CWDM data transmission for the VLVnT

This presentation focuses on detector to shore mass data moving Only. It does NOT cover

- Intra-detector data links
- Shore to detector links

➢ Context and assumptions

1) A VLVnT with ~ 10 K PMT
2) High agregate bandwidth is required from JB(s) to shore
3) A limited number of fibres will be usable for this purpose through MEOC(s) ~ a few 100 fibers
4) Data integrity, Reliability, Robustness are key issues

Agregate bandwidth rough estimates

- Assumptions
  1) 10 k PMT
  2) 1 MHz trigger rate
  3) 8 to 10 Bytes per "trigger" at PMT level
     - time stamp (4 Bytes)
     - Signal (4 to 6 Bytes)

➔ ~ 800 Gb/s agregate bandwidth

!! Some more is needed for

- Data encoding (8 to 10)
- Redundancy (times 2)

SAY 2000 Gb/s TOTAL

Options-Available Technics

- 1 color per fiber (No wavelength multiplexing)
  - @ 2.5 Gb/s, 800 fibers are required   far too many
  - @ 10 Gb/s, 200 fibers are required   why not ?

- Several colors per fiber

  - CWDM Coarse wavelength Data Multiplexing
    more than 8 colors usable per fibre
    - ❑ @ 2.5 Gb/s, 100 fibers are required
    - ❑ @ 10 Gb/s, 25 fibers are required

  - DWDM Dense wavelength Data Multiplexing
    more than 100 colors usable per fibre
    - ❑ @ 2.5 Gb/s, 8 fibers are required
    - ❑ @ 10 Gb/s, 2 fibers are required

Available Hardware

- Electronics, active optical devices

  - ✓Serialiser
  - ✓Laser driver
  - ✓Lasers
  - ✓PIN diode
  - ✓Transimpedance amplifier
  - ✓Deserialiser

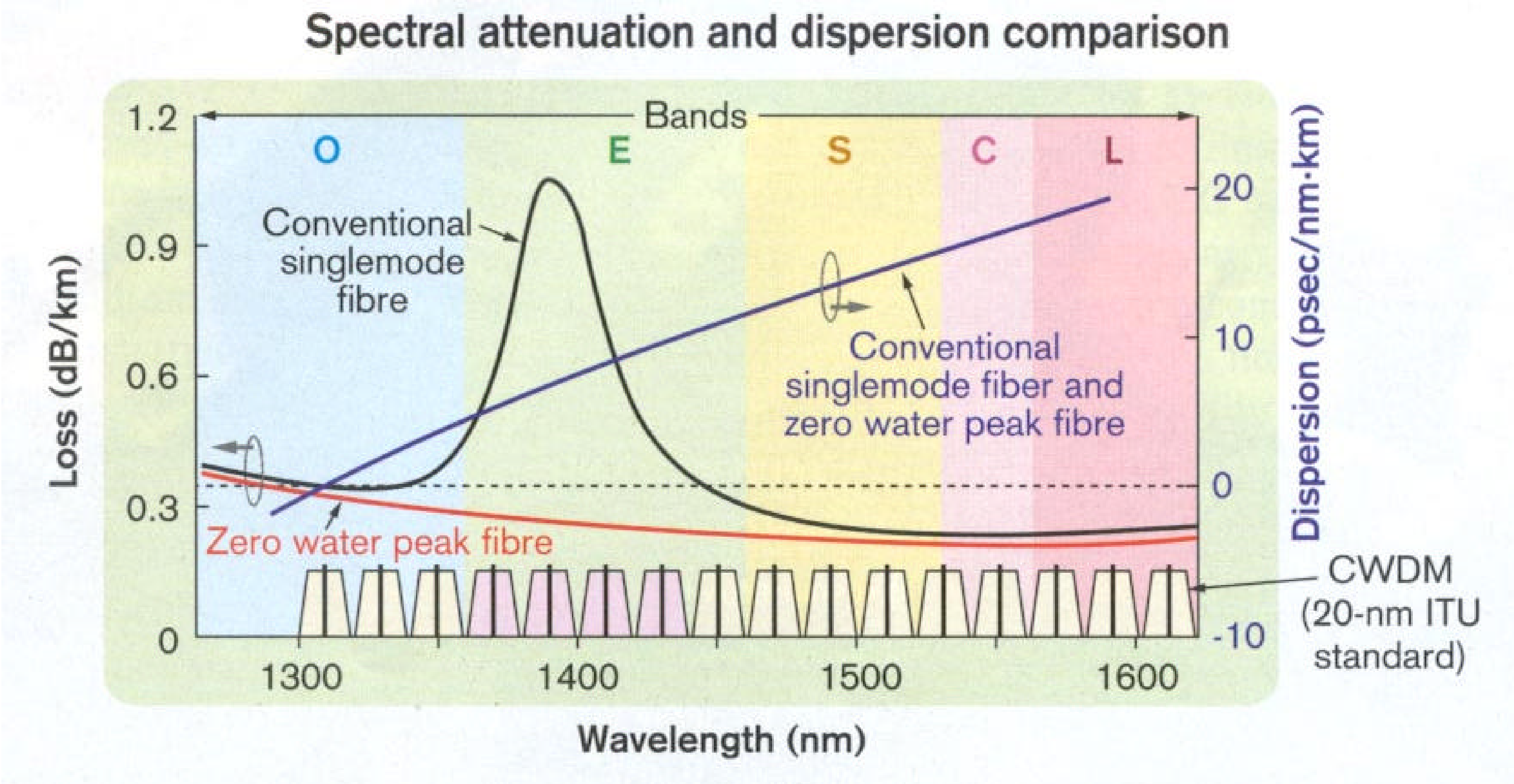
- Passive optical components

  - ✓Wavelength MUX/DEMUX
  - ✓Connectors

ALL IS AVAILABLE FOR 2.5Gb/s AND 10 Gb/s RATES

What about the fiber ?

DWDM channel spacing < 1nm
CWDM channel spacing = 20 nm



➢ “STANDARD” Single Mode FIBER ALLOWS FOR <u>BOTH CWDM AND DWDM</u>

Search for an Optimum

- Drivers are RELIABILITY and ROBUSTNESS

  • More common technologies must be prefered to more "high tech"
  • Systems with relaxed specs must be prefered to "on the edge of the specs" systems

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  ➔ 2.5Gb/s is better than 10 Gb/s, if achievable
  (jitter, chromatic dispersion, laser technology ...)

  ➔ Lower degree of Wavelength multiplexing is better than Higher degree, if achievable

DWDM Option

- Channel spacing < 1nm imposes the use of tightly controlled optical channels
  - Temperature control of laser series within fraction of a degree is necessary
  - Narrow optical filters are required
  - ➔LESS RELIABLE and LESS ROBUST

- Level of concentration is not adapted to the case
  - 8 fibers for all the data are too few, RISKY !

DWDM IS NOT A GOOD CHOICE

Remaining Options

Only TWO options remain

- One color per fiber (No wavelength multiplexing)
  - ❑ 200 fibers @ 10 Gb/s

➔Less multiplexing and Higher bandwidth

- Several colors per fiber
  - • CWDM Coarse wavelength Data Multiplexing
    - ❑ 100 fibers @ 2.5 Gb/s , 8 colors per fibre

➔ More multiplexing and Lower bandwidth

2.5 Gb/s IS SAFER

Roadmap to a CWDM demonstrator

- Check the numbers and assumptions (Bandwidth , fibers etc ...)!!!
- Design a highly redundant and robust block diagram
- Define how to encode the data
- Select the components and build a demonstrator that shows
    - Feasibility
    - Performance
    - Robustness
    - Components and subsystems sourcing
    - Cost

Conclusion

- CWDM transmission appears to be an attractive solution for massive data moving from detector to shore in the context of a VLVnT :
  - Relies on demonstrated stable technologies
  - Offers a good trade-off for :
    - Data Concentration
    - Redundancy
    - Robustness
- A demonstrator tailored for a proprietary embedded highly reliable system is necessary.
- The required manpower, schedule and budget are currently under estimation.