Transmission Technology Ses

SDH
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ADVANTAGES OF SDH
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FRAME REPRESENTATION
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NETWORK TOPOLOGY, etc....
WHAT IS SDH?

SYNCHRONOUS:
ONE MASTER CLOCK & ALL ELEMENTS SYNCHRONISE WITH IT.

DIGITAL:
INFORMATION IN BINARY.

HIERARCHY:
SET OF BIT RATES IN A HIERARCHICAL ORDER.
WHAT IS SDH? (CONTD)

SDH IS AN ITU-T STANDARD FOR A HIGH CAPACITY TELECOM NETWORK.

SDH IS A SYNCHRONOUS DIGITAL TRANSPORT SYSTEM, AIM TO PROVIDE A SIMPLE, ECONOMICAL AND FLEXIBLE TELECOM INFRASTRUCTURE.
SYNC STANDARDS - EVOLUTION

ATTEMPTS TO FORMULATE STANDARDS FOR TRANSMISSION OF SYNCHRONOUS SIGNALS BEGAN IN U.S. AT THE BEGINNING OF 1984, BY ANSI ACCREDITED T1X1 COMMITTEE.

IN 1985 ‘SONET’ STANDARD WAS BORN.

IN 1986 CCITT BECAME INTERESTED IN SONET STANDARD.
SYNC STANDARDS - EVOLUTION  
(CONTD)

CCITT PROPOSED CHANGES TO ‘T1X1’ COMMITTEE TO ACCOMMODATE BOTH AMERICAN AND EUROPEAN HIERARCHIES.

FINAL AGREEMENT WAS REACHED IN 1988 AND CCITT WORKING GROUP-XVIII CAME OUT WITH RECOMMENDATIONS ON SDH.
NEW ENHANCED SERVICES NEEDING SYNCHRONIZATION SOLUTION.

QoS REQUIREMENT

MULTI-OPERATOR ENVIRONMENT

LIMITATION OF TO-DAY’S NETWORK

ADVANTAGES OF SDH
LIMITATIONS OF PDH

• NON STANDARD EXPERIENCES:
  -THREE DIFFERENT HIERARCHIES WITH DIFFERENT SIGNAL FORMATS AND LINE ENCODING METHODS.

• BASIS OF TODAY’S HIGH CAPACITY NETWORK
  -ELABORATE ARRANGEMENT FOR DROPPING

• NETWORK REQUIREMENT
  -CHANGING REQUIREMENT
# PDH Hierarchies

<table>
<thead>
<tr>
<th>EUROPE (Mbps)</th>
<th>USA (Mbps)</th>
<th>JAPAN (Mbps)</th>
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</thead>
<tbody>
<tr>
<td>565</td>
<td>274 x4</td>
<td>400 x4</td>
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<tr>
<td>140 x4</td>
<td>45 x6</td>
<td>100 x3</td>
</tr>
<tr>
<td>34 x4</td>
<td>6 x7</td>
<td>32 x5</td>
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<td>8 x4</td>
<td>1.5 x4</td>
<td>6 x3</td>
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<tr>
<td>2 x4</td>
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LIMITATIONS OF PDH

• NON STANDARD EXPERIENCES:
  - THREE DIFFERENT HIERARCHIES WITH DIFFERENT SIGNAL FORMATS AND LINE ENCODING METHODS.

• BASIS OF TODAY’S HIGH CAPACITY NETWORK
  - ELABORATE ARRANGEMENT FOR DROPPING

• NETWORK REQUIREMENT
  - CHANGING REQUIREMENT
BASIS OF TODAY’S NETWORK

- ELABORATE DROPPING ARRANGEMENT
LIMITATIONS OF PDH

• NON STANDARD EXPERIENCES:
  - THREE DIFFERENT HIERARCHIES WITH DIFFERENT SIGNAL FORMATS AND LINE ENCODING METHODS.

• BASIS OF TODAY’S HIGH CAPACITY NETWORK
  - ELABORATE ARRANGEMENT FOR DROPPING

• NETWORK REQUIREMENT
  - CHANGING REQUIREMENT
Yesterday’s NETWORK → CUSTOMER’S NEED → Today’s NETWORK

POINT-TO-POINT TRANSMISSION → FASTER PROVISIONING OF CIRCUITS AND SERVICES & TELECOMMUNICATION NETWORKING

SUPPORTED BY MANUAL APPROACH TO NETWORK MANAGEMENT AND MAINTENANCE. → DEMANDS FOR SOPHISTICATED TELECOM SERVICES

SUPPORTED BY COMPUTER BASED INTEGRATED NETWORK MANAGEMENT MAINTENANCE
SDH- ADVANTAGES

SIMPLIFICATION (ABILITY TO DIRECTLY DROP LOWER TRIB)

CAN ACCOMMODATE BOTH EXISTING AND FUTURE SIGNALS

IMPROVED SERVICE QUALITY (THROUGH SUPERVISION)

ADVANCED N/W MANAGEMENT AND MTCE CAPABILITIES.

N/W SURVIVABILITY

DYNAMIC N/W CAPACITY MANAGEMENT

MULTI VENDOR NETWORKING
SDH ACCOMMODATES EXISTING SIGNALS
## SIGNAL HIERARCHY

### SONET vs SDH BIT RATES

<table>
<thead>
<tr>
<th>SONET</th>
<th>SYNCHRONOUS TRANSPORT SIGNAL</th>
<th>OPTICAL CARRIER</th>
<th>BIT RATE MBPS</th>
<th>SDH</th>
<th>SYNCHRONOUS TRANSPORT MODULE</th>
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<tr>
<td>STS-1</td>
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<td></td>
<td>STM-64</td>
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</tbody>
</table>

*BIT RATES FOR HIGHER ORDER IS N-TIMES THE LOWER ORDER*
REDUCED MUX STRUCTURE

(REDUCED DIAGRAM FOR SDH-MULTIPLEXING)
MUX PRINCIPLE

Container-\(n (n=1-4)\): A container is the information structure which forms the network synchronous information payload for a virtual container.
MUX PRINCIPLE: CONTAINERS (C-n)
Virtual Container-n (VC-n): It is the information structure used to support path layer connections in the SDH.

Two types of VCs:
- Lower order VC-n (n=1,2)
- Higher order Vc-n (n=3,4)
MUX PRINCIPLE: TU-n/ AU

- It is an information structure which provides adaptation between two layers:
  - Between lower and higher order path layers for TU
  - Between higher order path layer and section layer for AU

POINTER is an indicator whose value defines the frame offset of a VC with respect to the frame reference of the transport entity on which it is supported.
MUX PRINCIPLE: STM-1(from C-4 )

CONTAINER-4

SOH PTR PH CONTAINER-4
MULTIPLEXING FROM C-4

CONTAINER-4

POH

C-4

VC-4

PTR

VC-4

AU-4

PTR

AUG

STM-1

SOH

AUG

C-4

VC-4

AUG

STM-1

POH

C-4

VC-4

AUG

STM-1

SOH

AUG

STM-1
MUX PRINCIPLE: STM-1 (from C-3)
MUX PRINCIPLE: STM-1 (from C-1)
• **The Container (C)**
  – Basic packaging unit for tributary signals (PDH)
  – Synchronous to the STM-1
  – Bitrate adaptation is done via a positive stuffing procedure
  – Bit by bit stuffing

• **The Virtual Container (VC)**
  – Formation of the Container by adding of a POH (Path Overhead)
  – Transport as a unit through the network (SDH)
  – A VC containing several VCs has also a pointer area
• The Tributary Unit (TU)
  – Is formed via adding a pointer to the VC
• The Tributary Unit Group (TUG)
  – Combines several TUs for a new VC
• The Administrative Unit (AU)
  – Is shaped if a pointer is allocated to the VC formed at last
• The Synchronous Transport Module Level 1 (STM-1)
  – Formed by adding a Section Overhead (SOH) to AUs
  – Clock justification through stuffing in the AU pointer area
  – byte by byte stuffing
SDH FRAME REPRESENTATION

(MATRIX REPRESENTATION)
**RSOH**: Regenerator section overhead  
**MSOH**: Multiplex section overhead  
**Payload**: Area for information transport

Transport capacity of one Byte: 64 kbit/s  
Frame capacity: \(270 \times 9 \times 8 \times 8000 = 155.520\) Mbit/s  
Frame repetition time: \(125\) µs
THE TRUCK

OVERHEAD

PAYLOAD

Thursday, December 01, 2005

ALTTC/TX1/SDH/CONCEPTS
FRAME REPRESENTATION
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FRAME REPRESENTATION
**RSOH**: Regenerator section overhead  
**MSOH**: Multiplex section overhead  
**Payload**: Area for information transport

---

**Transport capacity of one Byte**: 64 kbit/s  
**Frame capacity**: $270 \times 9 \times 8 \times 8000$  
**= 155.520 Mbit/s**  
**Frame repetition time**: 125 µs
BIT RATE : STM-N

PAYLOAD

9

261

SOH

125 µSECONDS

270

(Matriz Representation)
BIT RATE : STM-N

- NUMBER OF ROWS = 9
- NUMBER OF COLUMNS = 9 + 261 = 270
- NUMBER OF BYTES = 9 \times 270
- NUMBER OF BITS = 9 \times 270 \times 8
- NUMBER OF BITS / SECOND = 9 \times 270 \times 8 \times 8000
  = 155520000
  = 155.520 Mbps (STM-1)
- BIT RATE OF STM-N = (N \times 155.520) Mbps
Pointers

The pointer technology provides a means to accommodate timing differences at SDH networks. The pointer indicates the start of the payload within a STM-1 frame.
RSOH

MSOH

AU pointer

VC-4

TUG-3

TUG-2

Tu pointer

TU-12

VC-12

Tu pointer
### SECTION OVERHEAD DETAILS

<table>
<thead>
<tr>
<th>A1</th>
<th>A1</th>
<th>A1</th>
<th>A2</th>
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<th>A2</th>
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<td>D12</td>
</tr>
<tr>
<td>S1</td>
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<td></td>
<td></td>
<td>M1</td>
<td></td>
<td>E2</td>
</tr>
</tbody>
</table>

- **A**: FRAMING
- **D**: DATACOM FOR NMS
- **F**: USER CHANNEL
- **K**: APS
- **B**: PARITY CHECK
- **E**: ORDERWIRE
- **M**: MS-REI
- ****: MEDIA DEPENDENT
- **X**: RESERVED FOR NATIONAL USE
- **🗑**: UNUSED RESERVED FOR FUTURE USE
SYNCHRONOUS MULTIPLEXER (MUX):

* MAPPING OF PDH SIGNALS INTO SDH.
* MULTIPEXING OF LOWER-ORDER SDH SIGNALS INTO SDH

63 Nos. OF 2Mbps or
3 Nos. of 34Mbps or
1 Nos. of 140Mbps or
combination of above
NETWORK ELEMENTS

ADD & DROP MULTIPLEXER (ADM):

* PERMITS ADD & DROP OF LOWER ORDER SIGNALS.

STM-n

ADM

STM-m

PDH

STM-n

(m<n)
Tributary Ports: \( n \times 2 \text{ Mbit/s} \) (34 Mbit/s)
SYNCHRONOUS DIGITAL CROSS CONNECT (SDXC):

* PERMITS SWITCHING OF TRANSMISSION LINES WITH DIFFERENT BIT-RATES.
* SDXC CAN ADD AND DROP LOWER-ORDER SIGNALS.
Synchronous Cross Connect

- 2.4 Gbit/s
- 622 Mbit/s
- 155 Mbit/s
- 34 Mbit/s
- 140 Mbit/s
- 140 Mbit/s
- 34 (45) Mbit/s
- 2 (1.5) Mbit/s

SDH Multiplexer

- VC11
- VC 4
- VC 3
- VC 12
NETWORK ELEMENTS

SYNCHRONOUS REGENERATOR (REG):

* REGENERATES THE INCOMING LINE SIGNAL.
* SUPERVISE THE TRANSMISSION QUALITY OF THE LINE
NETWORK ELEMENTS

SDH AIMS TO PROVIDE:

STANDARDISED, CENTRALISED O&M SYSTEM.
SDH MANAGEMENT

- Performance Management
- Fault / Event Management
- Configuration Management
NETWORK TOPOLOGY

* POINT-TO-POINT:

* POINT-TO-MULTIPOINT:
NETWORK TOPOLOGY

* HUB-TOPOLOGY:

(a) HUB WITH TM & ADM

(b) HUB WITH TM & DXC
* RING-TOPOLOGY:

![Ring Topology Diagram]
a) Mixed SDH-PDH network

STM-16
STM-4
STM-1

MAJOR TRUNKS
REGIONAL
LOCAL

b) Typical use of SDH rates.
SDH NETWORK STRUCTURE

Tier 1 (STM-16) CORE NETWORK
Tier 2 [STM-4/16] REGIONAL NETWORK
Tier 3 [STM-1] LOCAL/ACCESS NETWORK
Unidirectional Ring

[Diagram showing a unidirectional ring network with nodes A, B, C, D, E, and F, and labels for Working and Protection connections.]

Thursday, December 01, 2005
Two fiber Bidirectional Line-Switched Ring (BLSR)
THANK YOU