Read Out and Data Transmission Working Group

Synchronous Data Transmission Protocol for NEMO experiment

Discussed Items

1. Submarine neutrino telescopes requirements
2. Specific NEMO mechanical structure
3. SDH Protocol for NEMO experiment
4. Implementation of SDH protocol in NEMO
5. SDH protocol in Km^3 perspective

1.1 ν telescopes requirements: physical

- The apparatus needs a common timing
- "Calibration" procedure
- Fixed minimum data rate per channel: ~5 Mbps
  - 13" PMT => 50 Kevents/s
  - ~100 bit/spe

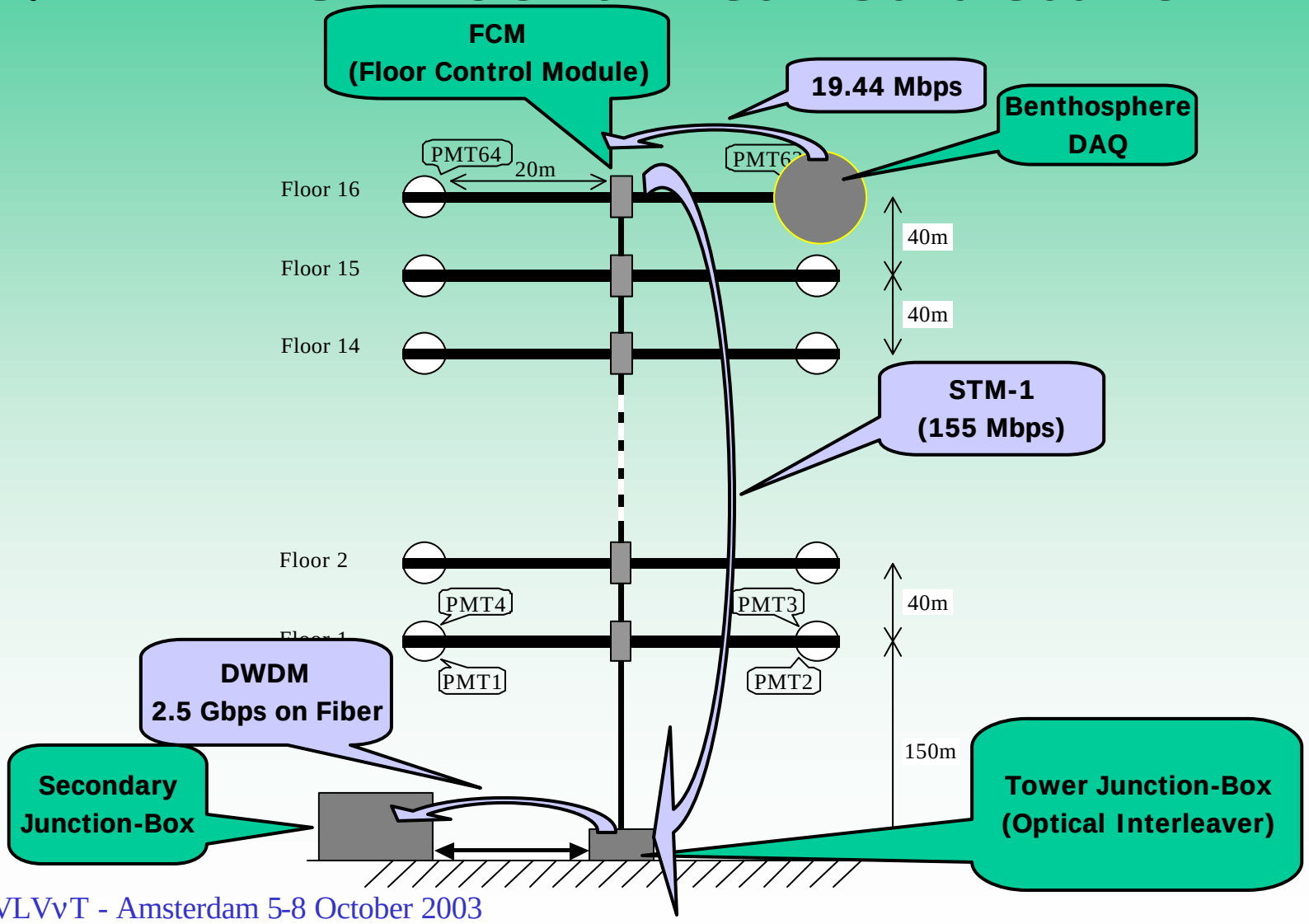
1.2 ν telescopes requirements: electronics

- Low jitter requirements on clock signals
- Small physical dimensions
- Low power consumption
- Reliability & Redundancy

1.3 ν telescopes requirements: engineering

- Minimize number of fibers/connectors
- Standardized protocols
- Off-the-shelf availability of devices
- Availabilty of test/control instrumentation
- Easy integration with third suppliers

2. NEMO mechanical structure



3.1 Possible Synchronous Protocols

- Many standards between synchronous protocols:
  - Ser/Des Devices from many manifacturer (HP, Motorola, Sierra, AMCC, ...)
  - SDH Protocols
  - USB, FireWire

3.2 SDH Protocol for NEMO Experiment

The protocol chosen for transmitting data from the floor to the tower junction box in NEMO is a telecom standard synchronous protocol:

155 Mbps STM-1 SONET/SDH

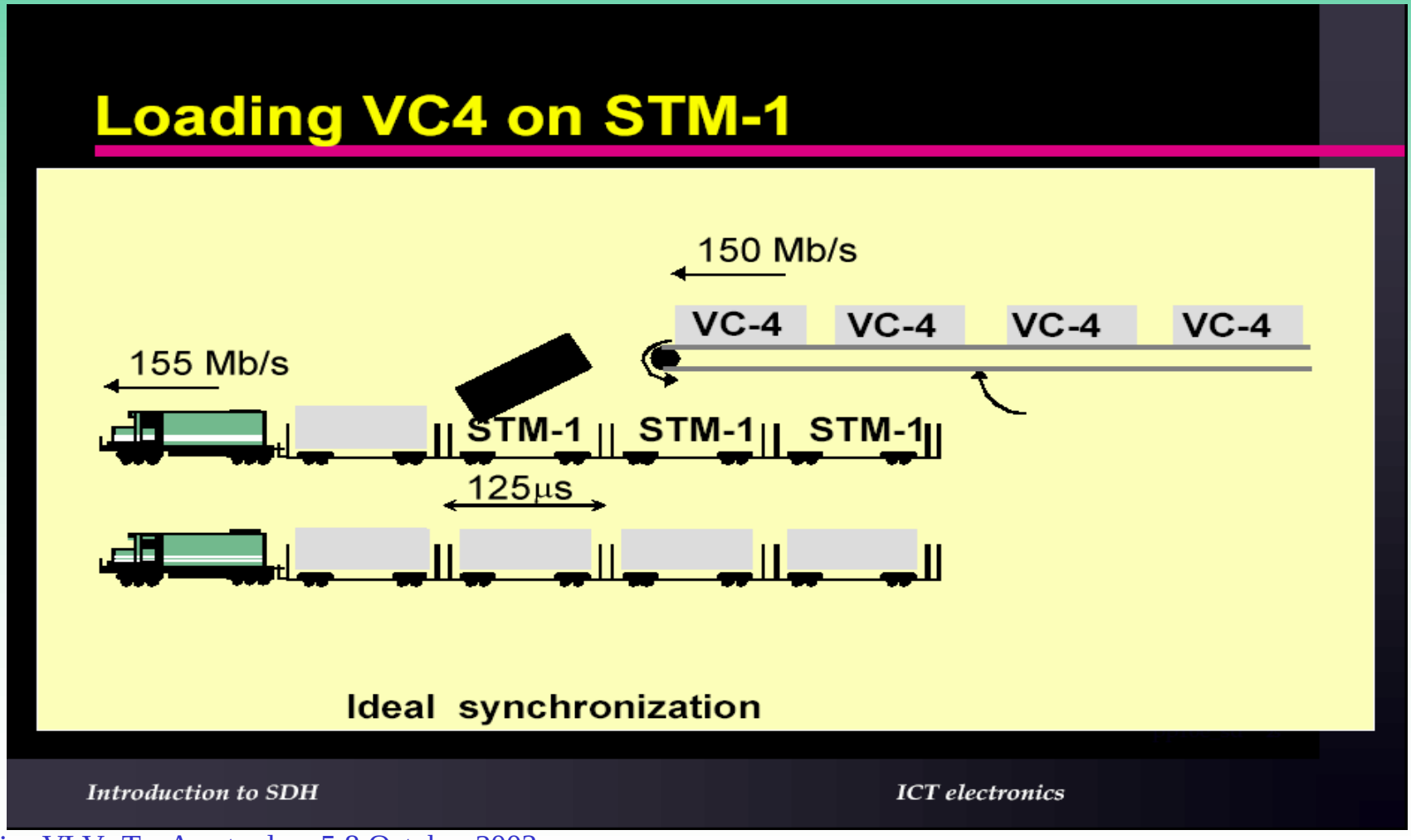
(Synchronous Over NETwork

Synchronous Digital Hierarchy)

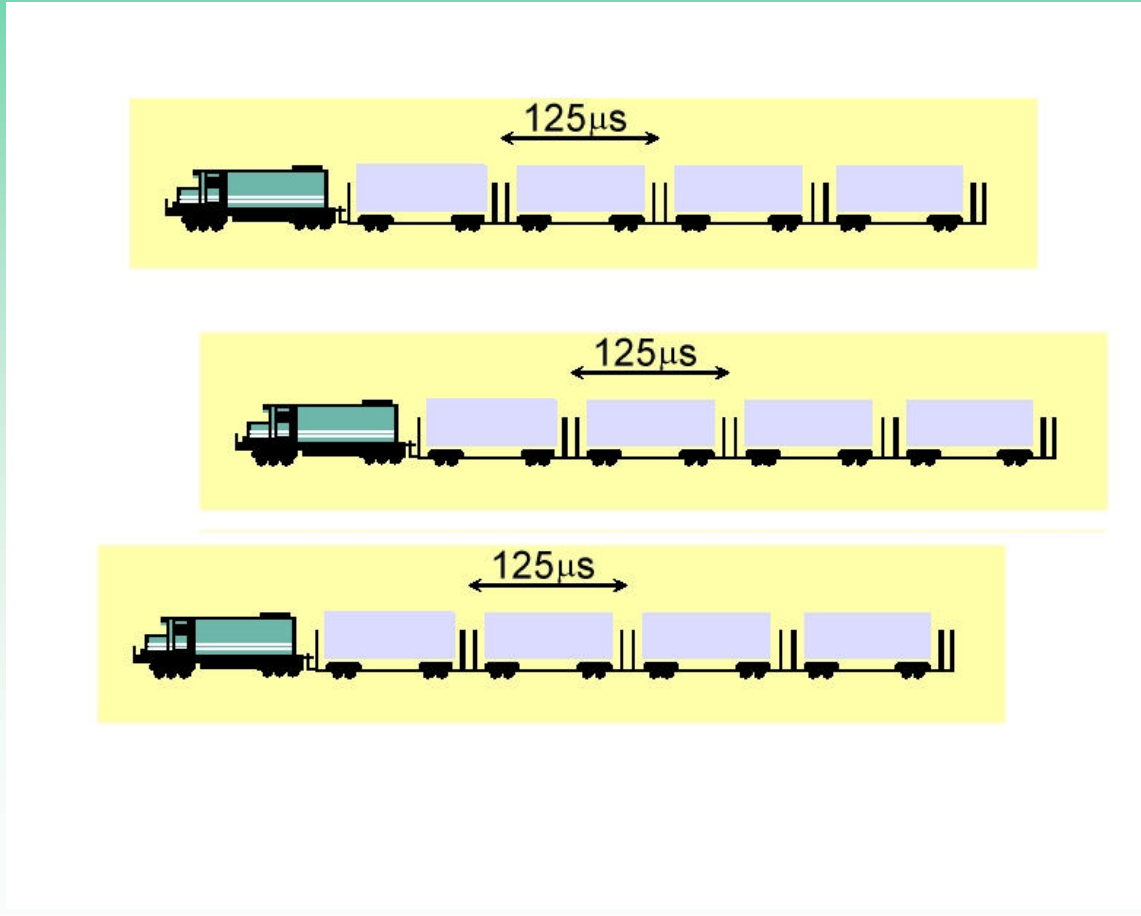
3.3 Benefits of SDH protocol

- Synchronous protocol (clock embedded in data)
  - Single fiber for unidirectional data transport
- Data rate range from 52 Mbps up to 10 Gbps
- Telecom standard (reliable, durable, supported, ...)
- Electro-Optical transceivers available (B/W and coloured)
- Relatively simple electronics

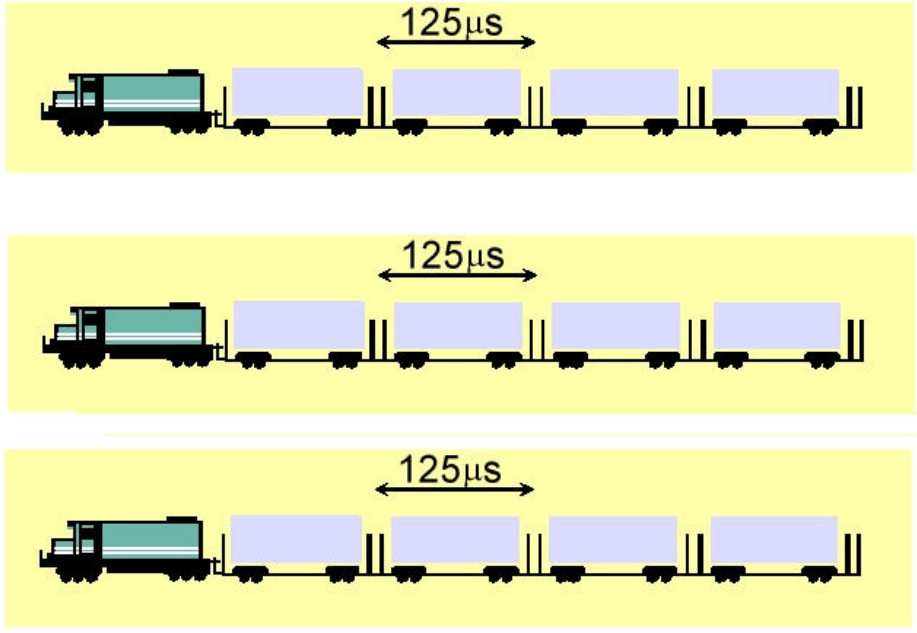
3.4 SDH Philosophy



3.4a SDH Synchronization Mechanism

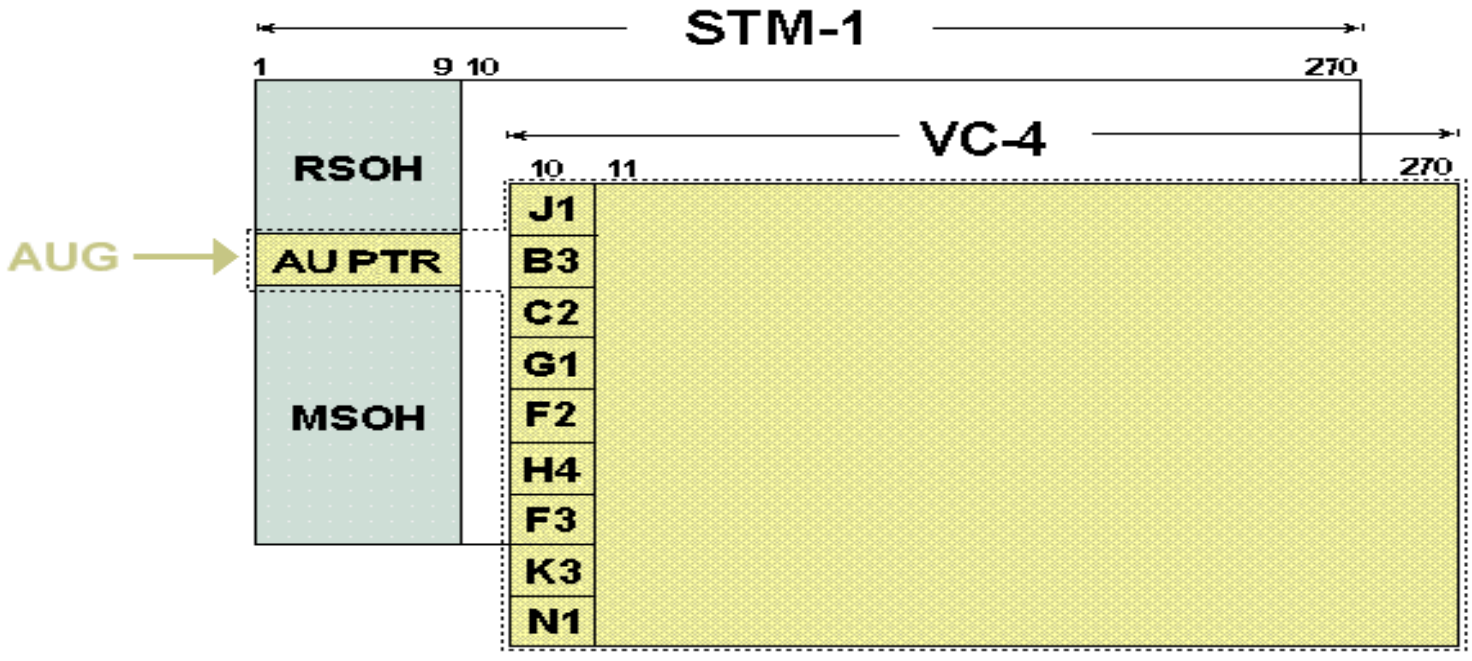


3.4b SDH Phasing Mechanism



3.5 SDH STM1 VC-4 Container

SYNCHRONOUS TRANSPORT MODULE - 1



RSOH: Regenerator Section Overhead.
MSOH: Multiplexer Section Overhead.

3.6 SDH Data Rates

SDH Data Rates

Floor Rate

Tower Rate

Designation	Data Rate	Payload Rate
OC-3 (STM-1)	155.52 Mb/s	150.336 Mb/s
OC-12 (STM-4)	622.08 Mb/s	601.344 Mb/s
OC-48 (STM-16)	2.49 Gb/s	2.405 Gb/s
OC-192 (STM-64)	9.95 Gb/s	9.621 Gb/s

4.1 Floor Control Module (FCM)

- Location: center of floor
- Exchange data between:
  - Local Slow Control
  - Benthospheres
  - Tower Junction Box
- Calibration Capabilities: Synch and Phase

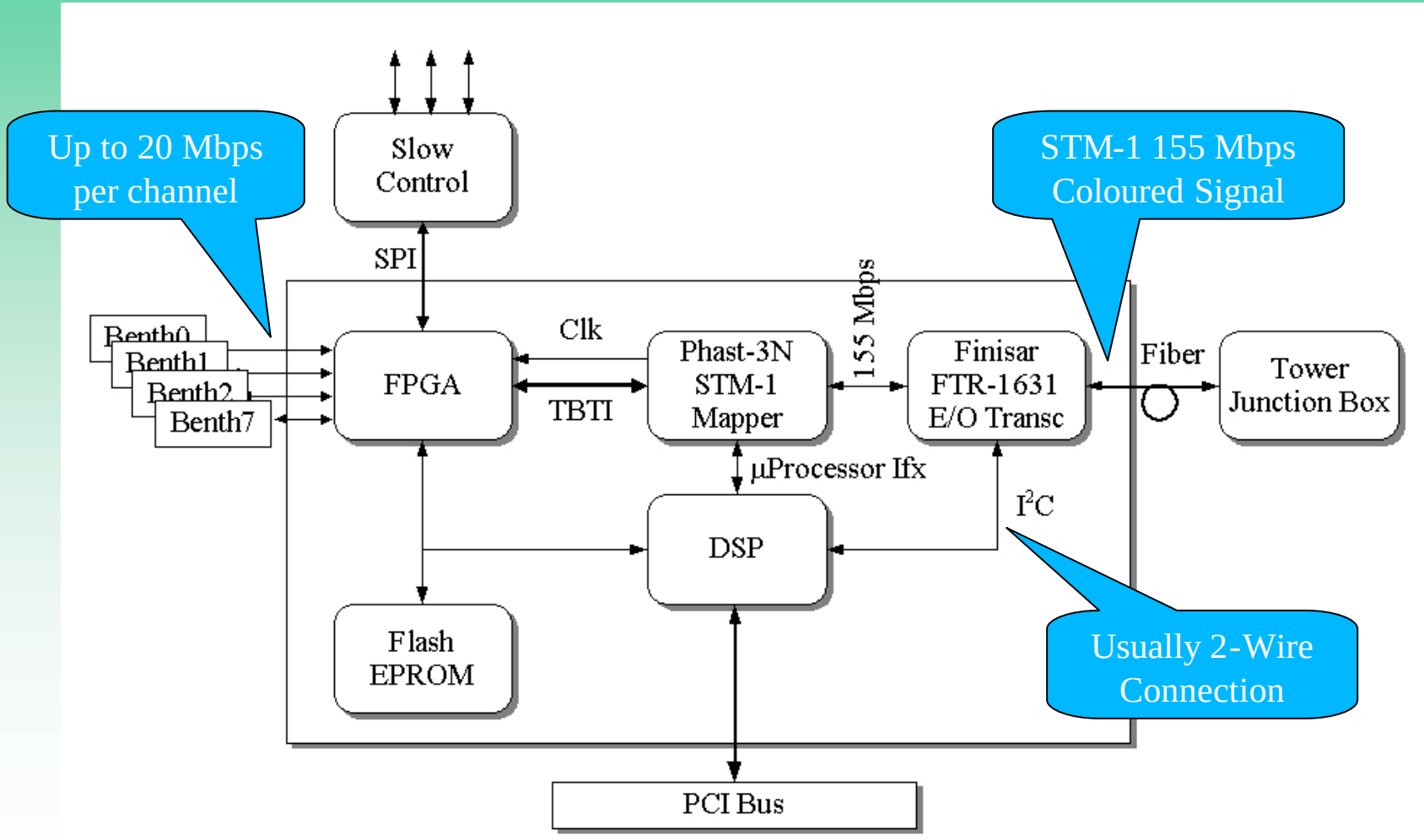
4.2 FCM Requirements

- From/To Optical Module (OM)
  - ✓ Transmit synchronism derived from STM-1 clock (1.215 MHz)
  - ✓ Transmit Slow Control data (432 Kbps)
  - ✓ Receive Event & Slow Control data (19.44 Mbps)
  - ✓ Supply and manage power
- From/To Tower Base JB
  - ✓ Pack and transmit floor data (PMT Data and Slow Control)
  - ✓ Receive and extract floor data (Slow Control and Synchronism)
- From/To Floor electronics
  - ✓ Manage floor Slow Controls data

4.3 FCM Interfaces

	• Optical Module	• Tower Base	• Floor Electr.
Protocol	Proprietary	STM-1	SPI
Medium	Electric	Fiber	Electric
Type	Bidirectional Asymmetric	Bidirectional Symmetric	Bidirectional Symmetric
Rate	In: ~ 19.44 Mbps Out: ~ 432 Kbps	155 Mbps	Max 5 Mbps

4.4 FCM Block Diagram



5. SDH protocol in Km^3 perspective

- Optical protocol: flexibility in distance arrangement
- Higher speed SDH protocols already available
- Vaste choice of devices
- FPGA IPs already available
- Low power system
- Complete system on a single board
- Same board for On and Off-Shore

5. FCM Specifications

- Defining standard interfaces the FCM could be reused in different scenarios:
  - Redefinition of a standard Link with Benthosphere
  - Redefinition of link with Slow Control
  - Definition of common data format for data in STM-1