Elite

Digital Switching System

General Description

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TX-Elite-Sys-GD-001
Introduction

This section provides general information about the capabilities, design, and the operation of the ELITE Central Office switching system.

**ELITE** is a switching system for Public application. The basic system is a digital switching exchange, providing connection of pulse code modulation (PCM) voice and data paths between ports of various types, under centralized stored program control.

Each shelf of **ELITE** can provide up to 512 ports (Analog or Digital). Up to four shelves can be accommodated in a **ELITE** cabinet giving 2048 ports without blocking or concentration.

Up to 64 shelves can be employed in a system, resulting in 32K Analog/Digital ports.

Different concentrations may be applied to each shelf according to the nature of traffic that is handled by a specific shelf.

Up to 16,384 Erlang traffic can be handled by a fully loaded system resulting 300,000 BHCA @ 100 Sec. Call average Holding Time (for more details, refer to Appendix D).

The Basic **ELITE** switch is equipped with one Shelf which includes one **MCC** (Main Communication Controller), one **PCC** (Peripheral Communication Controller) and one **PSU** (Power Supply Unit).

Redundancy for the above-mentioned cards is available on a full Hot Stand-by basis.

Universal Digital and Analog Interface cards are employed to accommodate all different Digital and Analog applications.

The **ULI** (Universal Line Interface) is equipped with a processor to control all types of Analog ports, such as Ordinary Subscriber Lines, Metering Subscriber Lines, Coin Box, E&M, DID, DOD and CO Trunks with all the standard signaling.

Also there is an option to employ one ULI card in the Line shelf as redundant for all active ULI cards of that particular shelf. This option could be used on a system basis as well. Each ULI card can accommodate up to 32 Analog ports.
The **UDI** (Universal Digital Interface) is also a processor equipped card to control all types of Digital ports such as E1, T1, J1, ISDN-BRI, ISDN-PRI, with all types of signaling such as CCS#7, CCS#5, V5.2, CAS, R1, R2.

Each UDI card can accommodate two Link Modules, each of which can interface to:

- One ISDN-PRI,
- One 2Mbps Link,
- Four ISDN-BRI, U Interface (2B1Q)
- Common Channel Signaling N0.7 Interface
- HDSL Primary Rate Interface
- LAN/WAN Interface
- Nx64KbpsSerial Interface(RS-232 or other)
- ISDN H0 rate physical Interface
- Modem Pool
- X.25 Packet Switching for B channel, HDLC or other
- 16 way Conferencing node(or higher)
- Voice Messaging node
- Extra Memory Module
- UDI Tester Module

The unique design of the **ELITE** allows the use of the first Shelf as a general line shelf for Universal Interface Cards and provides up to 512 ports when no other shelves are installed. Using just one shelf gives you the capability to have 1024 ports logically available.

The PCM switching network of the **ELITE** system is a distributed configuration. Each shelf has its own resident PCM switch and all line shelves are connected together by passive inter-shelf highways with 512 time slots providing non-blocking switching. In addition, one extra PCM highway is available for value added features without sacrificing capacity.

Different degrees of concentration (1:1, 3:4, 1:2, and 1:4) are available to have more ports in service.

The equipment is designed in modular units using standard components and connections for ease of installation, maintenance and unpredicted enhancement. Plug-in printed circuit board (PCB) cards are used for all interface types and common control equipment.

All interconnections between shelves are by twisted pair (Differential) plugs and jacks.

The **ELITE** system is available with a standard software package that is field configurable for various applications.

The **ELITE** provides full or partial redundancy options. Full redundancy can be obtained by adding additional MCC, PCC and PSU to the Global Shelf. Partial redundancy can have one or more of these three cards in any combination.

Redundancy can be added to ULI ports on a 1:n basis.
Specifications:

- PCM-TDM Technique
- **SPC** (Stored Program Control)
- ITU-T, *Bellcore*, ETSI UL1459, FCC, UL and CSA Conformity
- HW/SW fully modular and scalable
- 16K x 16K non-blocking, full available Switching Network
- Universal Slot, Universal Shelf, Universal Cabinet
- Five Cards Variety (MCC, PCC, PSU, ULI, UDI)
- Inter-System Communications on Redundant 2Mbps differential (RS-422) HDLC and LVDS Links
- Intelligence: On all Control, Power/Ring Supply and Universal (Analog/Digital Interface) Cards
- Customized Application Capability due to the use of FPGA, CPLD, DSP on all Cards
- 15 External built-in Alarm Sensors per shelf
- Temperature measurement of each shelf:
  - Air temperature intake
  - Air temperature exhaust
  - Ambient temperature
  - Thermal shutdown
- Alarm input to detect motion, water, open door, vibration, broken, fire, etc. (Sensors available in industry)
### Elite General Description

- **Capacity:** 32K Ports expandable to 64K Ports including WLL Ports
- **Caller ID feature for all Lines** complies with ETSI and Bellcore
- **Message Waiting feature for all Lines** complies with ETSI and Bellcore
- **Microprocessors:** 16, 32, 64 bits wide powerful Processors
  @ [25MHz (MC68302, IMP), 100MHz (i960, RISC), 200 MHz (Power QUICC II, RISC)]
- **1 Erlang traffic/Port, Tone (DTMF, R1, R2) Processing Capability**
- **Redundancy capability for Port Interface Cards.**
- **BHCA:** 300,000 @ 100 Sec. Average Holding Time
- **Interfaces:**
  - Analog: All types of Analog Lines and Trunks
  - Digital: E1, T1, J1, ISDN-PRA, and ISDN-BRA
- **Transmission Rates:** E1, E3, STM1 and OC3
- **Network:** 10BaseT, 100BaseT Ethernet Connection Interface
- **WLL:** System Built-in GSM
- **Signaling:** Loop Start (600/900 Ohm), Ground Start (600/900 Ohm), Battery Reversal, DTMF, R1, R2, CAS, CCS#5, CCS#7, ISDN-PRI, V5.2
- **X Signaling to Y Signaling Converter/Translator**
- **System Built in WLL based on GSM Standard** (Flexibility exists to meet other frequency allocation Plans)
- **155 Mbps Point to Point ADM (Add-Drop Multiplexing) interface on SDH Ring**
- **Highly reliable common control equipment with extensive fault detection and recovery capabilities and component level troubleshooting**
- **Built in Remote maintenance facility**
• Built in Remote LCD display on remote location
• Multiple ISDN Operators Console operation
• Blind ISDN Operator Console
• Voice recording capability on all consoles
• Built in directory
• Management monitoring and control features
• Flexible Numbering Plan
• 2 Hours of Digital Voice intercept Messaging per shelf
• 80 Hours Voice mail Capability per shelf
• Automatic Voice recording for malicious calls
• Interactive Voice Response (I.V.R)
• Three Way Conference Call for all lines with injection of any separate message to each of the parties on the conference call without any interruption of live calls.
• 32 Channel ADPCM Voice Compression/Decompression on IVM (Integrated Voice Mail) Card
• Stratum 4 or Stratum 3 Clock
• Application: Central Office, Transit Switch, Local/Tandem Switch, Rural Exchange, Intermediate Gateway Switch
• Power Consumption: Less than 0.5W/Port @ High traffic loads
• Built in 33.6K Modem on PCC, MCC and LCD Module
• Voice scrambling option availabl
• Built in RS232 serial port on all ULI and UDI cards for future applications
Elite PSTN and POTS Connections
Elite as a Central Office

SYSTEM CAPACITY (EXAMPLE)

ORDINARY SUBSCRIBERS: 20K
ISDN SUBSCRIBERS: 1K
PSTN E1 TRUNKS: 3K
Elite General Description

Capacity:
544 Subscribers
120 E1/T1 Channels (CCS#7, ISDN-PRA, V5.2, R1, R2, CCS5)
Elite as a Local / Transit Exchange

256 E1/T1
(7,680 E1/T1 CHANNELS)

20K PORTS
Elite Single Shelf Transit Exchange
Fully Hot Stand-by Redundant

Capacity: 960 E1/T1 Channels (CCS#7, ISDN-PRA, V5.2, R1, R2, CCS5)
Elite Single Cabinet Transit Switch
Capacity :1920 E1/T1/J1(CCS#7,V5.2,R1,R2,CAS,...)
Elite High Speed Network Connection
Elite as a Core in Access Network
Elite Multi Cabinets Public Switch
Capacity: 7K Lines, 1K E1/T1/J1 Long Haul (CCS#7,R2,R1,CAS,V5.2,...)
Design Concept

The concept behind the Elite design is to have a system for all applications in PTT Networks. The Modularity, Scalability and Flexibility are three major issues that are considered in this regard.

Basically the system consists of two Logical Blocks:

1. **GS** (Global System) and
2. **PBB** (Ports Building Block)

**GS** (Global system) is physically named GS (Global Shelf) and is the main controller portion of the system consisting of MCC, PCCs and PSU. Following is a brief description of the function of each of the cards on GS.

It should be noticed that GS could accommodate Analog and Digital interface cards as long as empty slots are available there.
1.1 **MCC (Main Communication Controller):**

**Specifications:**

a. Intel 100MHz *i960JT* RISC processor.

b. Four HDLC channels, two stand-by backup channels. One active channel is for MCC to PCC communication, and the second active channel is used for MCC to MCC private link.

c. Real Time Clock.

d. Three Serial ports, two of the serial ports can be configured as RS232/RS422.

e. One high speed 9600 baud modem (can be upgraded to 28.8 or 33.6 Kbaud).

f. 128 MB (maximum) system ROM (6 banks SIMM).

g. 128 MB (maximum) system RAM (8 banks SIMM).

h. 64 MB (maximum) PCMCIA Flash memory card, type I.

**MCC** is the Main Communication Controller of the system, it is equipped with i960 RISC processor @ 100 MHz and communicates to PCCs through a duplicated 2Mbps HDLC link. It is equipped with a built in 36.6K modem and a 64 MB PCMCIA flash card.

The MCC can perform active live update system software without interruption. Four banks of flash memory can be swapped by the software command able to re-map the different SIMMs into the System address space.
1.2 **PCC (Peripheral Communication Controller):**

**Specifications:**

- Intel 100MHz *i960JT* RISC processor.
- Two Motorola MC68302 IMP processors @ 25MHz for controlling HDLC communications.
- Four HDLC links, two HDLCs for inter-processor communications, the other two are used for inter-card communications.
- 512 Time-Slots (4x128 configurable Time Slots) On-shelf PCM switching and 512 Time-Slots for Inter-shelf switching.
- Tone generation.
- 64 channel DTMF decoder.
- Three Serial ports, two of the serial ports can be configured as RS232/RS422.
- One high-speed 9600-baud modem (can be upgraded to 28.8 or 33.6 Kbaud).
- Phase Lock Loop for digital trunk clock synchronization.
- 128 MB (maximum) system ROM (6 banks SIMM).
- 128 MB (maximum) system RAM (8 banks SIMM).
- 64 MB (maximum) PCMCIA Flash memory card, type I.
- 1 application dedicated read only PCM High (Broadcast High Way) Way for Announcement, Messaging and Paging
- 8184 seconds Tone / Voice Message announcer. The Message voice samples are stored into a PCMCIA Flash memory, maximum 64 MB.
Each of the PCCs (Peripheral Communication Controller) in the Global System is also equipped with one i960 RISC processor @ 100 MHz and two MC68302 RISC processors @ 25 MHz and communicates to the related PCC on the PBB (Physically named LS: Line Shelf) through the RS-422 Differential HDLC link @ 2Mbps.

The Switching Matrix is built up on the PCCs. Different Tone generation/injection and call conferencing / Voice messaging are done on PCC.

Eight levels of attenuation and A-law/u-law conversion is done by PCC as well.

On each PCC (PCMCIA memory card) there is 512 x 16 Seconds Recorded Messages/Announcements are available with the variable length option.

The PCCs of both GS and PBB are unique in Hardware and Software. They are configured at the time of system power up.
Elite General Description

Elite Simplified Design Architecture

MCC: Master Communication Controller

PCC

GS
Global System
1.3 **PSU (Power Supply Unit):**

**Specifications:**

- **a.** MC68302 Microprocessor operating at 25 MHz clock.
- **b.** 1 MB system Flash program memory.
- **c.** 256KB system RAM, expandable to 1 MB.
- **d.** Two HDLC channels at 2Mbps (1 active and 1 backup).
- **e.** 30 VA Ring Generator at 85Vrms output, with 20, 25 or 30Hz selectable frequency.
- **f.** External Ring Generator connections (800 Watts maximum).
- **g.** 16 External Alarm sensing monitor inputs.
- **h.** Siren and Alarm control relays.
- **i.** 6 temperature sensors, four sensors for DC/DC converters, one for PCB free air temperature and one for shelf temperature.
- **j.** Voltage supplies, Ring Generator, and battery monitoring.
- **k.** Power Shutdown control and Standby Backup control.
- **l.** Power ratings

  | Input Voltage: | -60 to -41 VDC | 35A maximum |
  | Output Voltage: | +5.0 VDC  | 40A maximum (supply to 3.3V Circuits). |
  |                | +5.0 VDC  | 15A maximum (supply to 5V Circuits). |
  |                | 15 VDC    | 6.3A maximum(supply to +12V Circuits) |
  |                | -12 VDC   | 2.0A maximum(supply to −12V Circuits) |
  |                | -48 VDC   | 25A maximum |

The standard and optional built in features of the PSU provide all output voltages monitoring, fuses and circuit breaker monitoring, two door sensors (front and back), cooling fan sensors, temperature monitoring including DC/DC converters temperature, PCB free air temperature, and cabinet temperature. The optional features include sixteen external sensors input, one external siren relay, and one external alarm relay, both relays provide maximum1A 30V DC loading.

The -48 VDC output is from the same input voltage but with a 25A 120V DC circuit breaker / switch.

The **PSU** (Power Supply Unit) benefits from a MC68302 processor @ 25 MHz and communicates to the MCC/PCC via a separate HDLC link @ 2Mbps for added reliability. It supplies different DC voltages for the MCC and PCCs as well as Ringing signal for the line cards. A variety of Alarms and Sensors are provided by PSU.

Below are illustrated the Elite System block diagrams for 16 and 64 shelves configurations:
Elite 64 Shelves Configuration Block Diagram
2. **PBB (Ports Building Block)** is designated **LS (Line Shelf)** and is identical to the GS except it has no MCC resident.

The **LS** is controlled by a PCC, which can operate on a fully Hot Stand-by duplication redundancy basis.
All the communication between Interface cards and the PCC is done through duplicated HDLC link @ 2Mbps.

The PCC on the LS communicates to MCC through a dedicated PCC on the GS. Up to 512 x 64Kbps Time Slots (4x128) on the LS is connected to Global Switching network. Different level of concentration (1:1, 1:2, 1:3 and 1:4) could be obtained in order to increase the number of ports accommodated by the system. Communication between local PCC and Global PCC is done through a 2Mbps HDLC link. Please refer to the above shown block diagrams.

Each Analog or Digital Port has it’s static assigned time slot on the 512 Local Switching network. For the applications, which need just one shelf, the number of Ports could be increased to 1024 by using an additional PCC by the shelf.
The **LS** accommodates **PCC, PSU, UDI and ULI** and following is a brief description of these cards in brief:

2.1 **PCC (Peripheral Communication Controller):**
The same as PCC on the **GS**.

2.2 **PSU (Power Supply Unit):**
The same as PCC on the **GS and it** communicates with the PCC through a separate 2Mbps HDLC link. It supplies the Ringing signal and different DC voltages for PCC and all Digital and Analog Interface cards.
2.3 **ULI (Universal Line Interface):**

**Specifications:**

- a. MC68302 Microprocessor operating at 25 MHz clock.
- b. 4 MB system Flash program memory.
- c. 1 MB system RAM.
- d. Two HDLC channels at 2Mbps (1 active and 1 backup).
- e. On Board DSP for Tone detection and generation.
- f. On Board 256x256 Cross Point switch.
- g. Equipped with auxiliary Port for On-hook FSK transmission of Message Waiting, Calling Name and Number display, PCM data analysis for a thorough parametric transmission test of the voice path and for running diagnostics to permit trouble shooting in the field.
- h. 32 Analog Ports with full service capability.
- i. Visual Waiting.

ULI is equipped with the MC68302 processor @ 25 MHz for low level call processing and two DSPs for different tones processing.

It also has its own 256 x 256 Cross Point for any internal time slot interchange.

Each ULI accommodates 8 AIFM (Analog InterFace Module) Modules. Each AIFM could services up to 4 Tip/Ring lines giving a total of 32 Analog ports per ULI card.

Test-In and Test-Out relays are provided for each of the Analog ports on the Back Cards. Also a provision is on the Back Cards for short loop subscribers, by which the -28VDC supply is fed to the loop instead of -48VDC to decrease power consumption and unnecessary heat.

Furthermore, every port of the system has its own DTMF transceiver channel resulting non-blocking for DTMF coding and decoding function. This adds flexibility for applications which require hook flash elimination.

The ULI Analog Line Interface Module is equipped with the **Quad Programmable Signal Processor** that performs virtually all the signal processing functions associated with a Central Office Line Termination.

Functionality includes Line Termination Impedance Synthesis, Adaptive or Fixed Hybrid Balance (Echo Chancellor, (ITU-T recommendation G.168), and Level conversion both in the Analog sense(Transmit equalization), to accommodate various Subscriber Line Interface Circuits and in the Digital sense, for adjustment of the levels on the PCM bus (Gain Transfer).

The ULI card is designed to meet or exceed CCITT, Bellcore LSSGR, EIA-464, ETSI ETS300-001, FCC part 68, DOC CS-03, UL1459, CSA C22.2 # 225-M90 specifications and recommendations for both in premise and off premise use.

Different standards and requirements for lightening and power cross protection on the metallic line could be easily achieved just by changing the ULI back card.

There is an option on each LS (Line Shelf) to have one or more ULI as a redundant(s) for the rest of the ULIs on the shelf.
ULI Functional Elements
AIFM Module Types and SLIM Feature Set

- E&M
- Analog R2
- Analog Trunk
- DID
- SLIM
- 2 Way Ringdown
- SS #5
- Pay Phone
- Magneto Phone

i.e. SLIM
- BORSCHT
- G.168 Echo Canceling
- Meter Pulse
- Ground/Loop Start
- Tip/Ring Reversal
- A-law/u-law/linear
- Programmable Transhybrid loss Impedance Gain

CrossPoint

uProcessor
Elite General Description

ULI # 16
Redundant

ULI # 15

ULI # 1

Back Card # 15

Back Card # 16
Redundant

SLIC + CODEC

SLIC + CODEC

SLIC + CODEC

Back-up lines

Network lines

Circuit lines

1 Line Card Redundancy per Shelf Concept in Elite
2.4 **UDI (Universal Digital Interface):**

**Specifications:**

a. MC68302 Microprocessor operating at 25 MHz.
b. 2 MB system Flash/ROM program memory.
c. 2 MB system RAM with Back-up battery.
d. Two HDLC channels running @ 2Mbps for inter-system communication (1+1).
e. On Board two DSP for Tone Processing/Conversion.
f. On Board two 256x256 Cross Points for time slot based information switching.
g. Equipped with powerful high density FPGAs and CPLDs.
h. On Board 256 Kbytes SRAM for storing different tones PCM samples.
i. 2 x E1/T1/J1 links with full service capability.
j. 2 x 4 ISDN 2B1Q U interface service capability.

UDI (Universal Digital Interface), is equipped with a MC68302 processor @ 25 MHz for low level call processing and two DSPs for different tones processing.

It is intended to support the following list of link modules but not limited to those:
- One ISDN-PRA,
- One 2Mbps Link,
- Four ISDN-BRA, U Interface (2B1Q)
- Common Channel Signaling N0.7 Interface
- HDSL Primary Rate Interface
- LAN/WAN Interface
- Nx64Kbps Serial Interface (RS-232 or other)
- ISDN H0 rate physical Interface
- Modem Pool
- X.25 Packet Switching for B channel, HDLC or other
- 16 way Conferencing node (or higher)
- Voice Messaging node
- Extra Memory Module
- UDI Tester Module

The design includes a 256 x 256 Cross Point for any internal time slot interchange function. Each UDI accommodates 2 Link Module and 2 Auxiliary Module daughter cards. Based on the application and the type of the connection, the Module can support:
2.4.1 One Primary ISDN Link (E1/T1/J1 Digital Trunk),

On the UDI Primary ISDN Link Module, there is a very powerful combined E1/T1 Transceiver which integrates Software selectable full-featured E1 and T1 frames for both short haul and long haul line interfaces.

The hardware meets or exceeds E1 and T1 short haul and long haul network access specifications including ITU-T G.703, G.704, ANSI T1.102, T1.403, T1.408, AT&T TR62411, as well as ETSI 300-011, TBR-12 and TBR-13. It provides encoding and decoding of AMI, HDB3 and B8Zs line codes.

It also provides transmit Jitter attenuation, Clock recovery and Line performance monitoring. Also on-board programmable binary sequence generators and detectors for error testing including support for patterns recommended in ITU-T O.151 is provided. It also supports NxDS0 fractional bandwidth back plane.

2.4.2 Eight ISDN-BRI U Interface (2B1Q @ 160 Kbps),

The hardware meets requirements for all ANSI and ETSI loops and it is fully compatible to: ITU-T G.961, ETSI TS102080, ANSI T1.601-1992, Bellcore approval IEC-Q V4.4.

2.4.3 Layer 1 and 2 of System Signaling No. 7 (CCS#7),

The hardware completes level 2 implementation of SS7 and it is compatible with CCITT(ITU-T), AT&T, ANSI and Bellcore Signaling System No.7 Link Level protocol. Optional operation to comply with Japanese TTC JT-Q703 specification requirements is provided.

Each type of Modules has its own ID. The UDI main card senses the ID at the time of Power-up in order to configure the software for the connected Module. This automatically reduces the set up time.
As mentioned before, Elite Hardware uses powerful RISC processors and DSPs as well as CPLDs and FPGAs.

These advanced semiconductors give the system maximum processing power and such flexibility that adding different interfaces and applications can be easily achieved through Software/Firmware and DSPs code changes and modifications on the CPLDs and FPGAs.

The table below shows some of the intelligence used on the different cards:

<table>
<thead>
<tr>
<th>MCC</th>
<th>PCC</th>
<th>PSU</th>
<th>UDI</th>
<th>ULI</th>
<th>Display Module</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intel <strong>i960</strong> RISC Processor @ 100 MHz</td>
<td>1</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Motorola <strong>MC68302</strong> RISC Processor @ 25 MHz</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Analog Device 16 Bits <strong>DSPs</strong> Family @ 50 MHz</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>9</td>
<td>-</td>
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<tr>
<td>XILINX <strong>Virtex-E FPGA</strong> Series (XCV400E) :</td>
<td>-</td>
<td>2</td>
<td>-</td>
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<td>-</td>
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<tr>
<td>- 569,952 Gates</td>
<td>-</td>
<td>-</td>
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<tr>
<td>- 320 Kbits RAM</td>
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<tr>
<td>XILINX <strong>Virtex-E FPGA</strong> Series (XCV50E) :</td>
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<td>1</td>
<td>-</td>
<td>-</td>
<td>-</td>
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<tr>
<td>- 71,693 Gates</td>
<td>-</td>
<td>-</td>
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<td>-</td>
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<tr>
<td>- 90 Kbits RAM</td>
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<td>-</td>
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<td>XILINX <strong>Spartan-XL FPGA</strong> Series (XCS10XL) :</td>
<td>1</td>
<td>3</td>
<td>-</td>
<td>-</td>
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<tr>
<td>- 10,000 Gates</td>
<td>-</td>
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<td>-</td>
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<td>XILINX <strong>Spartan-XL FPGA</strong> Series (XCS05XL) :</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>-</td>
<td>-</td>
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<tr>
<td>- 5,000 Gates</td>
<td>-</td>
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<td>XILINX <strong>XC5000 FPGA</strong> Series (XC5215) :</td>
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<tr>
<td>- 23,000 Gates</td>
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<td>-</td>
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<tr>
<td>XILINX <strong>Fast Flash XC9500(XL) CPLD</strong> Family (XC95144XL) :</td>
<td>4</td>
<td>4</td>
<td>2</td>
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<td>9</td>
</tr>
<tr>
<td>- 144 Macrocells</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
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<tr>
<td>XILINX <strong>Fast Flash XC9500 CPLD</strong> Family (XC9572) :</td>
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<td>-</td>
<td>-</td>
<td>3</td>
<td>-</td>
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<tr>
<td>- 72 Macrocells</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
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<tr>
<td><strong>Memory:</strong></td>
<td>6</td>
<td>2</td>
<td>-</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td><strong>SIMM Flash ROM</strong>, 4 x 512 Kbytes x 32 bit</td>
<td>8</td>
<td>2</td>
<td>1</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><strong>SIMM Static RAM</strong>, 4 x 512 Kbytes x 32 bit</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
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<tr>
<td><strong>PCMCIA Flash Memory Card</strong>: 64 MB</td>
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<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><strong>Flash ROM</strong>, 512 Kbytes x 16</td>
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<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
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<tr>
<td><strong>Static RAM</strong>, 512 Kbytes x 16</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
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<tr>
<td><strong>Built in 33,600 Baud MODEM</strong></td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><strong>Serial Port (RS-232 / RS-422 Configurable)</strong></td>
<td>-</td>
<td>-</td>
<td>-</td>
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</tr>
</tbody>
</table>
Mechanical Design Concept

The Elite system has a universal unique shelf, which is used as a Global Shelf (GS) or as a Line Shelf (LS).

The Back-Plane for both Global and Line shelves is similar and unique. Each shelf has 26 slots and each slot is connected to the Back-Plane through:

- 6 x (5 x 6 = 30 Pins) LVDS,
- 2 x (5 x 6 = 30 Pins) power and
- 1 x (5 x 48 = 240 Pins) Signal

connectors.

Slot # 2 to Slot # 25 are all universal, Slot #1 and Slot #26 are for PSU and LVDS Connectors are not available but power connectors are there instead.

On each Elite card there is also one 32 x 3 = 96 Pins DIN connector used to connect each card to the related Back Card which has no connection to the Back Plane.

The Back Card normally includes the Passive circuitry and the outdoor interface connections and protections.

All the TIP and Ring Connections to the MDF and DDF are via the Back Cards and not through System Back-Plane. This increases fault tolerance and reliability.

Each Elite cabinet consists of four shelves. There is a global ring generator located at the bottom of the cabinet as a redundancy for the local ring generator on every shelf.
**Elite Shelf Cage Rear View**

- **Back Plane**
- **Back Card Connector**
- **Main Card**
- **LVDS Connectors**
- **Power Connectors**
- **SIGNAL Connectors**

**Dimensions:**
- Width: 24" (22" with Main Card)
- Height: 15.7"
- Depth: 18.75"

*Note: The Solid shown Connectors have connection to Back Plane. No connection to Back Plane.*

---

TX/Communications Canada Inc.  
*Elite General Description*
## System Data for different Configurations

<table>
<thead>
<tr>
<th>Model</th>
<th>No. of Ports (Max.)</th>
<th>Dimension/Raw Space (cm)</th>
<th>Weight (kg)</th>
<th>Power Cons. (Watts) @ 0.25 Erlang traffic/Line</th>
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<tr>
<td></td>
<td>Digital</td>
<td>Analog</td>
<td>Height</td>
<td>Width</td>
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<tr>
<td>Single Shelf</td>
<td>960</td>
<td>512</td>
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<td>71</td>
</tr>
<tr>
<td>Double Shelves</td>
<td>960</td>
<td>960</td>
<td>95</td>
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<tr>
<td>Three Shelves</td>
<td>1,440</td>
<td>1,572</td>
<td>140</td>
<td>71</td>
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<tr>
<td>Single Cabinet</td>
<td>1,920</td>
<td>1,952</td>
<td>184</td>
<td>71</td>
</tr>
<tr>
<td>2 Cabinets (8 Shelves)</td>
<td>3,600</td>
<td>3,840</td>
<td>184</td>
<td>145</td>
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<tr>
<td>3 Cabinets (12 Shelves)</td>
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<td>4 Cabinets (16 Shelves)</td>
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<td>300</td>
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<td>8 Cabinets (32 Shelves)</td>
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<td>600</td>
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<tr>
<td>16 Cabinets (64 Shelves)</td>
<td>32K</td>
<td>32K</td>
<td>184</td>
<td>2x600</td>
</tr>
</tbody>
</table>
POWER

To provide continuous operation without call loss during brown outs and power outages, *Elite* operates from a single 48 Volt primary supply. Each shelf has its own PSU to supply the various voltages required by the ICs, processors, memories and peripheral circuitry, thus maintaining modularity.

Also hot stand-by duplication is provided for more reliability.

The Power Supply Unit (PSU) which provides different Voltages for each shelf from single input –48V supply, contains the 16 bits microprocessor to control the function and monitoring the converted voltages.

In case of power outage lasting beyond the expected back up, each shelf can be programmed to shut down those subscribers whose lack of service will least affect their performance.

ALARMS:

Alarms and monitoring facilities provided on each shelf Power supply Unit (PSU).

The status and detected alarms are transferred to local PCC through HDLC Link:

1. Actual Voltage Level Monitoring:
   - Input Battery Voltage: Above - 41V and below – 60V
   - PSUs Output Voltages

2. Ring Generator:
   - Detect Ring Strobe Presence for Internal and External Ring Generators.
   - Relay Control Transfer to External Ring Generator.

3. Temperature Monitoring:
   - 2°C to 70°C, 8 bits resolution ± 1°C for:
   - PSUs
   - Free Air Temperature ( Power Supply Unit )
   - Cabinet Temperature ( Outside the Shelf )
   - Cabinet Temperature ( Inside the Shelf )
   - Ambient temperature
CHARGER and BATTERIES

ELITE is powered from an external -48 Volt battery plant and charger. This battery plant must meet the following requirements to be acceptable for use on a telephone system:

- single ground point
- noise figure 27dBmC

The type of charger and batteries used with the ELITE switch will vary depending on the size of the system. For example, a fully loaded ELITE cabinet will use 30 amps charger.

It is recommended that you consider 20% over the maximum cabinet load when choosing a charger. Thus, in the case of a fully loaded ELITE, it is suggested that a 30-amp charger be used.

The charger equipment used should be of the battery “float charge” type and must be equipped with Low Voltage Disconnect (44V recommended). If a “charger fail” alarm is provided, it can be interconnected to the switch’s alarm system. ELITE will cut off at 43 volts or less and will not reconnect until the AC voltage has returned to normal.

Battery types used with the charger may be Gel Cell if installed in the Elite equipment room or lead-acid cells if installed in a separate ventilated room.

Most charger manufacturers will recommend a battery type to be used with their equipment.
Administration and Maintenance

Introduction:

The ELITE switching system supports more than 200 commands for administering and maintaining the system. Commands are entered interactively on a service terminal, which can be local, or at remote location connected to the switch through a built in modem.

Various commands exist to change configuration data for the system, subscribers, attendants and trunks. The ELITE switch also offers an extensive range of commands to trace faults on the system, display current status of calls and examine traffic statistics.

THE SERVICE TERMINAL

The commands to the system are entered on the service terminal. Any responses resulting from the commands are displayed on the Service Terminal. Service terminals can be simple display units or Personal Computers running any serial communication program. One of these programs maybe ELITE’S own TXLINK. The advantage of using TXLINK is that configuration files can be saved and reloaded from the computer’s memory.

TERMINAL TYPES

Any data terminal device (including hard copy terminals) that meets the following requirements can be used as a Service Terminal:

- Display/print ASCII Character Set
- Generate all uppercase characters (CAPS LOCK capability)
- RS-232C Serial Interface
CONNECTIONS

The Service Terminal can be located either on the same premises as the ELITE switch, or at a remote location through the use of modems. Local connection of the Service Terminal to the ELITE is via a serial port on the MCC port located on the back panel of the cabinet. Remote connection is via one of the 2 built in Modem ports on the back panel. To communicate with one another the communications setting of the Elite’s serial port and the Service Terminal must be identically configured. The default settings of the Service Processor are as follows:

- 9600 bits per second transmission speed
- 8 data bits and no parity
- 1 stop bits

For more information about connecting the Service Terminal to the ELITE see the appropriate ELITE Installation and Maintenance Manual and the terminal's documentation.

TXLINK

TX Link is a proprietary software program that allows an IBM Personal Computer (PC) or compatible device to operate as a Service Terminal. Unlike a "dumb" terminal, using a PC permits the storage of the Elite’s configuration data on disk. In the event of a long-term power failure the configuration data can be reloaded from the PC to the ELITE. The information and instructions provided in this document apply regardless of whether a dumb terminal or a PC is being used as a Service Terminal. See the TX Link User's Guide or System programming Guide for more information.

USING TWO SERVICE TERMINALS

When two Service Terminals are connected to the Elite (one to the MCC serial port and the other to the Modem port) the first terminal to log on will have use of the Service Processor. Any attempt to access the Service Processor while it is in use will result in a "COMMAND IN PROGRESS" message. Access to the Service Processor can be gained when the terminal that is currently using the Service Processor logs off, or when the command in progress has been processed. In either case, to get the attention of the Service Processor, see the STUG manual. When the Command Line prompt (<) appears enter a command must be entered before preset time out, otherwise the other terminal will regain control of the Service Processor.
SERVICE TERMINAL ERROR CODES

A number of hexadecimal error codes may appear on the screen during the operation of the Service Terminal. These error codes are produced for a variety of reasons as explained in the Service Terminal Error Codes Table located in Appendix A of this guide.

COMMAND LISTING BY FUNCTION

Some system components or features such as Least Cost Routing are programmed using two or more commands. For each significant component or feature, all of the commands required to make the component or feature operational are listed on the STUG manual.

DEFAULT CONFIGURATION

When powered up for the first time the Elite automatically produces a configuration based on a five digit numbering plan and a scan of the hardware installed. The type of hardware in each slot will be reconfigured to the installed hardware. For each component or feature for which data can be altered, the default programming is stated. Among the more significant default conditions are:

- Equipment Shelves with ISDN Feature Sets (IFS) installed when the Elite is first powered up, are configured with CLS option 4 (i.e., Digiphone Broadcast enabled.)
- All lines that are associated with IFS are programmed as type S.
- All equipped ports are programmed as type T for analog ports (ULI) and S for digital ports (UDI).
- All subscribers are assigned to Station Class of Service 0 which allows unrestricted access for outgoing calls.
- The first audited trunk (loop or ground start) determines the trunk type of route 0. All subsequent trunks of the same type are assigned to this route.
SERVICE TERMINAL COMMANDS

TYPES OF COMMANDS

There are two broad categories of commands: (1) Changing or Modifying (normally called "C" or "M") commands) and Print or Show (normally called "P" or "S") commands. The Change commands as the name implies allow changes to be made to the configuration data of the Switch while the Print commands permit data to be displayed on the screen for the purpose of examination only. As a general rule for each Change command there is a corresponding Print Command. A typical example is the CTD Command, which is used to change the programming of individual parameters.

Note: For getting more information on Command structure and different types of command, refer to the Elite STUG manual.

Administration functions (e.g. Data base generation, changes and modifications, Class of Service, Trunk Routing) can be preformed interactively via the service terminal.

The service terminal can be provided on-site or at a remote location via the built in modem.

The Attendant console can also do limited administration.
GENERAL SOFTWARE DESCRIPTION

Introduction

The Elite Switch software is highly modular consisting of more than 1000 system files compiled and linked together to make a program executing on the Main Communication Controller (MCC). In addition a separate set of programs are generated for Peripheral Communication Controller (PCC), a Universal Line Interface (ULI) and Universal Digital Interface (UDI).

All the software is written in C language. The files are compiled and linked on R&D mainframe computer and the executable files are transferred to the flash memory on the interface cards. The flash can be programmed using a separate flash programmer or by transfer ring directly from a file to a flash SIM on board using a proprietary TXLINK communication program.

After the flash SIM is programmed there is a provision to swap the flash to start running on the new program. If the data structures are compatible it is possible to update software without dropping any calls.

Operating System

The Elite consists of several different operating systems, which depend on the interface cards. All the operating systems are proprietary. The operating systems are combinations of different priority interrupt handlers, different levels of task handlers and polling for status changes.

Power up Initialization

On power up each card initializes all the hardware registers and assumes default configuration. This means that the system is ready to process calls even if configuration data is not available. After initialization each card is ready to communicate with its master. It makes its request known on the card status line.

Card Status Line

A unique feature of the Elite system is the card status line. This is a PCM highway of 32 timeslots connecting all the cards on the back plane. Each card slot is allocated 1 timeslot. Thus each card can transmit 8 bits of data every 125 us to its master. One of the bits is a request for communication.

The status line also shows to any card on the system if a given slot contains an interface card. Thus if a card is unplugged a backup system can take over immediately instead of waiting for a communication timeout.
Inter Card Communication

The communication between cards takes place over 2Mbit HDLC highways. There is a separate link for communication between PCC and line cards (ULI, UDI) and for communication between MCC and PCC.

The communication is point to multi point. The master polls each card based on requests on the card status line, messages and timeouts. The HDLC address is read from the back plane and is unique to each card slot.

Most messages are routed through the active MCC. The MCC talks to all the PCC's connected on the global shelf. The PCC's talk to the line cards. The MCC is a master to PCC's and the PCC's are masters to line cards.

Message Structure

There are 2 types of messages used by the MCC. The external messages are used for communication between different cards. Internal messages are used for communication between states or tasks.

The structure of external messages is as follows:

- Message length: (2 bytes)
- HDLC address: (2 bytes)
- Control: (2 bytes)
- Destination address: (3 bytes)
- Message type: (1 byte)
- Information: (up to 504 bytes)
The destination address is the final destination point (card or port) of the message and is fixed for a given message. The HDLC address may change depending which processor is relaying the message.

The information field may consist of several different information elements with the following structure:

- **Info type** (1 byte)
- **Length** (1 byte)
- **Information** (up to 256 bytes)

Some special message types have a fixed information element and do not require an information element descriptor.

Internal messages have the following structure:

- **Destination code** (1 byte)
- **Destination shelf** (1 byte)
- **Destination port** (1 byte)
- **Activity code** (1 byte)
- **Source party** (1 byte)
- **Destination party** (1 byte)
- **Call register** (2 bytes)

These messages are exchanged between call register parties during a call setup. Note that there are up to 3 parties in the call register.
System Data Organization

The system data is organized into 3 sections: configuration data which can only be changed using the service terminal, the global dynamic data which can be accessed by different states and tasks, and temporary data which is only valid when a given task or state is accessed.

Global data contains call register data, which records all the information relevant to a given call. Some of the call related information is also stored in a port dynamic data. The call register lasts for the duration of a call. The message buffers and traffic statistics are also stored in the global data.

The global data is lost when the system power is removed.

Configuration Data

All configuration data is kept in RAM on the MCC. The configuration RAM is battery backed for more than 72 hours so that if the power to the system is lost the configuration data is preserved. The configuration data can be saved on flash memory or a flash memory card resident on the MCC. The configuration data can also be saved on a computer, which is attached to the system running a TXLINK serial communication program. If the configuration data stored in RAM is lost the data can be retrieved from one of the above storage media. The data from flash to MCC can be downloaded in less than 2 minutes. It takes about 15 minutes to download the data from a PC file.

The MCC also receives and processes system configuration messages received from a service computer connected on one of the RS232 ports on an MCC card.

Hot Standby

The Elite System can be equipped with 2 MCC, one active and one hot standby.

The MCC’s are inserted in slots 24 (left MCC) and slot 20 (right MCC). The left MCC is referred to as the primary and the right as the secondary.

When the system is powered up the secondary MCC waits a few seconds before starting up. There is no wait on the primary so that the primary has the priority of becoming active before the secondary.

On power up each MCC checks if the other MCC is installed and active using two status lines on the back plane. If the other MCC is installed and active (active means that it can process all call activity messages and service terminal messages) then the MCC being powered up goes into standby mode.

If the MCC determines that it is to become active it continues in the normal way by checking its configuration data and if it is corrupted it reloads it from a flash card if available.

The standby MCC initializes itself as follows:

It starts flashing the BKP STATUS LED and sends a request for software and data version numbers. It repeats the request every 5 seconds until it is successful in getting it.
When it gets the version number it requests the reload data. The complete reload takes about 10 seconds. After the reload it requests the PCC equip status and then shelf audit of all the ports to equip its own ports.

When the audit is completed it checks the data version number of the active MCC and if it is the same it requests memory transfer of the active call records. When this is taking place both the active and standby MCC flash the BKP STATUS LED. During this time no new calls are processed. The user actions made during the call data transfer are buffered and processed after the transfer is completed. This takes about 5 seconds. When the active call data transfer has been completed the BKP STATUS LED is turned on both MCC’s. When the 2 LEDs are on, then it is an indication that the standby MCC has been updated and is ready to take over.

The standby MCC is constantly monitoring the active MCC. As soon as the other MCC becomes in operational, indicated by the fact that the install status line shows unequipped or the shutdown status line shows that the other MCC is in shutdown mode, the standby MCC takes over the call processing.

During normal standby ready operation all activities received by the active MCC are relayed to the standby MCC to process them on its own. Thus all calls and data updates are immediately updated on the standby MCC.

Since the two MCC’s can run independently on completely different software versions it means that one MCC can be unplugged and the software changed without shutting the system down.

**System Initialization**

When the MCC first powers up it checks if it is the first MCC on the system. If there is another MCC it assumes a backup status and requests configuration and call updates from the active MCC. If there is no active MCC on the system the MCC assumes an active status and checks if the configuration data is valid. If the configuration data is not valid the MCC looks for a flash memory or a flash card which contains the configuration data. If one is found the data is downloaded into RAM. If no data is found the system starts up with default data.

Once the MCC has initialized the configuration memory it starts polling the PCC’s that are found to be plugged in based on the status line. Once a PCC responds the MCC updates the PCC with all the relevant configuration data such as the general system data, slot data and cadence tables.

After the PCC receives all the configuration data it starts polling the line cards. When a line card responds with a power up message, which is passed, directly to the MCC, the MCC sends the configuration data to the line card. The line card waits for the configuration data before initializing the hardware ports. The equipped status of the hardware ports is relayed to the MCC to equip the ports.

After the cards have received all the configuration data from the MCC the system is ready to accept call-processing messages.

The MCC also receives and processes system configuration messages received from a service computer connected on a RS232 port.
Call Processing

At least 3 processor equipped cards (Intra-Shelf calls: 1ULI/UDI, 1 PCC, 1 MCC) are responsible in call setup. For inter-shelf or outside calls, 7 processor-equipped cards are involved for call processing (2 ULI/UDI, 4 PCC, 1 MCC).

The MCC takes care of all the resources and routing of the messages. The PCC exchanges messages between the MCC and the line cards. It also sets up the PCM connections under the direction of the MCC. The responsibility of the line cards is to detect any changes in the line signaling.

All call processing messages are routed through the MCC. The MCC is responsible for allocation resources and giving direction to PCC cards and line cards to send appropriate signals and make connections.

All resource information is kept in a buffer called Call Register. The call registers consist of a general section and 3 party sections, which store all the data, related to the 3 parties that can be involved in a call. The call register data is about 200 bytes in length.

During a call setup one dialing buffer is required to store the dialed digits. The dialing buffer is released after a destination party is found and the digits are transferred to the SMDR buffer.

The MCC constantly scans for call processing messages from line cards. When a new call is initiated the MCC allocates a call register and a dialing buffer if necessary to store the dialed digits.

Since the cards can only send messages when asked by the MCC, the MCC never gets overloaded with messages. After it processes a batch of messages it asks for more messages. It is up to the interface cards to buffer the messages. Thus it is very unlikely that messages can be lost during an overload condition. During an overload condition a delay in dial tone may be experienced but there is no chance of a catastrophic system failure.
Elite Wireless Interface

Overview

The new Elite End Office Switch will add a variety of wireless interface offerings to the extensive list of PSTN and subscriber interface types currently supported. These wireless interfaces will include, but are not limited to DECT, GSM, CDMA, back-haul microwave, and satellite links. In keeping with the tradition established with the UDI and ULI interface products, the architecture of the wireless interface products are highly flexible and modular. A complete wireless interface consists of two cards, namely the UWI and RTU. The RTU is an air interface specific design similar to that of the analog and digital applique interface modules that are mounted onto the ULI and UDI cards respectively. The UWI card is analogous to the ULI or UDI motherboards that control the applique interface modules. The partitioning of the design in this way is made possible by embracing the software radio paradigm: A good portion of the wireless design is implemented in software so as to permit in-field re-targeting of the UWI to different wireless standards.
Figure 1: Rear View of the RTU and UWI Midplane Interconnect within the Elite Shelf
Figure 1 above illustrates the two card wireless solution. High speed data and control information are shuttled between the two cards via the point-to-point LVDS link on the Elite midplane. For voice communication, the received RF signal is down-converted, digitized and sent to the Drop and Insert LVDS Multiplexor (DILM). The RTU DILM sources data onto the LVDS link where it is received by the UWI DILM. The UWI converts the received signal into baseband format, demodulates it, extracts the codified voice, and sends the resultant PCM data to the cross-point. The cross-point sources the PCM data onto the midplane where it is circuit switched like any other voice data. For RF transmit data the process is reversed.

**RTU Card Functionality**

The RTU card (Radio Transceiver Unit) is responsible for down converting an incoming RF signal to a digital IF signal on the receive side and up converting a digital IF to an outgoing RF signal on the transmit side. The digital IF data is transmitted and received to/from a UWI card via a high speed LVDS Add/Drop bus implemented on the Elite midplane. Any UWI can relay data to any RTU connected to this LVDS bus.
Figure 2: RTU Functional Elements
Figure 2 shows the high level building blocks of the RTU. Control of the RTU is managed by the 16 bit MC68302 micro-processor. The RTU can interact with the system through the system HDLC link. The system HDLC link also supports “user-to-user” messaging to effect a medium speed communication link between the UWI and the RTU. A high speed UWI-to-RTU link can be implemented on the LVDS bus. The Dual UART is present for control of a “rack and stack” RF power amplifier.

Salient features of the RTU include:

- The RTU is air interface dependent: filters are optimized for the particular RF band of operation (i.e. 900 MHz for GSM-900, 1900 MHz for PCS-1900 etc.)

- Each RTU will support up to 2 separate RF inputs and outputs. These may be used for the purposes of diversity, redundancy or increased capacity.

- Each RF input may support either narrowband (single carrier) or wideband (multi-carrier) receiver topologies.

- Each RF output may support either narrowband (single carrier) or wideband (multi-carrier) transmit topologies.

- Each RTU consumes one slot in a shelf. For single carrier transceivers, this equates to one diversity RF channel per slot.

- Each RTU will provide status and control bits to interface with external Power Amplifier, Low Noise Amplifier, and ancillary filtering equipment.
UWI Card Functionality

The second card that comprises the wireless interface is the Universal Wireless Interface (UWI) of figure 3. This card is fully digital and makes extensive use of TI TMS320C62xx DSPs and Xilinx Virtex FPGAs to perform the following lower layer functions:

- Converts incoming IF to baseband and outgoing baseband to IF all in the digital domain.
- Demodulates and modulates incoming and outgoing data
- Codifies and de-codifies data for error detection/correction
- Interleaves and de-interleaves data for time diversity
- Performs data encryption/decryption
- Voice codifying and de-codifying (CODEC) for compression
- V.110, V.120, and group 3 FAX data conversion
- Carrier and symbol timing recovery
- Equalization
Figure 3: UWI Functional Elements
For processing higher protocol layers the UWI contains a Module MPC8260 RISC microprocessor (Power Quicc-II) which performs the following:

- Call setup and tear-down
- Frequency hopping (for multi-carrier RTUs)
- Call hand-off and roaming (for mobile applications)
- Special services (calling name delivery, call waiting, etc.)
- Control of the RTUs in the system

Because the UWI is DSP and microprocessor based, all of the above functions are performed in software. The UWI is therefore easily re-targeted to meet different current and future wireless technology standards. Industry refers to this type of architecture as that of a software radio. A partial list of air interface and protocol standards that may be realized by the UWI include:

- AMPS
- TACS
- IS-95 (CDMA)
- IS-136
- GSM (900 MHz)
- DCS-1800
- PCS-1900
- DECT
- CT2
- CDMA-2000
- 3GPP

New air interfaces and protocols may be implemented in software and upgraded in the field.
High Speed LVDS Link

A fully redundant 4 Gb/s bidirectional drop and insert LVDS bus supports communication between the UWIs and the RTUs. Each UWI and RTU contains a microprocessor controllable Drop and Insert LVDS Multiplexor (DILM) that orchestrates the insertion and removal of data onto and off of the LVDS midplane point-to-point bus. Salient features of the LVDS link include:

- **Full Duplex high speed (4 Gbit/sec) link based on differential LVDS logic provides high signal integrity**

- **The LVDS link is fully redundant:** Any single RTU or UWI can fail without affecting data on the link. Redundant RTUs and UWIs can be “warm swapped into the wireless network.”

- **The LVDS bus is point-to-point.** The bus performance is not affected by loading.

- **Each shelf can support many LVDS links and therefore many different wireless air interface standards.**

- **The LVDS link and presentation layer format are fully software programmable.**
WLL Solution

The initial wireless product offering within the Elite End office will be GSM-900 MHz for wireless local loop applications. The design will feature:

Two full duplex RF channels per RTU. To meet demanding GSM sensitivity specifications, the receiver portion of the RTU uses a narrow-band (single carrier) processing topology. The following features apply:

- The RF channel spectrum occupancy is designed in compliance with ETSI specifications. The absolute broadcast frequency can be easily shifted +/- 150 MHz for non-standard applications.
- The RTU supports two channel Spatial Receive diversity (three or more to follow)
- Two Full Duplex single channel narrow band RF carriers per RTU
- Thirty two full rate GSM voice channels per UWI
- Up to 35 km coverage radius
- Supports Slow frequency hopping for lower channel BER variance
- Supports GPRS for high speed internet connection (76.8 Kb/s burst rate)

Figure 4 below illustrates a fully loaded shelf delivering a total of 96 full rate GSM voice channels with receive diversity. A fully loaded non-diversity solution would comprise 10 RTUs and 5 UWIs to yield 160 voice channels. Finally, a fully loaded shelf loaded with 8 RTUs and 8 UWI can deliver 256 half rate GSM voice channels with no receive diversity.

Shelf expansion can be realized by installing LVDS bus expansion cards positioned beside the left most RTU and the right most UWI. In this manner the full 35 MHz GSM spectrum can be covered by one base station.
Figure 4: Shelf Capacity of a GSM-900 MHz GSM WLL Solution with Spatial Receive Diversity
Elite

SDH Optical Interface

S.O.I
Introduction:

**SDH (Synchronous Data Hierarchy)** is a standard recommended by the ITU-T. SDH was first introduced into the telecommunications network in 1992 and has been deployed at rapid rates since then. It is deployed at all levels of the network infrastructure, including the access network and the long distance trunk network.

It's based on overlaying a synchronous multiplexed signal into a light stream transmitted over Fiber-Optic cable. The increased configuration flexibility and bandwidth availability of SDH provides significant advantages over the older telecommunications system. The advantages include:

- A reduction in the amount of equipment and increase in network reliability.
- The provision of overhead and payload data permitting management of the payload data on an individual basis and facilitating centralized fault sectionalized.
- The definition of a synchronous multiplexing format for carrying lower level digital signals (such as 2 Mbit/s, 34Mbit/s, 140Mbit/s) which greatly simplifies the interface to Digital switches, Digital Cross-connects, and Add-Drop multiplexers.
- The definition of a flexible architecture capable of accommodating future applications, with a variety of transmission hierarchy.

<table>
<thead>
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<th>Bit Rate</th>
<th>Abbreviated</th>
<th>SDH</th>
<th>SDH Capacity</th>
</tr>
</thead>
<tbody>
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<td>51.84 Mbit/s</td>
<td>51 Mbit/s</td>
<td>STM-0</td>
<td>21 E1</td>
</tr>
<tr>
<td>155.52 Mbit/s</td>
<td>155 Mbit/s</td>
<td>STM-1</td>
<td>63 E1 or 1 E4</td>
</tr>
<tr>
<td>622.08 Mbit/s</td>
<td>622 Mbit/s</td>
<td>STM-4</td>
<td>252 E1 or 4 E4</td>
</tr>
<tr>
<td>2488.32 Mbit/s</td>
<td>2.4 Gbit/s</td>
<td>STM-16</td>
<td>1008 E1 or 16 E4</td>
</tr>
<tr>
<td>9953.28 Mbit/s</td>
<td>10 Gbit/s</td>
<td>STM-64</td>
<td>4032 E1 or 64 E4</td>
</tr>
<tr>
<td>39813.12 Mbit/s</td>
<td>40 Gbit/s</td>
<td>STM-256</td>
<td>16128 E1 or 256 E4</td>
</tr>
</tbody>
</table>
Specification:

- One Motorola **MPC8260 Power Quicc II** RISC Processor @ 200 MHz.
- One Intel 100MHz **i960JT** RISC processor.
- Two Motorola **MC68302** IMP processors @ 25MHz for controlling HDLC communications.
- 128 MB (maximum) system ROM (6 banks SIMM).
- 128 MB (maximum) system RAM (8 banks SIMM).
- 64 MB (maximum) PCMCIA Flash memory card, type I.
- Four HDLC links, two HDLCs for inter-processor communications, the other two are used for inter-card communications.
- 63 E1 = 1890 x 64Kbps Link capacity
- Providing 32Kbps ISDN tandem connection on the STM-1 ring
- Providing Orderwire services of the STM-1 ring
- ITU-T G.742, G.751, Conformity
- Supporting all Signaling Schemes on the PDH (R1, R2, CAS, CCSNo.7, V5.2, …)
- SDH STM-1/SONET OC-3 Interface, ITU-T G.707 Conformity
- Point to Point and Ring ( Unidirectional Self Healing ),
- 1 + 1 APS ( Automatic Protection Switching), ITU-T G.841 Conformity
- 1300 nm, Single Mode, Optical Transceiver
- ATM 155 Mb/s Physical layer Conformity
- Laser Bias and Laser Power Monitoring capability
- FCC Class B, EMI (Electro Magnetic Interference) Conformity
- Three Serial ports, two of the serial ports can be configured as RS232/RS422.
SOI (SDH Optical Interface):

SOI is an interface for Elite, and as shown in below, is employed to connect the Switch to a remote Add/Drop Multiplexer (ADM) in point to point or SDH ring through Fiber Optic Link.

The ADM is located on an SDH ring and is used to carry traffic in a backbone network. The SIO is designed to handle the traffic of 63 E1 signal, the whole bandwidth of the SDH frame can be utilized by E1 signals.

The employed STM-1 ring is the type of USHR (Unidirectional Self-Healing Ring) that is described below.

In the system side, the SOI is connected to 63 E1 TDM Highways running in the back plane of the ELITE system. The TDM highways might be either unframed LVTTL serial streams at 2.048Mbps or E1 signals. Ring connection for STM-1 is also supported in the design so that a minimal change or adjustment should be performed for applications in which ELITE will be used as transit switch connecting directly to a backbone SDH ring.

It is to be noted that for an ADM application, the switch core should also be properly programmed to handle the management of the crossing traffic. Nevertheless, the whole bandwidth of an STM-1 signal should be partitioned into dropping and crossing traffics.

ELITE system SDH interface consists of two SOI cards running on a fully hot active stand by basis for supporting required protection on the ring (Automatic Protection Switching).
APS on a point to point configuration:

Figure below shows the Elite system connection to STM-1 Fiber Optic on a point to point configuration. As illustrated, each of the SOI cards is connected to two Fiber Optic cables, one on the receiving direction and the other on the transmitting direction.

Physically, the connected cables to each of SOI cards are separately distributed. In normal condition, The SDH interface process the information received from the active SOI card and transmits the information to both of active and stand by SOI cards.

In case of broken down the connection to active SOI card or malfunctioning of the active SOI card, the SDH interface switches to the stand by SOI card. Then the appropriate Maintenance Alarms/Information will be generated and sent through the STM-1 administration header block bits to the system administration and maintenance facility.

Elite in Point to Point Configuration
- **APS on a Ring configuration:**

    The ELITE system SDH interface is connected to the SDH ring via two SOI cards. Figure below shows the protection mechanism on a USHR ring:

    An USHR ring consists of two unidirectional fiber optic rings to support switching for the required protection. The architecture of the ring is in accordance with the APS 1+1.

    In normal condition, a copy of the information on the active ring is transmitted to one of the input nodes on both active and stand by fiber optic ring. On the receiving node a selector is monitoring the information received from both active and stand by fiber and in case of no signal or poor signal on the active one, the stand by fiber will be switched to take over the active one. The time for this switching should be less than 50ms. By using two SOI cards, which each is connected to a pair of fiber optic cable (Transmit and Receive), the ELITE can be interfaced to USHR ring in two ways:
1. North/South Configuration:
On this configuration each ring is completely assigned to one SOI card. There is a Ring Control Path named Ring Alarm for transmitting the errors to the rest of the system.
2. West/East Configuration:
On this configuration both of SOI cards are used to implement USHR ring. On each ring, one SOI card does the receiving job, while the other perform the transmitting function. Due to the fact that received information by each of SOI cards comes from the other, there is no need for Alarm Signals on this configuration.
ELITE supports the West/East Configuration.

Elite in West-East Configuration
**Elite**

Integrated Voice Mail

I.V.M
Introduction

The IVM (Integrated Voice Mail) is a menu driven system which can be customized to best suit the needs of your organization. You can tailor options and menus to your site. Users can also customize personal greetings to convey availability daily, weekly or hourly if necessary.

The IVM provides 32 simultaneous connections to the voice mail facilities and because the voice mail for the Elite system is offered on an interface card, no additional subscribers are needed.

The Voice mail provides at least 1300 mailboxes each with 30 minutes of recording time.

IVM can manage communications without a live operator. The IVM will greet caller with an introduction, ask them to provide the called party’s extension or select from options, then transfer the calling party to their requested destination.

The IVM also offers advanced features that will request the calling party for their name for call screening, and can even announce the call over your in-house paging system.

The IVM can also direct the caller to prerecorded messages providing frequently requested information such as directions to your facility, department contacts, product information, etc.

The IVM programming can be done from the system’s service terminal. Recording is done easily using a handset and following voice recorded instructions.

Administrative Features:

- Automated Attendant for operator free reception and transfer
- System administration by telephone or Service Terminal
- Remote administration
- Multiple time of day configurations for each class of service, mailbox, menu, or extension
- Call screening and paging options
- Set time and date
- Print or view system administration reports
- Add or delete mail boxes
Users Conveniences

- First time user tutorial for easy set up of mail boxes
- Password protection
- Multiple messaging option including private, urgent, future delivery, and confirmation receipt
- Messages can be played faster, slower, louder, softer or skipped
- Each message can be replayed, saved, deleted, forwarded or replied to with annotation
- Date/time stamp and sending mailbox ID on every message
- Multiple greeting per mailbox, including standard, temporary, busy and time sensitive
- Call screening with calling party name played to mailbox owner who can then accept, reject, or forward the call to another station
- Address by name or mailbox number
- Re-record message reminder
- End of recording warning
- Return to personal operator
IVM (Integrated Voice Mail)

Specifications

The Integrated Voice Mail Card contains two micro-controllers, an i960 and a MC68302. The MC68302 is used for the ELITE system interface, and the i960 is used for the user interface and storage. There is a 1KB DPR for inter-processor communications. The Voice Mail Card will use double line card slots.

i960 RISC Processor Section

a. Intel 100 MHz i960JT Processor
b. 33 MHz external CPU clock.
c. 2 M bytes system RAM, expandable to 64 M bytes (4 SIMMs).
d. 2 M bytes system ROM, expandable to 64 M bytes (4 SIMMs).
e. Real Time Clock.
f. 10BaseT Ethernet connection.
g. IDE Hard drive Interface.
h. Built-in two IDE disk Drive, one of the drive is for Backup.
i. Up to 64 MB PCMCIA Flash memory card.
j. One RS232C serial port and modem.