

# Jak postavit PON síť

## Optimalizace topologie

Jaromír Šíma

seminář - Sítě FTTx v roce 2011



# P2P nebo PON?



## Home Passed – Home Connected Kde umístit prvky/odbočnice/splitery?

### Point to Point Ethernet

- N fibers
- 2N optical transceivers



32/64 fibers  
64 transceivers

P2P



Ex. N=32 Nodes

### Curb Switched Ethernet

- 1 fiber
- Minimum fiber/space in CO
- 2N+2 optical transceivers
- Electrical power in the field



1/2 fiber  
66 transceivers

P2P

curb switch



### Ethernet PON (EPON)

- 1 fiber
- Minimum fibers/space in CO
- N+1 optical transceivers
- No electrical power in field
- Drop throughput up to trunk rate
- Downstream broadcast (video)



1 fiber  
33 transceivers

P2MP

passive optical splitter

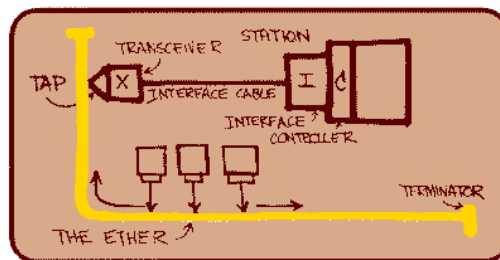


3

# Ethernet - historie



- 1970-1973 Robert Metcalfe, Xerox PARC
- CSMA/CD - Carrier Sense Multiple Access with Collision Detection



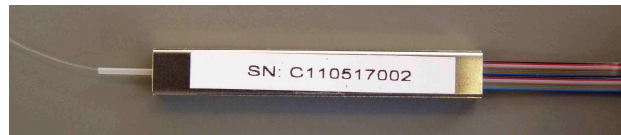
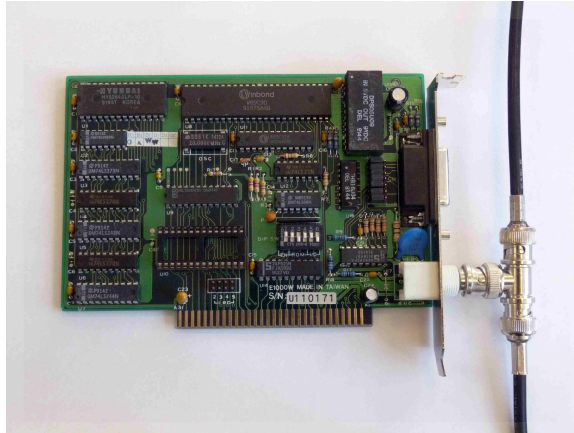
- Ethernet II
- 10BASE-5, 10BASE-2, 10BASE-T, 100BASE-TX, 100BASE-T4, ...
- FOIRL, 10BASE-F, 100BASE-FX, 1000BASE-SX, 10GBASE-SR, ...

Od 10 Mbit/s do dnešních 100 Gbit/s



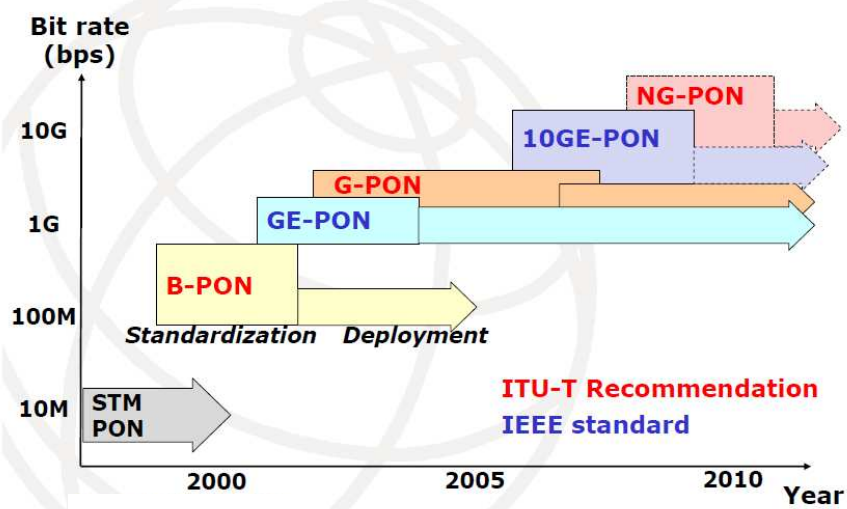
4

# PON = „optická sběrnice“



5

# PON Passive Optical Network

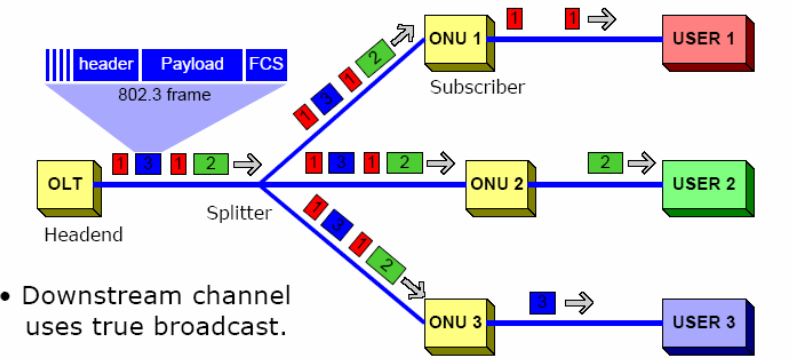


6

# PON - princip



## EPON Downstream



- Downstream channel uses true broadcast.
- 802.3 Frames extracted by MAC addresses.

OLT = Optical Line Terminal  
ONU = Optical Network Unit



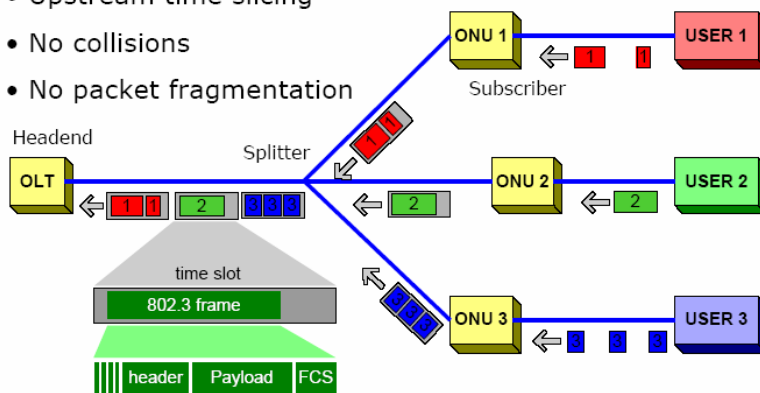
7

# PON - princip



## EPON Upstream

- Upstream time slicing
- No collisions
- No packet fragmentation



8

# EPON - specifikace rozhraní



Description	1000BASE-PX10-U	1000BASE-PX10-D	1000BASE-PX20-U	1000BASE-PX20-D	Unit
Fiber type	B1.1, B1.3 SMF				
Number of fibers	1				
Nominal transmit wavelength	1310	1490	1310	1490	nm
Transmit direction	Upstream	Downstream	Upstream	Downstream	
Minimum range <sup>a</sup>	0.5 m to 10 km		0.5 m to 20 km		
Maximum channel insertion loss <sup>b</sup>	20	19.5	24	23.5	dB
Minimum channel insertion loss <sup>c</sup>	5		10		dB

<sup>a</sup>In an FEC enabled link, the minimum range may be increased, or, links with a higher channel insertion loss may be used.

<sup>b</sup>At nominal transmit wavelength.

<sup>c</sup>The differential insertion loss for a link is the difference between the maximum and minimum channel insertion loss.

- a) Point-to-multipoint on optical fiber.
- b) 1000 Mb/s up to 10 km on one single-mode fiber supporting a fiber split ratio of 1:16.
- c) 1000 Mb/s up to 20 km on one single-mode fiber supporting a fiber split ratio of 1:16.
- d) BER better than or equal to  $10^{-12}$  at the PHY service interface.



9

# GPON limity útlumu



- **ITU-T-G.984.2 GPON (PMD layer specification)**

- Class A 5-20 dB
- Class B 10-25 dB
- **Class B+ 13-28 dB**
- Class C 15-30 dB
- Class C+ 17-32 dB

- **Splitter maximum loss**

- 1:2 3,7 dB
- 1:4 7,4 dB
- 1:8 10,8 dB
- 1:16 14,1 dB
- 1:32 17,3 dB
- 1:64 21,0 dB
- 1:128 25,3 dB

- **Měrný útlum vlákna**

- 0,31 až 0,40 dB/km pro 1310 nm

**Optimalizace dělení**

**64 uživatelů**

**Splitter celkem 1:128  
pro krátké trasy**



10

## Další vývoj PON

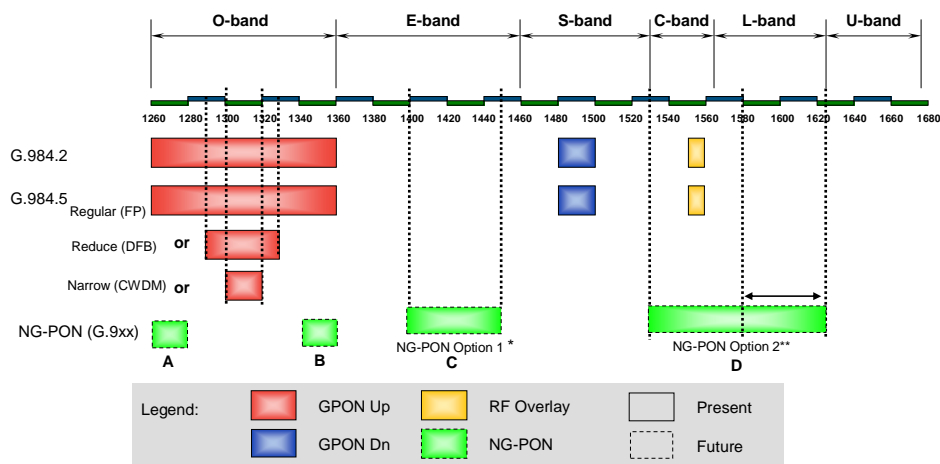


- Když dnes nainstalujete G-PON, tak
- za cca 7 let se očekává přechod na 10G PON
  - NG PON .... XG-PON1, XG-PON2
  - NG2 PON ... 40 až 100 Mbit/s ?
- za dalších cca 7 let je předpoklad přechodu na WDM PON



11

## Přechod na NG-PON



12

# PON porovnání – EPON/GPON

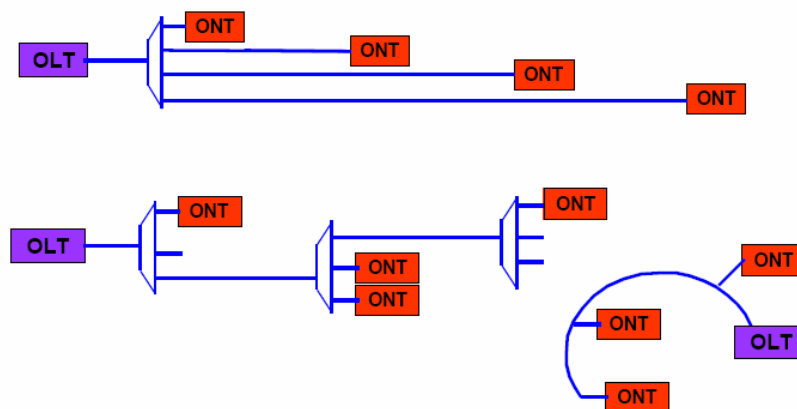


	<b>EPON</b>	<b>GPON</b>	<b>10G EPON</b>	<b>XG-PON</b>
Rychlost Dwn/Up	1G/1G	2.5G/1.2G	10G/1G,10G/10G	10G/2.5G,10G/10G
kódování	8/10b	NRZ	64/66B	NRZ
Split ratio	16/32	32/64/128	16/32	64/128
Logický dosah km	10/20	60, rozdíl 20	10/20/30	60, rozdíl 20
FEC	-	ano	ano	ano
Power budget	PX10/20	Class B+,C,C+	PRX/PR10/20/30	Class B+,C,C+
Šifrování	ne	AES	volitelně	AES
Rámec	Ethernet	GEM	Ethernet	GEM



13

# Varianty PON

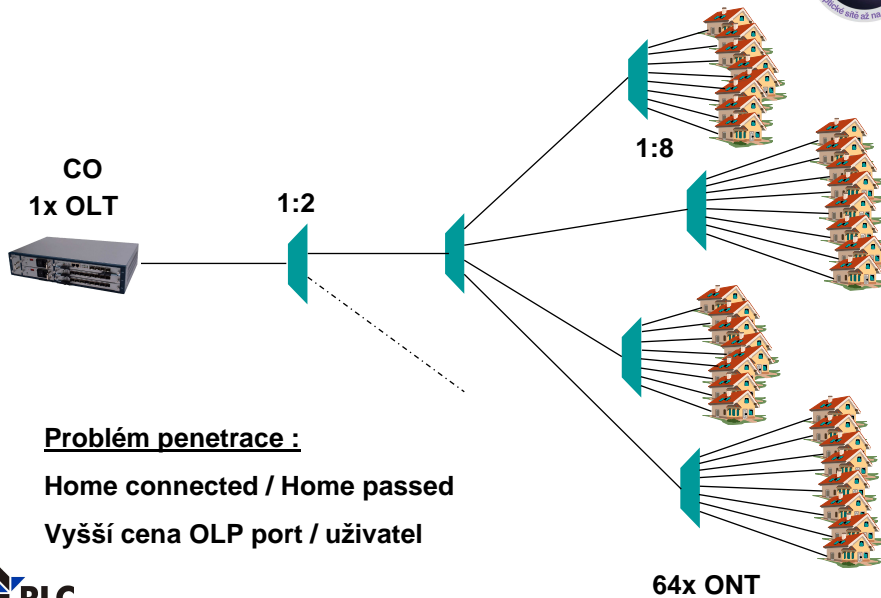


- Point-to-point, trees, linear add/drop, rings,
- Single or cascaded splitter (1:32); (1:2) (1:16), (1:4)(1:8)....
- Simple engineering of facilities—optical loss budgets



14

## PON – tradiční topologie

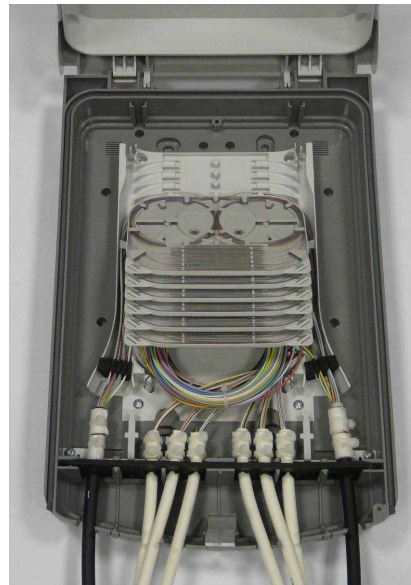
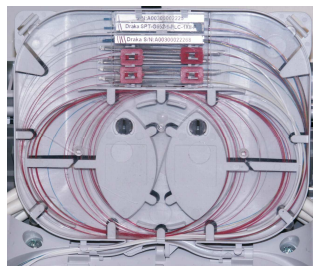


15

## PON – jak osadit splitter?y?



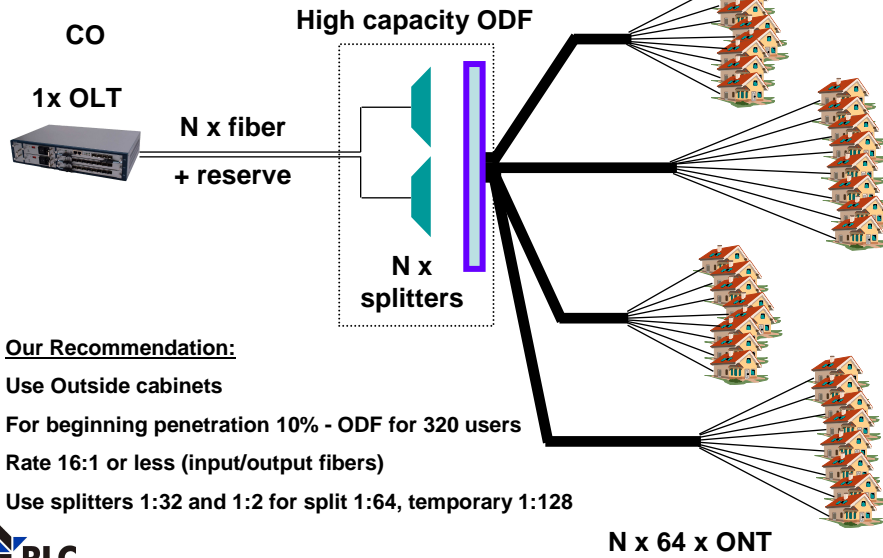
- Osadit splitter přímo?
- Použít konektory?
- Svary - mech. spojky?
- Jak měřit?
  - Alespoň jeden konektor/splitter
- Jak připojovat ?
  - Časové hledisko



16

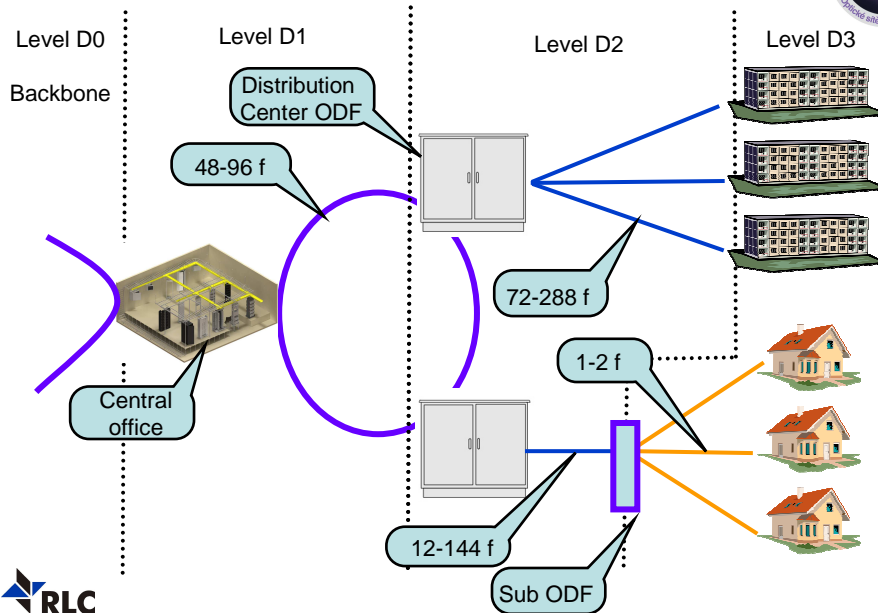


# PON – koncentrace v ODF



17

# Struktura FTTH síť



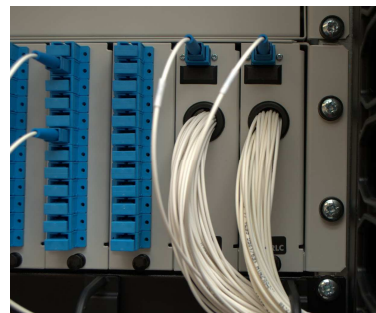
18

## PON – venkovní pasivní ODF



19

## PON – vnitřní pasivní ODF

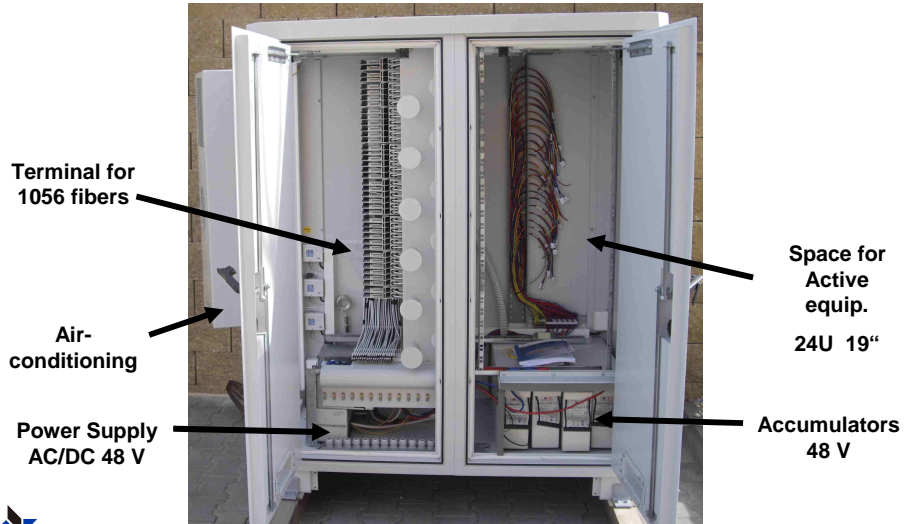


20

## Outdoor universal cabinet RLC



- Passive/Active or Passive/Passive with splitters



21

## CO – Outdoor steel cabinet



22

## Agregace v sítích PON

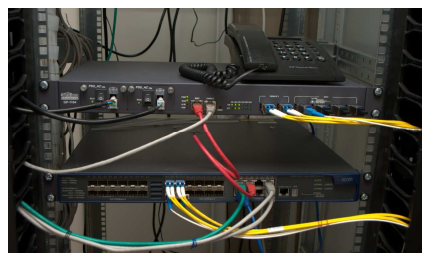


- PtP – volbou aktivních prvků volím způsob a místo agregace



48x100Mbit/s – 4x1Gbit/s

- PON síť – první stupeň agregace začíná přímo na splitterech
- Další rozhodnutí závisí na počtu zákazníků v lokalitě a poskytovaných nebo plánovaných službách.



2x 1Gbit/s Ethernet – 4x GPON 2,5Gbit/s



23

## Agregace v sítích PON



- 16/32/64 zákazníků na port OLT
- Počet portů PON OLT
- Počet a typ portů upstream OLT
  - N x 1GBE, N x 10GBE



## Závěr



### **Motto:**

**Jakákoli FTTH síť je lepší než žádná ! 😊**

**Dotazy ?**

**Děkuji za pozornost**



25