Multi-PHY Operation

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Multi PHY Operation

》 Operation

- Loop bonding and data rate aggregation
- Differentiated level of services on multi-pair
    - Different BER can be allocated to each copper pair
- Protection Switching
    - Allow switch over operation when one link fails
- Transmission coordination
    - Allows cross talk cancellation

VDSL Std sub-layers

IKANOS communications

» **VDSL modem sublayers:**

- Transport Protocol Specific Transmission Convergence (TPS-TC) sublayer
- Physical Media Specific Transmission Convergence (PMS-TC) sublayer
- Physical Media Dependent (PMD) sublayer

» **TPS-TC sublayer being defined for Ethernet Transport**

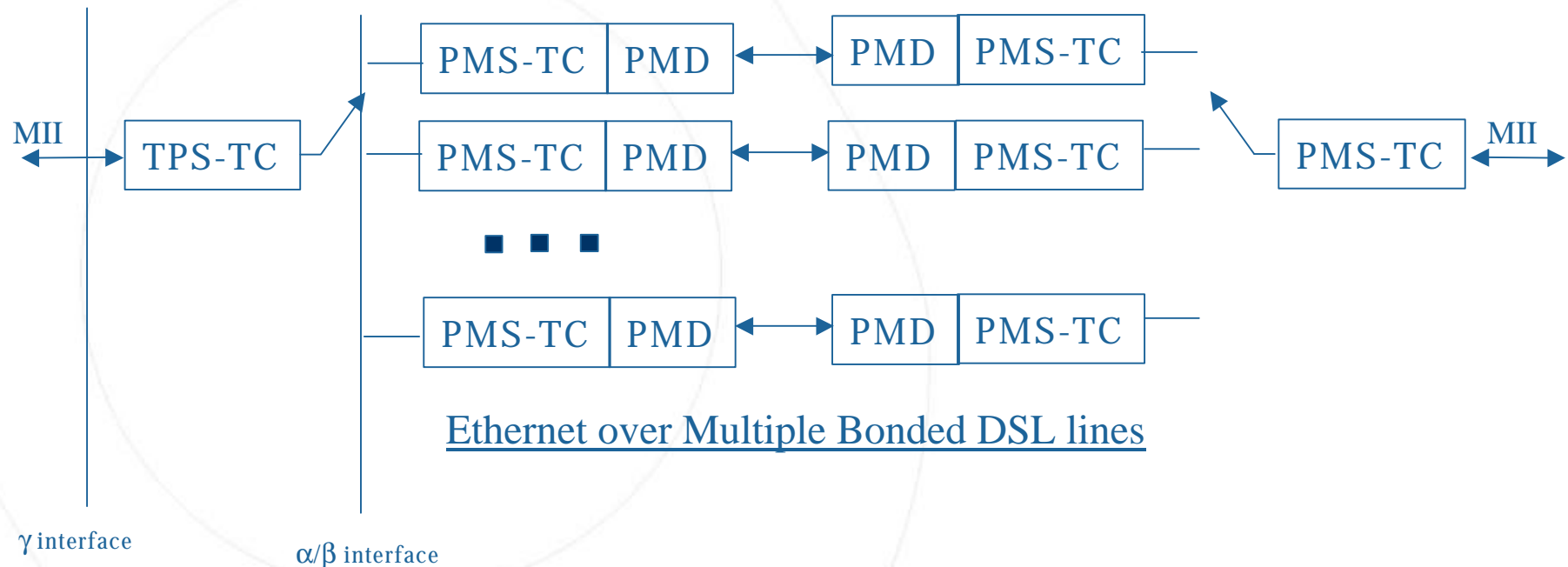- HDLC encapsulation with byte stuffing for rate matching

xMII ←→ | TPS-TC | PMS-TC | PMD | ←→ | PMD | PMS-TC | TPS-TC | ←→ xMII
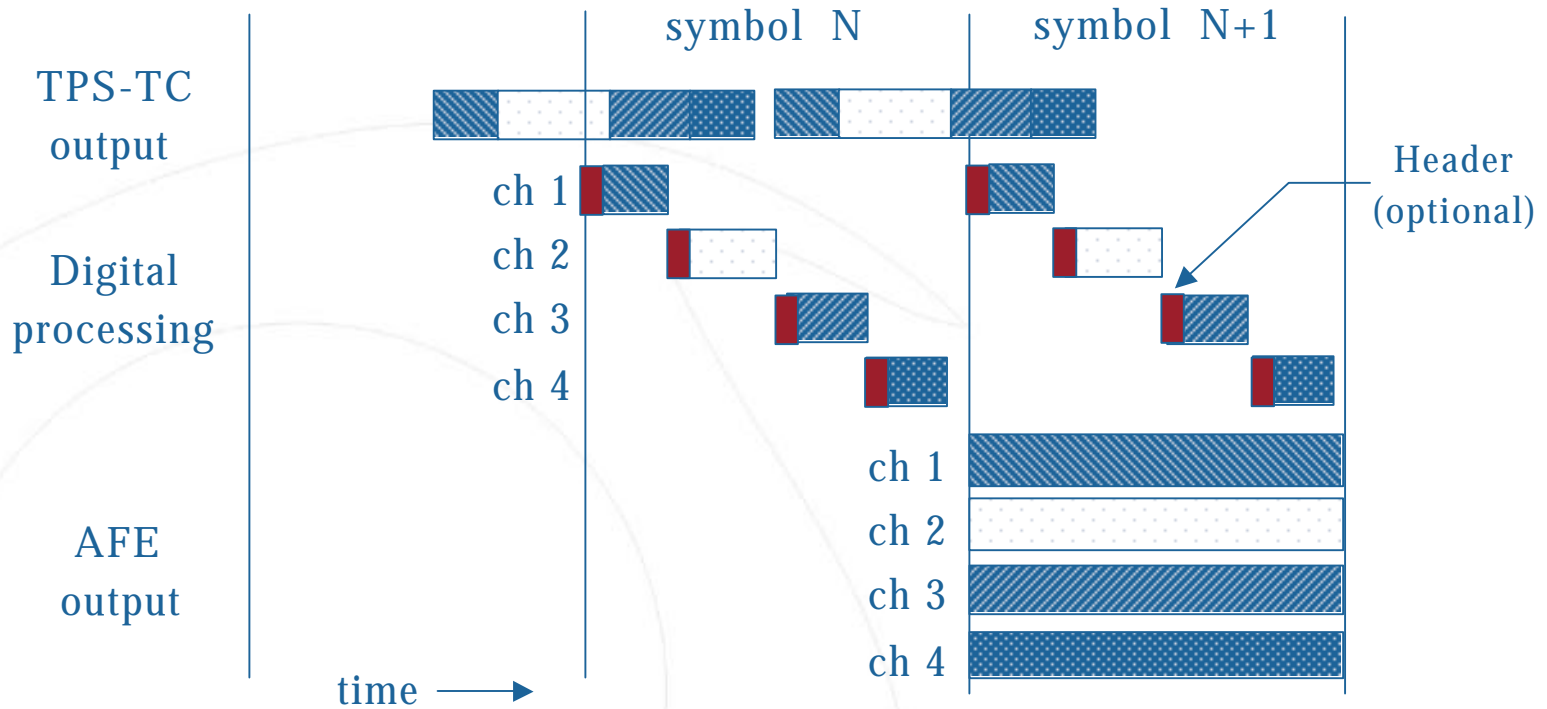
Ethernet over Single VDSL/ADSL line

Multi-PHY, Loop aggregation

≫ **TPS-TC sublayer output muxed onto multiple lines:**

- TPS-TC output is rate matched stream of bytes
- Send TPS-TC output on each line, once every symbol, in sequence
- Each line takes the number of bytes which will be sent per symbol on that line
- Receive side puts them back together in same sequence

		PMS-TC | PMD	↔	PMD | PMS-TC	

MII → TPS-TC → PMS-TC \| PMD ↔ PMD \| PMS-TC → PMS-TC ← MII

■ ■ ■

PMS-TC \| PMD ↔ PMD \| PMS-TC

<u>Ethernet over Multiple Bonded DSL lines</u>

γ interface   α/β interface

Data Flow in Bonded System

Data flow thru 4 channel Bonded DSL system

» **Single Channel Initialization, SCI**

- Determine channel capacity
- Determine noise margin
- Identify presence of narowband and wideband disturbers
- Determine bit rate

» **Multi PHY Channel Initialization, MCI**

- Repeat n times SCI

» **Bonding**

- Coordinate across n channels

» **Advanced features**

- Optimize PSD by sharing channel information

```
                        ┌─────────────────────┐
                        │  Multi-pair operation │
                        └──────────┬──────────┘
                                   │
                                   ▼
                        ┌─────────────────────┐
                        │   Select Data Rate    │◄────────┐
                        └──────────┬──────────┘          │
                                   │                      │
                                   ▼                      │
                              ◇ Enough pairs?             │
                    no        ◇  Coarse-LUT               │
                              ◇                            │
                                   │                      │
                                   ▼                      │
                        ┌─────────────────────┐          │
                        │      Initialize       │          │
                        │     Copper pairs      │          │
                        └──────────┬──────────┘          │
                                   │                      │
                                   ▼                      │
              no            ◇ Enough pairs? ◇    yes    ┌──────────┐
                            ◇              ◇ ──────────►│ Bonding  │
                            ◇              ◇            │  begin   │
                                                        └──────────┘
```

Select data rate

no Cost model?

Calculate no Copper pairs

no Min Data rate?
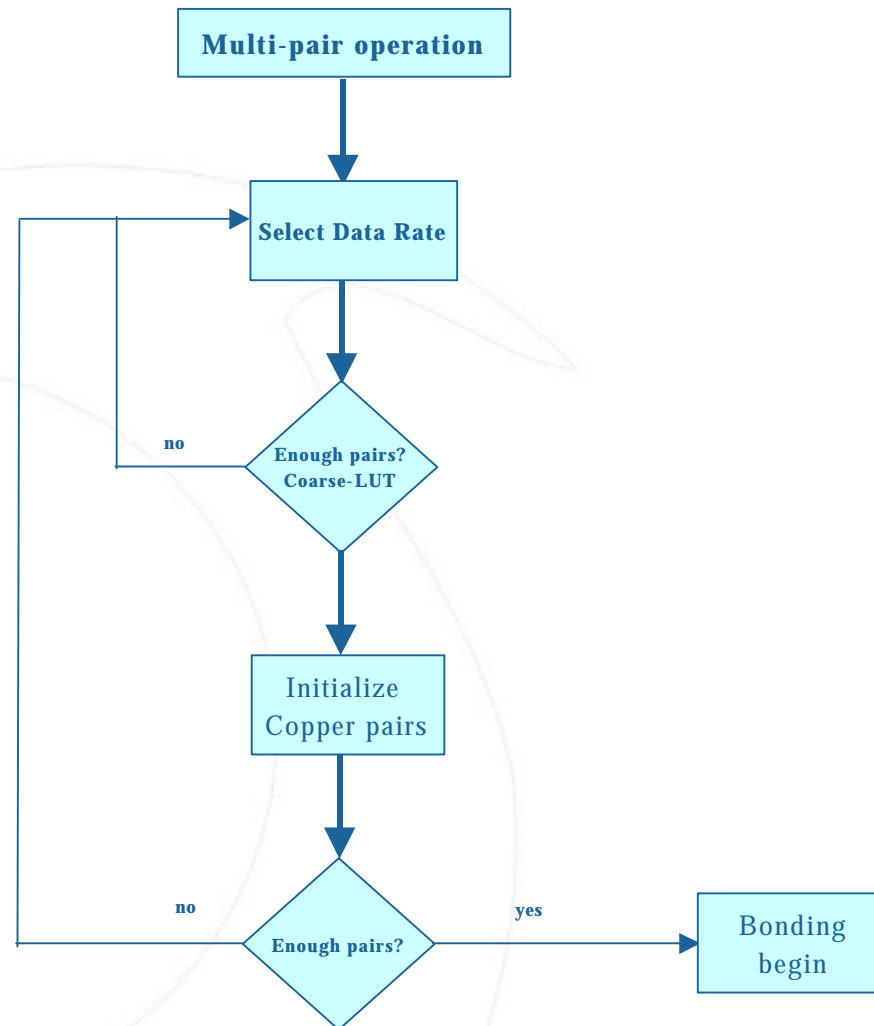
Control of Bonded System
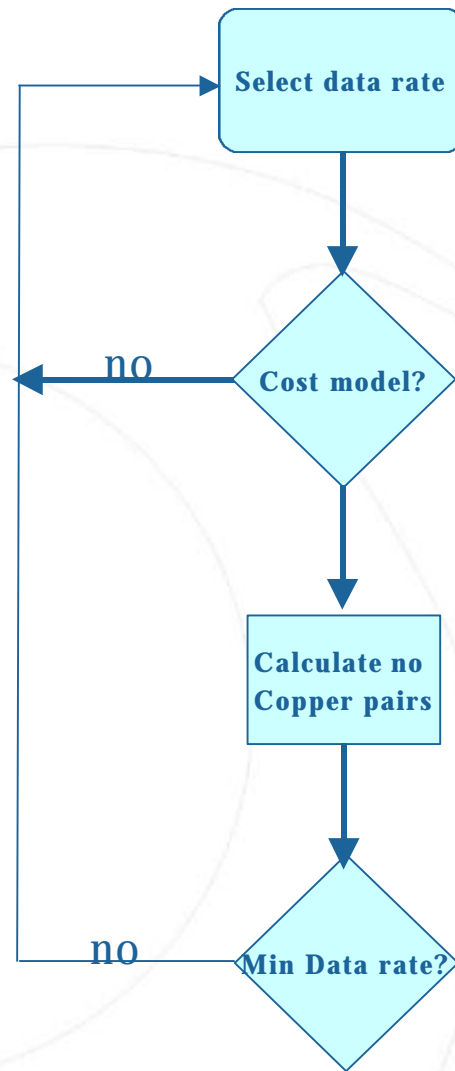
» **Optional header has sequence number:**

- Sequence number used for segmenting and reassembly

» **Can work without header:**

- When a line comes up, it is assigned an ID by CO side and a position in the line sequence used for segmenting and re-assembly
- When a line goes down, EOC messages can be sent on other lines to drop the line from the line sequence

» **CRC check of segments not needed:**

- Segments sent on each line already have CRC & RS encoder (DSL framing)
- HDLC encapsulation adds its own CRC
- Ethernet frames have their own 32-bit CRC

Coordination of multi-PHY

» **Bit/Byte synchronous operation, single x MII interface**

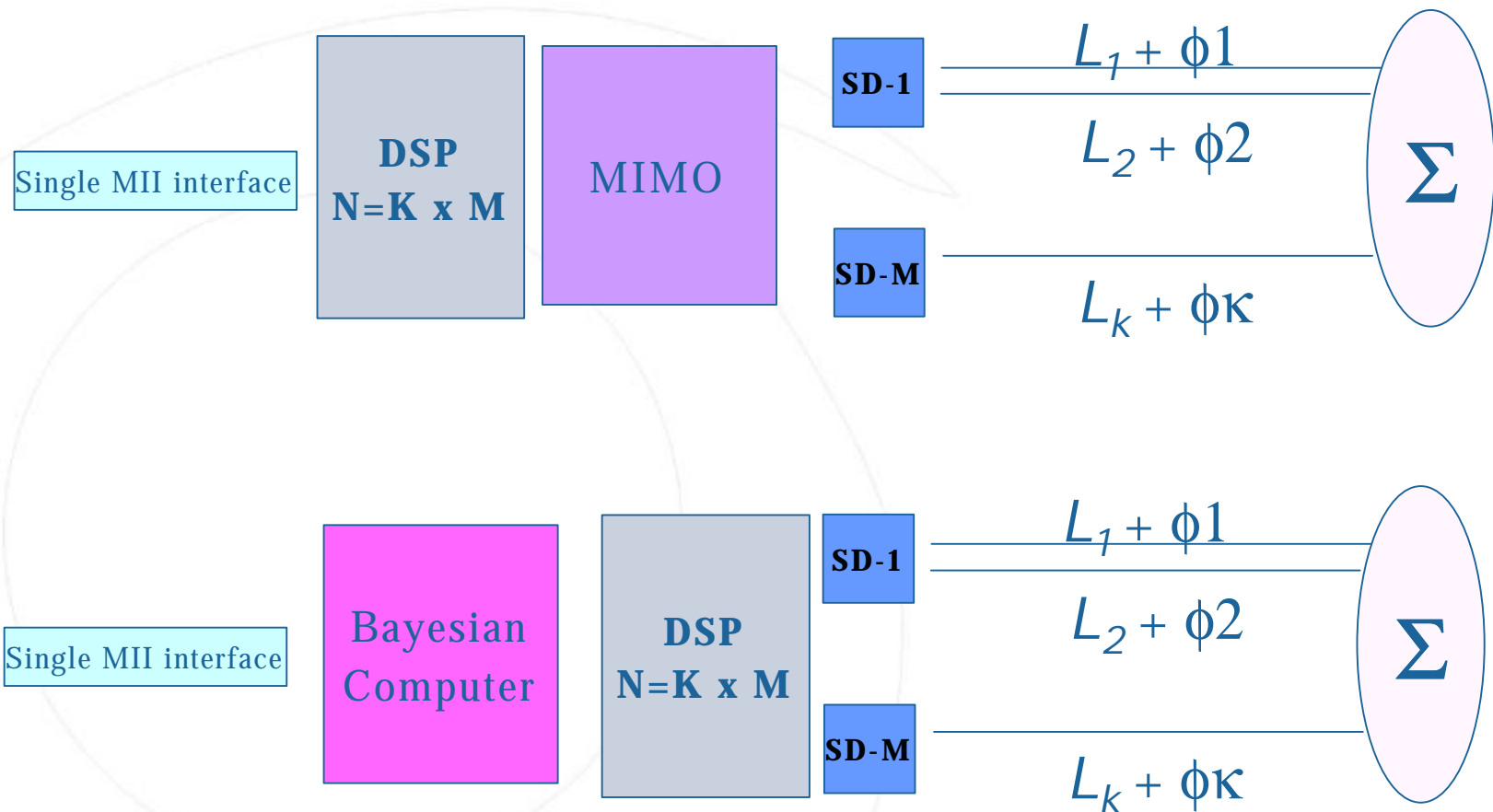- Single N-port device operating on M sampling j-port devices, serving K lines of unequal channel capacity
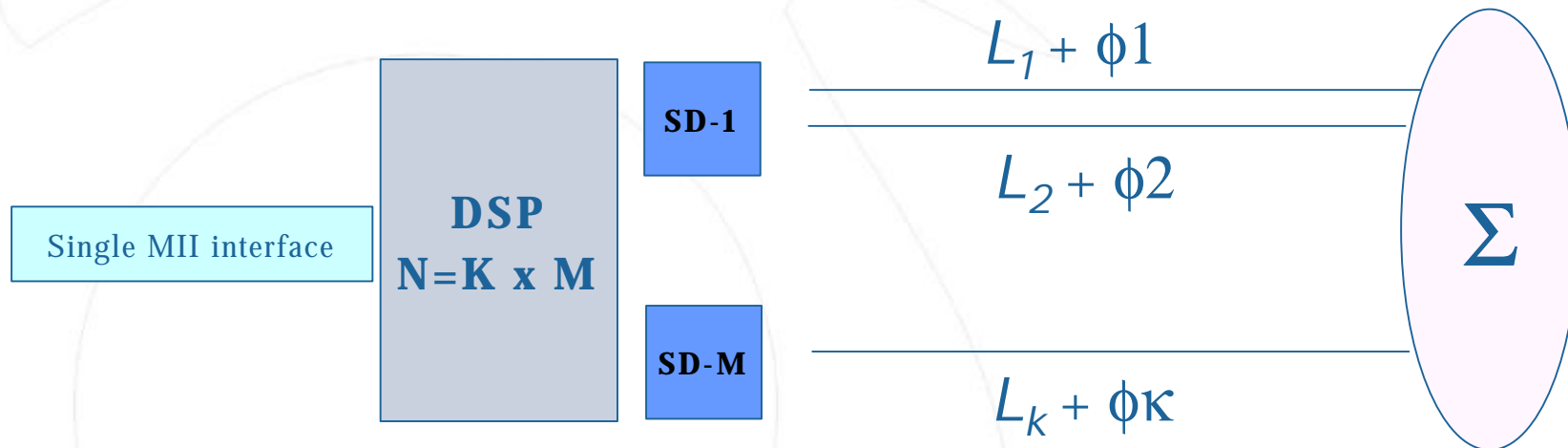
≫ Modulation independent, line interface

≫ Modulation Dependant operation