Generic Framing Procedure (GFP) for NG-SONET/SDH: An Overview

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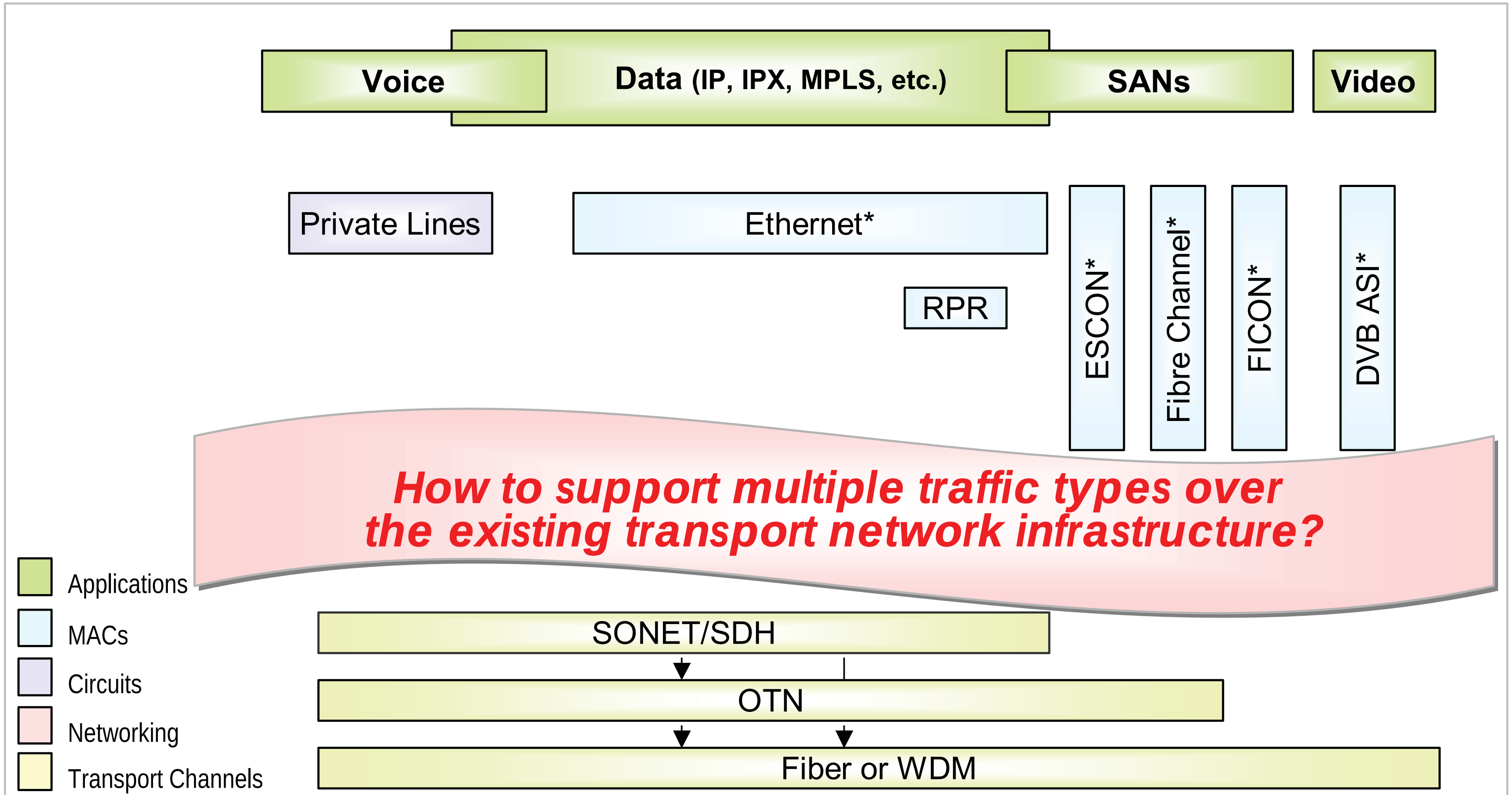
Generic Framing Procedure - GFP

A "generic" mechanism to adapt multiple client traffic types as either:

- *a physical link (Layer 1) client*
- *a logical data link (Layer 2) client*

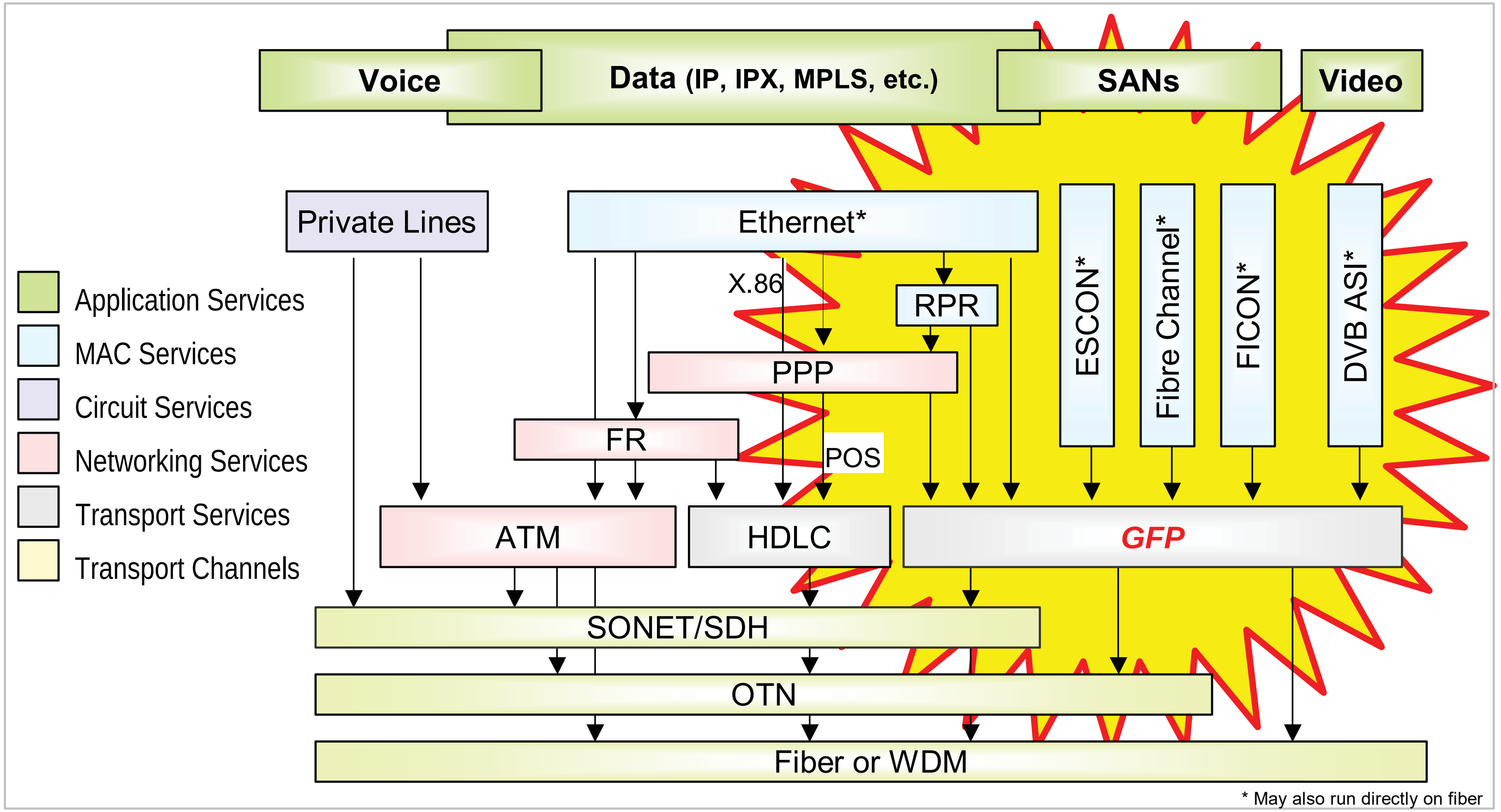
into a bit synchronous or octet-synchronous transmission channel

The Problem:
Public Multi-Service Transport

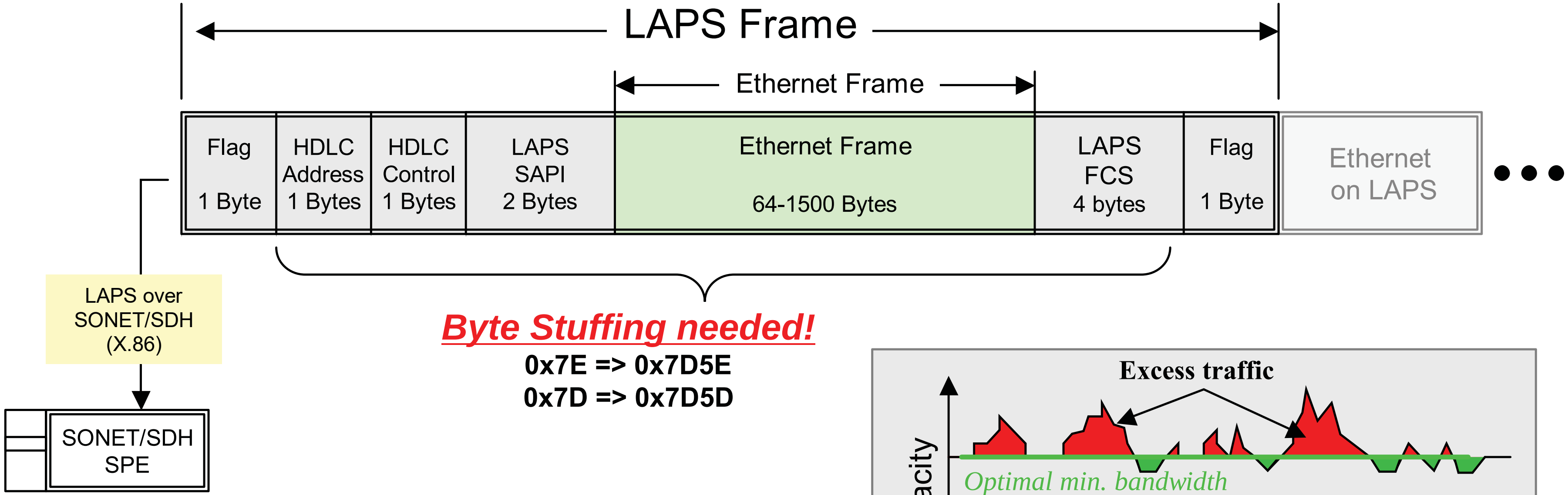


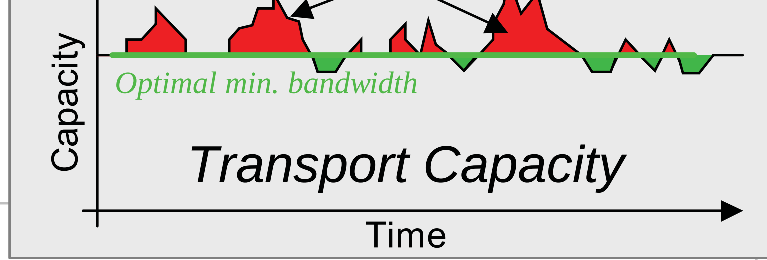
* May also run directly on fiber

The Solutions:
A Fragmented Solution Space



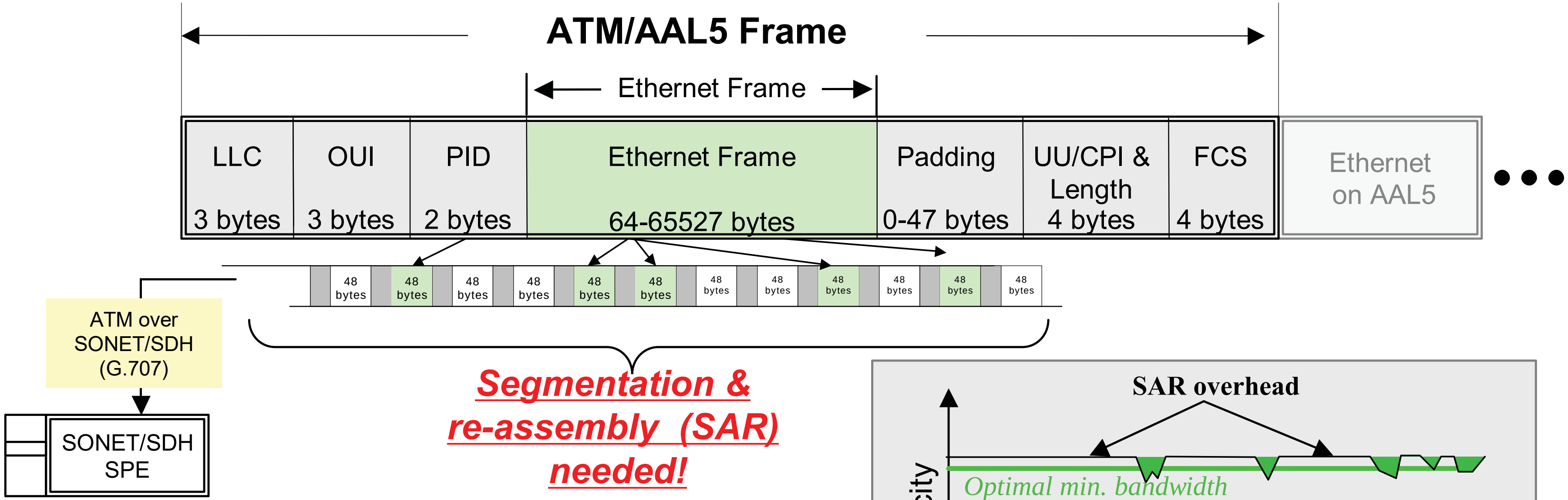
Example 1:
Ethernet over LAPS (ITU-T X.86)

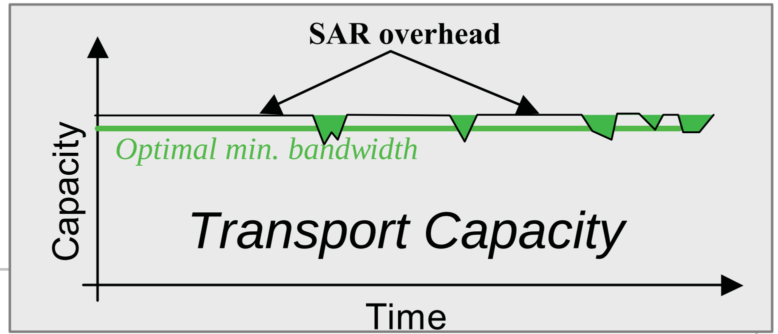




- **Ethernet in "HDLC-like Framing"**
  - Non-deterministic transport overhead
  - Byte stuffing interferes with QoS/bandwidth management
  - Flag-based delineation computationally expensive as speed increases

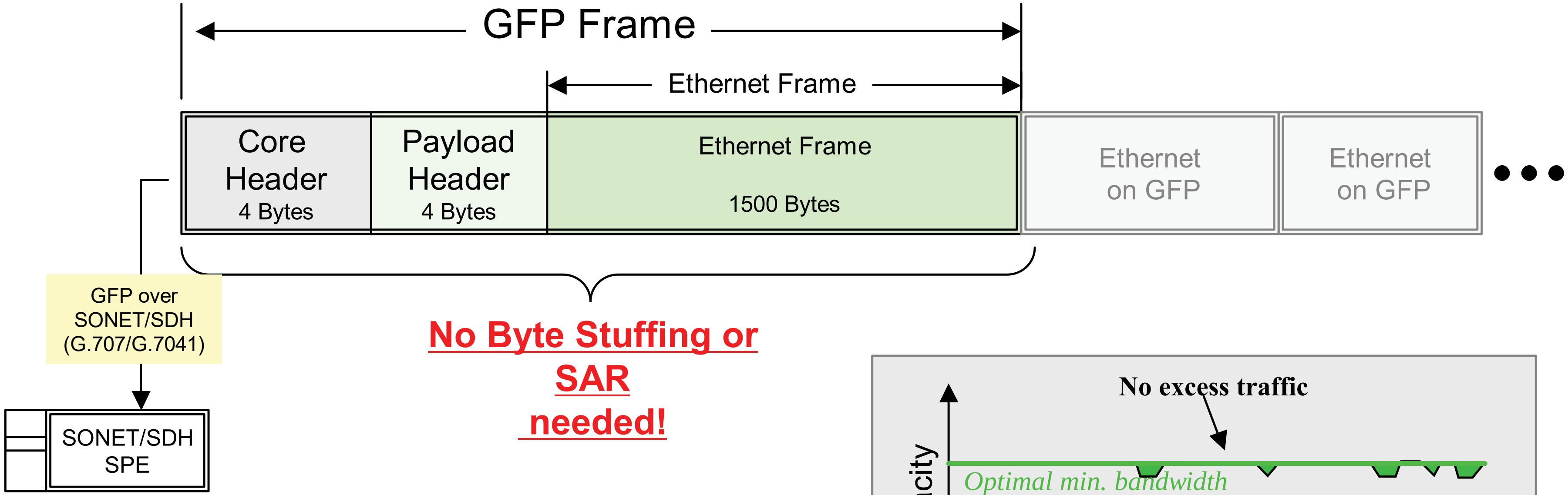
Example 2:
Ethernet over ATM (IETF RFC 1483)



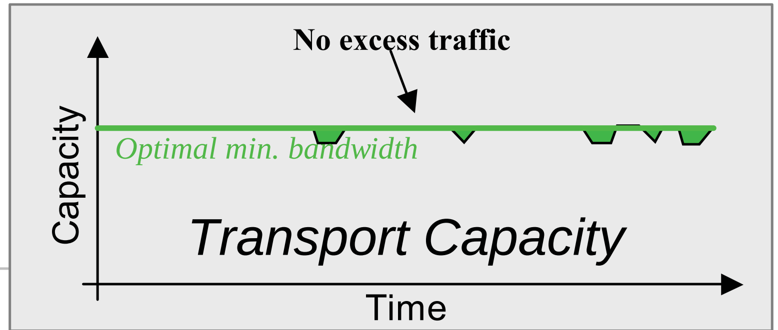


- **Ethernet over ATM**
  - Excellent QoS management capabilities
  - Large transport overhead for small packets
  - SAR expensive for simple connectivity services

Example 3: Ethernet over GFP-F (ITU-T G.7041)

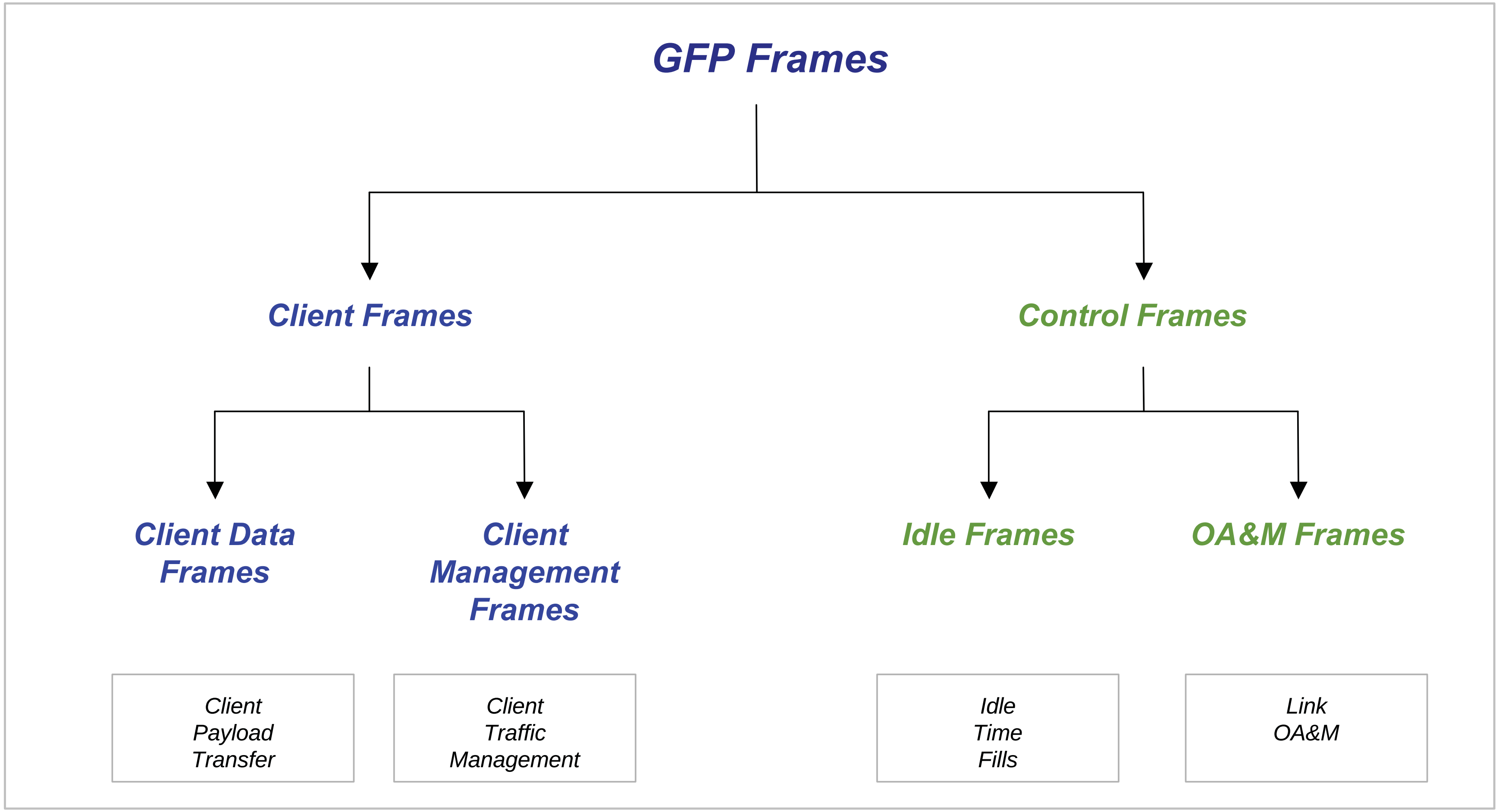


No Byte Stuffing or SAR needed!

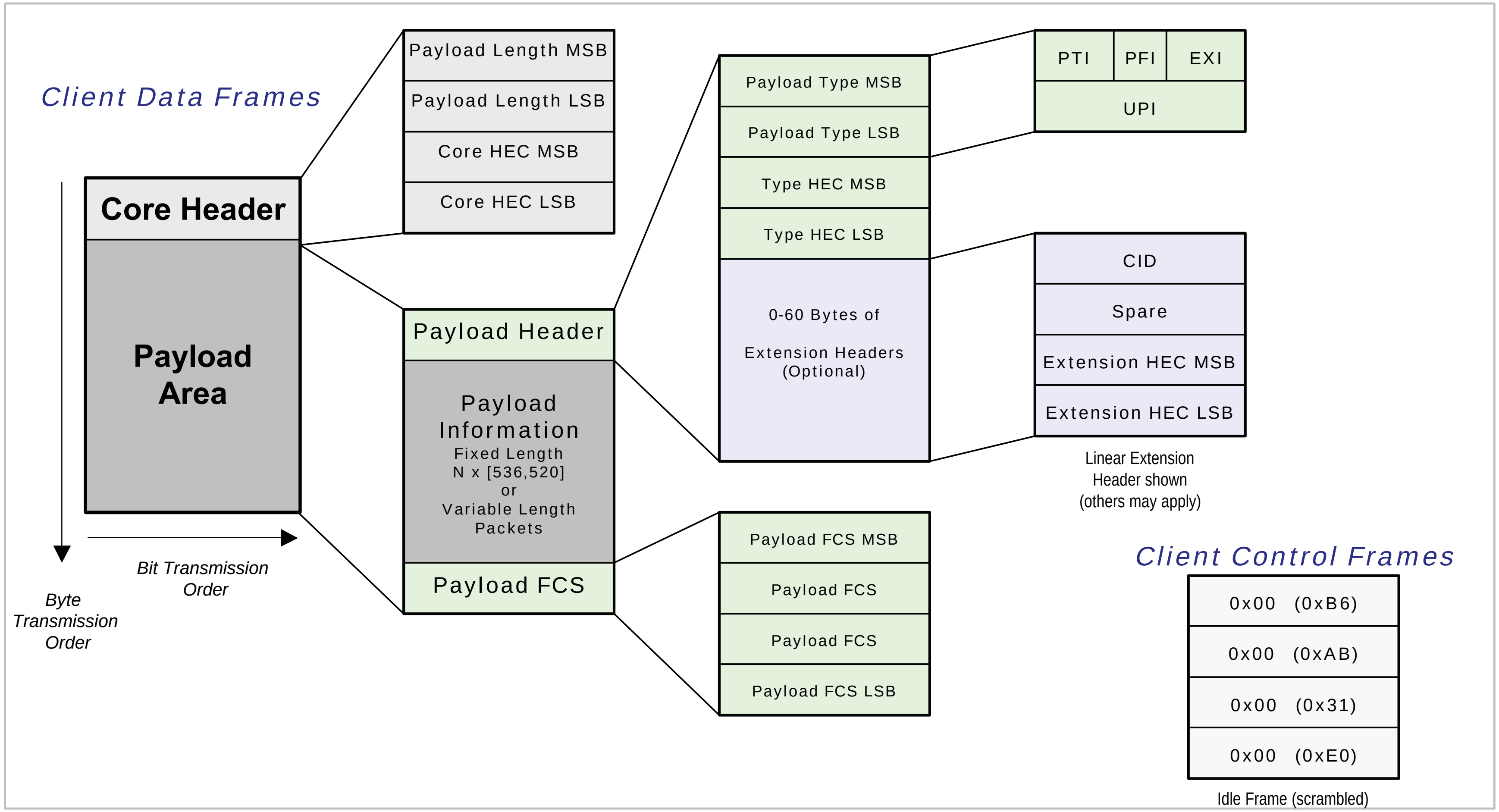


- **Ethernet over GFP**
  - Deterministic transport overhead
  - No adaptation interference with QoS/bandwidth management
  - Low complexity frame delineation that scales ups as speed increases

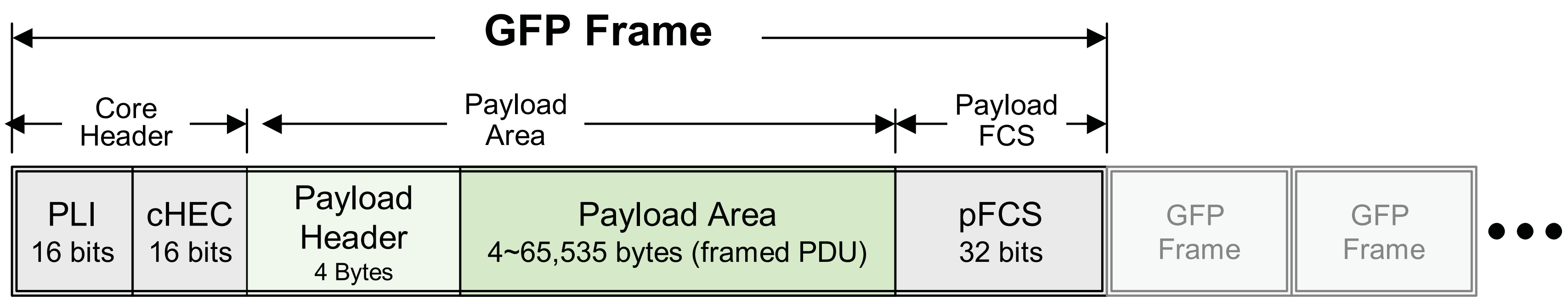
Frame Types


GFP Frames
Client Frames
Control Frames
Client Data Frames
Client Management Frames
Idle Frames
OA&M Frames
Client Payload Transfer
Client Traffic Management
Idle Time Fills
Link OA&M

Generic Frame Structure

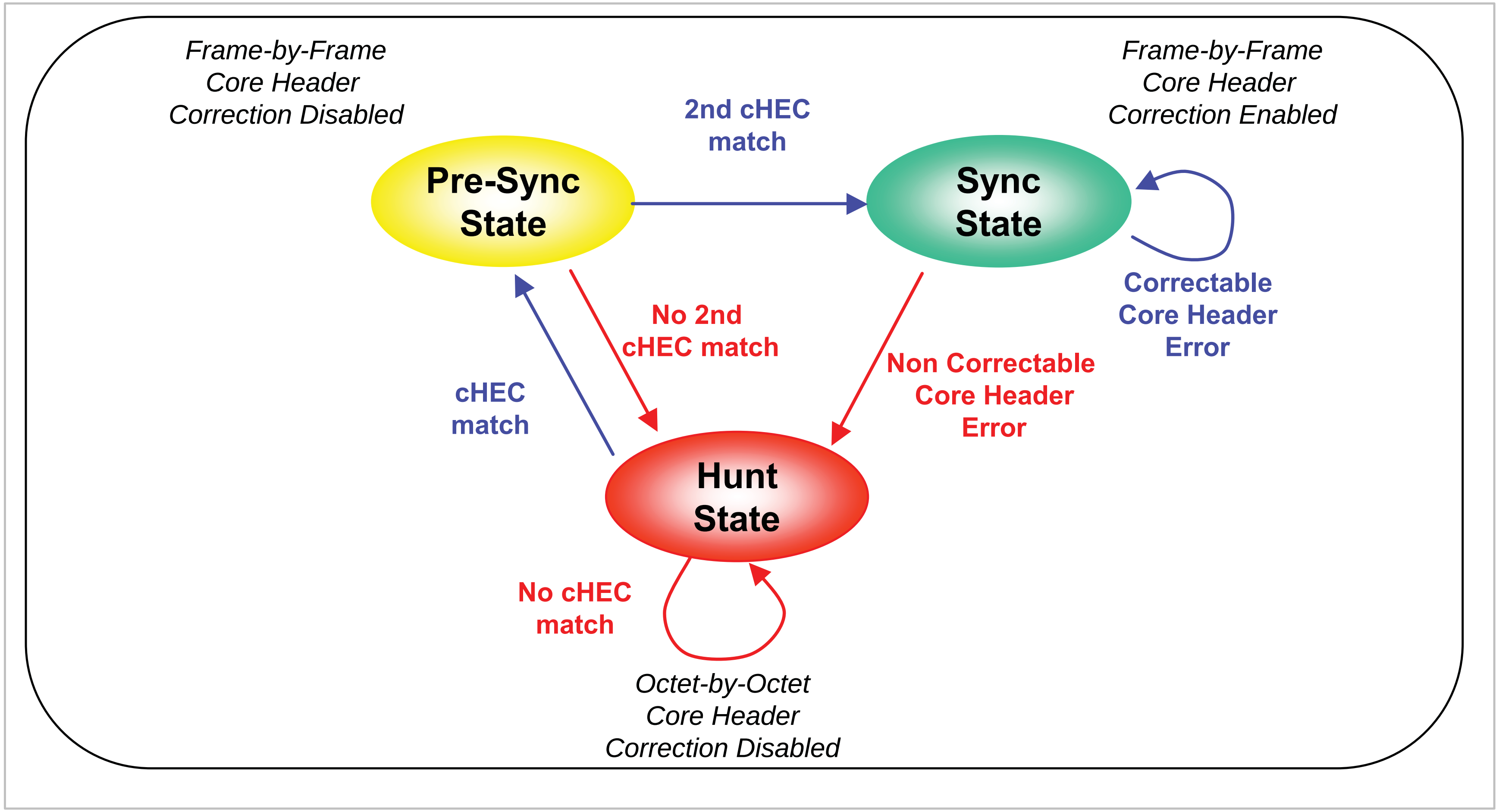


Basic GFP Frame Format



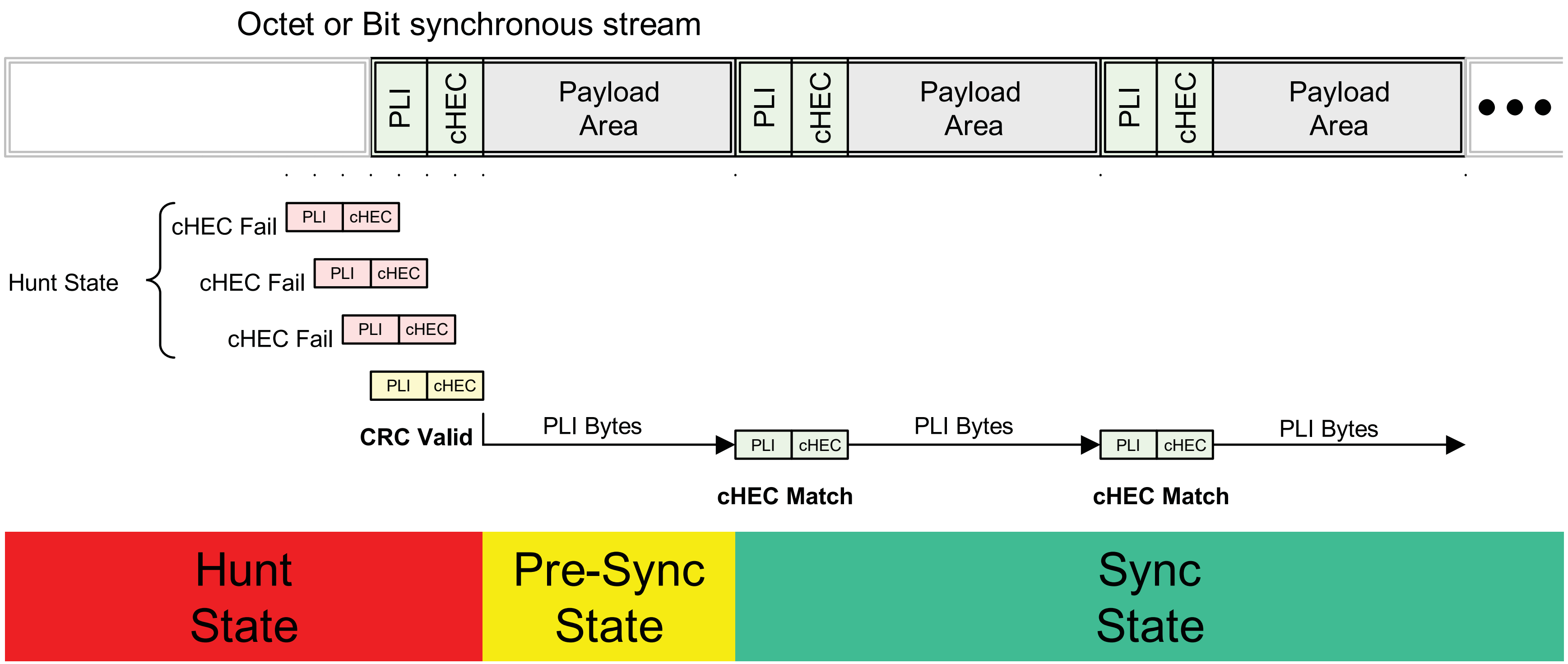
- **PLI** := Payload Length Indicator
- **cHEC** := Core Header CRC (ITU-T CRC-16)
- **Payload Area** := Framed PDU (PPP, IP, Ethernet, etc.)
- **Payload Header** := Client PDU management
- **pFCS** := *Optional* Payload FCS (ITU-T CRC-32)

Frame Delineation: GFP State Machine



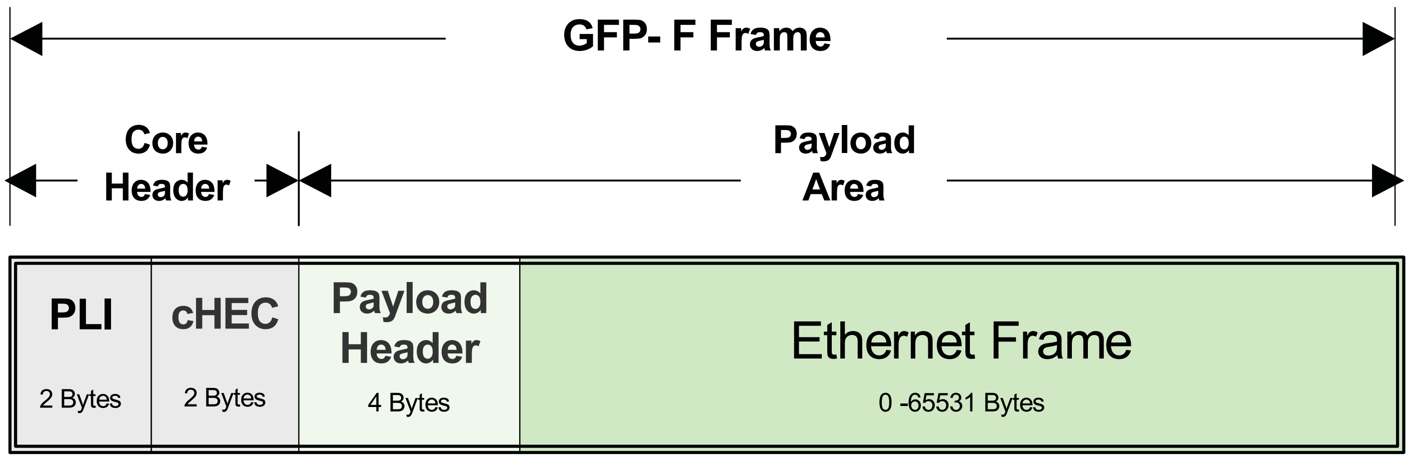
Frame Delineation
An Example

- Two consecutive cHEC field matches vs. computed CHEC
- Pointer-based (PLI field) offset to next incoming frame



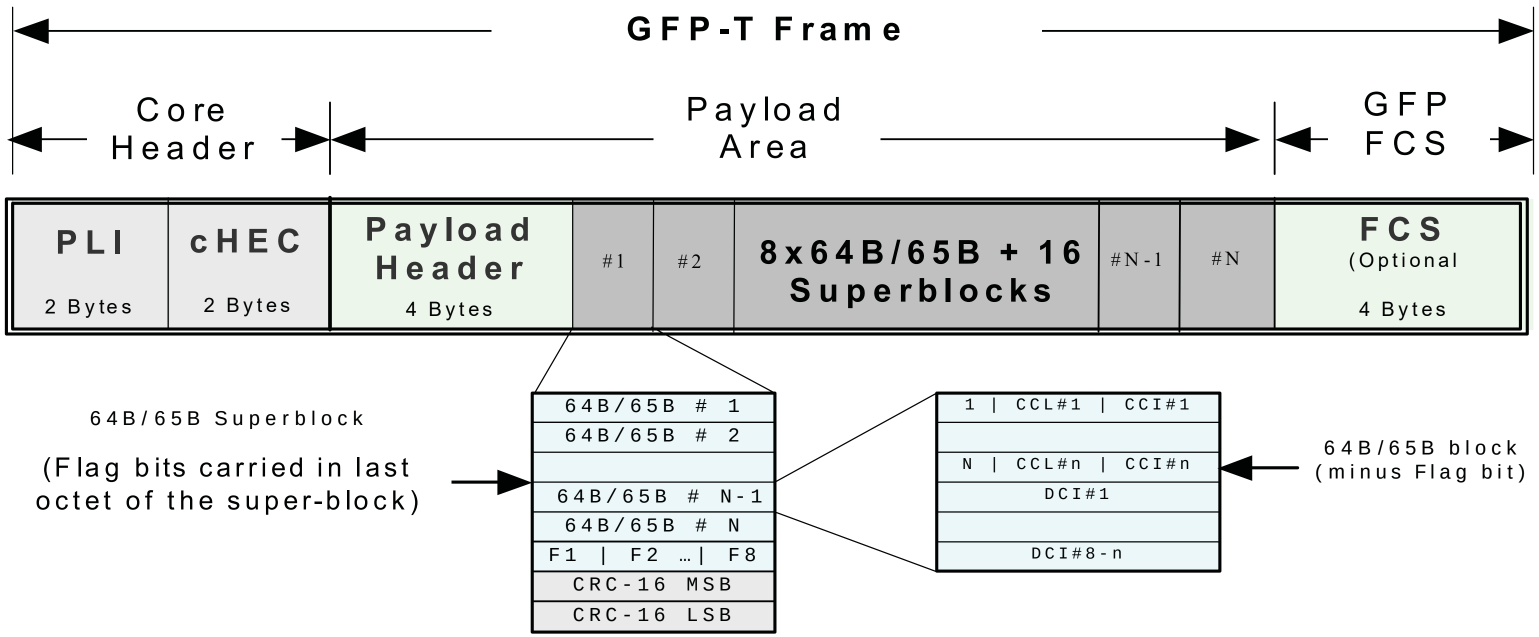
Adaptation Modes: Frame-Mapped GFP

- 1-to-1 mapping of L2 PDU to GFP payload
- Payload header indicates L2 PDU type
- Example: IEEE 802.3/Ethernet MAC frames



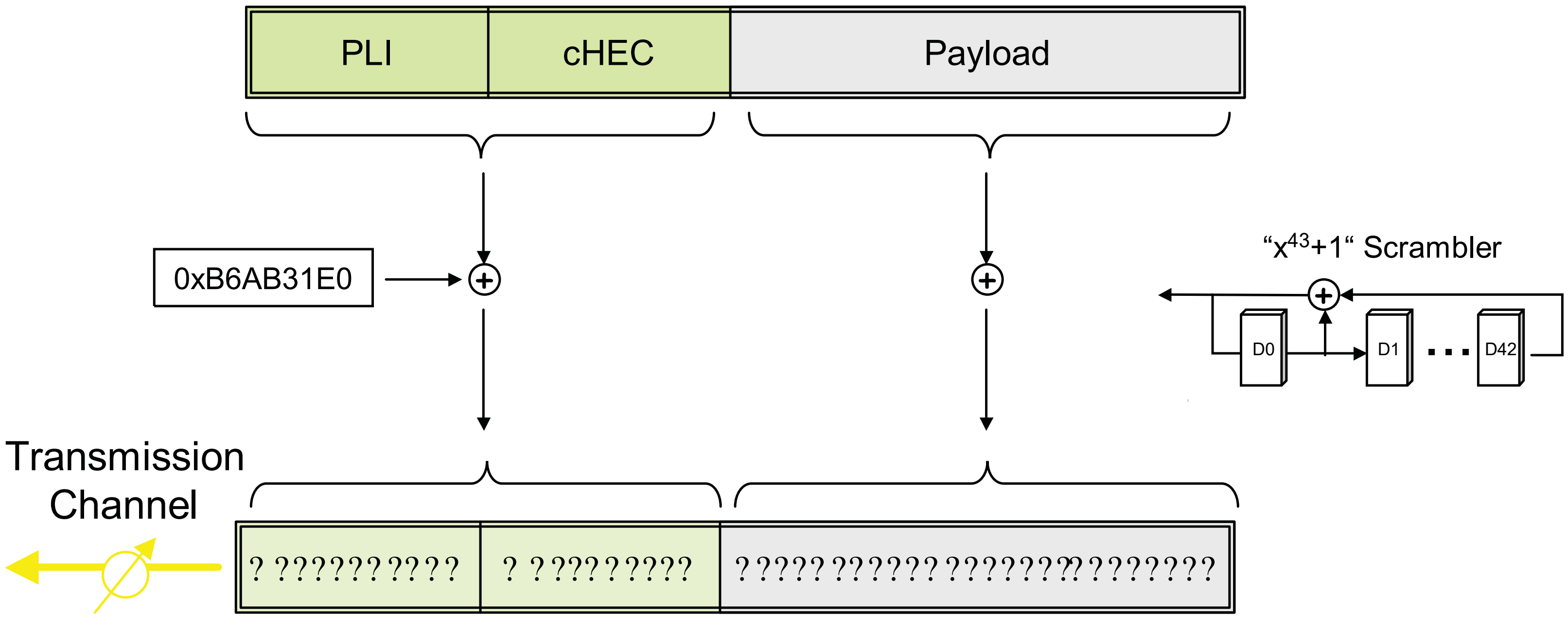
Adaptation Modes: Transparent-Mapped GFP

- N-to-1 mapping of L1 codewords to GFP payload
- Example: 8B/10B codewords



Scrambling:
DC Balance & Payload Scrambler

- **Header (PLI Field + CHEC) XOR'd with the 32 bit value *"0xB6AB31E0"* before transmission for DC balance.**
- **Payload scrambled with ATM-style self-synchronous scrambler**



Error Handling

- **Multi-bit Error Detection & Correction:**
  - Core Header – cHEC (ITU-T CRC-16):
  - Payload Type Field – tHEC (ITU-T CRC-16)
  - GFP-T payload (Optimized CRC-16)

1-bit error correction

3-bit error correction

- **Multi-bit Error Detection:**
  - Payload Extension Header – eHEC (ITU-T CRC-16)
  - Payload Information Field – pFCS (ITU-T CRC-32)

Summary
GFP Advantages

- ***Versatility:*** **Enables transport services for either Layer 1 or Layer payloads:**
  - PPP, IP, MPLS, Ethernet, HDLC & MAPOS at Layer 2
  - Fibre Channel, FICON, ESCON, Infiniband, DVB ASI at Layer 1
  - Endorsed by multiple communities including IEEE RPR WG & IETF
- ***Scalability:*** **Demonstrate transport capabilities at rates from 10Mbps to 10Gbps (and soon beyond)**
- ***Simplicity:*** **Eliminates need for ATM and HDLC networking for simple connectivity services resulting in more efficient, lower-risk component designs**
- ***Component availability:*** **Broader user demand expected to drive future applications, feature maturity, interface commonality and lower cost**

GFP Characteristics and Benefits

- **Simple Header Error Control (HEC) based synchronization:**
  - Generalizes ATM's HEC synchronization (inexpensive table lookup)
  - Supports variable or fixed length packets (IP/Ethernet datagrams, block codes or ATM cells)
- **Simple pointer-based frame delineation:**
  - Low processing complexity without payload expansion
  - Low (deterministic) adaptation overhead
  - High data link efficiency (scalable to 10Gbps and beyond)
  - Amenable to strict/loose QoS support, particularly for real-time services
- **Flexible traffic adaptation modes:**
  - Frame-Mapped GFP (GFP-F): *Suitable for elastic applications*
  - Transparent-Mapped GFP (GFP-T): *Suitable for in-elastic applications*