Network Enabling of Legacy HF Systems

HF Data, Voice, Control over IP;
Transitioning Legacy HF to the 21st Century

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Legacy HF Remote Site Systems

- Legacy HF Radio Networks with remote stations usually interconnected by telephone circuits supporting audio transport
- Audio lines suitable for HF modem waveforms expensive
- For large HF Radio networks dependent upon leased audio circuits at the DS0 level, infrastructure maintenance can be difficult and complex
- Keyline management using E & M signaling leads in tandem with telephone line audio pipes can be challenging, whether voice or modem audio

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Network Centric HF Communications Systems

- Modern HF systems are being developed, JTRS for example, with embedded network interfaces
- Less expensive integration of Legacy HF Systems into IP Network allows expensive JTRS-like upgrades to be spread over time.
- MIL-STD-188-110B App C (section C.5.4.1.3) requires Ethernet Interface, but the definition of the Ethernet data interface not yet standardized

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Network Centric HF Comms Systems (cont'd)

- MIL-STD-188-110B revision Technical Advisory Committee (TAC) has proposed socket data interface definition for industry review
- An implementation of serial data over IP, Audio over IP, and serial control over IP for legacy HF systems is the topic of this discussion

Concept of HF Data Services Gateway for Legacy Systems

- Transport of serial sync/async and socket data over an Ethernet link to remote HF stations
- Control of remote HF equipment over IP
- Transport of digitized audio traffic over IP
- HF modem with a network interface at each communications station supported by network infrastructure

Concept of HF Data Services Gateway for Legacy Systems (cont'd)

- HF modem serves as "HF Data Services Gateway" to legacy HF Systems
- Each HF Data Services Gateway modem has its own unique IP address (static or leased) or host name
- Multiple services supported on each modem using unique port number for each unique service

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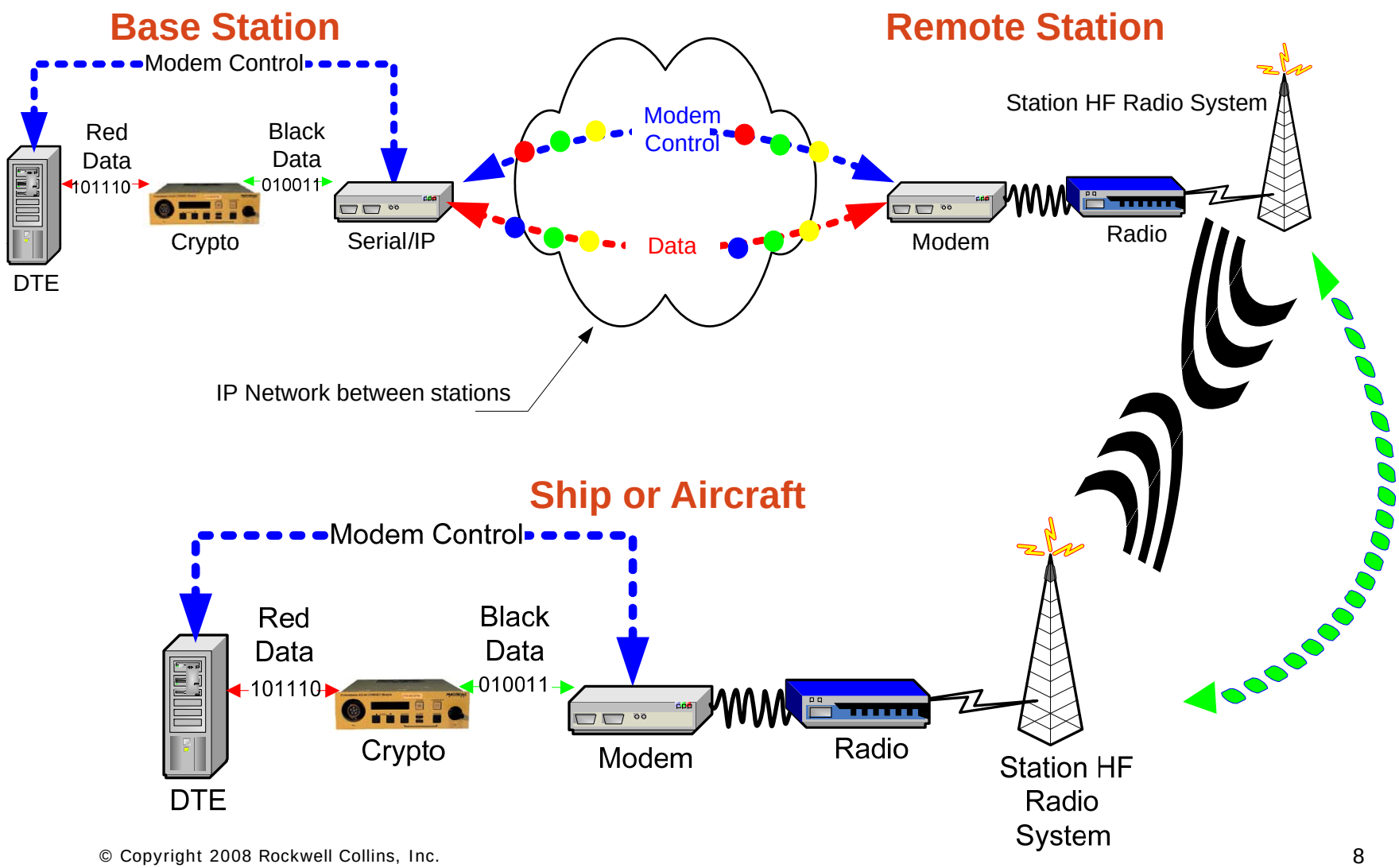
Sync Serial Data Transport over IP

- Control link is established between secure base station modem and modem at remote HF site
- Base station modem functions only as the serial data to socket data converter, IP link establishment, and remote modem controller (no audio functions)
- Base station receives serial data from encryption device and bundles the payload into TCP or UDP packets, depending upon the selected protocol

Data over IP HF System Network



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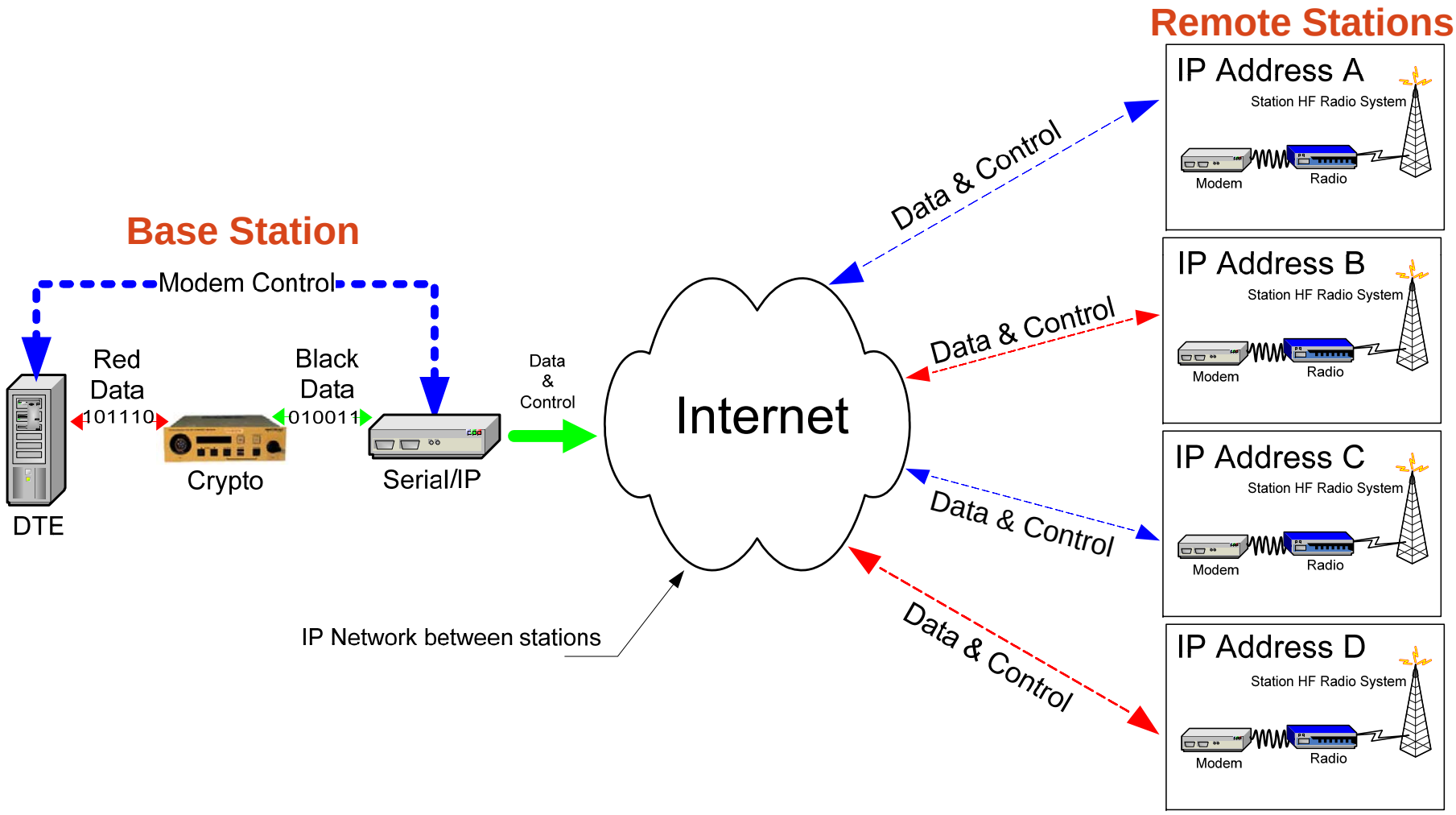
Sync Serial Data Transport over IP (cont'd)

- Payload is transported over the IP network infrastructure to the desired remote HF station…defined by the remote station modem IP address or host name

- Remote modem receives packets from base station modem, strips protocol and modem specific headers, then encodes, interleaves, and modulates payload for OTA HF transmission

Data over IP HF System Network

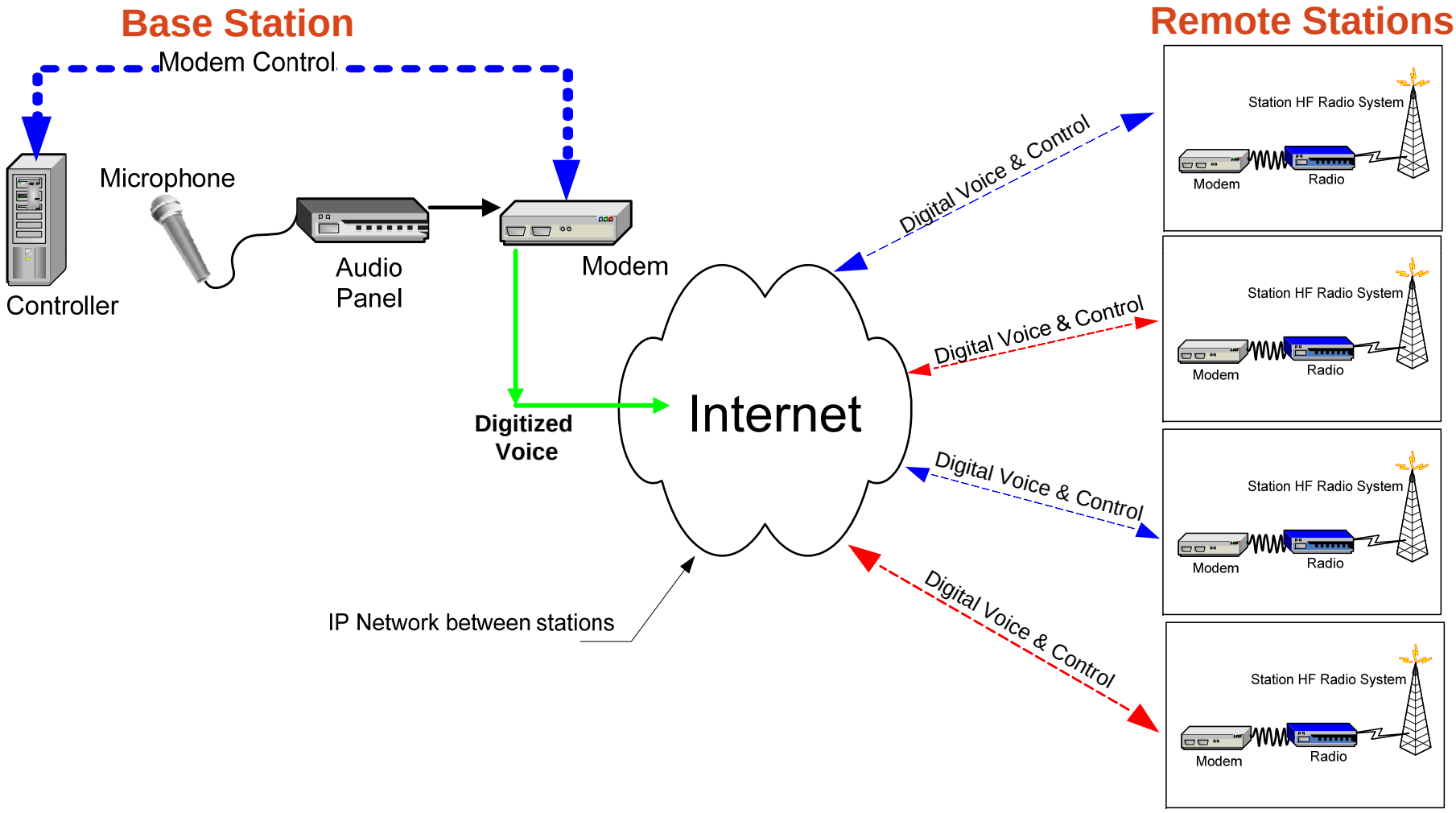


Audio over IP (AoIP) Transport over IP

- Analog signal, voice or any other type of audio, is routed into a modem audio port; if a PTT keying mechanism is used, the keyline is routed to the modem interface connector supporting keyline inputs

  1) A link is established between the base station modem and remote HF site modem

Audio over IP HF System Network



AoIP Transport over IP (cont'd)

2) Audio is digitized and transported to the remote HF modem along with the keyline signal (if PTT is keying mechanism)

3) Keying can also be initiated via Voice Activation if configured for Audio threshold keying

4) Digitized audio is modulated, and transferred to the HF radio system for OTA transport

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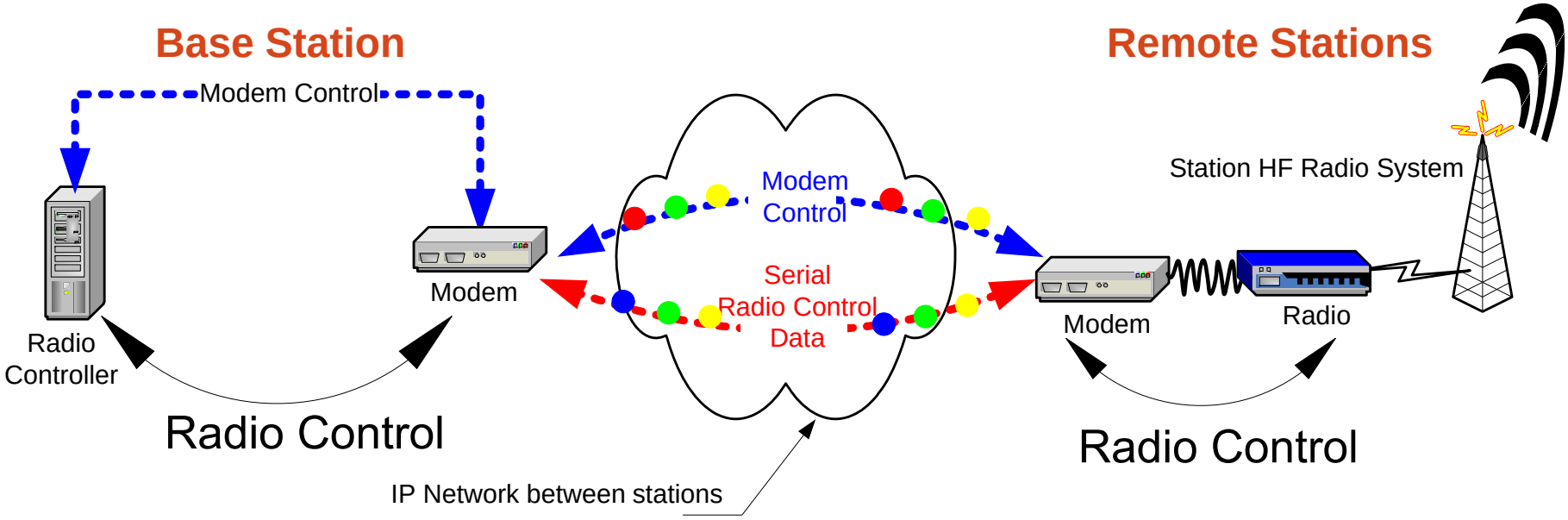
Serial Control over IP (SCoIP) of Remote Devices (HF Radios)

- Network-enabled HF modem serves as conduit for serial control of remote, serially controlled devices (HF radios or any device supporting serial control)
- Example: HF radio control computer routes the serial control packets into base station modem AUX port

Serial Control over IP HF System Network



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SCoIP of Remote Devices (HF Radios) cont'd

- Base station modem bundles control bits into packets for transport over the network link
- Remote modem restores IP packets to serial control bits, then transfers the control commands to radio's control port
- Status messages for base station HF radio controller are transported over IP from remote to the base station control computer in the same manner

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Potential Future HF Data Services over IP

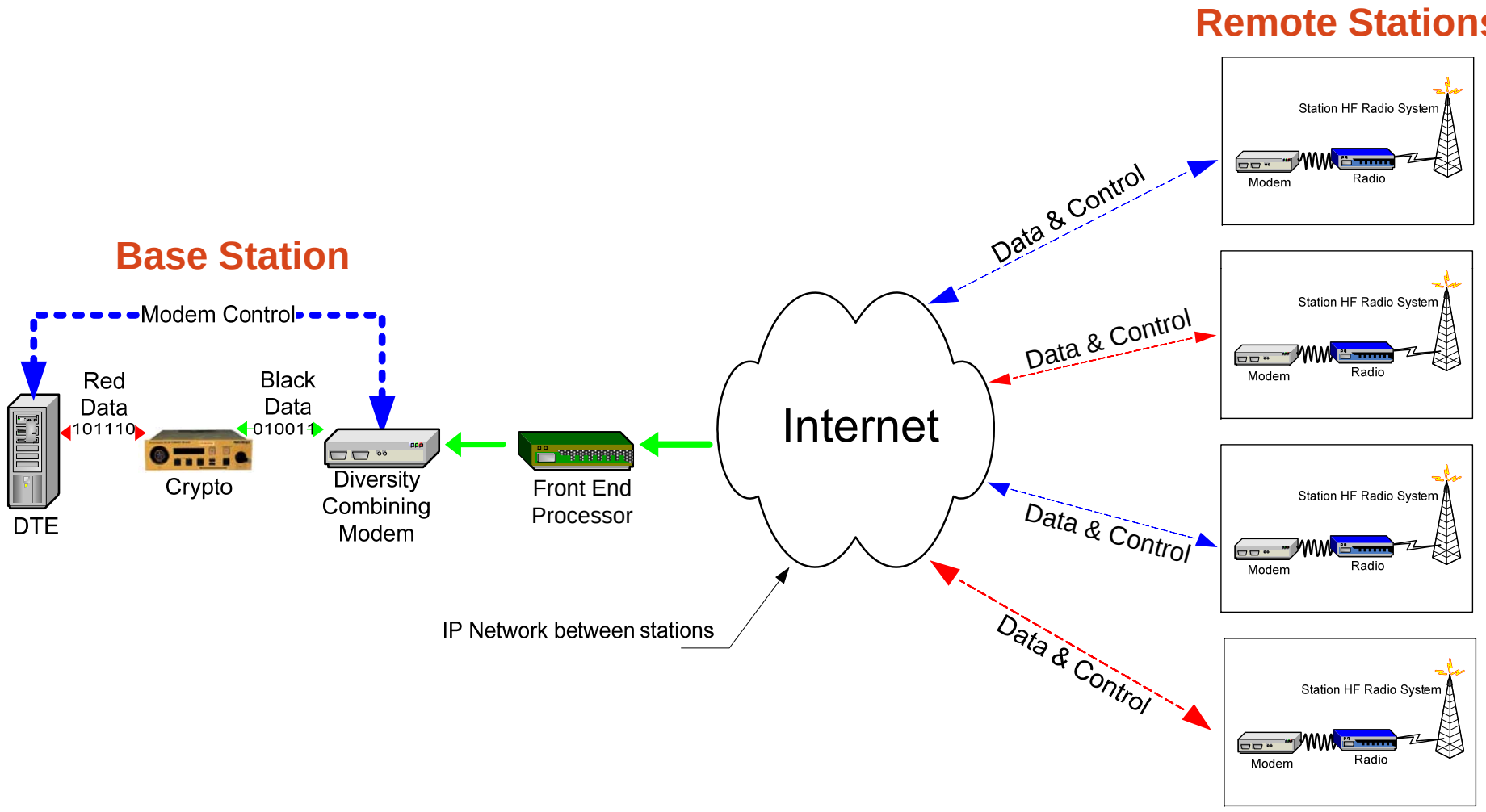
- Spatial Receive Diversity Combining over IP employing multiple remote stations listening on one frequency

  - Each remote station demodulates data, bundles data into TCP or UDP packets, and transports to the base station

  - A “front end” data collection “modem” buffers the data from the multiple sources and re-synchronizes each data stream

  - Due to delays over the network, the re-synchronized data streams are co-aligned with respect to time

Spatial Receive Diversity over IP



Potential Future HF Data Services over IP (cont'd)

- The selected re-synchronized and time-aligned streams are modulated and transferred to a standard, diversity combining modem

- 4-channel diversity combining can increase performance up to 18 dB dependent upon HF channel characteristics

- 2-channel diversity combining of an App F (2-channel) waveform reception can provide up to 10 dB performance gains

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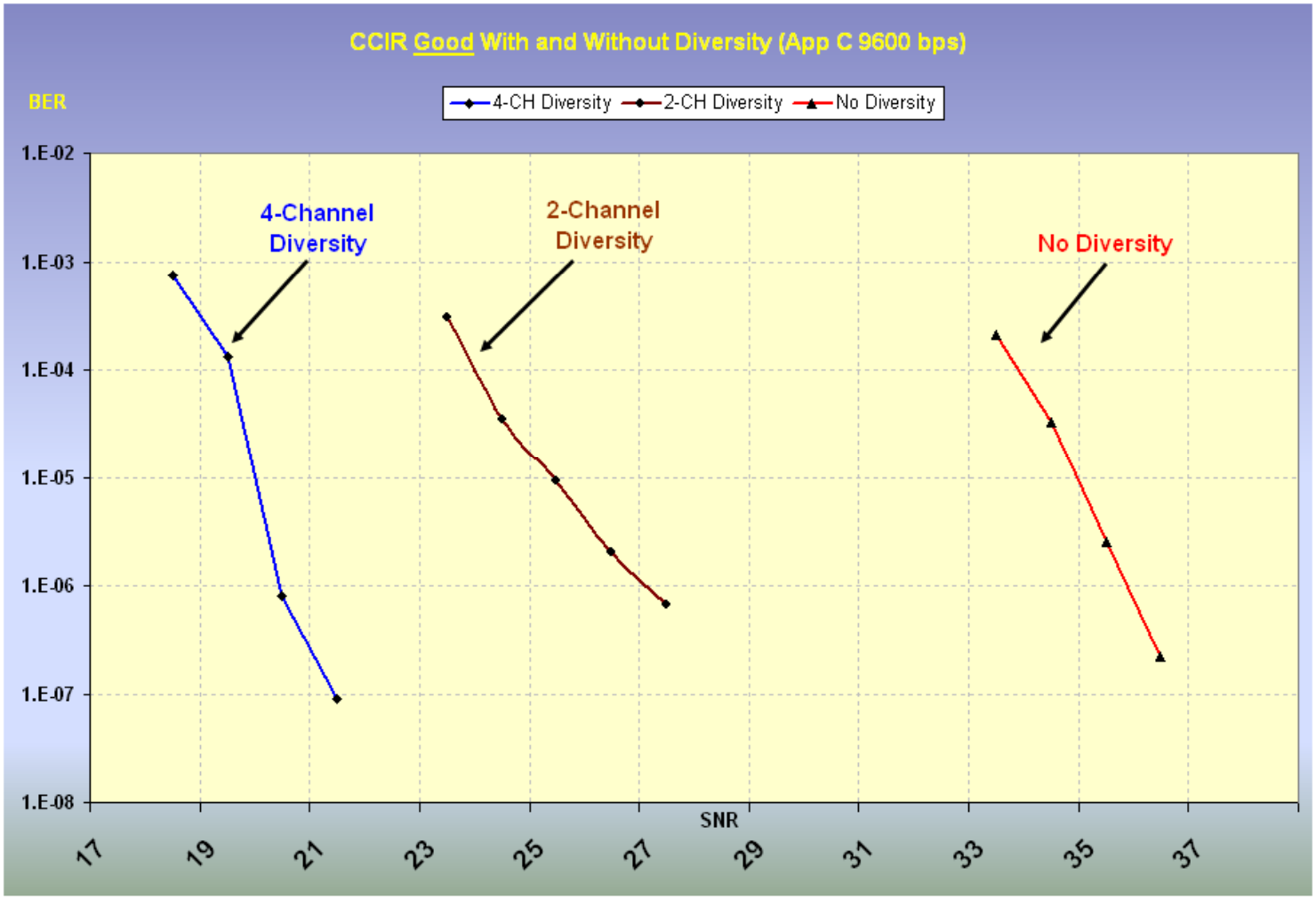
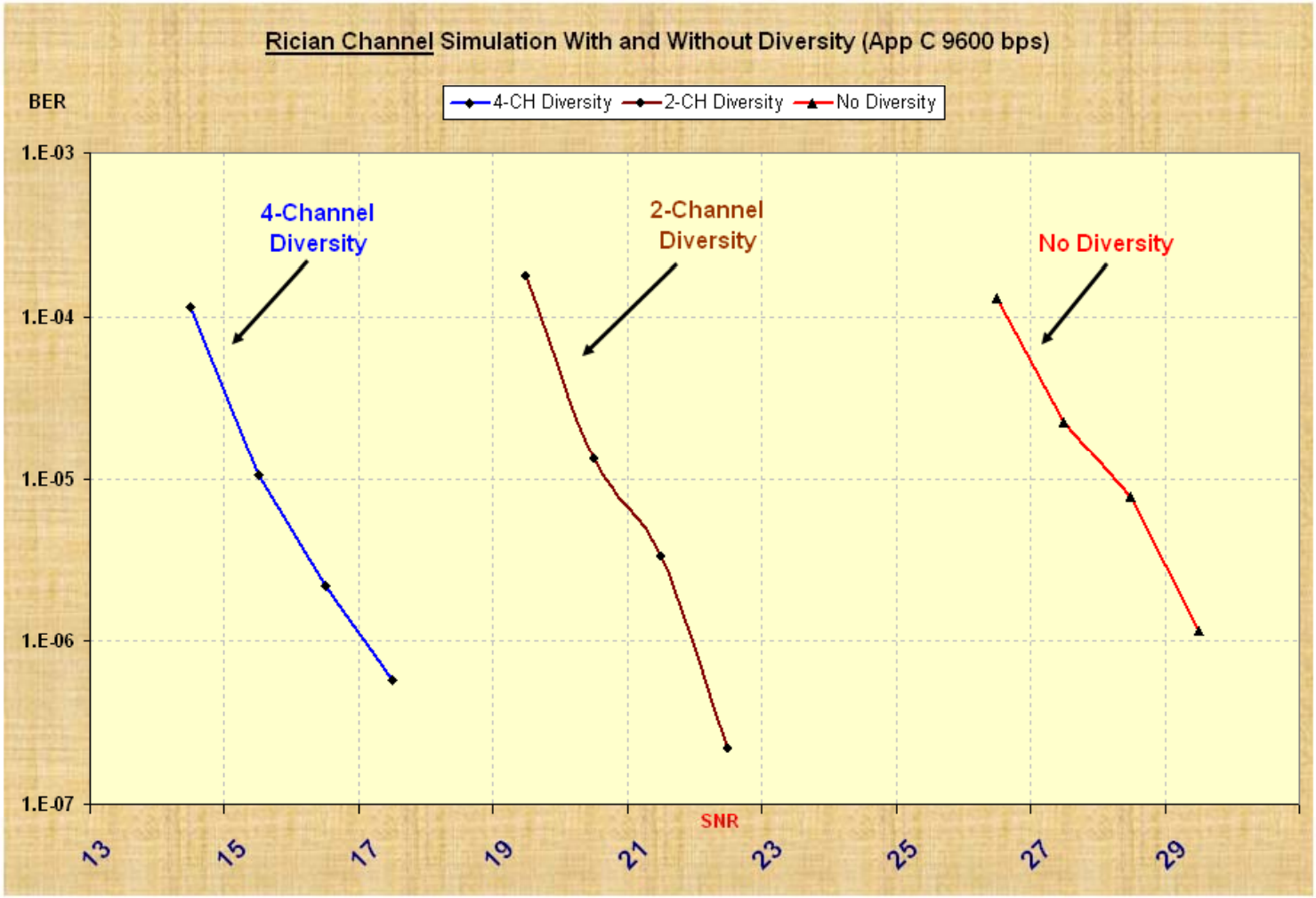
Spatial Receive Diversity Gains with Multiple Receivers

- Multi-channel Spatial Receiver Diversity Simulations with same SNR and channel type on each signal path
- Simulated independent fading on each signal path
- 4-channel Receive Diversity for 110B Appendix C
- 2-channel Receive Diversity for 110B Appendix F one diversity channel for each of the two App F data streams

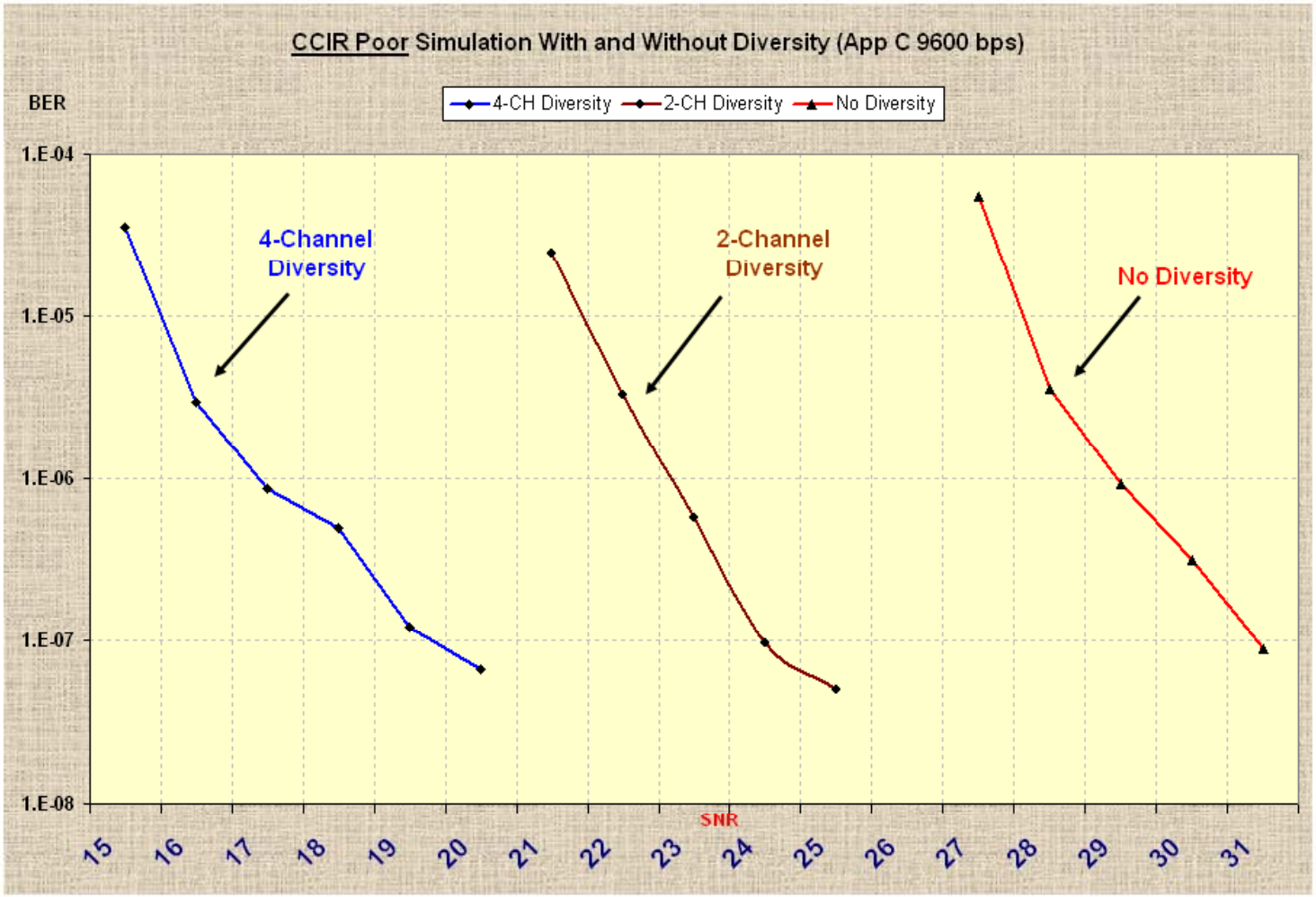
CCIR Good Diversity App C 9600 bps



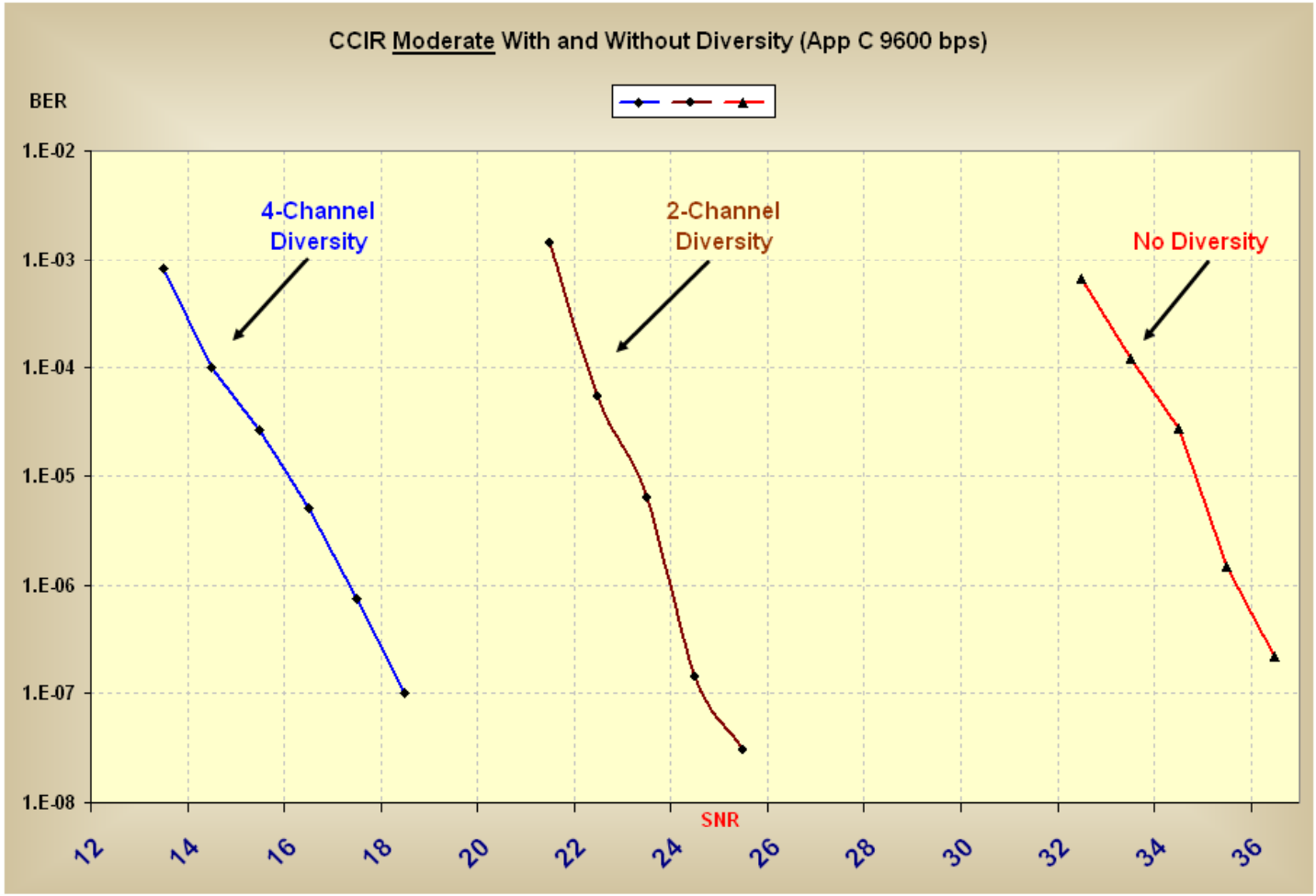
Rician Channel Diversity App C 9600 bps



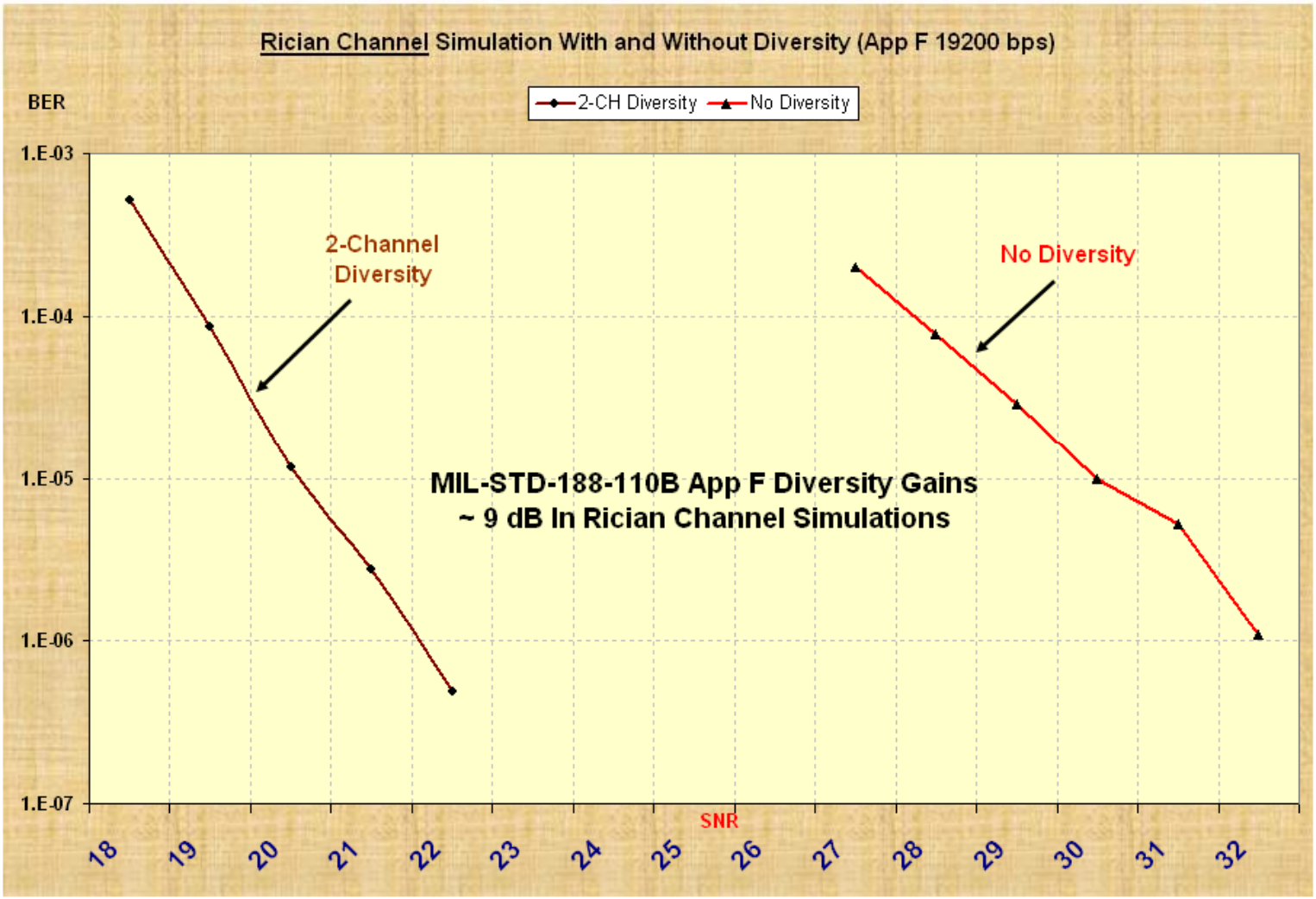
CCIR Poor Diversity App C 9600 bps



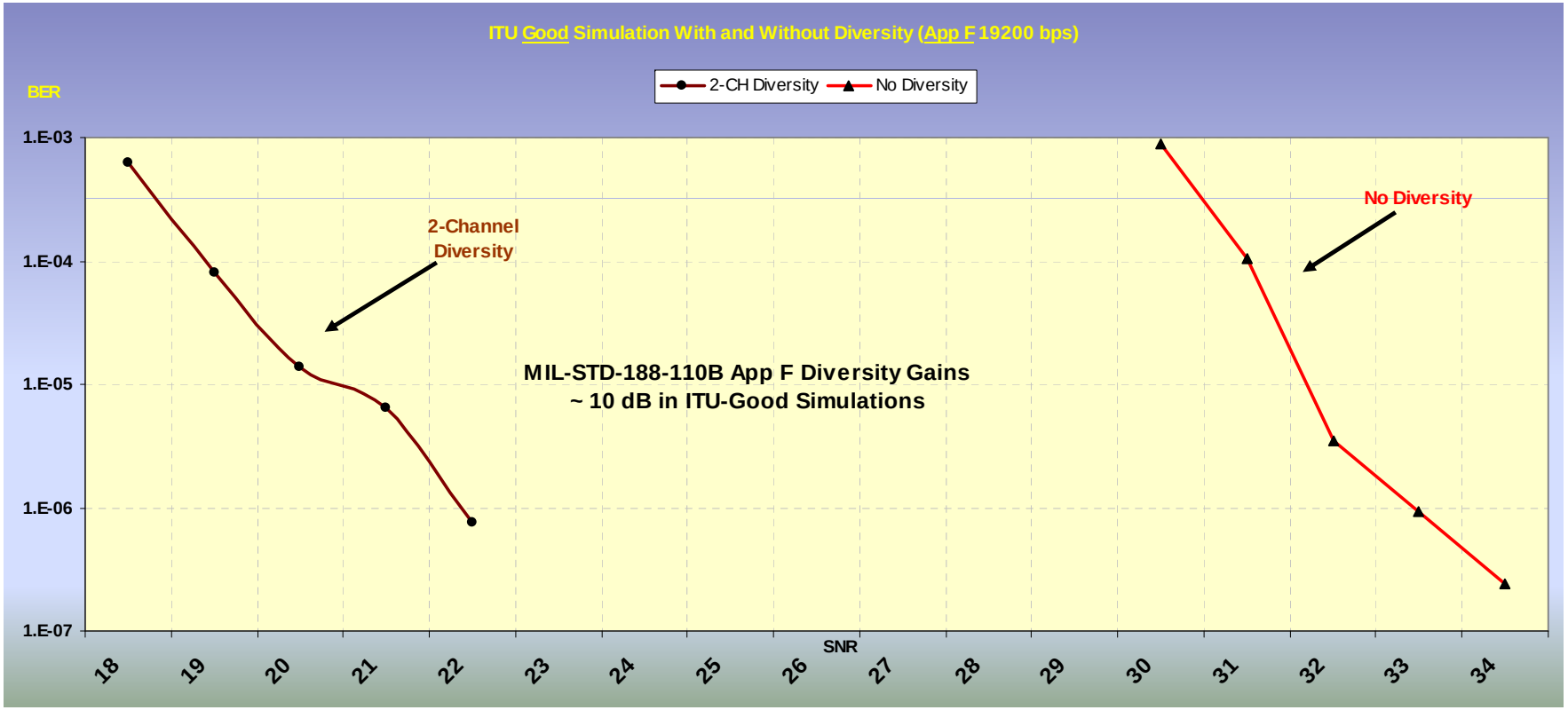
CCIR Moderate Diversity App C 9600 bps



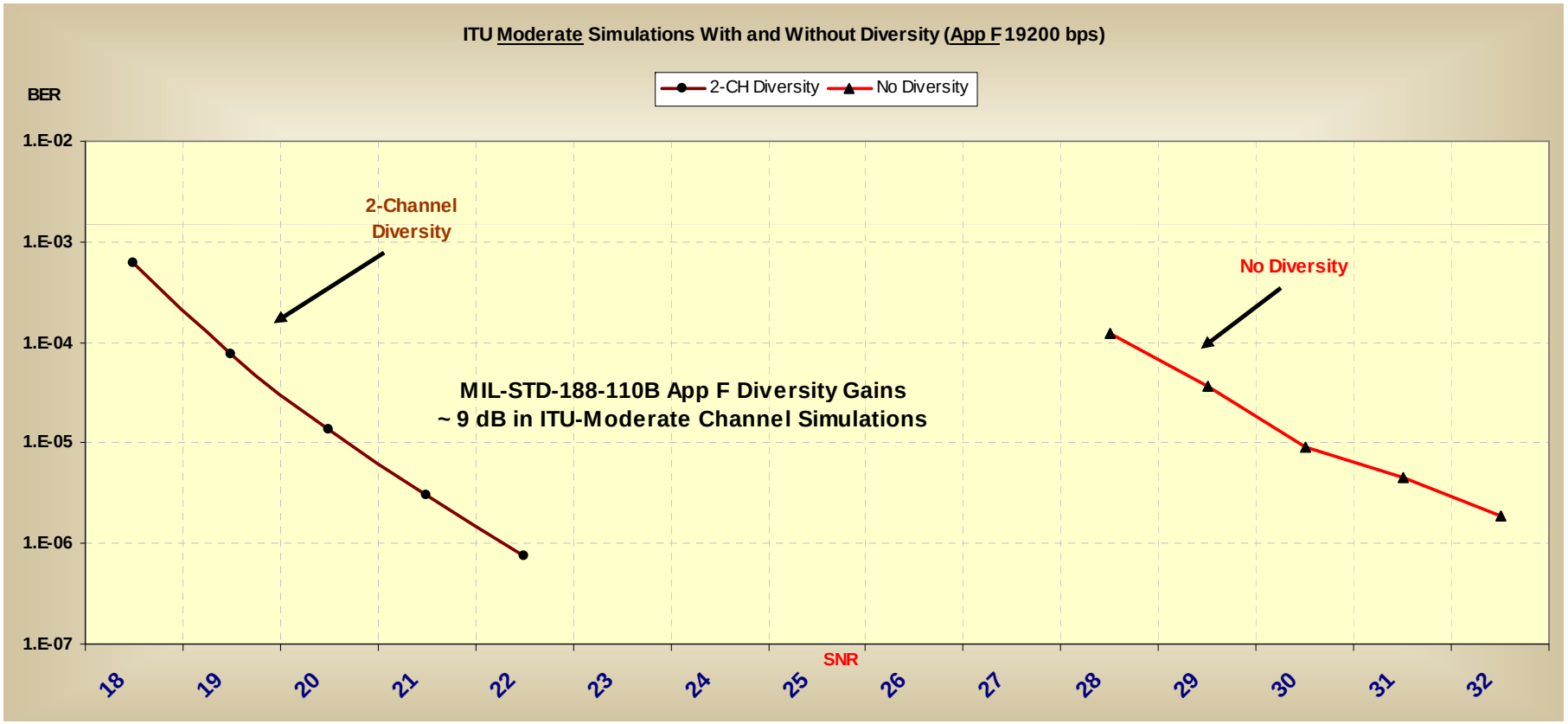
Rician Channel Simulation Diversity App F 19200 bps



ITU Good Simulation Diversity App F 19200 bps



ITU Moderate Simulation Diversity App F 19200 bps



ITU Poor Simulation Diversity App F bps