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# E1 RAN Optimization Feature Overview

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The CDM-570 Satellite Modem product family, which includes CDM-570, CDM-570L, CDM-570-IP, CDM-570L-IP, CDM-570-IPEN and CDM-570L-IPEN, now supports the E1 RAN Optimization for Point-to-Point circuits. This feature overview provides the details behind this patent-pending technology, which is designed to provide maximum savings while maintaining superior voice quality.

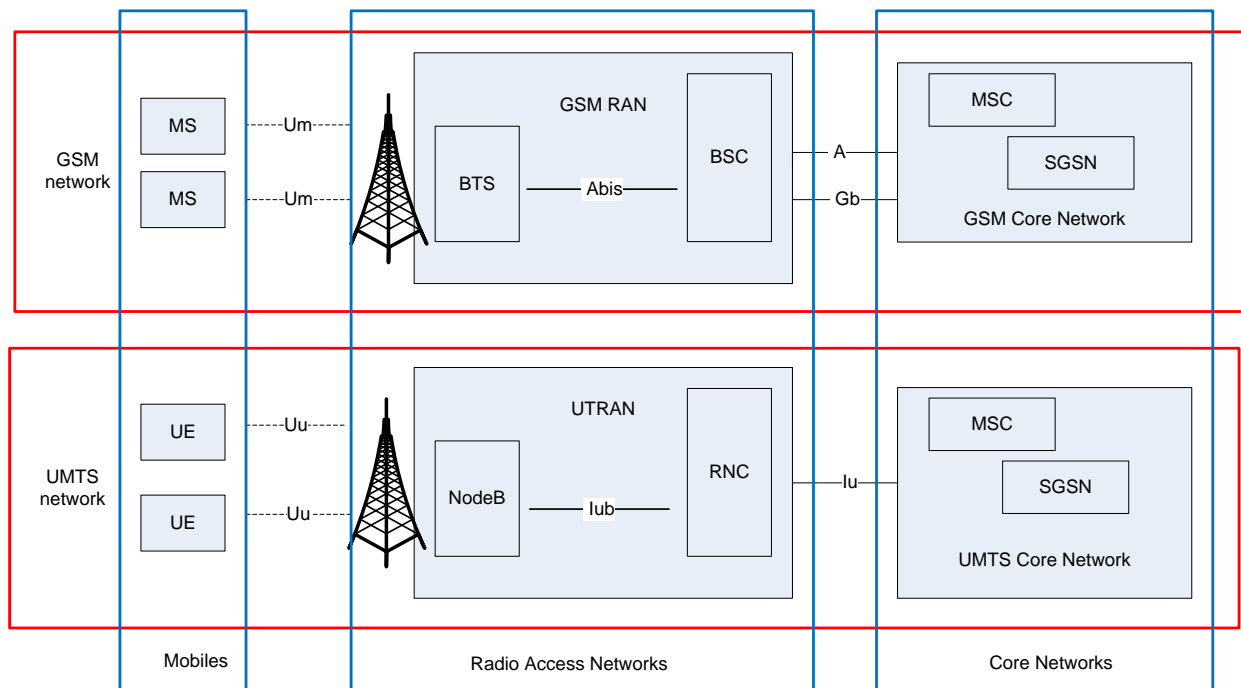


## Radio Access Network (RAN)

In the cellular network, the RAN connects cell-site nodes with central-site nodes:

- For Global System for Mobile Communications (GSM) / 2G, the Base Transceiver Stations (BTS) connect to the Base Station Controllers (BSC) via the Abis interface. Voice, data and signaling are transported over one or more E1s.
- For Universal Mobile Telecommunications Systems (UMTS) / 3G, the NodeB connects to the Radio network Controller (RNC) via the Iub interface. Voice, data and signaling are transported over one or more E1s using Asynchronous Transfer Mode (ATM).

Figure 1 shows the typical RAN for 2G and 3G networks:



**Figure 1. 2G/3G Radio Access Network (RAN)**

## RAN Inefficiency

The 2G/3G RAN design is not efficient for satellite backhaul. For example, in the GSM Abis interface, the resource allocation is on a fixed basis (one or more E1s per BTS) irrespective of the actual traffic. Within the E1, the Time Slots (TS) are dedicated to signaling, voice and data per Transceiver (TRX).

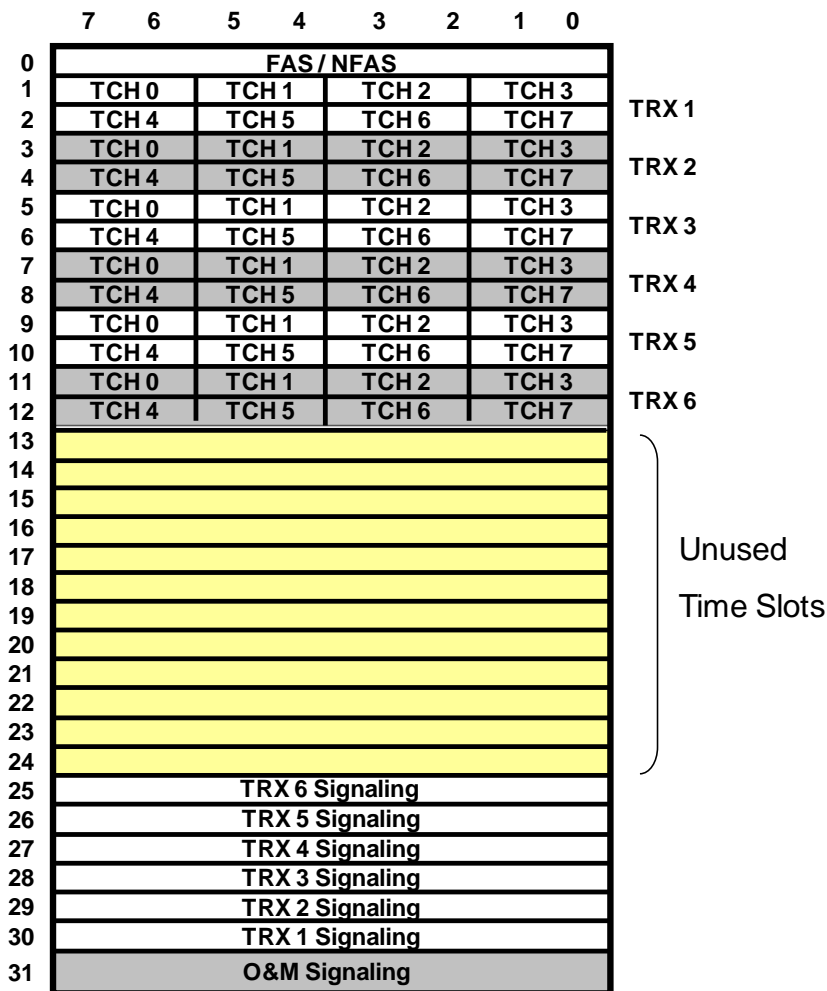


Figure 2. Typical Abis Map

## RAN Optimization

Jointly developed by Comtech EF Data, our sister division, Comtech AHA, and our subsidiary, Memotec, the RAN Optimization technology significantly reduces the Wide Area Network (WAN) / satellite bandwidth required to carry an E1 bearer used for cellular backhaul. RAN Optimization allows the transmit modem data rate to be reduced relative to the input terrestrial data rate, thus allowing the transport of a user-selectable channel subset of bearer E1 using less bandwidth. In the receive direction, the data is restored to the E1 format for transport over the G.703 E1 interface.

The process is designed to allow varying levels of optimization to accommodate the incoming terrestrial data in the reduced modem data rate. Optimization performance depends on the traffic profile and the difference between the terrestrial data rate (based on input timeslot selection) and the transmit modem data rate. The optimization is performed in hardware for optimal performance.

The user has complete control over the desired level of optimization by selecting the time slots to be optimized and the transmit modem data rate. Depending on the traffic profile, typical bandwidth reduction of 30-35% can be achieved with little or no impact to the voice quality. Users have the option to reduce the WAN bandwidth by as much as 60% relative to the ingress data rate. This allows the users to achieve desired bandwidth savings while maintaining desired voice quality.

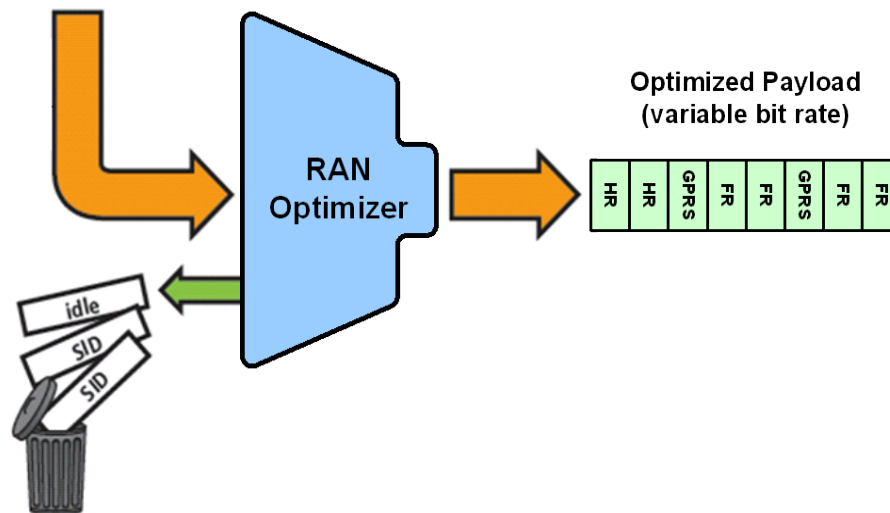
### Process Overview

On the transmit side, the RAN optimization process can be summarized as follows:

- The incoming 64 kbps Time Slots are de-multiplexed into Traffic Channels (TCH)
- TCH are inspected in real-time to identify Signaling, Voice, Data, and Idle
- Idle TCH are removed
- Silence frames are removed from the Voice channel
- Signaling and Data TCH are compressed using lossless compression
- O&M frames are compressed using lossless compression
- Voice frames are compressed using lossless compression
- Pre-emptive Bandwidth Management to maintain service quality
- The optimized payload is sent to the modem for transmission

Idle	FR	FR	GPRS
SID	Idle	FR	FR
GPRS	HR	SID	Idle
Idle	SID	Idle	HR

Ingress E1  
(Fixed TDM  
bandwidth)



**Figure 3. RAN Optimization (GSM Abis Interface)**

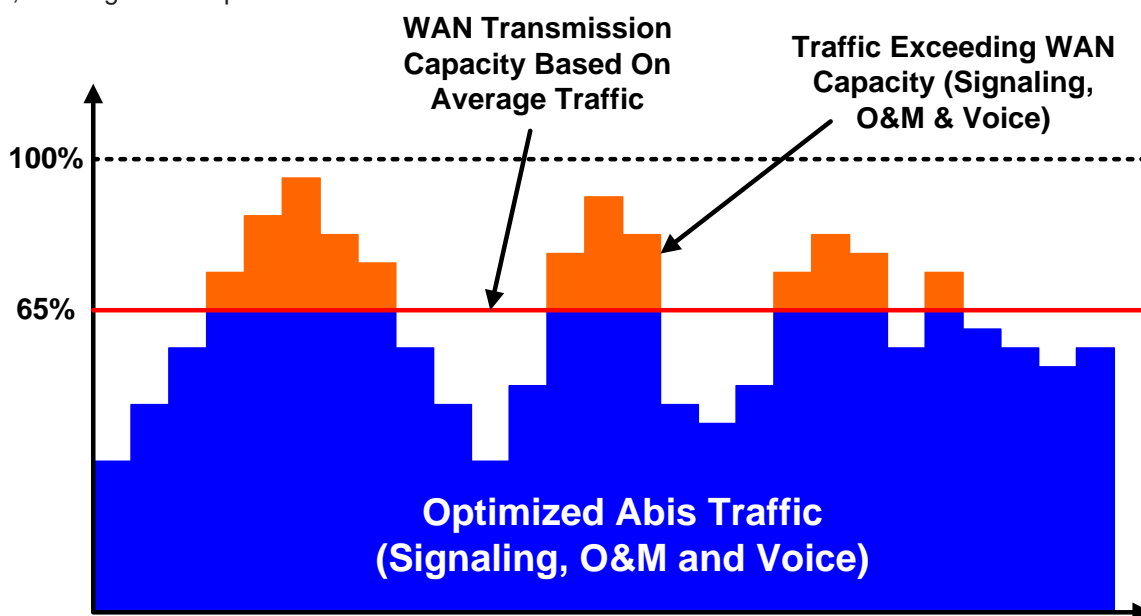
This process is reversed on the receive side re-creating the E1 for transmission over the G.703 E1 interface.

### **WAN Link Dimensioning and Pre-emptive Bandwidth Management**

The RAN traffic varies over time – variations during the day that peak at certain time(s) and longer term variation as user density/profile(s) changes. The WAN link can be dimensioned to accommodate the peak traffic, or it can be dimensioned to meet a statistically derived value (e.g. average traffic).

Dimensioning the WAN link for peak traffic may not be economically viable. However, dimensioning the WAN link for average traffic has its challenges. What happens when the optimized traffic exceeds WAN capacity?

Typical of most other vendors' RAN optimization solutions, Figure 4 shows the optimized Abis traffic as a function of time, depending on the BTS traffic load. The red line is the pre-defined WAN link capacity (assuming 35% target optimization). Each time the optimized Abis traffic exceeds WAN capacity, packets are dropped and the voice quality degrades dramatically – even leading to dropped calls or in the worst case, causing BTS drop.



**Figure 4. Optimized Abis Traffic without Pre-emptive BW Management**

The simplistic packet drop in case of WAN congestion employed by most vendors has potentially disastrous effects on the voice quality and call handling. The results can include clicks, blank calls, and eventually call drops, in particular if the BCCH channel of the TRX is impacted. In the worst case, it may even lead to BTS drop. To compensate for that, most other vendor solutions are forced to over-dimension the WAN link leading to significant inefficiencies.

This methodology should not be acceptable to mobile operators. A good RAN optimization solution should be nearly transparent and provide the same level of service to the mobile customers as when there is no RAN Optimization, WHILE providing a significant reduction in the RAN transmission bandwidth.

The superior method of handling WAN congestion – as implemented by Comtech EF Data – is to perform pre-emptive and selective voice packet discard. Comtech EF Data's RAN optimization solution employs a sophisticated bandwidth management capability to maintain *Service Quality*. The signaling and O&M traffic is always protected from being dropped in case of WAN congestion. This ensures that the BTS/NodeB stays connected and synchronized. The bandwidth manager smoothes peak traffic variation

before the optimized RAN traffic reaches the available WAN capacity. This mechanism maintains good voice quality while effectively reaching the optimal target optimization rate.

Comtech EF Data's patent pending algorithm on voice packet discard is designed to minimize the impact on the voice quality. This results in superior voice quality and improved *Service Quality* even at peak hour traffic load. Implementing a RAN optimization solution without such capability serves little purpose.

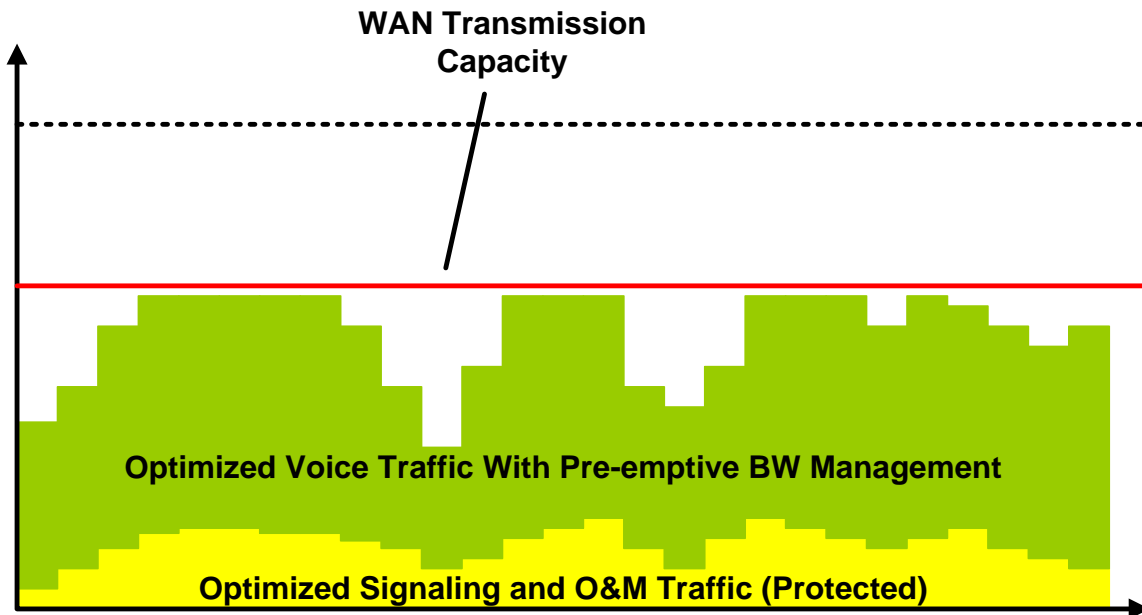


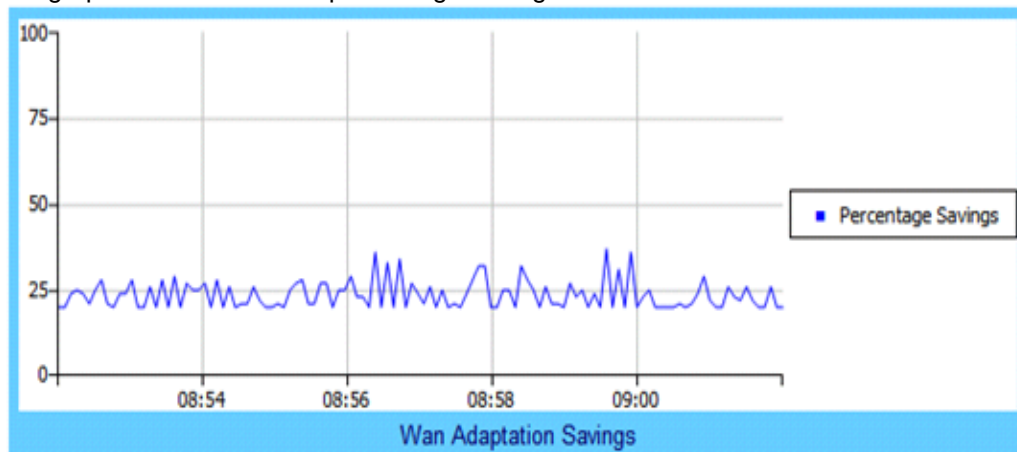
Figure 5. Optimized Abis Traffic with Pre-emptive BW Management

### Performance Monitoring

The RAN optimizer collects detailed usage and performance statistics that can be accessed via the web browser. This information can be used by the users to monitor the link performance and to take appropriate action, as needed.

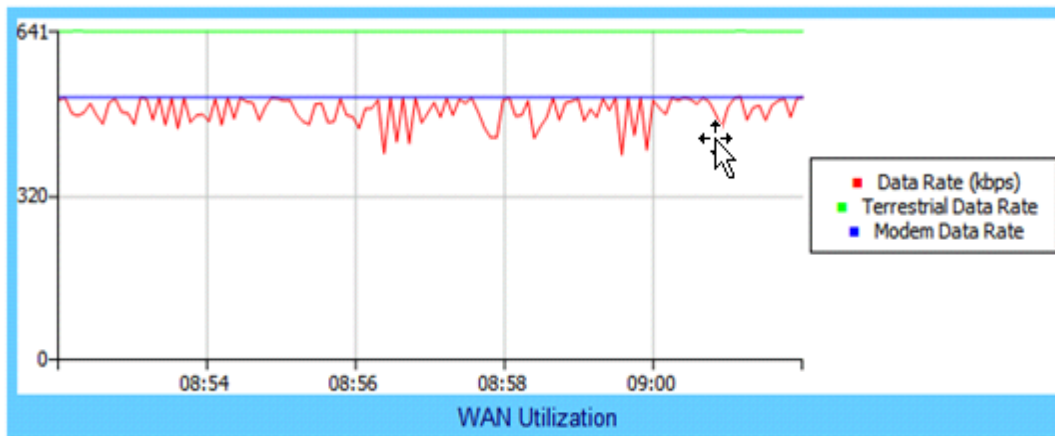
The graphs can be viewed by the minute, the hour or the day. The following graphs are available:

- **RAN Optimization (WAN Adaptation) Savings**
  - This graph shows the actual percentage savings



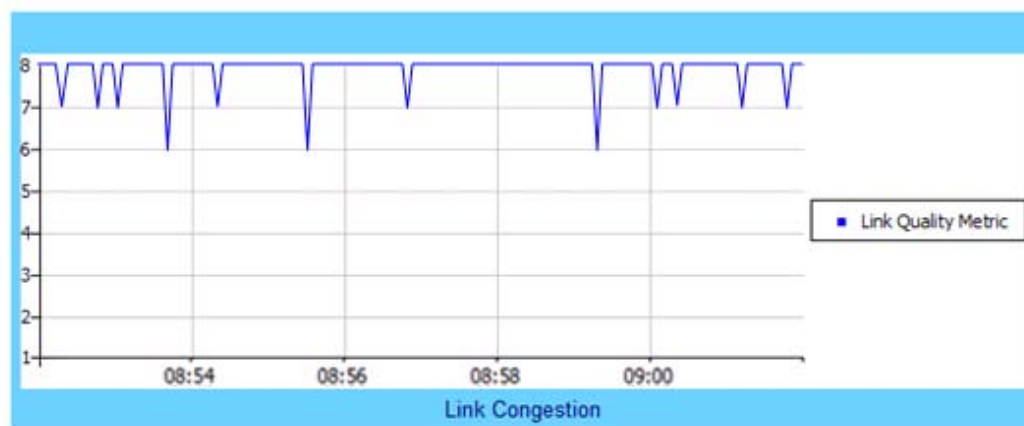
## WAN Utilization

- This graph shows:
  - The ingress data rate (Terrestrial Data Rate) based on selected number of Time Slots
  - WAN or the Modem Data Rate (egress), and
  - The instantaneous optimized RAN traffic rate



- **Link Congestion/Quality**

- This graph displays the Link Quality Metric, a qualitative measure of the voice quality predicted by the level of the compression and voice packet discard required to accommodate the incoming traffic into the available WAN (satellite) bandwidth
  - "8" indicates the highest quality, with no voice traffic discard



## Compatibility

E1 RAN Optimization can be added to a CDM-570 by adding the RAN Optimization / WAN Adaptation Processor Board (CEFD P/N PL-0000599) to the expansion slot also used by the Reed Solomon Codec. This precludes Reed Solomon Codec from being used along with the RAN Optimization.

E1 RAN Optimization is available for the CDM-570/L, CDM-570/L-IP and CDM-570/L-IPEN. The IP Module and the RAN Optimization capability can coexist in a modem, however the IP Module and the RAN Optimization cannot be operated concurrently.

E1 RAN Optimization can be ordered as a factory installed option in a new modem, or it can be field installed in an existing modem by a qualified technician. **If upgrading an existing CDM-570 modem, the modem must have been ordered with the E1/T1 transceiver. If the modem was ordered without the E1/T1 transceiver, RAN optimization cannot be added to that modem.** In addition, base modem firmware should also be upgraded to Version 1.7.0 or later, which supports the E1 RAN Optimization feature.

Enabling E1 RAN Optimization does not require any FAST codes.

To learn more about the E1 RAN Optimization capability in the CDM-570 Satellite Modem family, please refer to the datasheet and user documentation available on our web site, [www.comtechefdata.com](http://www.comtechefdata.com). To place your order, please contact your Comtech EF Data sales associate.



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