Overview
The CDM-625-EN Advanced Satellite Modem builds on Comtech EF Data’s legacy of providing the most efficient satellite modems for IP-centric applications that require data encryption. It is the first modem to combine advanced Forward Error Correction (FEC) such as VersaFEC® and Low Density Parity Check (LDPC) codes with the revolutionary DoubleTalk® Carrier-in-Carrier bandwidth compression, allowing for maximum savings under all conditions. This combination of advanced technologies enables multi-dimensional optimization, allowing satellite communications users to:

- Minimize operating expenses (OPEX)
- Maximize throughput without using additional transponder resources
- Maximize availability (margin) without using additional transponder resources
- Minimize capital expenses (CAPEX) by allowing a smaller BUC/HPA and/or antenna
- Or, a combination to meet specific business needs

Features
- DoubleTalk Carrier-in-Carrier bandwidth compression
- Carrier-in-Carrier Automatic Power Control (ACM)
- Adaptive Coding and Modulation (ACM)
- Packet Processor with header compression, payload compression, advanced Quality of Service (QoS) and Managed Switch Mode
- AES Data Encryption for IP traffic (Packet Processor)
- Dual Band Capability: 70/140 MHz and L-Band in same unit, extended L-Band receive
- Data Rate: 18 kbps to 25 Mbps
- Symbol Rate: 18 ksp to 12.5 Msps
- Modulation: BPSK, QPSK/OQPSK, 8PSK/8-QAM, 16-QAM
- FEC: Viterbi, Sequential, Concatenated Reed Solomon, TCM, Turbo Product Code (TPC) (IESS-315 Compliant), LDPC Code and VersaFEC (low-latency LDPC)
- Widest Range of Data Interfaces: 4-port 10/100Base-T Ethernet, EIA-422/530, V.35, G.703 T1, G.703 E1, G.703 T2, G.703 E2, Quad G.703 E1, ASI, LVDS, HSSI
- 4-port Managed Ethernet Switch with VLAN and QoS
- Sub Mux to multiplex IP/Ethernet traffic with serial or G.703 traffic
- Drop & Insert for T1/E1
- Enhanced D&I+ for Single T1/E1 & Quad E1
- Management: 10/100Base-T Ethernet with SNMP, Distant End SNMP Proxy, HTTP, Telnet and EIA-232/EIA-485
- Carrier ID using MetaCarrier® Technology
- Embedded Distant-end Monitor and Control (EDMAC)
- Automatic Uplink Power Control (AUPC)
- Standard high-stability internal reference (± 6 x 10⁻⁸)
- 5-tap Adaptive Equalizer
- L-Band TX: 10 MHz reference for BUC, FSK communications and optional BUC power supply
- L-Band RX: 10 MHz reference and LNB power supply
- Redundancy switches available

DoubleTalk Carrier-In-Carrier
DoubleTalk Carrier-in-Carrier, based on patented “Adaptive Cancellation” technology, allows transmit and receive carriers of a duplex link to share the same transponder space. DoubleTalk Carrier-in-Carrier is complementary to all advances in modem technology, including advanced FEC and modulation techniques. As these technologies approach theoretical limits of power and bandwidth efficiencies, DoubleTalk Carrier-in-Carrier utilizing advanced signal processing techniques provides a new dimension in bandwidth efficiency.
Adaptive Coding & Modulation (ACM)

Satellite users have traditionally relied on worst case link margin to overcome rain fade which leads to significant inefficiencies. ACM converts the fade margin into increased throughput – gain of 100% or more is possible. ACM maximizes throughput under all conditions – rain fade, inclined orbit satellite operation, antenna mis-pointing, noise, interference and other impairments. ACM can also be used with DoubleTalk Carrier-in-Carrier.

Low Density Parity Check Codes (LDPC) & Turbo Product Codes (TPC)

CDM-625-EN offers an integrated LDPC and 2nd Generation TPC codec. LDPC is an advanced Forward Error Correction technique capable of providing performance much closer to Shannon limit. The current LDPC implementation can provide 0.7 to 1.2 dB additional coding gain compared to an equivalent TPC code.

When observed on a spectrum analyzer, only the Composite is visible. Carrier 1 and Carrier 2 are shown in Figure 2 for reference only.

As DoubleTalk Carrier-in-Carrier allows equivalent spectral efficiency using a lower order modulation and/or code rate, it can simultaneously reduce CAPEX by allowing a smaller BUC/HPA and/or antenna. Alternatively, DoubleTalk Carrier-in-Carrier can be used to achieve very high spectral efficiencies e.g., DoubleTalk Carrier-in-Carrier when used with 16-QAM approaches the bandwidth efficiency of 256-QAM (8 bps/Hz).

When combined with VersaFEC or LDPC/TPC, it can provide unprecedented savings in transponder bandwidth and power utilization. This allows for its successful deployment in bandwidth-limited and power-limited scenarios, as well as reduction in earth station BUC/HPA power requirements.

Carrier-in-Carrier® is a Registered Trademark of Comtech EF Data
DoubleTalk® is a Registered Trademark of Raytheon Applied Signal Technology
VersaFEC® is a Registered Trademark of Comtech EF Data

Carrier-in-Carrier Automatic Power Control (CnC-APC)

The patent-pending Carrier-in-Carrier Automatic Power Control (CnC-APC) mechanism enables modems on both sides of a CnC link to automatically measure and compensate for rain loss while maintaining the Total Composite Power. In addition to automatically compensating for rain loss, CnC-APC also enables the modems to share link margin, i.e., a modem in clear sky conditions can effectively transfer excess link margin to a distant end modem experiencing fade, thereby further enhancing overall availability.

VersaFEC Forward Error Correction

CDM-625-EN offers VersaFEC, a patent-pending system of high performance short-block low-latency LDPC codes designed to support latency-sensitive applications, such as cellular backhaul over satellite. VersaFEC provides excellent coding gain with lowest possible latency. VersaFEC’s Eb/No performance is similar to that of DVB-S2 (short block) or LDPC (16k block) with 70-90% lower latency. Compared to TPC, VersaFEC can provide coding gain of 1.0 dB or more.

The new Ultra Low Latency (ULL) codes provide even lower latency compared to standard VersaFEC codes.

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Dual Band Capability

CDM-625-EN supports 70/140 MHz and L-Band capability in the same unit with independently selectable transmit and receive IF. This simplifies sparing and stocking in networks requiring 70/140 MHz and L-Band units.

4-Port Managed Ethernet Switch with VLAN & QoS

CDM-625-EN incorporates a 4-port 10/100Base-T managed Ethernet switch with VLAN capability and priority-based Quality of Service. Access (Native) Mode and Trunk Mode are supported. Traffic can be prioritized using port-based priority or VLAN priority. The maximum Ethernet frame size with Rev 2 HW is 2048 bytes.
Packet Processor
The Packet Processor enables efficient IP networking and transport over satellite by adding routing capability with very low overhead encapsulation, header compression, payload compression and Quality of Service to the CDM-625. The advanced QoS combined with header and payload compression ensures the highest quality of service with minimal jitter and latency for real-time traffic, priority treatment of mission critical applications and maximum bandwidth efficiency.

Packet processor also supports AES data encryption.

Header Compression
The Packet Processor incorporates industry-leading header compression for IP traffic. Header compression can reduce the 40 byte IP/UDP/RTP header to as little as 1 byte. For TCP/IP, the 40 byte header is reduced to as little as 3 bytes. For applications such as VoIP, header compression can provide bandwidth savings exceeding 60%. E.g. the 8 kbps G.729 voice codec requires 24 kbps of IP bandwidth once encapsulated into an IP/UDP/RTP datagram. With header compression, the same voice call needs about 8.5 kbps – a saving of almost 65%. And, bandwidth requirements for typical Web/HTTP traffic can be reduced by 10% or more with TCP/IP header compression.

Payload Compression
The Packet Processor incorporates industry-leading payload compression for IP traffic. Implemented in the hardware for maximum throughput and efficiency, payload compression can reduce the required satellite bandwidth by as much as 40-50%.

Streamline Encapsulation (SLE)
The Packet Processor incorporates Comtech EF Data's patent-pending very low overhead Streamline Encapsulation (SLE). SLE can reduce the encapsulation overhead by as much as 65% compared to industry standard HDLC.

Advanced Quality of Service (QoS)
The Packet Processor incorporates multi-level QoS to ensure the highest quality service with minimal jitter and latency for real-time traffic, priority treatment of mission critical applications and maximum bandwidth efficiency.

Supported modes are:
- DiffServ – Industry-standard method of providing QoS enabling seamless co-existence in networks that implement DiffServ
- Max/Priority – Provides multi-level traffic prioritization with the ability to limit maximum traffic per priority class
- Min/Max – Provides a Committed Information Rate (CIR) to each user defined class of traffic with the ability to allow a higher burstable rate depending on availability

Managed Switch Mode
Managed switch modem enables layer 2 operation with the Packet Processor. This provides significant bandwidth savings for layer 2 operation with very low overhead Streamline Encapsulation, header compression and payload compression.

AES Data Encryption
Configurable on a per route basis, the modem supports AES data encryption for transmission security to prevent unauthorized access to data transmitted over the satellite link. AES data encryption is only available for IP traffic processed by the Packet Processor.

Quad E1 Interface (QDI) with Enhanced D&I++
The CDM-625-EN supports a Quad E1 interface that can aggregate up to four full or fractional E1s into a single carrier, with very low overhead. This provides significant CAPEX savings by reducing the number of modems and could possibly reduce the BUC/HPA size by eliminating the multi-carrier backoff. A proprietary, closed network drop & insert (D&I++) allows for dropping or inserting any combination of 1 to 31 time slots on each E1. D&I++ is supported for E1-CCS only.

IP Sub Multiplexer
The IP sub mux allows multiplexing IP/Ethernet traffic with serial or G.703 traffic into a single carrier. This is particularly useful for cellular backhaul when both E1 and IP backhaul is required. This reduces the number of modems and could possibly reduce the BUC/HPA size by eliminating the multi-carrier backoff. The IP sub mux ratio ranges from 9:1 (IP data rate is 9 times that of the serial or G.703 data rate) to as low as 1:59.

EDMAC & AUPC
The CDM-625-EN supports EDMAC, EDMAC-2, EDMAC-3 and AUPC. EDMAC/EDMAC-2/EDMAC-3 can be used to monitor and control the distant end of a satellite link using a proprietary overhead channel. EDMAC-3 is also used for SNMP management of the distant end modem. AUPC enables automatic uplink power control for a duplex link.

Management & SNMP Proxy
The modem can be managed via the front panel, the remote M&C port (EIA-232/EIA-485), or the 10/100Base-T Ethernet port. With support for SNMP, HTTP and Telnet, the modem can be easily integrated into an IP-based management system.

The CDM-625-EN can also act as SNMP proxy for the distant end modem. This allows distant end modem management using SNMP without requiring an end-to-end IP link.

Advanced FSK for LPOD Monitoring & Control
The Advanced FSK allows for monitoring and control of LPOD through modem front panel menus, serial remote control and Telnet

Feature Enhancements
Enhancing the capability of the CDM-625-EN in the field is easy. Features that do not require additional hardware can be added on site, using FAST access codes purchased from Comtech EF Data.
Specifications

**Data Rate**
- 18 kbps to 25 Mbps, in 1 bps steps (modulation, FEC & data interface dependant)
- 18 kbps to 12.5 Mbps

**Operating Frequency**
- 50 – 180 MHz (standard) and 950 – 2000 MHz (TX) & 950 – 2150 MHz (RX) (Option), (Note: extended L-Band receive supported on modems shipped since January 2013)
- 100 Hz resolution, independent TX and RX operation

**Major Operating Modes (See User Manual For Details)**
- Open network, per IESS-308 / 309 / 310 / 314 transparent, closed network per IESS-315
- LDPC / TPC Codec (optional plug-in module)
- VersaFEC Codec (optional plug-in module) with ACM or Constant Coding & Modulation (CCM)
- EMDAC Framed with/without AUPC
- RS Outer Codec
- High rate ESC / Enhanced ESC (ESC++)
- Drop & insert (D&I) / Enhanced D&I++
- Quad E1 drop & insert (QDI)
- DoubleTalk Carrier-in-Carrier (optional plug-in module)

**FEC Options**
- None
- Uncoded BPSK/QPSK/OQPSK
- Viterbi: k=7, per IESS-308/309
- Rate 1/2 BPSK/QPSK/OQPSK
- Rate 3/4 QPSK/OQPSK
- Rate 7/8 QPSK/OQPSK
- Viterbi with Reed Solomon
- Rate 3/4 16-QAM
- Rate 7/8 16-QAM
- Sequential
- Reed Solomon
- Open network and closed network modes
- TCM (Per IESS-310)
- 8PSK/TCM Rate 2/3

**Integrated LDPC and TPC (2nd Gen Codec (Optional Plug-in Module))**
- VersaFEC Codec (Optional Plug-in Module)
- BPSK Rate 0.488
- QPSK Rate 0.533, 0.631, 0.706, 0.803
- 8-QAM Rate 0.576 (ECCM), 0.642, 0.711, 0.780
- 16-QAM Rate 0.644 (ECCM), 0.731, 0.780, 0.829, 0.853
- BPSK 0.493 (ULL)
- QPSK 0.493, 0.654, 0.734 (ULL)

**Scrambling**
- IDR Mode, no RS, - per ITU V.35 (Intelsat variant)
- BPSK mode, no RS, per IESS-309, externally frame synchronized
- Transparent Closed Network mode, no RS or Turbo coding - per ITU V.35 (Intelsat variant)
- EMDAC mode, no RS coding - externally frame synchronized - proprietary
- Turbo Product Code/LDPC/VersaFEC modes - externally frame synchronized - proprietary
- All RS modes - externally frame synchronized per IESS-308/309/310

**Management**
- 10/100Base-T Ethernet with SNMP, HTTP, Telnet support, EIA-232, EIA-425 (2- or 4-wire)

**Form C Relays**
- Hardware fault, RX and TX traffic alarms, open network backward alarms

**External Reference (Input OR Output)**
- BNC connector
  - Input: 1, 2, 5, or 10 MHz, -6 dBm to +10 dBm, 50 Ω/75 Ω (nominal)
  - Output: 10 MHz, 2.7 V peak-to-peak ± 0.4 V, low impedance output

**Data Interfaces**
- EIA-422/530 DCE, Up to 14 Mbps: 25-pin D-sub (female)
- V.35 DCE, Up to 14 Mbps: 25-pin D-sub (female)
- LVDS Serial, Up to 25 Mbps: 9-pin D-sub (female) or BNC (female)
- HSSI Serial, Up to 25 Mbps: 9-pin D-sub (female)
- G.703 T1, 1.544 Mbps (Balanced 100 Ω): 25-pin D-sub (female)
- G.703 T2, 6.312 Mbps (Unbalanced 75 Ω or balanced 110 Ω): 25-pin D-sub (female)
- G.703 E1, 2.048 Mbps (Unbalanced 75 Ω or balanced 120 Ω): 25-pin D-sub (female)
- G.703 E2, 8.448 Mbps (Unbalanced 75 Ω): 25-pin D-sub (female)
- ASI, Up to 25 Mbps: BNC (female)
- Additional 2.048 Mbps E1 Ports for Quad-E1 (Balanced 120 Ω): 9-pin D-sub (female)
- Overhead Data: 44-pin High-density D-sub (male)
- Modern Alarms: 15-pin D-sub (male)
- 4-port 10/100Base-T Managed Ethernet Switch: 4 x RJ-45

**Modulator**
- Frequency Stability: ± 0.06 ppm (± 6 x 10⁻⁸), 0° to 50°C (32° to 122°F) with internal reference
- Transmit Filtering: Per IESS-308
- Transmit Filter Rolloff: 25%, 35%
- Harmonics and Spurious: Better than -60 dBc/4 kHz (typically < -65 dBc/4kHz)
- Measured from 1 to 500 MHz (50-180 MHz band)
- Measured F₂ ± 500 MHz (950-2000 MHz band)
- Transmit On/Off Ratio: -60 dBc minimum
- Output Phase Noise: < 0.48° rms double sided, 100 Hz to 1 MHz
  - Minimum 16 dB better overall than the Intelsat IESS-308/309 requirements
  - Frequency Offset
    - -63.0 100 Hz
    - -73.0 1 kHz
    - -83.0 10 kHz
    - -93.0 100 kHz
- Fundamental AC line spurious is -42 dBc or lower
- The sum of all other single sideband spurious, from 0 to 0.75 x symbol rate, is -48 dBc or lower

**Output Power**
- 50-180 MHz: 0 to -25 dBm, 0.1 dB steps
- 950-2000 MHz: 0 to -40 dBm, 0.1 dB steps

**Demodulator**
- Input Power Range, Desired Carrier
  - 50-180 MHz: -105 + 10 log (symbol rate) to -70 + 10 log (symbol rate) dBm
  - 950-2150 MHz: -130 + 10 log (symbol rate) to -80 + 10 log (symbol rate) dBm
- Max Composite Operating Level
  - 50-180 MHz: 94 – 10 log (symbol rate, desired carrier) dBc, +10 dBm max., with the additional requirement that within ± 10 MHz of the desired carrier the composite power is ≤ +30 dBc
  - 950-2150 MHz: 102 – 10 log (symbol rate, desired carrier) dBc, +10 dBm max., with the additional requirement that within ± 10 MHz of the desired carrier the composite power is ≤ +30 dBc
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