Ethernet 40/100Gb

Jiří Novotný
novotny@ics.muni.cz

7.10.2009 Klínovec

Ethernet Evolution

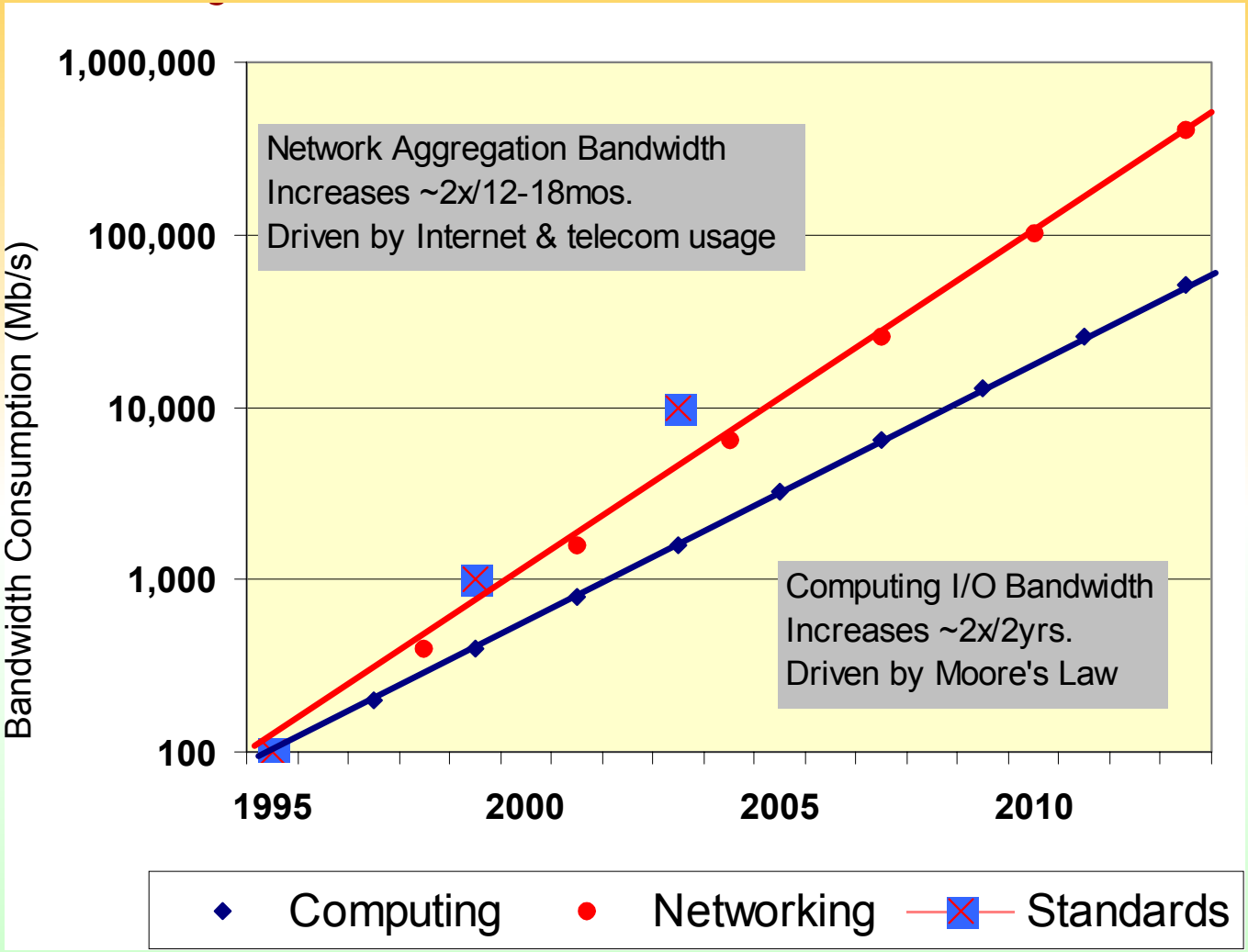

Fig.: Ethernet Evolution

Ethernet Evolution

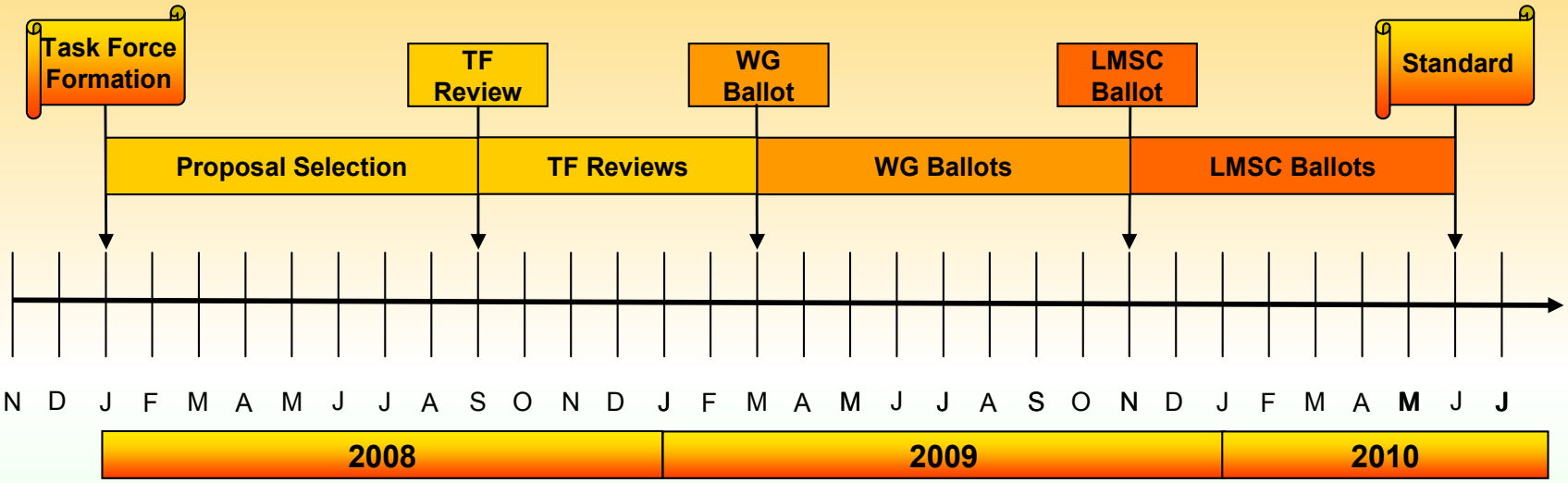

Fig.: Standards Timetable of 40/100G Ethernet

Standard IEEE 802.3ba

Milníky

- 1973-1975 první návrh ve firmě XEROX
- 1980 zahájen proces návrhu standardu
- 1982 standard *IEEE 802.3*
- 1983 první dostupná ethernetová karta 3COM
- 1995 100MbE s autonegociací *IEEE 802.3u*
- 1999 1GbE (včetně TP) *IEEE 802.3ab*
- 2002 10GbE *IEEE 802.3ae*
- 2007 zahájen proces standardizace 40/100GbE *IEEE 803.2ba*
- 2010 předpokládané ukončení procesu standardizace 40/100GbE
- 2015 předpověď Roberta Metcalfa - 1TbE

Model ethernetu

OSI model

aplikační vrstva
prezentační vrstva
realační vrstva
transportní vrstva
síťová vrstva
datová vrstva
fyzická vrstva

Model ethernetu

Datová vrstva

počet byte	význam
7	preambule
1	start symbol
6	cílová adresa
6	zdrojová adresa
4	případný VLAN tag
2	délka/typ
42-1500	data
4	kontrolní součet

Model Ethernetu

Fyzická vrstva 10MbE až 100GbE

Mb/s	**100Mb/s**	**1Gb/s**	**10Gb/S**	**40Gb/s**	**100Gb/s**
MAC	MAC	MAC	MAC	MAC	MAC
REC	REC	REC	REC	REC	REC
MII	*MII*	*GMII*	*XGMII*	*XLGMII*	*CGMII*
PLS	PCS	PCS	PCS	PCS	PCS
AUI	PMA	PMA	PMA	PMA	PMA
PMA	PMD	PMD	PMD	PMD	PMD
MDI	*MDI*	*MDI*	*MDI*	*MDI*	*MDI*
MEDIUM	MEDIUM	MEDIUM	MEDIUM	MEDIUM	MEDIUM

Model ethernetu

Rozhraní

Speed	Reconcilation	Extension	Removable	Medium
10M	MII	AUI	AUI	Coax, TP, Fb
100M	MII		No	TP, Fb
1G	GMII		GBIC, SFP	TP, Fb
10G	XGMII	XAUI	XENPACK, XFP, SFP+	TP, Fb
40G	XLGMII	XLAUI	QSFP,	TP, Fb
100G	CGMII	CAUI	CFP	TP, Fb

Back to Old History - 1Gb Ethernet

- Datastream:

inter-frame	preamble	sfd	data	efd

- GMII

D0..D7	C	CLK

- 8 to 10 conversion - complex conversion table
- 1GBASE-XX

Back to History - 10Gb Ethernet :-)

- Datastream:

inter-frame	preamble	sfd	data	efd

- XGMII:

Lane 0	Lane 1	Lane 2	Lane 3	Clock
D0..D7 C0	D8..D15 C1	D16..D23 C2	D24..D31 C3	CLK

- XAUI - 4x3.15 Gb serial, data alignment

Lane 0	Lane 1	Lane 2	Lane 3

- 64 to 66 conversion - sync header + simple conversion table
- scrambling
  $G(x) = 1 + x^{39} + x^{58}$
- 10GBASE-XX

Back to History - 10Gb Ethernet :-)

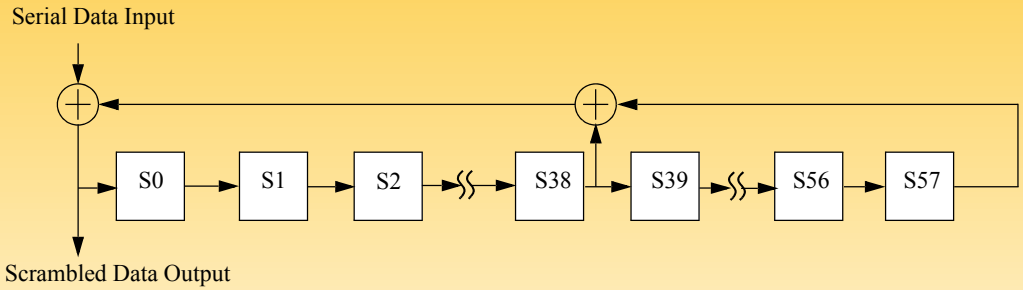

Fig.: Scrambler

Input Data	Sync	Block Payload							
Bit Position: / Data Block Format:	0 1	2							65
$D_0\ D_1\ D_2\ D_3/D_4\ D_5\ D_6\ D_7$	01	D_0	D_1	D_2	D_3	D_4	D_5	D_6	D_7
Control Block Formats:		**Block Type Field**							
$C_0\ C_1\ C_2\ C_3/C_4\ C_5\ C_6\ C_7$	10	0x1e	C_0	C_1	C_2	C_3	C_4	C_5	C_6	C_7
$S_0\ D_1\ D_2\ D_3/D_4\ D_5\ D_6\ D_7$	10	0x78	D_1	D_2	D_3	D_4	D_5	D_6	D_7
$O_0\ D_1\ D_2\ D_3/D_4\ D_5\ D_6\ D_7$	10	0x4b	D_1	D_2	D_3	D_4	D_5	D_6	D_7
$O_0\ D_1\ D_2\ D_3/D_4\ D_5\ D_6\ D_7$	10	0x55	D_1	D_2	D_3	D_4	D_5	D_6	D_7
$T_0\ C_1\ C_2\ C_3/C_4\ C_5\ C_6\ C_7$	10	0x87		C_1	C_2	C_3	C_4	C_5	C_6	C_7
$D_0\ T_1\ C_2\ C_3/C_4\ C_5\ C_6\ C_7$	10	0x99	D_0		C_2	C_3	C_4	C_5	C_6	C_7
$D_0\ D_1\ T_2\ C_3/C_4\ C_5\ C_6\ C_7$	10	0xaa	D_0	D_1		C_3	C_4	C_5	C_6	C_7
$D_0\ D_1\ D_2\ T_3/C_4\ C_5\ C_6\ C_7$	10	0xb4	D_0	D_1	D_2		C_4	C_5	C_6	C_7
$D_0\ D_1\ D_2\ D_3/T_4\ C_5\ C_6\ C_7$	10	0xcc	D_0	D_1	D_2	D_3		C_5	C_6	C_7
$D_0\ D_1\ D_2\ D_3/D_4\ T_5\ C_6\ C_7$	10	0xd2	D_0	D_1	D_2	D_3	D_4		C_6	C_7
$D_0\ D_1\ D_2\ D_3/D_4\ D_5\ T_6\ C_7$	10	0xe1	D_0	D_1	D_2	D_3	D_4	D_5	C_7
$D_0\ D_1\ D_2\ D_3/D_4\ D_5\ D_6\ T_7$	10	0xff	D_0	D_1	D_2	D_3	D_4	D_5	D_6

Fig.: 64 to 66 Coding

40/100G Ethernet

- Datastream:

inter-frame	preamble	sfd	data	efd

- XGMII:

Lane 0	Lane 1	Lane x	Lane 7	Clock
D0..D7 C0	D8..D15 C1	Dy..Dz Cx	D56..D63 C7	CLK

- 64 to 66 conversion - sync header + simple conversion table
- scrambling
- PCS block distribution
  - 40G - 4 lines
  - 100G - 20 lines
- 40/100GBASE-XX

40/100G Ethernet

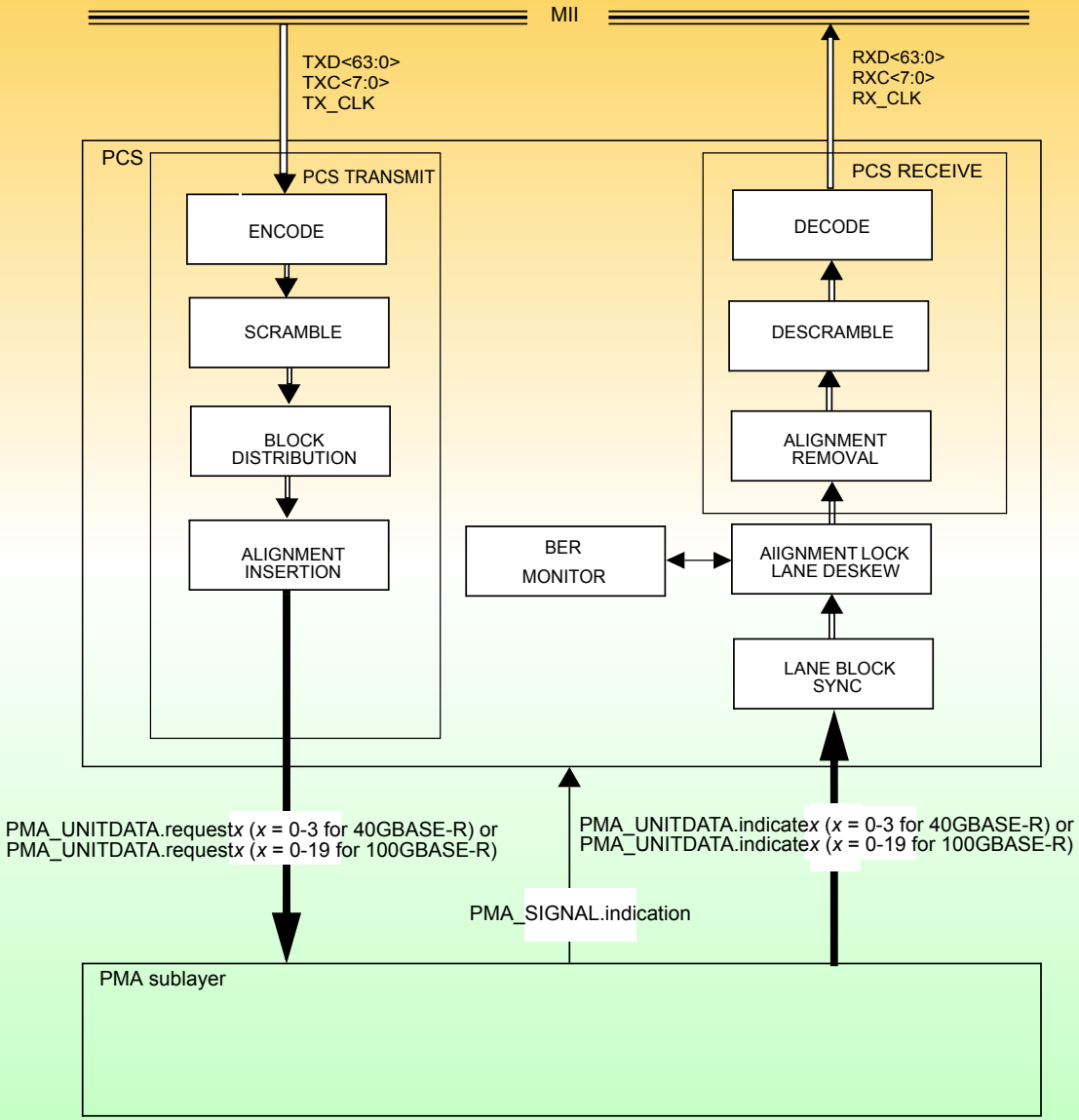

Fig.: Functional Block Diagram

40/100G Ethernet

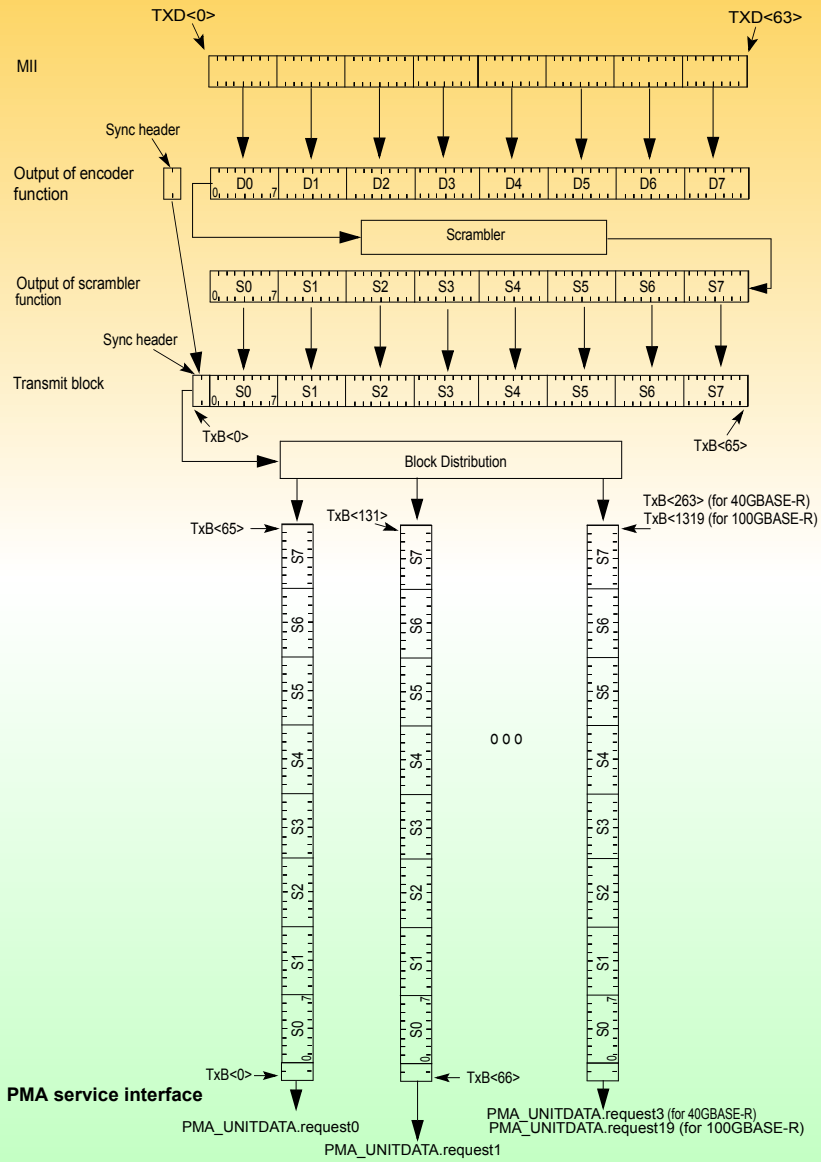

Fig.: Transmit

40/100G Ethernet

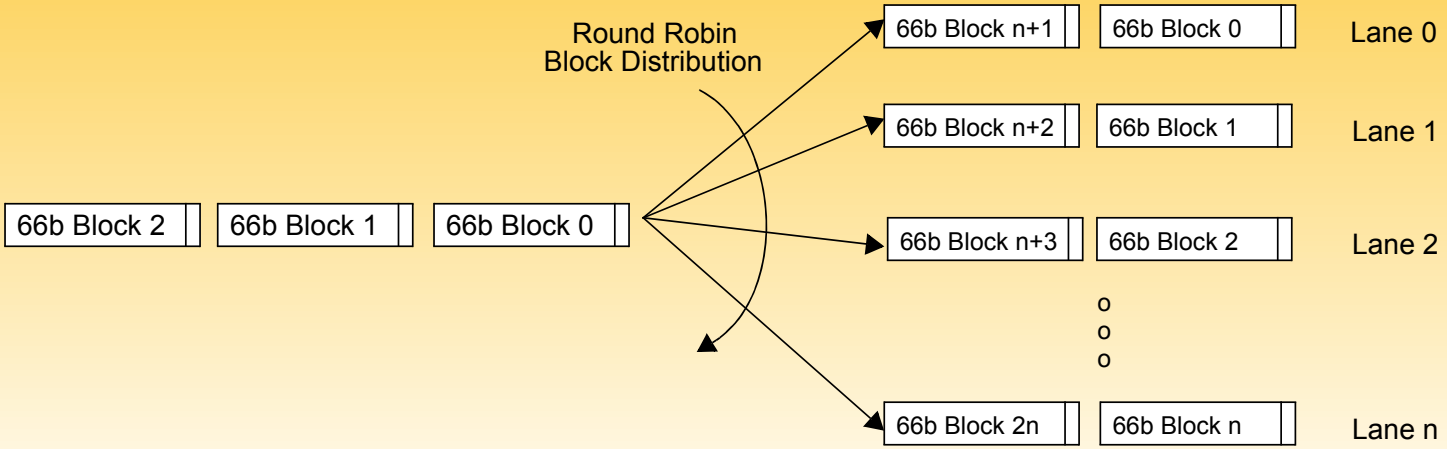

Fig.: Block distribution

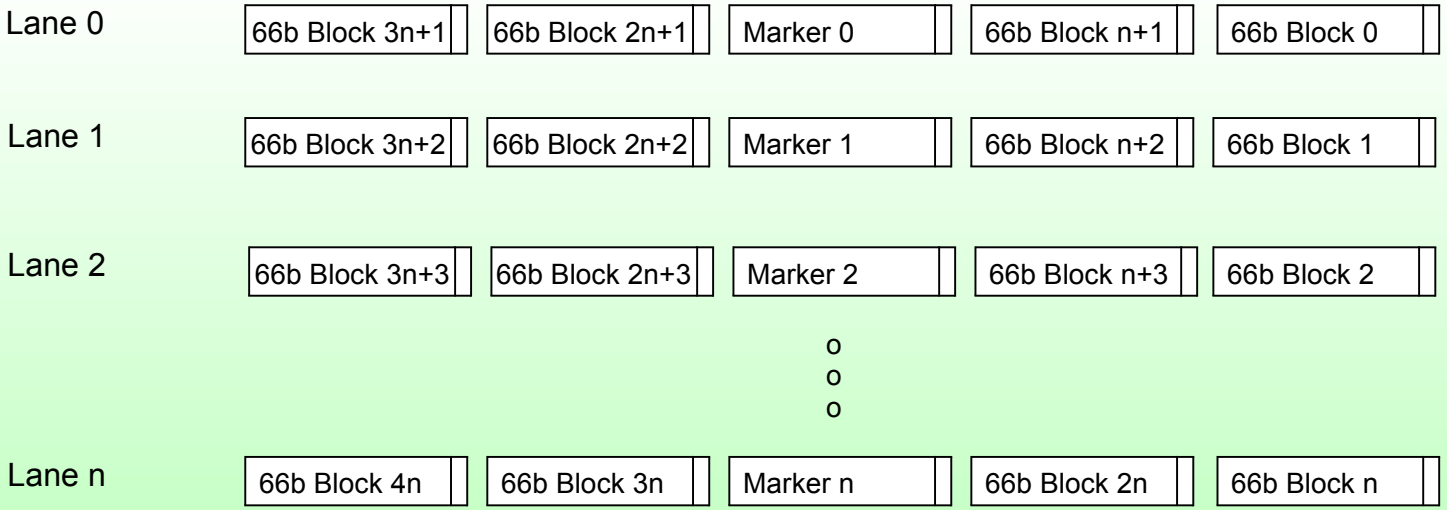

Fig.: Line Aligment

40/100G Ethernet

PMD:

At least	40Gb	100Gb
1m backplane	40GBASE-KR4	-
10m copper	40GbASE-CR4	100GbASE-CR10
100m MMF	40GbASE-SR4	100GbASE-SR10
10Km SMF	40GbASE-LR4	100GbASE-LR4
40Km SMF	-	100GbASE-ER4

VIRTEX solutions

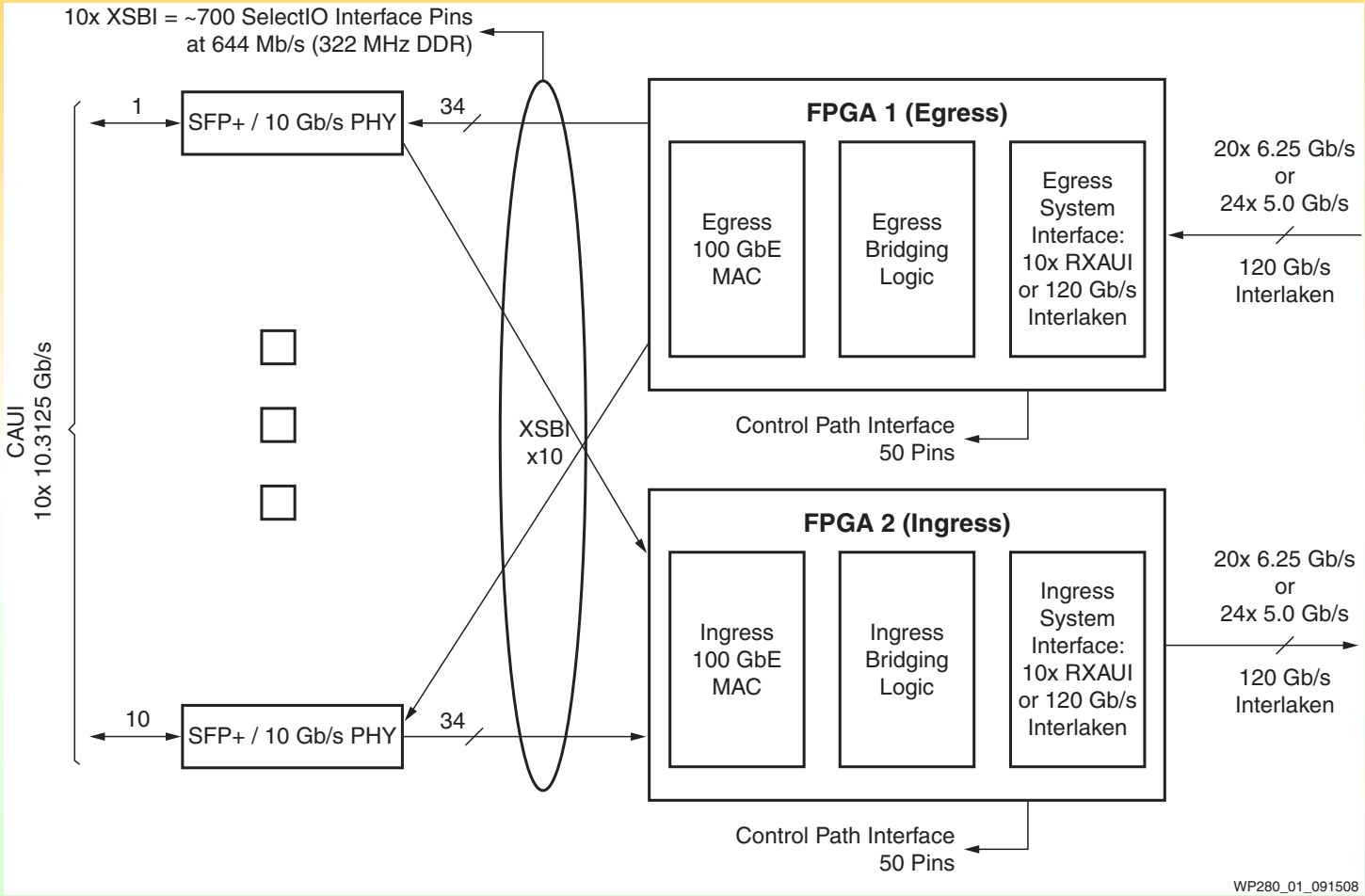

Fig.: Ser/Des Solution

VIRTEX solutions

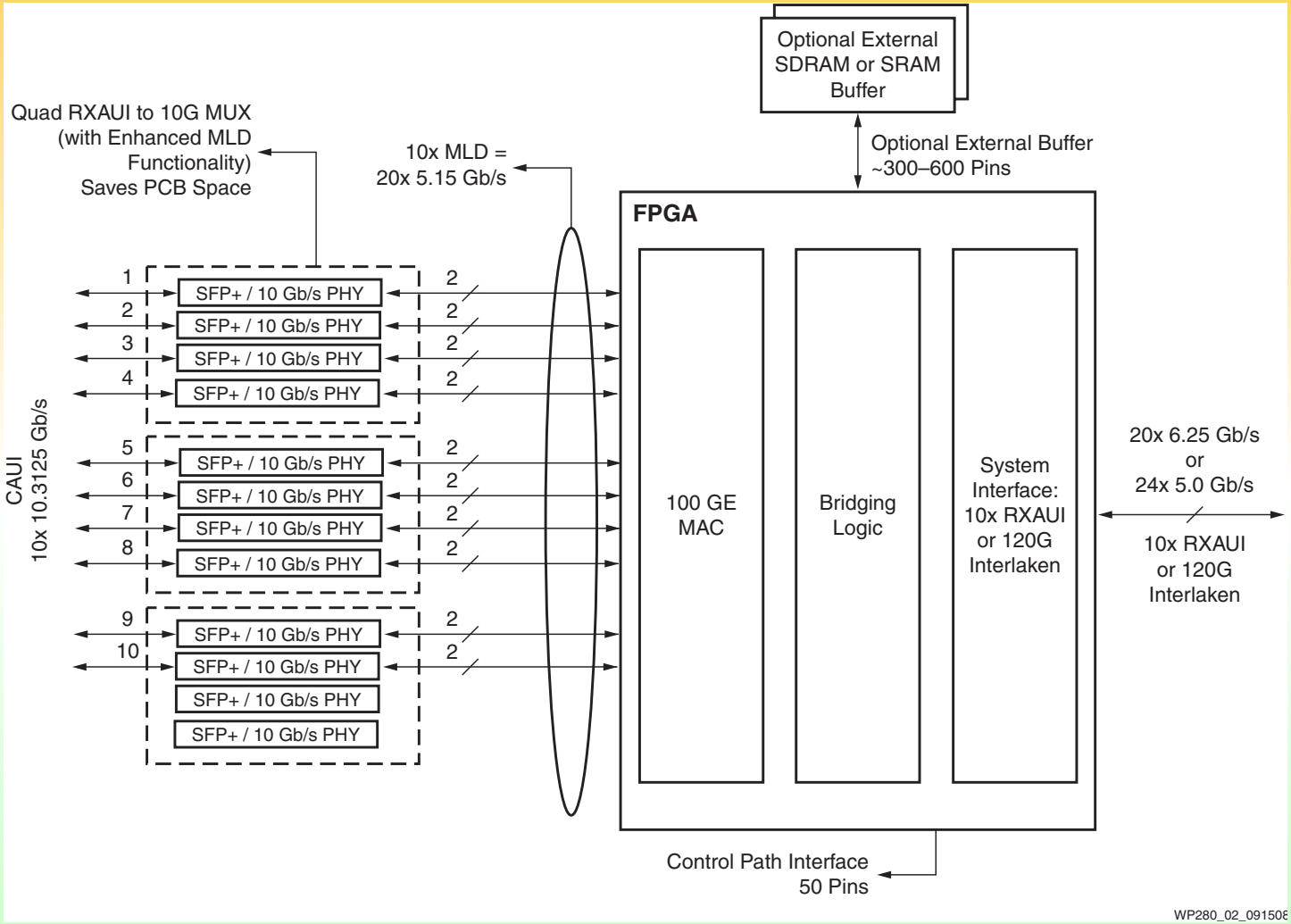

Fig.: RI/O Solution

Otázky ???

Děkuji za pozornost