Adaptive Impairment Mitigation Techniques for Satellite Communications

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Abstract

Adaptive impairment mitigation techniques have the potential to benefit a variety of existing and planned commercial satellite services. Reliable and efficient implementation of adaptive methods requires a sufficient understanding of relevant propagation phenomena, including details such as fade rates and fade durations, the joint probability of occurrence of impairments on multiple propagation paths and, in cases, even spectral features of the propagation mechanisms. Potential applications include Ka-band and V-band systems being planned to access the large bandwidths allocated at these frequencies for multimedia services, as well as communication services provided with satellites in nongeostationary orbits.

Candidate adaptive impairment mitigation techniques available for implementation in some satellite communication systems include:

- site diversity (provision of two or more earth stations for a given communication channel)
- path, or orbital, diversity (provision of two or more satellites for a given channel)
- transmit power control (transmitter power adapted to path fading)
- depolarization compensation (receiver and/or transmitter adapted in response to changes in cross-polarization on the propagation path)
- frequency diversity (provision of spare capacity in another frequency band that may be less impaired for some conditions)
- time diversity (signal intelligence transmitted at later time if necessary)
- adaptive forward error correction (FEC)
- adaptive information (symbol) rate

Impediments to incorporation of adaptive impairment mitigation techniques include: expense; increases in system complexity; difficulty in unambiguously identifying, and responding to, path phenomena (as opposed to system effects); and difficulty in identifying and appropriately responding to distinct propagation mechanisms (e.g., attenuation and refractive fading).

Aspects of adaptive impairment mitigation are addressed in this presentation, with the main focus on the propagation issues.