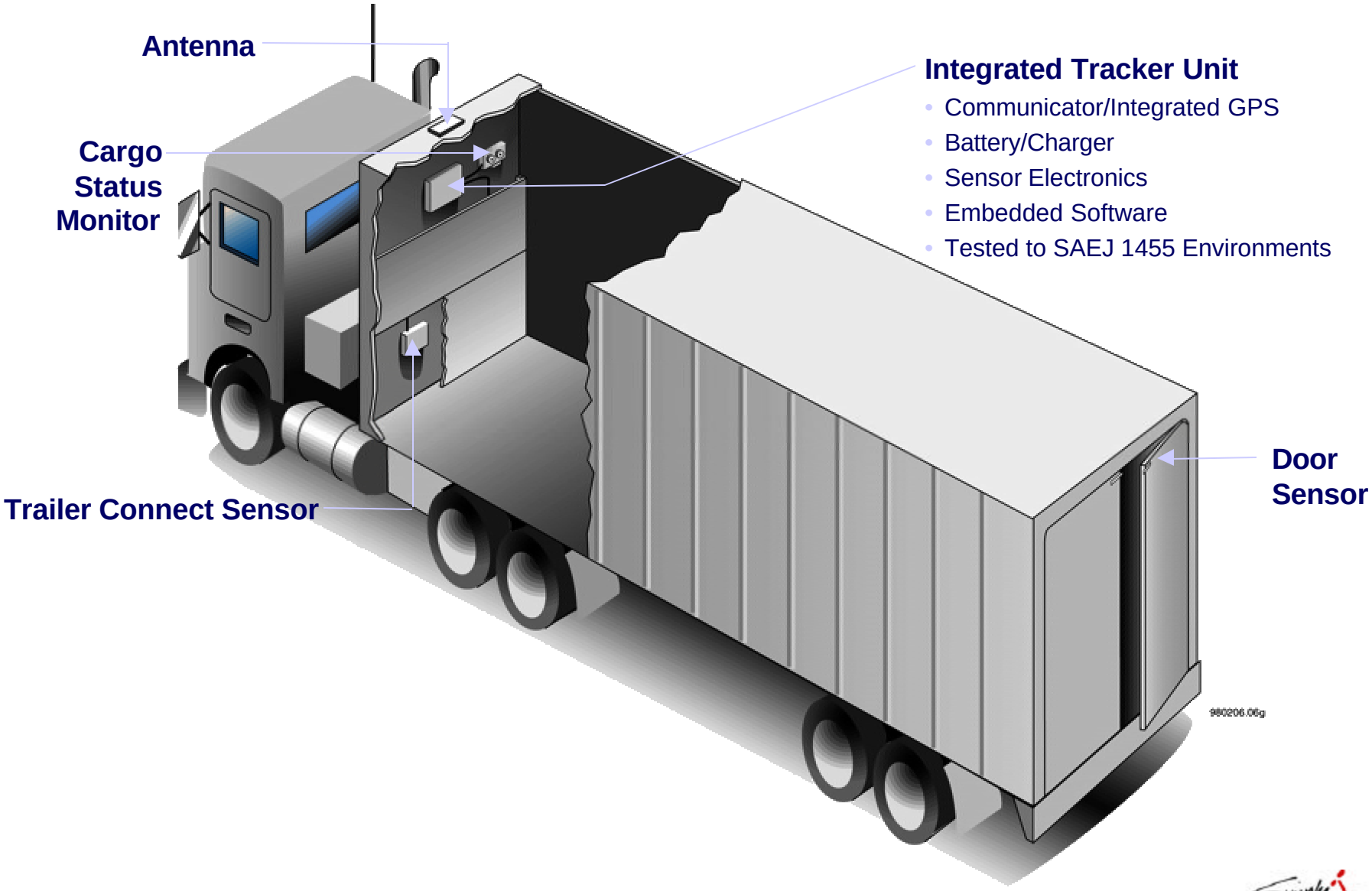
- Licensees Responsibilities
  - Build and operate gateway
  - Secure regulatory authority
  - Market ORBCOMM services
- ORBCOMM Responsibilities
  - Provide gateway hardware, software and training
  - Maintain space segment and manage global system

Mobile Tracking

Definition of the Trailer Management Problem

- Low asset utilization
- High trailer-to-tractor ratios
- Costly errors from faulty trailer information
- Inefficient collection and management of trailer information
- Detention problems
- Trailer pool inefficiencies
- Cargo theft claims
- Customer service impaired by trailer management problems
- Driver frustration

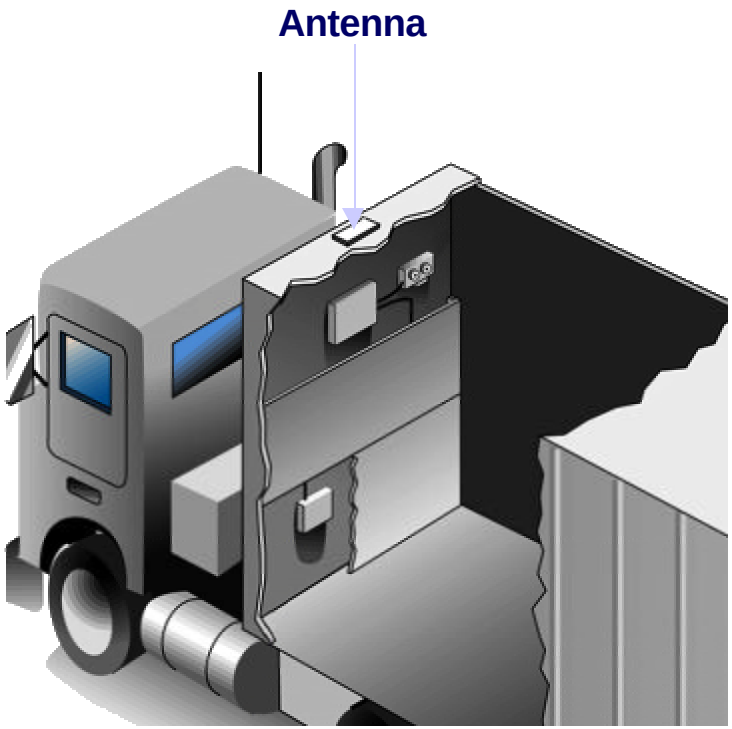
Integrated Tracker and Sensor Suite



Integrated Tracker Unit

- Communicator/Integrated GPS
- Battery/Charger
- Sensor Electronics
- Embedded Software
- Tested to SAEJ 1455 Environments

Very Low Profile Tracker Antenna



- Trailer roof optimal location for antenna
- Very low profile roof-top mount
  - Must be no greater that .7 in. tall to stay under trailer height limit of 13 ft. 6 in.
  - Two Very Low Profile antenna models
    - Scientific Atlanta
      15.25 in. x 22.25 in. x .65 in.
    - Ball Wireless
      17 in. x 23.75 in. x .65 in.
  - GPS antenna integration

Tracker and Cargo Monitor

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Hardware Subsystems

Simply Everywhere

Daily Energy Use - Typical Application

Mode	Current	Duration	Energy
Sleep	22 uA	24 Hr	0.528 mA-Hr
Process	120 mA	2 Min	4.000 mA-Hr
GPS Fix	145 mA	90 Sec	3.625 mA-Hr
Receive	170 mA	10 Min	28.33 mA-Hr
Transmit	1.2 A	100 mSec	0.033 mA-Hr
Tractor Com.	1.0 A (est)	1 Sec	0.278 mA-Hr
Cargo Status	250 mA (est)	1 Sec	0.070 mA-Hr
Daily Use Time Between Recharge:			36.86 mA-Hr ~ 43 Days

Tracker Software Functionality

- Tracker conserves battery power
  - Typically in a low power state for maximum battery conservation
- Tracker can be programmed to exit low power state when it detects:
  - Change in state of door switch
  - Keyed power from tractor
  - Terminal voltage of internal battery drops below the preset threshold
  - Timer alarm caused by periodic position reporting event (every two hours)
  - Timer alarm caused by satellite pass time event
  - Change in state of connect switch

Current Product Issues/Potential

- Issues
  - Tracker dimensions - will not fit into all trailers
  - No power interface on containers to charge battery
- Potential
  - Growth/expansion capability
    - 1708 interface (PLC4Trucks)
      - Tractor ID
      - Engine monitoring
  - Additional sensors
    - Security
    - Tire pressure
    - Weight
    - Volume

Customized Applications Software

Trailers empty and available

Trailer assigned by dispatcher

Trailer loaded at customer lot

Trailer en route

Trailer located on schedule—piggyback

Trailer arrived at consignee facility

Information to People Who Can Act on It

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Data from Asset

Data processed through Vantage Information System

Operational Information

Timely, accurate trailer information integrated into existing fleet management software

- Trailer Status
- Load Status
- Mapping
- Exception Alerts

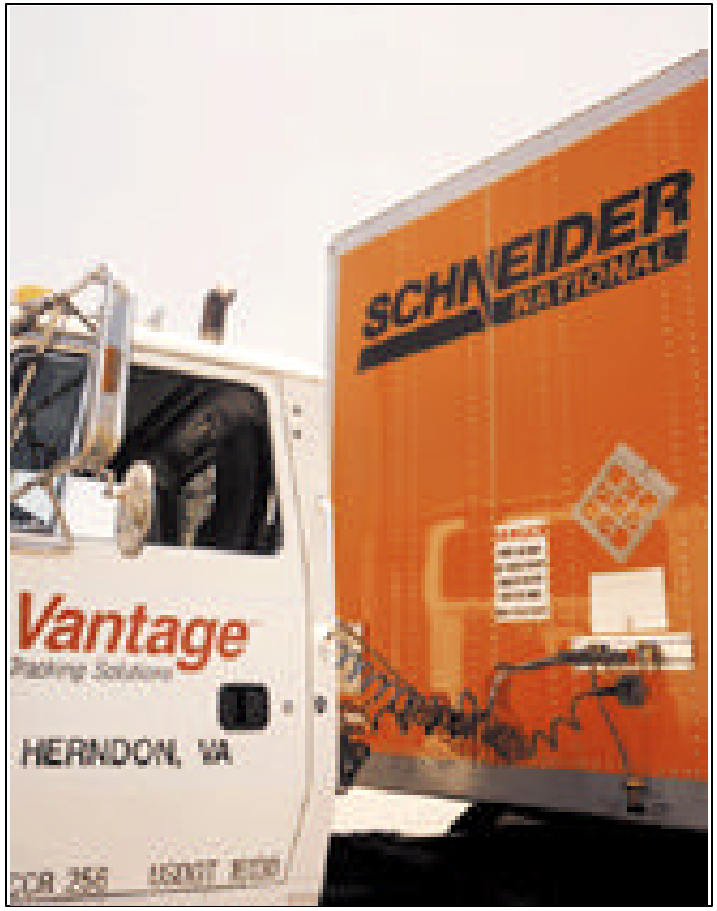
Management Information

Desktop access to summary performance data and management reports

- Trailer Utilization Manager
- Detention Manager
- Trailer Pool Manager
- Mapping

Simply Everywhere

Customer Reaction



"ORBCOMM/Vantage have a very strong focus on the key factors that will create benefits for carriers, not only from a technology perspective, but from a business application perspective as well. We believe they are the emerging leader in this technology space."

—Paul Mueller
Vice President,
Communications and Networking Services
Schneider National