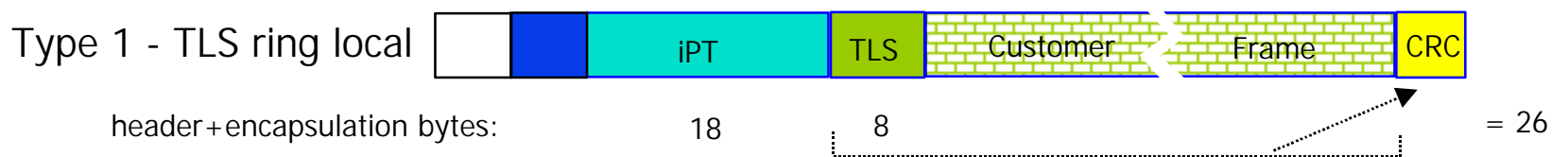
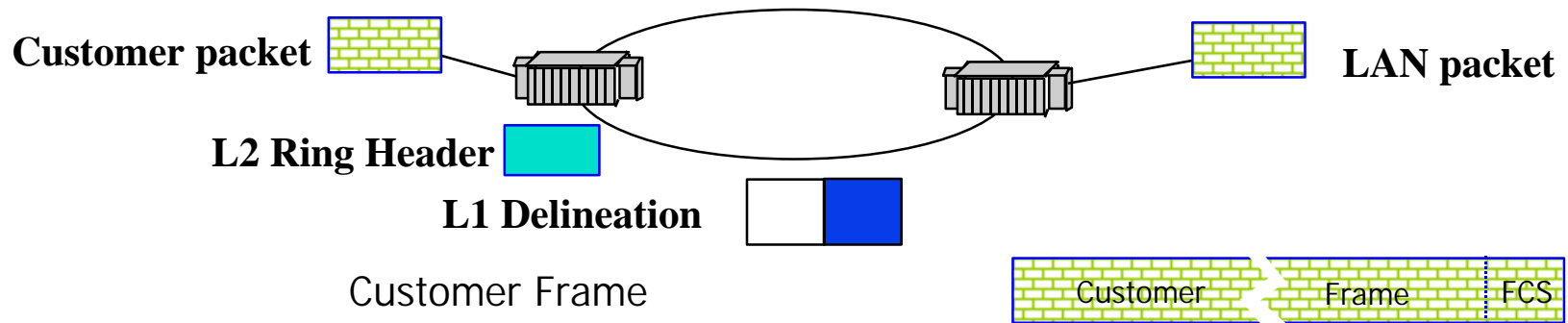


- **Motivations for Header**
- **Header Fields**
 - **Header Detail**

- **Global uniqueness in Addressing**
- **Destination addressing: Spatial reuse**
- **Source identification: source removal, learning, debug**
- **Handles black hole scenario: Ring**
- **QoS**
- **Instrumentation support**
- **Header checking: robustness under degraded condition**
- **Type field for encapsulation identification**
- **Flexible and evolvable**
- **Scalable**

L2 Packet Encapsulation

iPT Header



iPT Base Header (18 bytes)

iPT Header

Fields:	Dst port	Src port	UD/ Spare	priority DE COS	TTL	Destination Addr	Source Addr	HEC
Bits:	4	4	12	4	8	48	48	16

- **Destination Port (4 bits)**
 - Aggregation: Destination node Port number
- **Source Port (4 bits)**
 - Source node Port number
- **User Define**
 - E.g.
 - Version: 2 bits
 - Type: 4 bits
 - header extension: 2 bit
 - Spare: 4 bits
- **Time-To-Live (8-bits)**
 - maximum iPT node hop count
- **Priority (4 bits): two fields**
 - 1 bit: (DE) Discard Eligibility
 - 3 bits: COS
- **Destination Label (48 bits)**
 - iPT Destination Node Label
- **Source Label (48 bits)**
 - iPT Source Node Label
- **HEC (16 bits)**
 - Header Error CRC
 - $X^{16}+X^{12}+X^5+1$

- **Need Header verification**
- **Robust mechanism**
- **Potential single error correction**
- **HEC polynomial:**

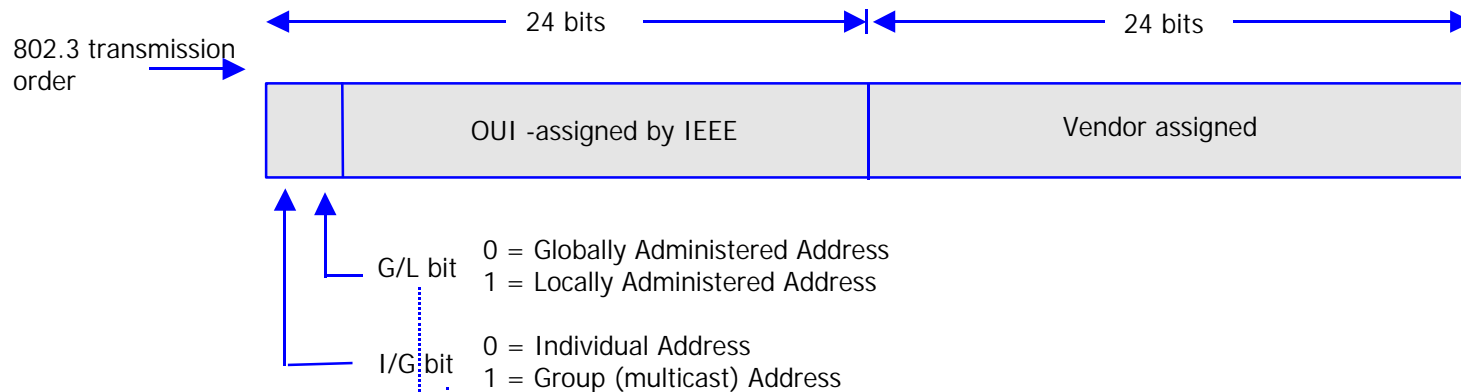
$$X^{16}+X^{12}+X^5+1$$

- **Broadcast**
 - 0xffff_ffff_ffff
- **iPT Label uses IEEE 802 MAC address format**
 - Ring
 - each matched label results two actions: drop and/or continue
 - broadcast always matches, other multicast and unicast are datafilled
 - drop only: ucast, drop and continue: mcast
 - mismatched labeled packets are continued

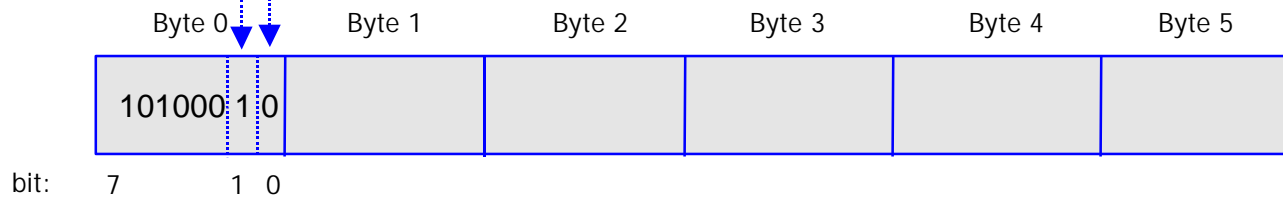
Bit Order Transmission

iPT Header

- **iPT Label uses IEEE 802 MAC address format**



- **IEEE 802.3 uses lsb transmission order; iPT uses msb**

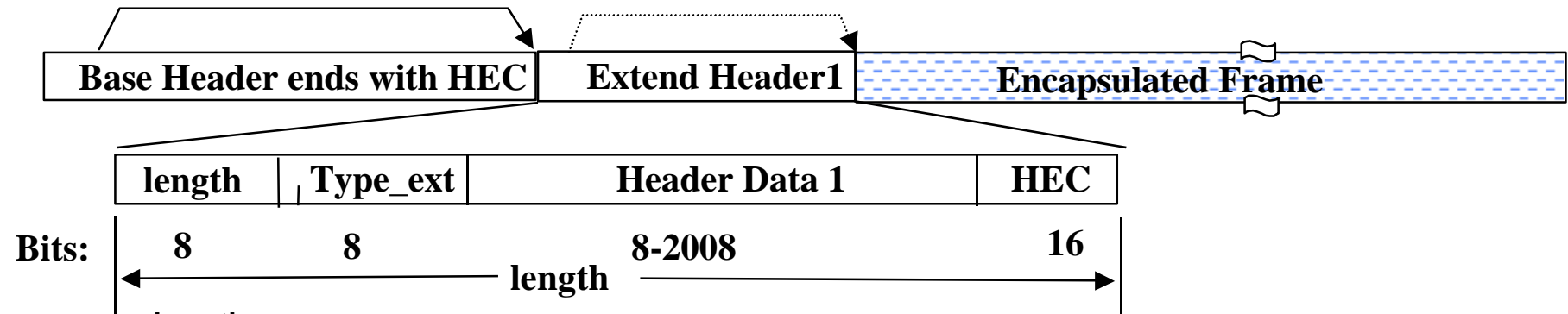


For an address in canonical format, eg. A2-41-42-59-31-51, Ethernet transmits byte 0 bit 0 first

iPT transmits byte 0 bit 7 first

In canonical format, byte 0 bit 0 is the I/G bit and bit 1 is the G/L bit

- **Type_ext Definition**
 - type 4'b1111 in base header indicates header extension
 - this is for future expansion, and is not processed by currently planned hardware



- **Length**
 - number of bytes in extended header including length, type, data, and HEC fields
 - length: in bytes min 4 with one data byte, max 255. The extended header ends at double-byte boundaries.
- **Type_ext Definition**
 - (1 bit) if set: another extended header follows, next header must also be in extended format
 - (7bits) header type: identifies header data type
- **Data**
 - extended header 1-251 bytes
- **HEC1**
 - HEC calculated over extended header only. Same implementation as HEC in base header

Header Types

iPT Header

- 0 - Etherframe
- 1 - TLS/L2 encapsulation
- 2 - 7 Reserved IPT Control Messages
- 4 - Ring Local Optimization
- 13 - IPT Msg. Data
- 14 - IPT Hello Message

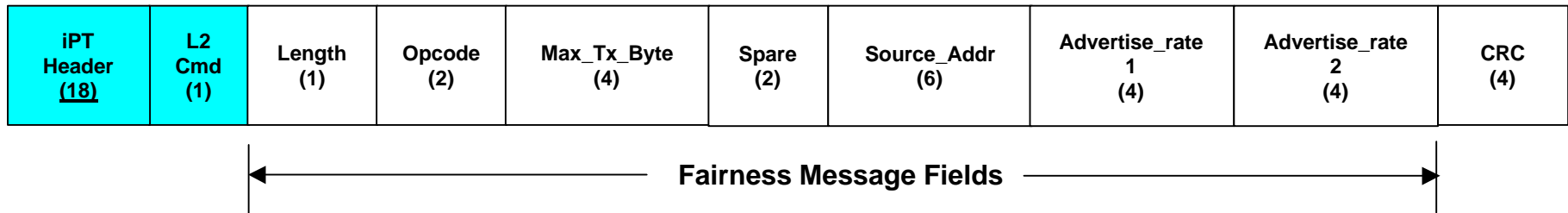
Fields:	User	Data/ control	Reserved	Transparent Domain Identifier	HEC
Bits:	7	1	16	24	16

- Need to handle carrier network size:16M
- Qtag Translation
- Customer separation
- End point provisioning

1. Transparent Lan Service (TLS)/L2

iPT Fairness Message Format

iPT Header



Length [7:0]: Length in bytes of fairness message. Covers Fairness message fields

OPCODE[15:0]: [15] 0=invalid message, 1=valid message
[14] 0= not loop back message, 1= loop back message
[13] 0= not direct, 1= direct
[12] 0= forward, 1=not forward
[11] 0=down stream Rx failed, 1=not failed
[10] 0= version
[9:4] hop count to congestion
[3:1] last HOL packet priority
[0] 0= no HOL congestion, 1 HOL timer congestion

Max_Tx_Byte maximum link BW in bytes.

Source_Addr Message Source address, used for source removal

Advertised_raten Advertised rate to upstream node, 2 classes defined

CRC CRC-32 for message integrity

Serial scheme

CRC-32 Generation

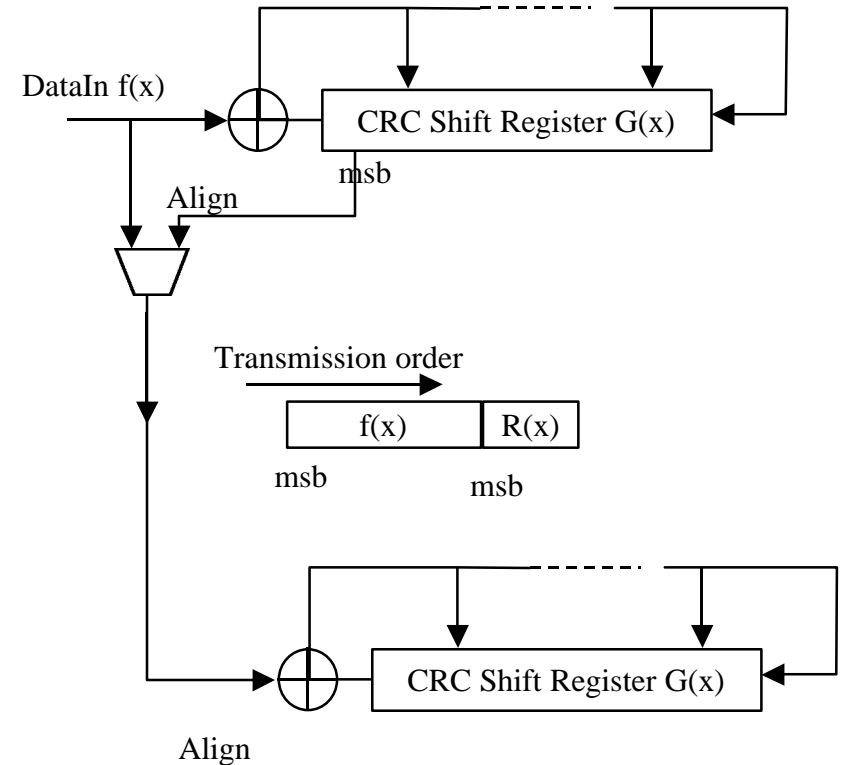
- 1) shift $f(x)$ msb first
- 2) pad to 32 bit word aligned
- 2) divide: $f(x)/G(x)$, $G(x)$ **PRESET** at beginning

$$G(x) = x^{32} + x^{26} + x^{23} + x^{22} + x^{16} + x^{12} + x^{11} + x^{10} + x^8 + x^7 + x^5 + x^4 + x^2 + x + 1$$

- 4) append $R(x)$ to $f(x)$ as CRC

CRC-32 HW Checking

- shift in $f(x)$, msb first
- divide by $G(x)$, **PRESET** at beginning
- continue shift $R(x)$
- CRC register becomes all zeros, if error free..



Some Packet Delineation Schemes:

1. HEC: Header Error Check
ATM
2. HDLC: bit/byte escaping
POS, PPP-POS
3. Ethernet: Preambles, SOF, IPG
4. COBS: