Clause 50: WIS Overview

Andy Baldman
UNH InterOperability Lab
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Overview

- WIS Objectives
- Summary of Functions
- WIS Service Interface
- The SPE: A Closer Look
- Scrambling
- Fault Processing
- Synchronization

WIS Main Objectives

- Support full duplex Ethernet MAC
- Support PCS, PMA, and PMD as defined for 10GBASE-W
- Support a 10GB/s effective signaling rate at the MAC layer, with MAC in pace mode
- Provide a 9.95328 GB/s data rate at the PMA service interface
- Provide SONET STS-192c and SDH VC-4-64c compatible frame rates
- Implement the framing, scrambling, and defect/anomaly detection to allow minimal compatibility with the requirements of SONET/SDH networks
- Preserve the duplex and BER objectives of the PCS and PMD sublayers with which it may be used

In the transmit direction…

- Mapping of ‘data-units’ from the PCS into the payload capacity of a STS-192c SPE
- Addition of Path overhead and fixed stuff to create SPE
- Creation of frames by adding Line and Section OH to SPE
- Generation of BIP octets in the Section, Line, and Path overheads
- Scrambling of the WIS frames
- Transmission of the frames to the PMA via the PMA service interface

… and at the other end

- Reception of data from the PMA
- Delineation of octet boundaries (if no SUPI, i.e. WWDM PMA) and STS-192c frame boundaries within the data stream from the PMA
- Descrambling of the payload and OH fields within the frames
- Processing of the pointers in the line OH to delineate the SPE boundaries within the received WIS frames
- Checking the Bit-Interleaved-Parity (BIP) octets at the Section, Line, and Path levels
- Removal of the SOH, LOH, POH, and fixed stuff
- Handling errors and exception conditions and reporting to Layer Management
- Mapping of the octets extracted from the payload into data-units to be passed up to the PCS

Keeping track of your bits…

- SONET:
  - Numbered 1 to 8 inclusive
  - 1 is MSB, 8 is LSB
  - Transmitted MSB to LSB, 1 to 8, left to right, just like you read them
- Ethernet:
  - Numbered 0 thru 7 inclusive
  - 0 is LSB, 7 is MSB
  - Transmitted LSB to MSB, 0 to 7, like you're reading them backwards
- Clause 50 uses the SONET numbering scheme, except for the WIS service interface

WIS Service Interface

- Allows the 10GBASE-R PCS to get info to and from the WIS
- WIS_UNITDATA.request(tx_data-unit<15:0>)
  - 16 bit vector = single data unit prepared by the PCS for transmit
  - 16 bits represented by tx_data-unit<15:0> where 0 is the LSB of the vector, and bits <7:0> are the LSO, which is generated first by the PCS
  - When the WIS transfers the data from the PCS to the PMA, it is mapped s.t. the LSO is transmitted first to the PMA
  - The 16-bit words are transmitted down into the WIS at 599.04 MHz, which corresponds to the STS-192c PAYLOAD rate of 9.58464 GB/s

WIS Service Interface cont.

- WIS_UNITDATA.indicate(rx_data-unit<15:0>)
  - 16 bit vector = single data unit prepared by the WIS, going up to the PCS
  - 16 bits represented by tx_data-unit<15:0> where 0 is the LSB of the vector, and bits <7:0> are the LSO, which is processed first by the PCS
  - When the WIS obtains the data from the PMA, it is mapped s.t. the LSO is received first by the PCS
  - The 16-bit words are transmitted up to the PCS at 599.04 MHz
- WIS_SIGNAL.request(FRAME_LOCK)
  - Sent by PCS down to WIS to indicate that it has/doesn't have delineation of the code words present in the received data stream, via OK or FAIL status
  - This causes the WIS to verify the presence/absence of a LCWD condition, and report to peer via LCD-P defect indication

WIS Service Interface cont.

- WIS_SIGNAL.indicate(SIGNAL_DETECT)
  - Sent by WIS up to PCS to indicate status of the Receive process
  - Used to propagate detection of severe error conditions to the PCS (e.g., no valid signal being received from the PMA) via OK or FAIL status
  - OK = Rx process is delineating valid payload info from the PMA stream and it is being passed to the PCS via WIS_UNITDATA.indicate
  - FAIL = Errors detected that prevent valid data from being passed up to PCS. In this case WIS_UNITDATA.indicate(rx_data-unit<15:0>) are meaningless
  - Generated whenever there is a change of value of SIGNAL_DETECT
  - Effect of receipt not specified by WIS

A pretty picture

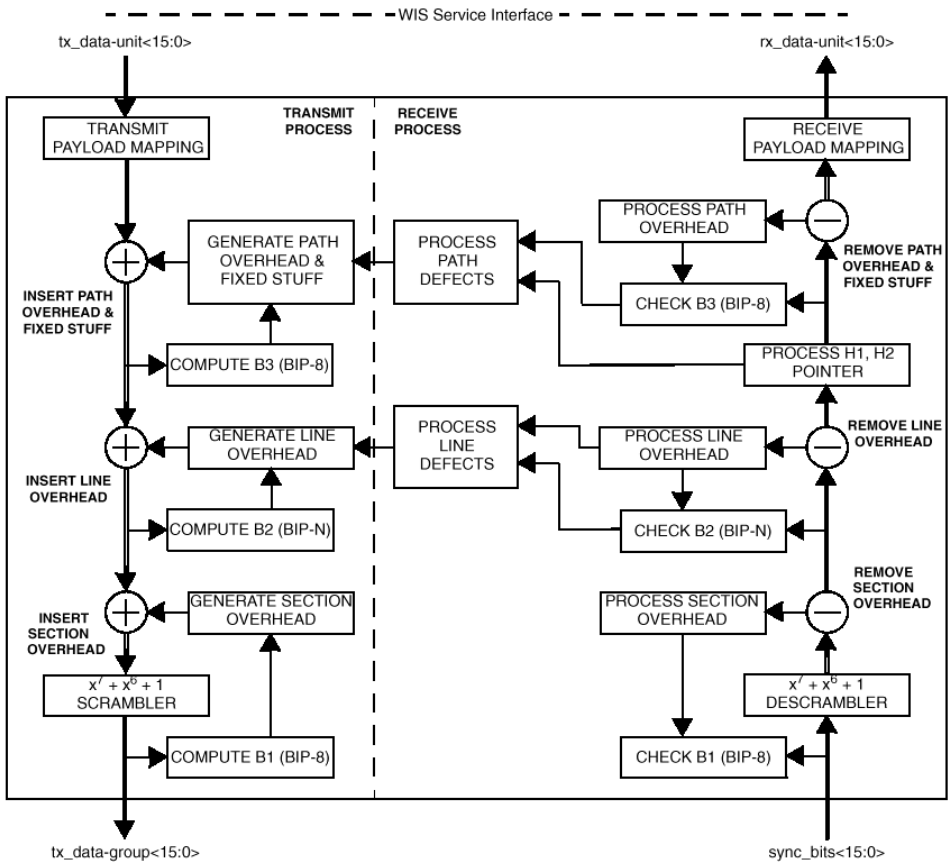


Figure 50–3—WIS Transmit and Receive processes

Review

- Transmit
  - Get data units from PCS
  - Map to payload
  - Add POH and fixed stuff to complete SPE
  - Add LOH and SOH
  - Scramble with frame-synchronous scrambler
  - Do all of this once every 125us (i.e., 8000 frames/s). No gaps between frames.
  - Send to PMA

- Receive
  - Get stream from PMA
  - Delineate octet and frame boundaries (i.e., 'sync')
  - Descramble
  - Strip off SOH and LOH. Get payload pointer in LOH
  - Find start of SPE and extract POH
  - Strip off Fixed Stuff and pass the resulting data stream up to the PCS

Inside the SPE (with a little math)

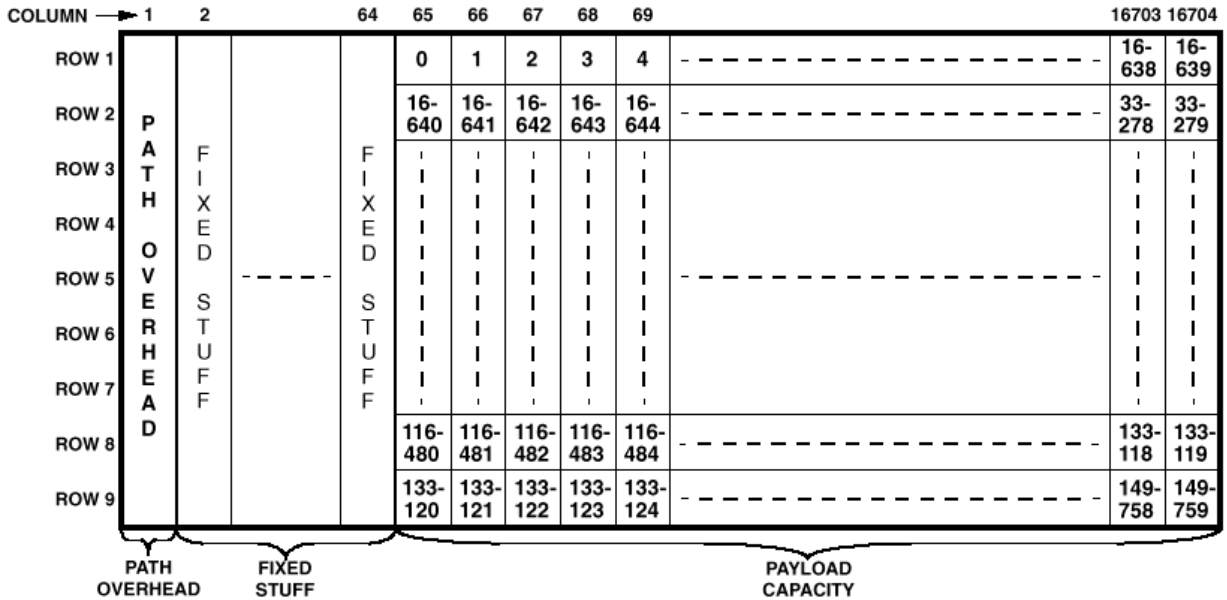


Figure 50–4—Structure of Synchronous Payload Envelope

9 rows x 16704 cols. 1 col = POH. 63 cols = fixed stuff. Rest is free.

16704-64 = 16640 x 9 rows = 149,760 octets x 8 bits x 8000 fps = 9.58464GB/s

Free bytes are numbered 0 - 149759. Tx order is left-right, top-bottom.

Also, 149,760 / 2 = 74880 16-bit words per WIS frame.

Bit remapping revisited

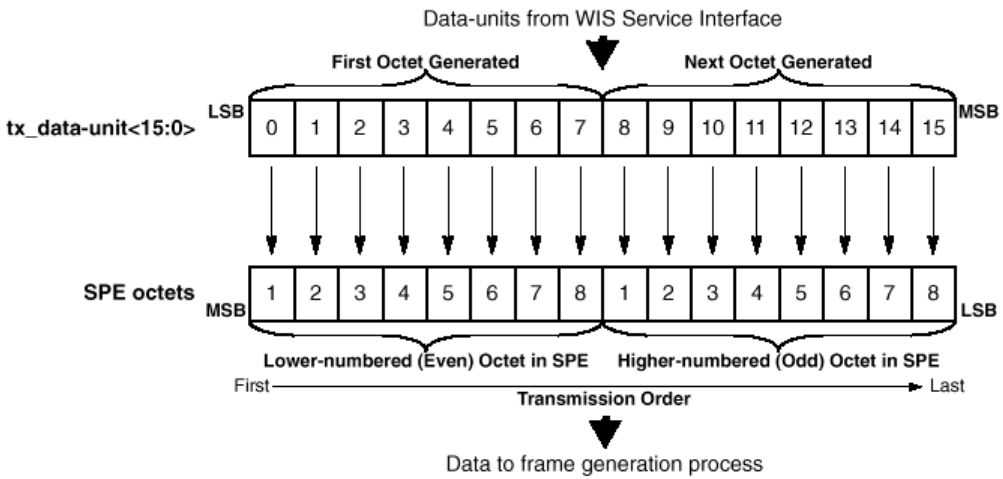


Figure 50–5—Transmit bit relabeling function

- Bit 0 of tx_data_unit<15:0> becomes bit 1 of the lower numbered (even) SPE octet
- Bit 15 of " becomes bit 8 of the higher numbered (odd) SPE octet
- This is done because SONET transmits MSB-LSB, 1-8, just like you read them while ethernet transmit order is LSB-MSB, 0-7, like reading them backwards
- Remapping causes *payload* of SPE to be sent LSB to MSB wrt data accepted from WIS service interface, but the *POH, LOH, and SOH* are MSB-LSB as required by SONET

Reception Process

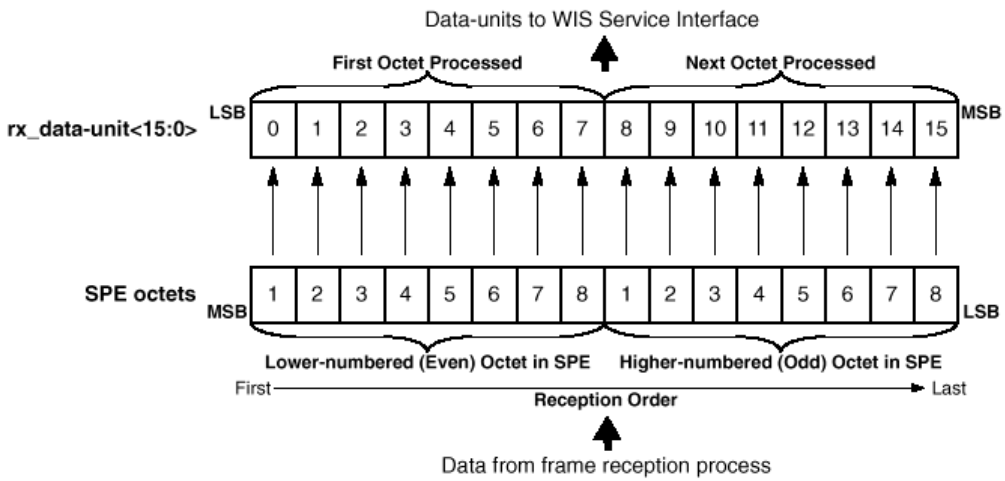
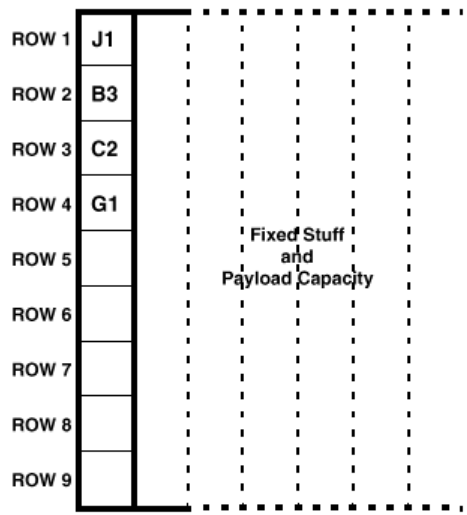


Figure 50–6—Receive bit relabeling function

- End result is that bits get received in the 'proper' order from an Ethernet perspective

Path Overhead in Detail

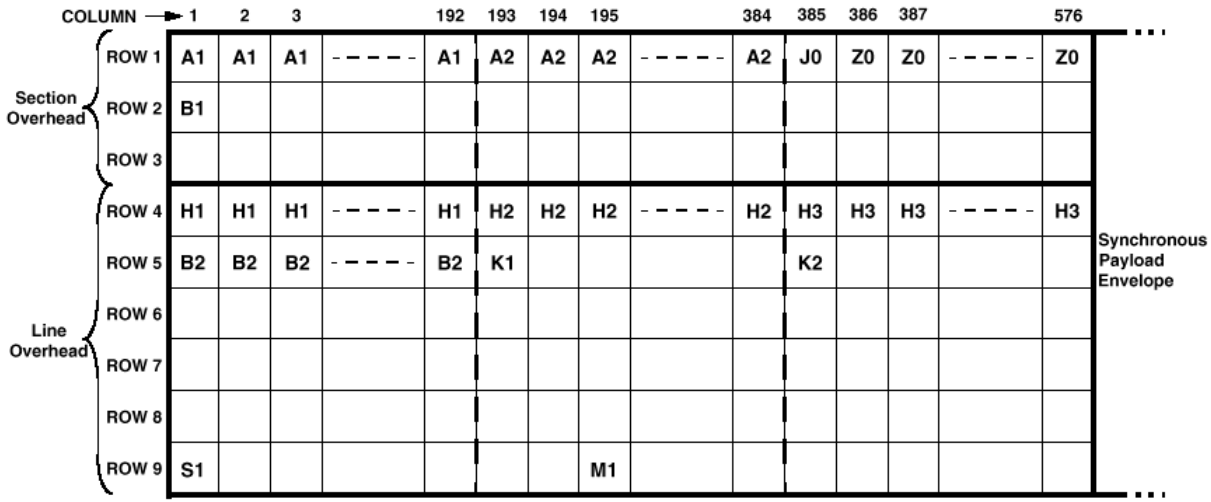
- J1 = STS Path trace (used to send 16-octet repeating trace pattern) - extracted and placed in WIS JI Rx register set.
- B3 = Path BIP octet
- C2 = STS Path signal label (00011010 = 'Selector Field' defined for 10GB ethernet)
- G1 = Path status (Used for RF indication
- Rest are fixed at 00000000



NOTE—The Path Overhead comprises 9 octets in total. Only 4 octets are defined for the WIS. Undefined and unused octets are left blank.

Figure 50–8—Structure of Path Overhead Generated by WIS

Section and Line Overhead



NOTE—The Section and Line Overhead comprise 5184 octets in total (576 x 9). Only 1349 octets are defined for the WIS. Undefined and unused octets are left blank.

Figure 50–7—Structure of Section and Line Overhead Generated by WIS

- A1, A2 = Frame Sync (F6, 28). Z0 = SONET reserved (fixed 11001100).
- H1, H2= pointer (fixed 522d). H3 = Ptr. action (fixed 00000000).
- B2 = Line BIP.
- K1 = APS (fixed 00000001). K2 = 00010+Line Remote Defect Indication (RDI-L).
- S1 = Sync messaging (fixed 00001111 - don't use tx clock for synchronization)
- M1 = Inform partner of BIP errors (fixed 00000000). ALL OTHERS 00000000.

‘Floating SPE’

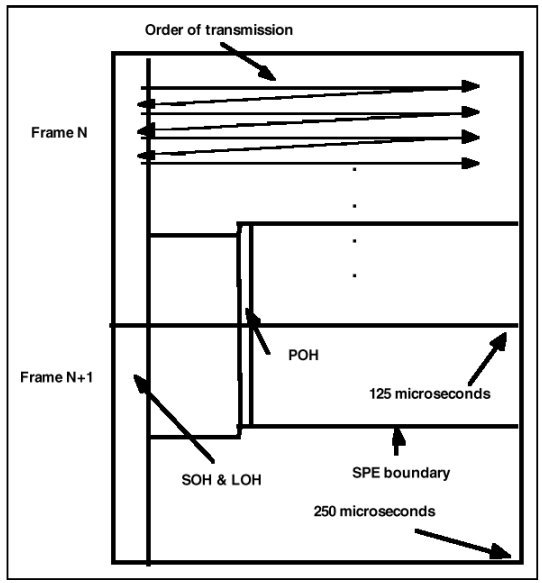


Figure 1 - Order of byte transmission

- SPE spans across frame boundaries

Scrambler

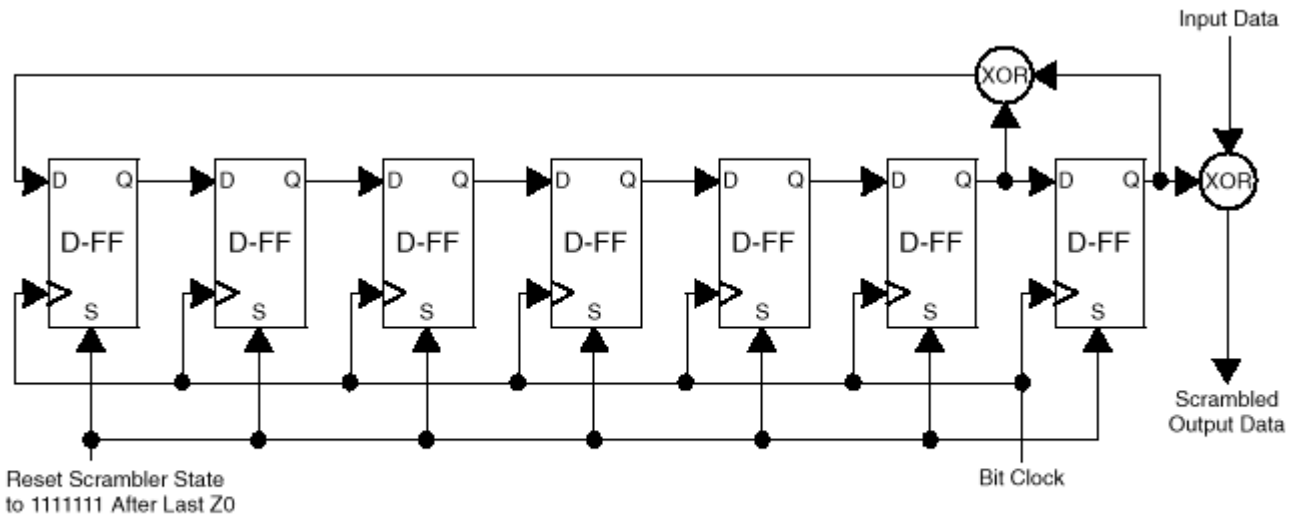


Figure 50–9—Scrambling function

- Used to provide DC balance (equal 1's and 0's), and sufficient transition density
- Frame-synchronous 127-bit repeating pattern. (Scrambler seed is reset at start of every frame to 1111111.)
- Covers all except A1, A2, J0, and Z0 octets. Starts with MSB, bit 1 of leftmost octet, and works left to right (...just like you read them).

Fault Processing - SONET Terms

- Anomaly - "A discrepancy between the desired and actual characteristics of an item."

- Defect - "A limited interruption in the ability of an item to perform a required function."

ANSI vs. 802.3 Faults

- ANSI

Table 2 - Near-end events and far-end reports

Primitives for failure and performance monitoring							
	Physical media	Section		Line		Path (facility)	
	Defect	Anomaly	Defect	Anomaly	Defect	Anomaly	Defect
Near-end	LOS	BIP-N (S)	SEF/LOF	BIP-N (L) BIP-2 (LV)	AIS-L SEF-LV LOF-LV	BIP-N (P)	LOP-P AIS-P TIM-P UNEQ-P
Far-end				REI-L REI-LV	RDI-L RDI-LV	REI-P	RDI-P OR ERDI-P

- 802.3

Table 50–4—WIS supported Near end events and Far end reports

	Physical media	Section		Line		Path	
	Defect	Anomaly	Defect	Anomaly	Defect	Anomaly	Defect
Near end	LOS	BIP-N(S)	SEF/LOF	BIP-N(L)	AIS-L	BIP-N(P)	LOP-P AIS-P
Far end	N/A	N/A	N/A	REI-L	RDI-L	REI-P	ERDI-P

All must be detected by WIS, but only a subset get processed

Also…

- WIS must support Path Label Mismatch (PLM-P)
  - Occurs when the C2 bytes ('selector field') in 5 successive frames contain a label different from those allowed to be received.
- Loss of signal (LOS)
  - ANSI - defined as "no transitions on the incoming signal (before descrambling) for time T (2.3<T<100us)"
  - Clause 50 specifically defines T to be 3 row periods (~41.6667us)
  - Clause 50 also states that the WIS "shall not use any services provided by the PMA or PMD sublayers for this purpose.

Octet and Frame Sync

- State-Machine has basically 3 parts:
  - 1) Look for pattern of *n* consecutive A1's
  - 2) Look for *n* A1's followed by *k* A2's
  - 3) Look for repetitions of (2) spaced 155,520 octets apart

- Failure to maintain sync results in Severely Errored Frame (SEF), or Loss Of Frame (LOF) being indicated

Error Propagation

- WIS sets WIS_SIGNAL.indicate(SIGNAL_DETECT) to FAIL if any of the following occur:
  - WIS can't achieve octet/frame sync
  - A Path Label Mismatch (PLM-P) defect is detected
  - An Alarm Indication Signal (AIS-P) is received. (5 frames with K2(6,7,8) = 111)
  - A Loss of Pointer (LOP-P) defect is detected.

- Reporting to PCS must happen ASAP, and recovery must provide valid data to PCS within 125us of the removal of all error conditions

- WIS must also be able to identify when the PCS signals Loss of Code Group Delineation via WIS_SIGNAL.request(FRAME_LOCK)
  - If this persists for >3ms, an LCD-P defect shall be reported to far-end WIS
  - Reporting shall cease when PCS reports lock for at least 1ms.

PMA Service Interface

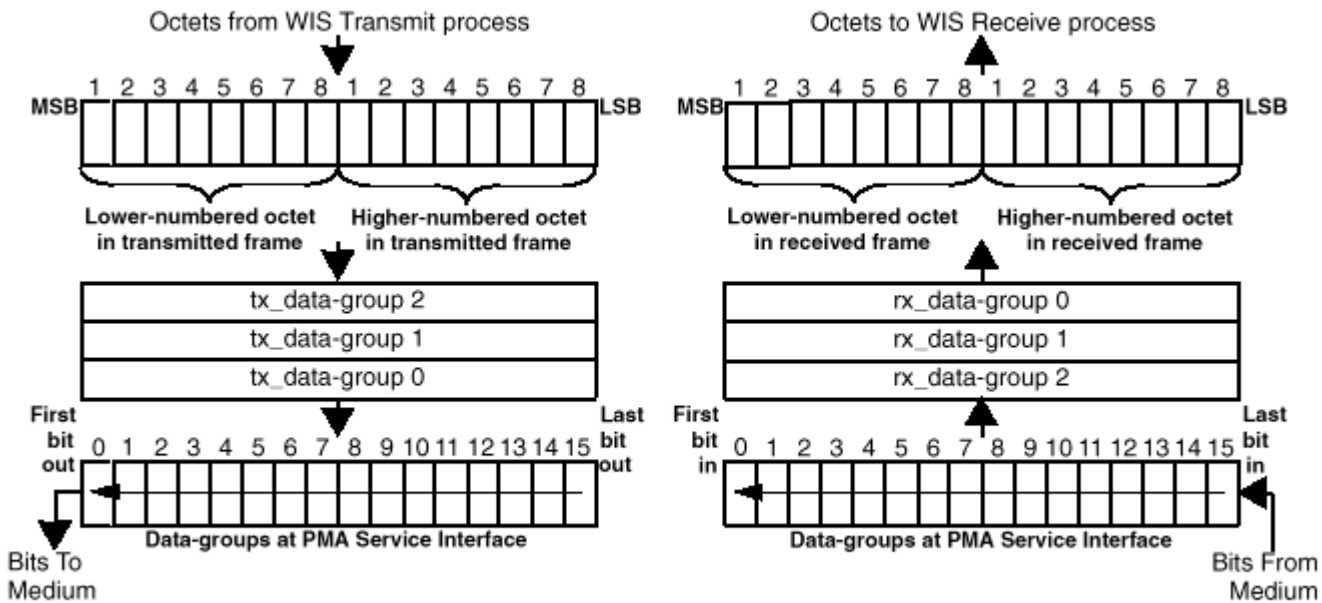


Figure 50–11—Transmission order

- PMA Svc. Int. may also be instantiated as a physical interface (i.e., the XSBI)

Last PMA Detail…

- WIS also uses signal detect primitive from PMA to determine when the PMA is unable to provide valid data to the WIS. The primitive is used to unlock the frame/octet sync state machine and force re-synchronization

Management registers

- (Not Today…)

Conclusion

- Review
- Questions