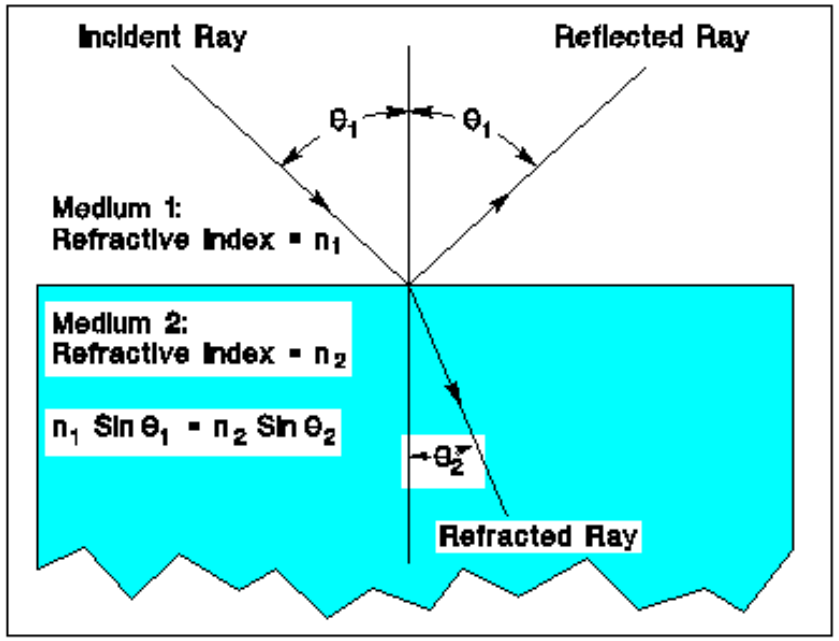
Optické sítě

Pavel Pospíchal

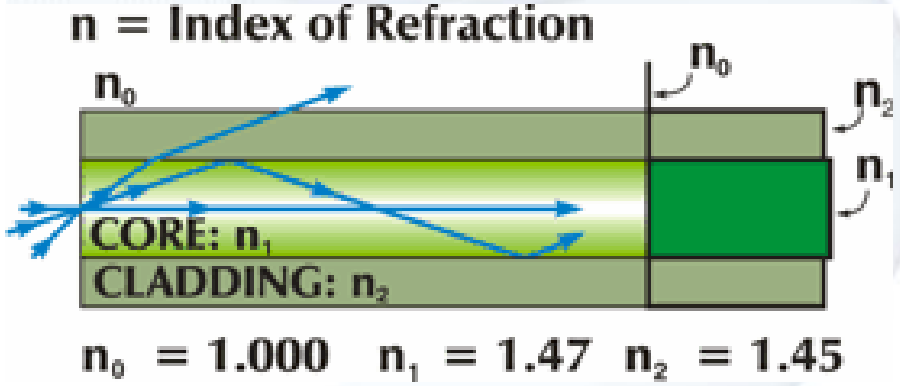
Optické sítě

Přenos signálu po optickém vlákně:

Snellův zákon – odraz světelného paprsku na rozhraní dvou prostředí s rozdílným indexem lomu



Snell's law



Optické sítě

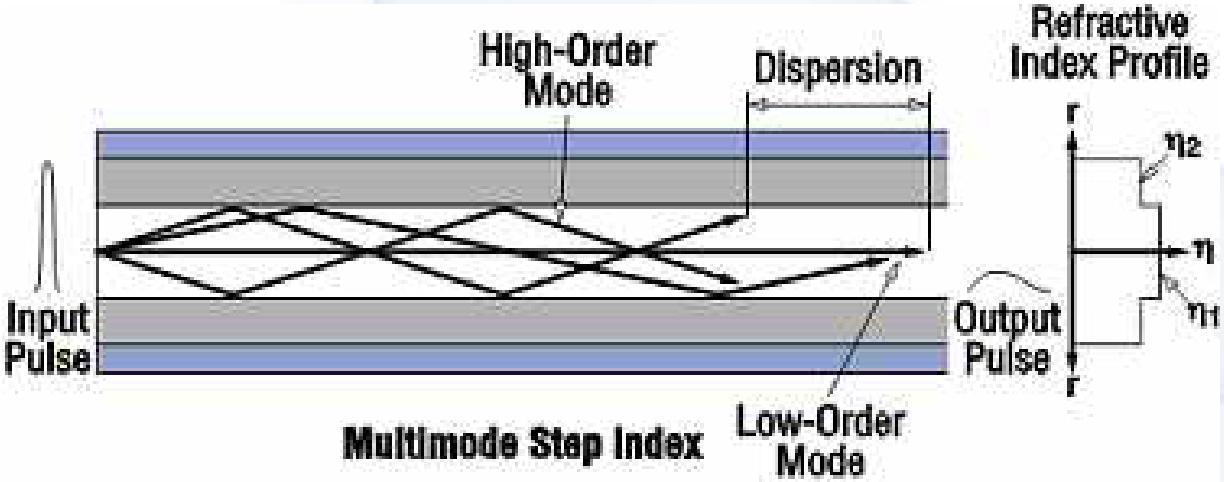
Výhody optického vlákna:

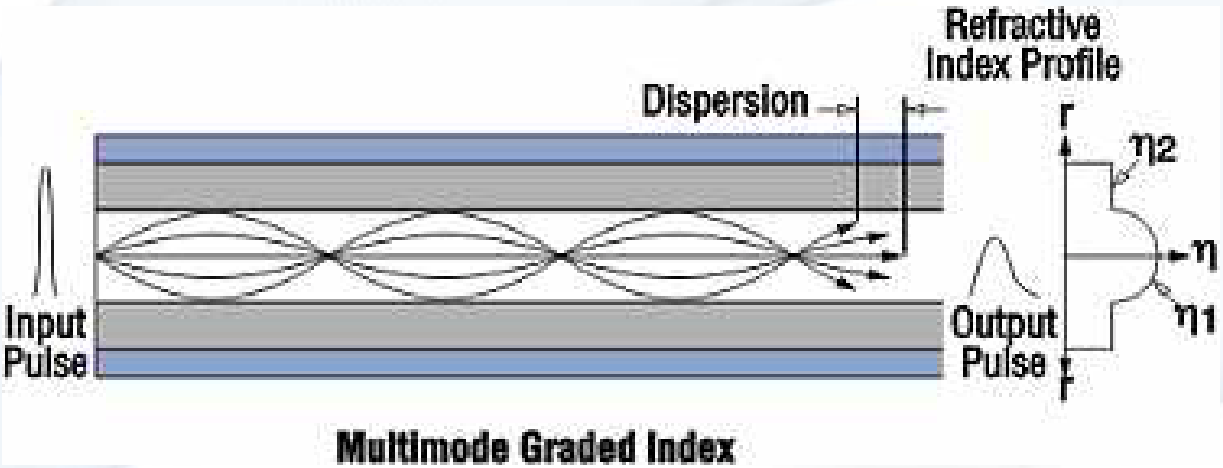
- malé rozměry, nižší váha
- elektromagnetická imunita, odolnost proti rušení
- galvanické oddělení telekomunikačního zařízení
- velká přenosová kapacita
- velká dosažitelná vzdálenost bez regenerace signálu

Druhy optického vlákna:

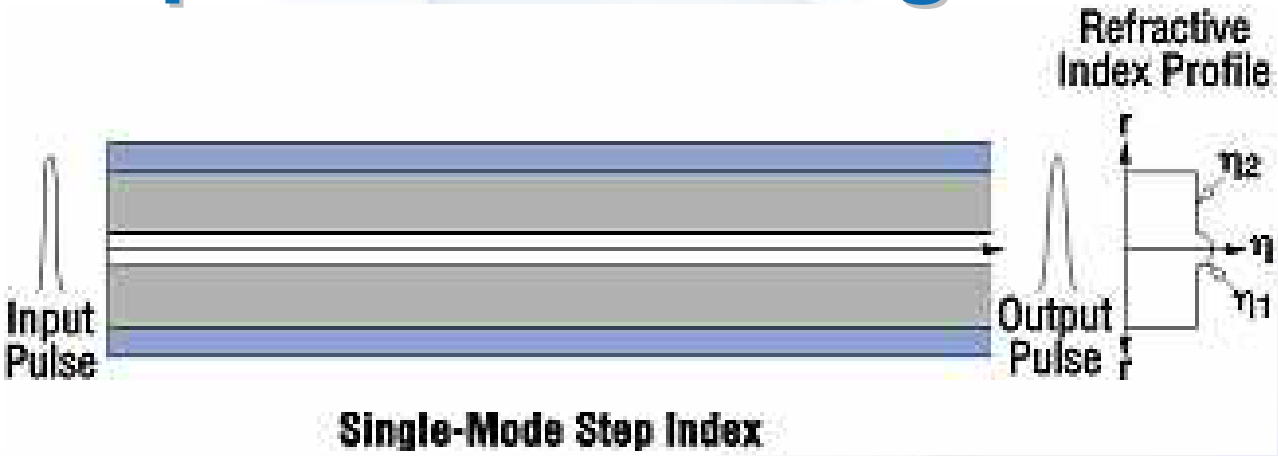
- multimode (mnohovidové, vícevidové, ...)
- singlemode (jednovidové, jednomodové, ...)

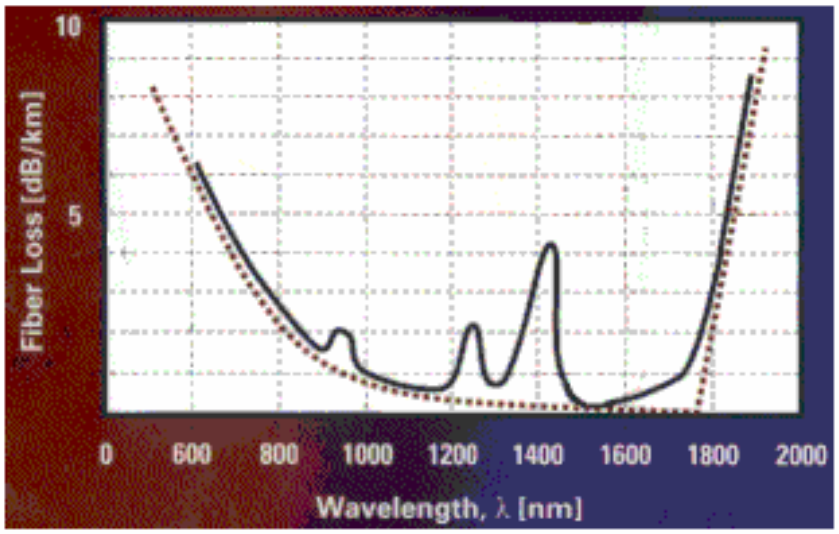
Optické sítě - multimode





Optické sítě - singlemode





Loss in an Optical Fibre

Vlnové délky:

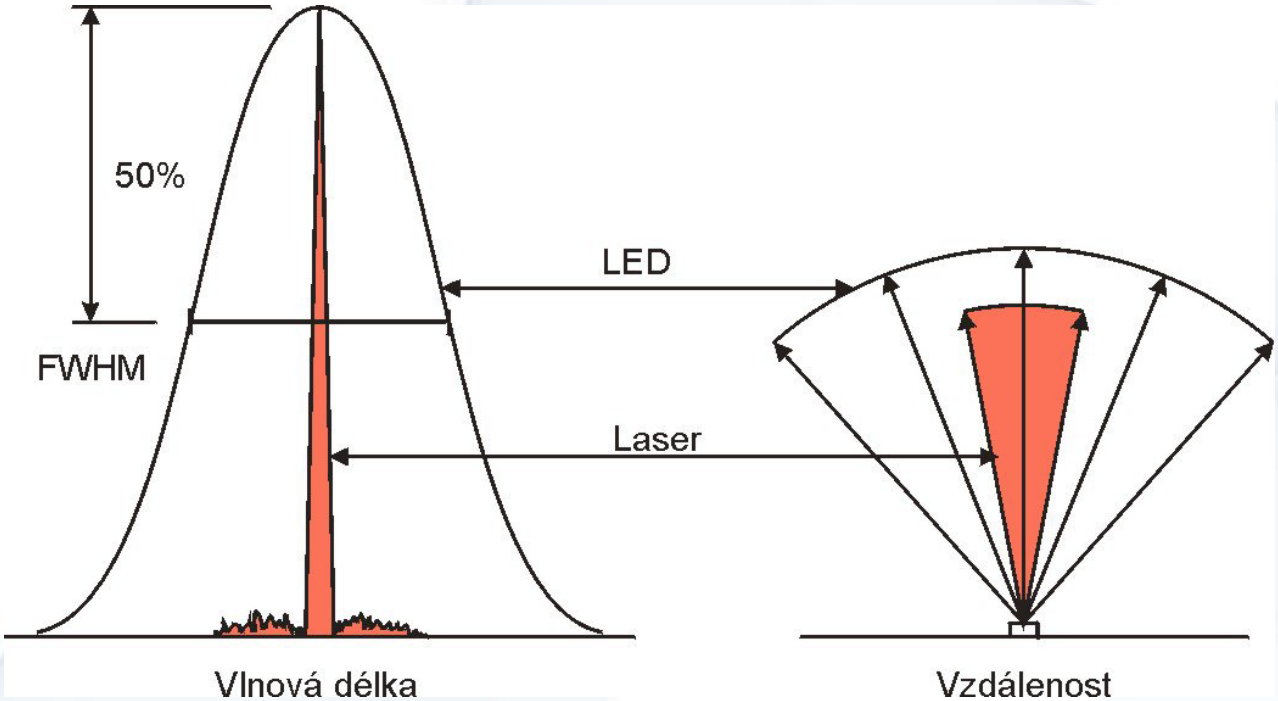
MM: 850, 1300 nm

SM: 1310, 1550, 1625 (1650) nm

Výstraha

- **záření neviditelné**
- **může dojít k poškození zraku**

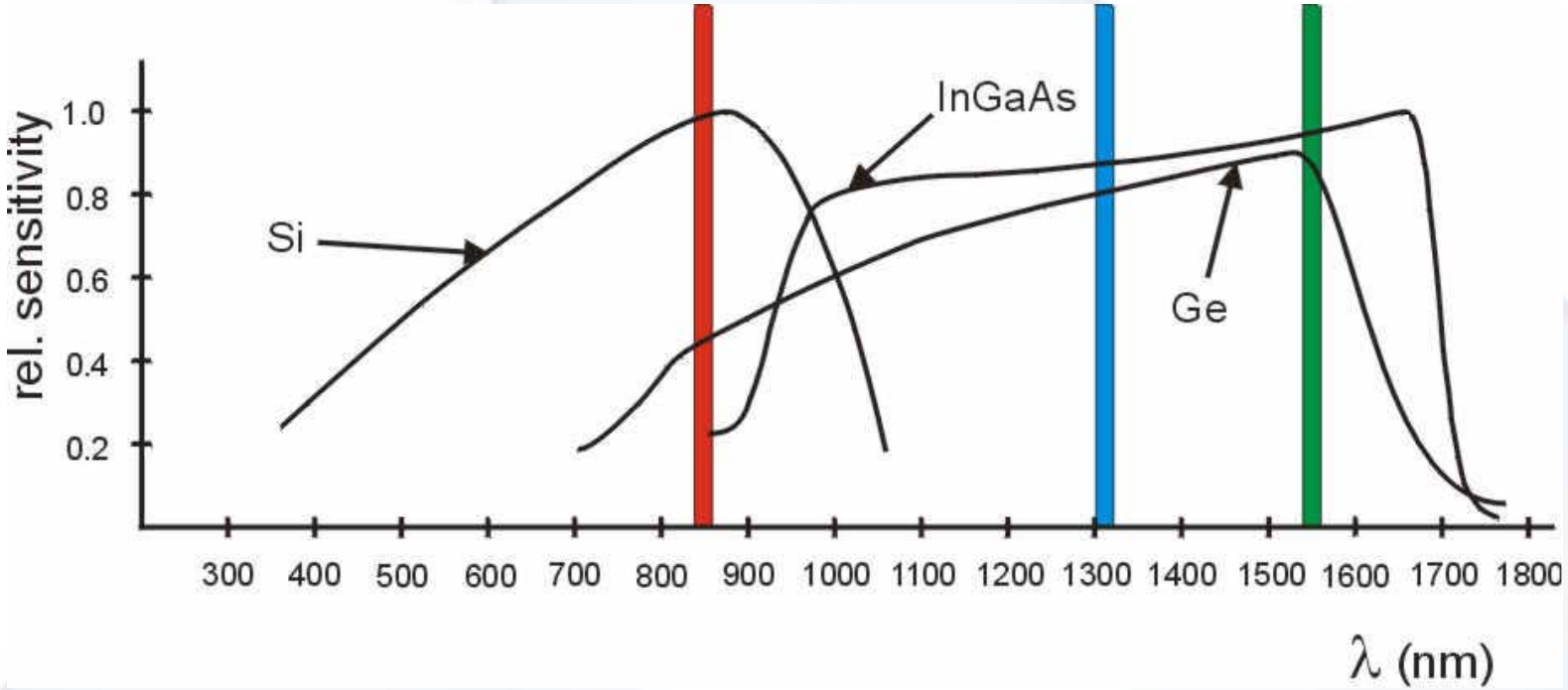
Optické sítě – zdroje záření



Vlnové délky:

MM:	850, 1300 nm	LED, VCSEL laser
SM:	1310, 1550, 1625 (1650) nm	LED, FP laser, DFB laser

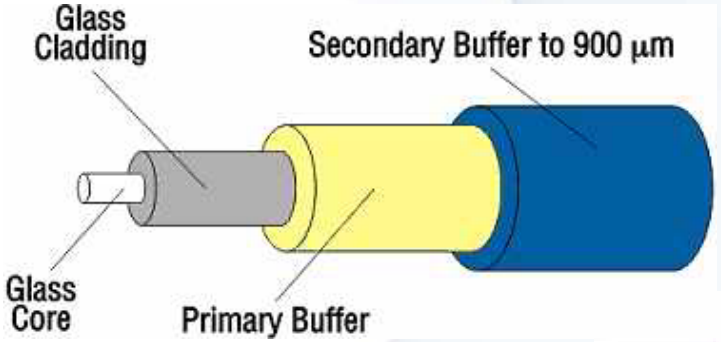
Optické sítě – detektory

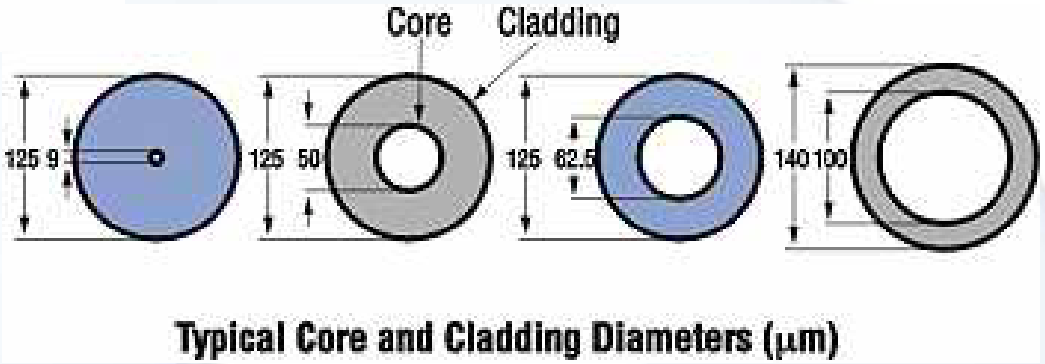


Vlnové délky:

MM:	850, 1300 nm	Si, Ge, (InGaAs)
SM:	1310, 1550, 1625 (1650) nm	Ge, InGaAs

Struktura optického vlákna



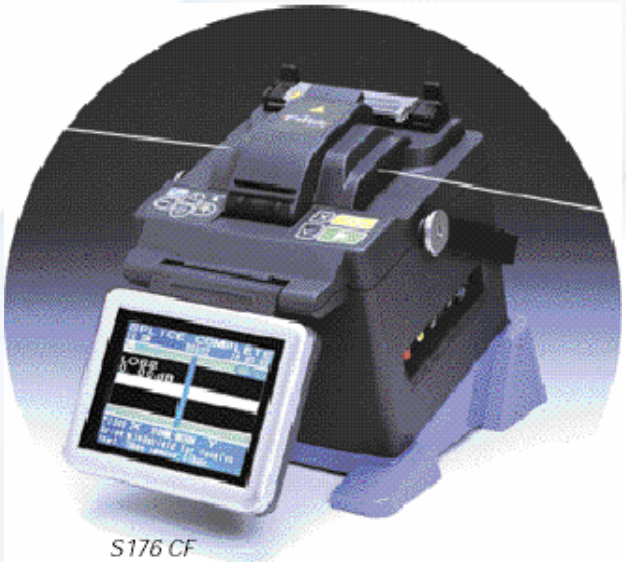


typ vlákna	MM	SM	DS
primární ochrana	250 µm	250 µm	250 µm
plášť	125 µm	125 µm	125 µm
jádro	50 / 62,5 µm	8 - 10 µm	6 - 8 µm

Optické sítě - výstavba

Výstavba optických sítí – spojování optických vláken

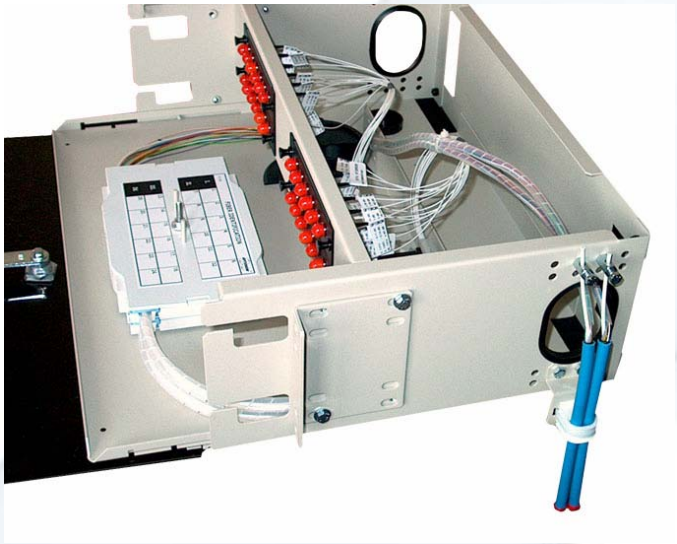
- Konektory - spojky
- Sváření optických vláken
- Různé mechanické spojky



Optické sítě - výstavba

Výstavba optických sítí – ukončení optických kabelů

- Systém optických rozvaděčů:



Optické sítě

Pasivní komponenty optických sítí

1. optické konektory, konektorové spojky
2. atenuátory, terminátory
3. optické rozvaděče, kabelové spojky
4. rozbočnice/slučovače (splitters/couplers)
5. vlnové multiplexery
   - WDM
   - CWDM
   - DWDM

Optické sítě

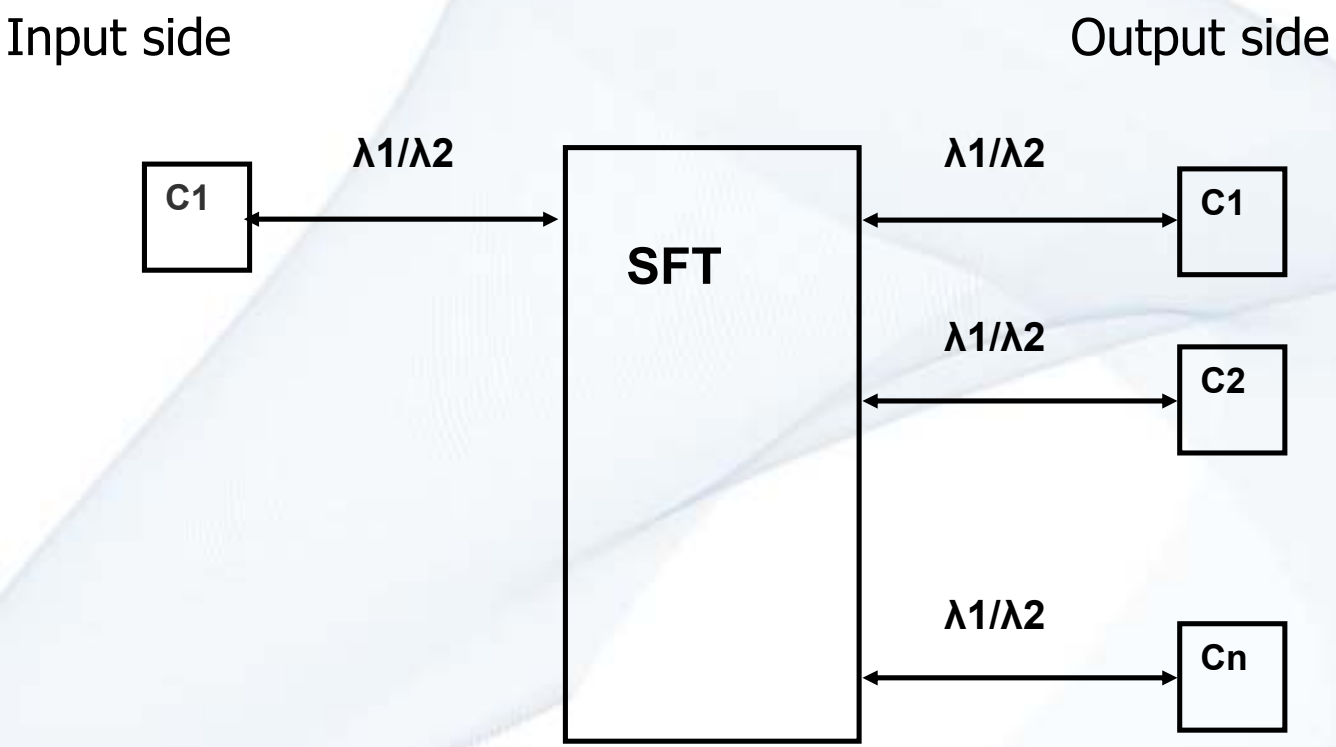
Atenuátory:

- Vyrovnání optického výkonu
- Testování optických sítí

Terminátory:

- Bezodrazové ukončení optických přenosových systémů
- Ochrana obsluhy před nežádoucím laserovým zářením

Couplers/splitters

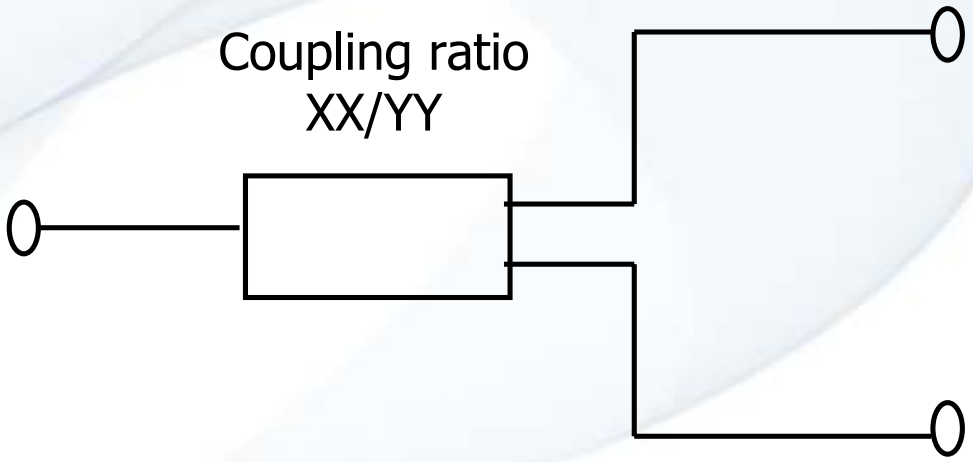


Couplers/splitters

- Base element:

  01 x 02 ports configuration

- Operating wavelengths:
  - SM: 1310 nm & 1550 nm (dual window)
  - SM: 1310 nm or 1550 nm (single window)
  - MM: 850 nm or 1300 nm (single window)



Couplers/splitters

- Coupling ratio:
  - Type 01X02

50/50	80/20
66/33	90/10
60/40	99/1
70/30	on demand

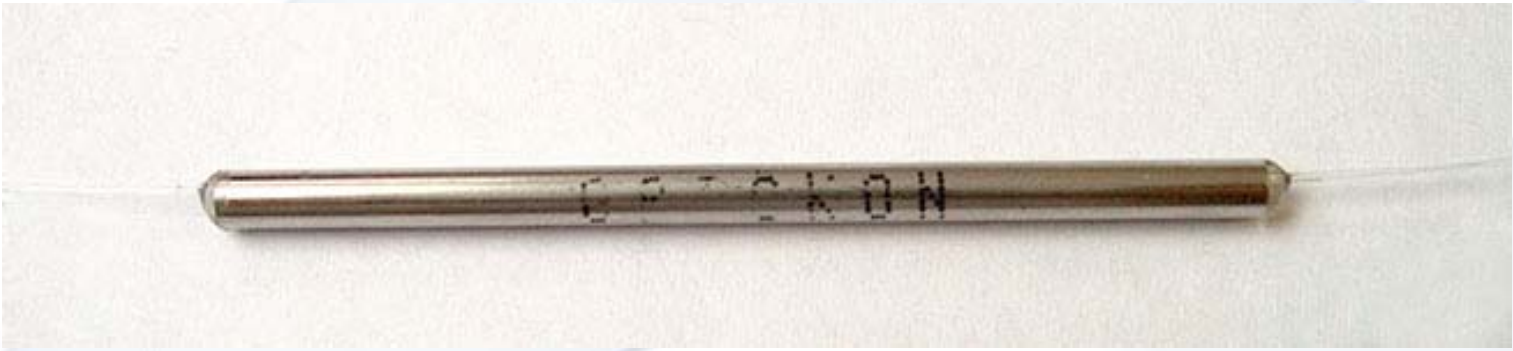
- Type 01xN

01x03	33/33/33
01x04	25/25/25/25

Couplers/splitters

- Packaging:

  BFS – base element

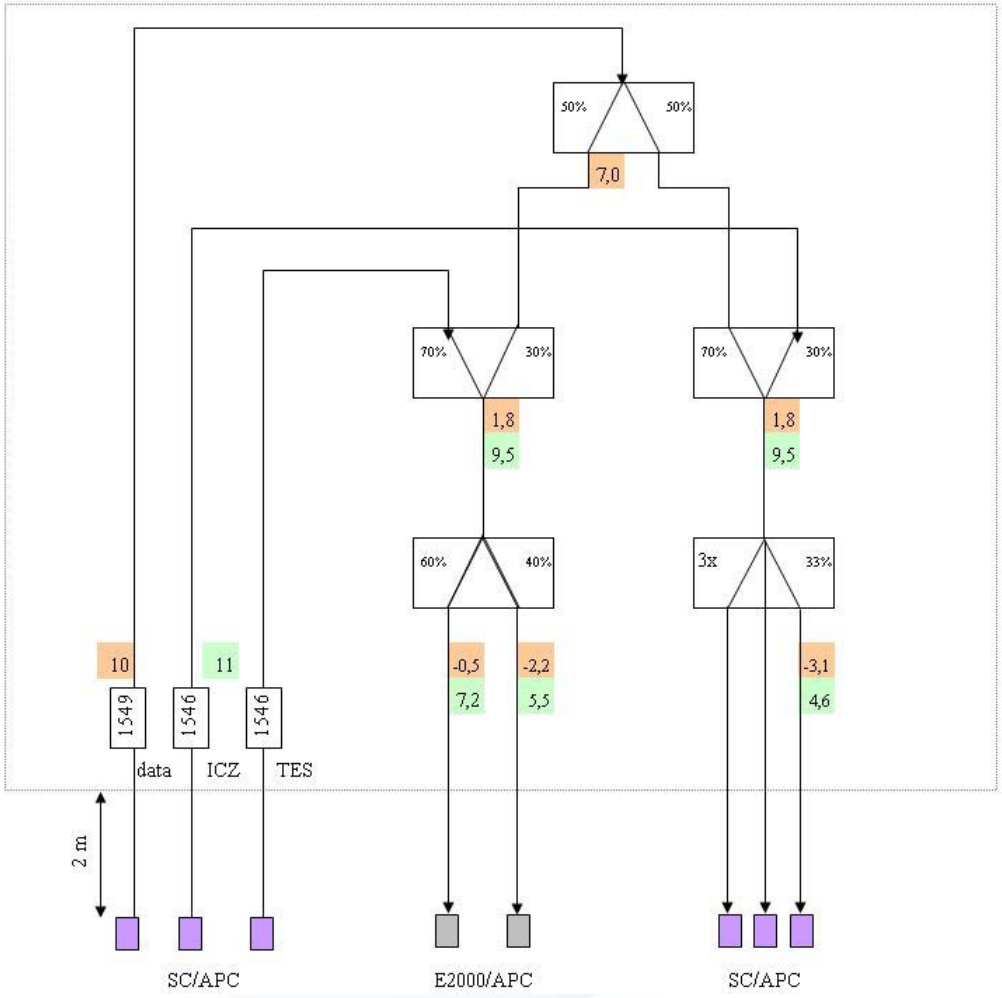


BFS-Bare fiber 250 μm, standard tube
(stainless steel tube Ø 3 mm, L=54 mm,
fiber length – 1 m)

Couplers/splitters

CATV application:
(special custom order)

- Coupled **Data** and **TV** signals
- Split into several ouputs
- Different Input/output connectors
- Built into MCNP-1U frame

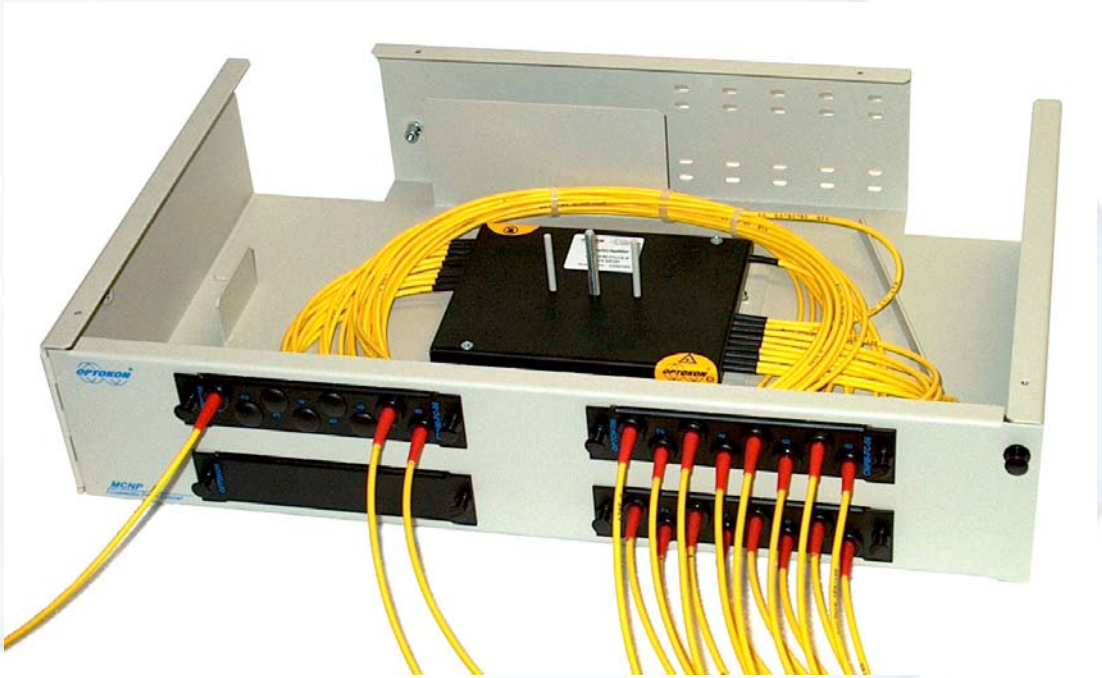


Couplers/splitters

CATV application:
(special custom order)

-Coupler/Splitter configuration 1x18

-Built into MCNP-2U frame



WDM, DWDM, CWDM

Wavelength division multiplexers

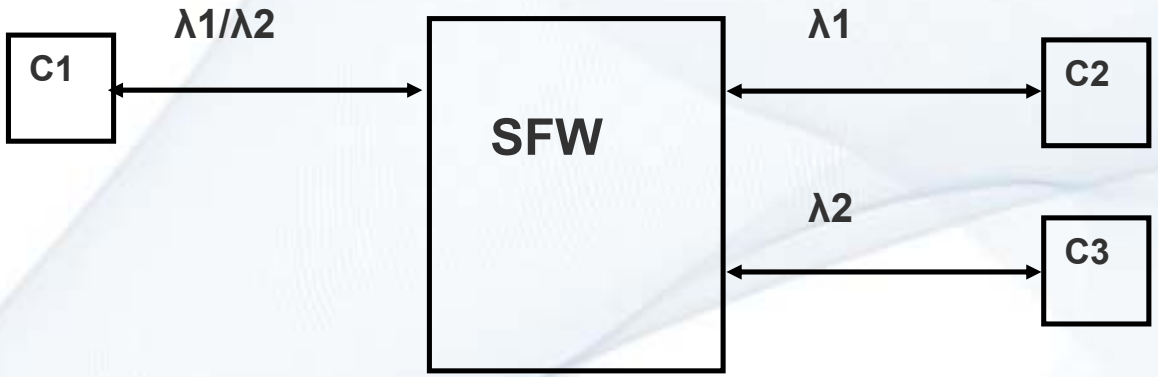
- WDM - 2 channels
  - SM 1310/1550 nm
  - MM 850/1300 nm
- *DWDM - dense WDM*
  - *SM window 1550 (4,8,16 .. channels)*
  - *Channel spacing (ITU grade) 0.8, 1.6, 3.2 nm*
- CWDM - coarse WDM
  - Wavelength range 1260 – 1650 nm
  - Channel spacing 20 nm
  - Up to 16 channels

WDM

General schema

Multiple IO

Separate channels



Parameters:

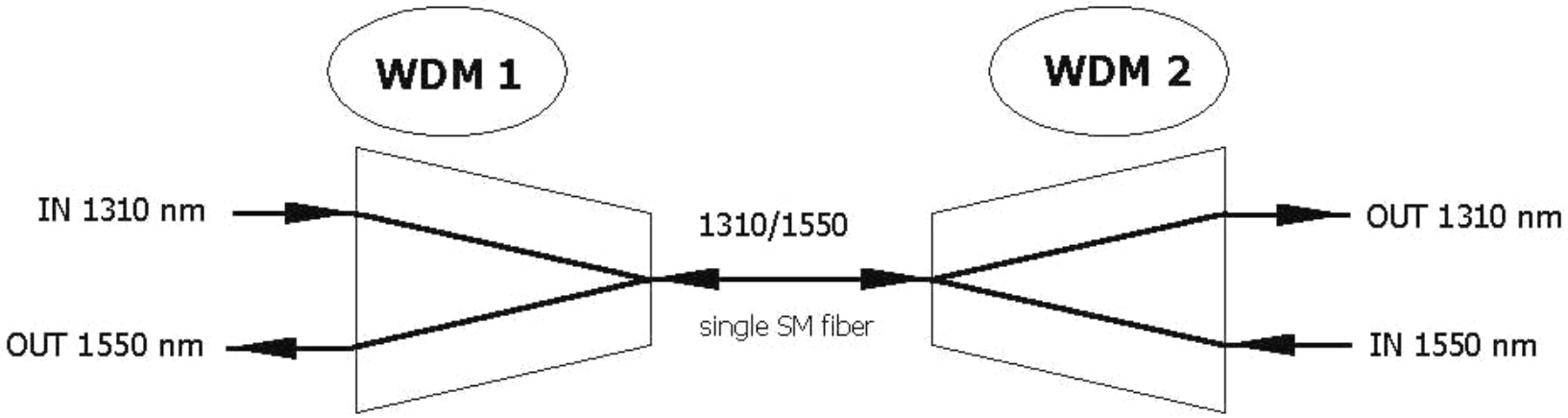
Insertion loss

Isolation (far end crosstalk)

WDM

Typical application:

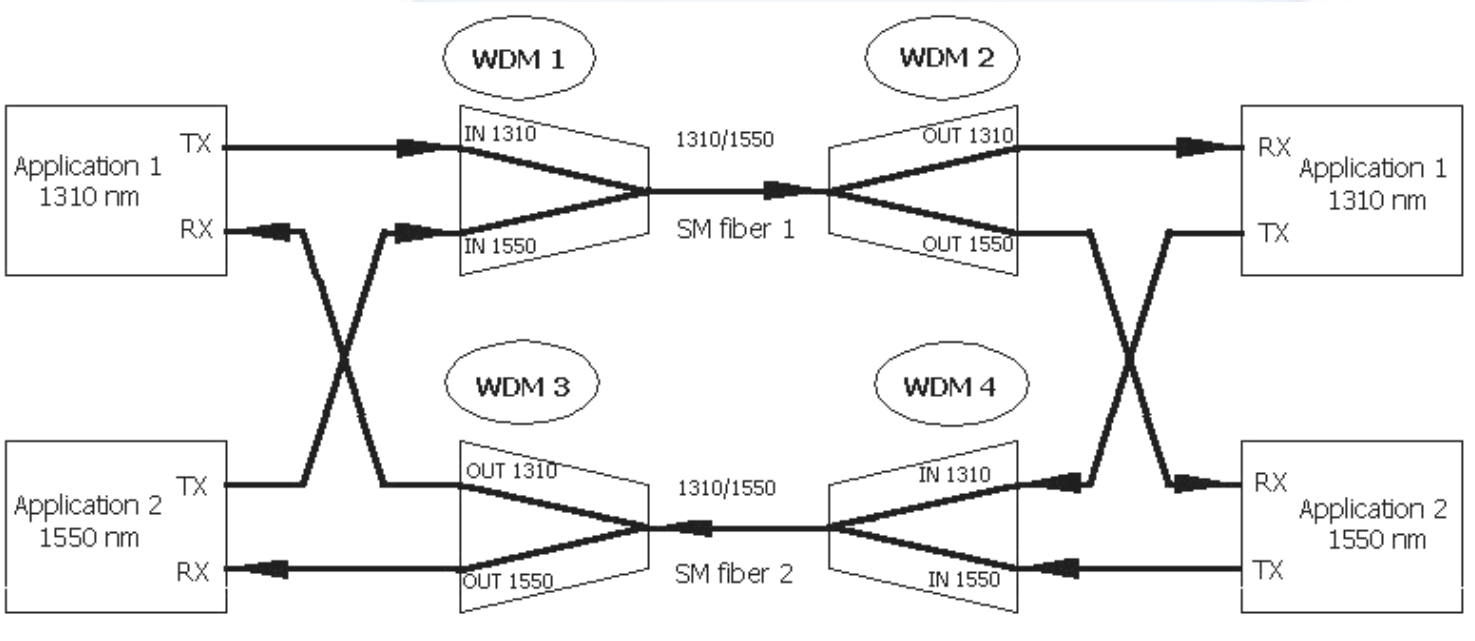
Full duplex over one fiber



WDM

Typical application:

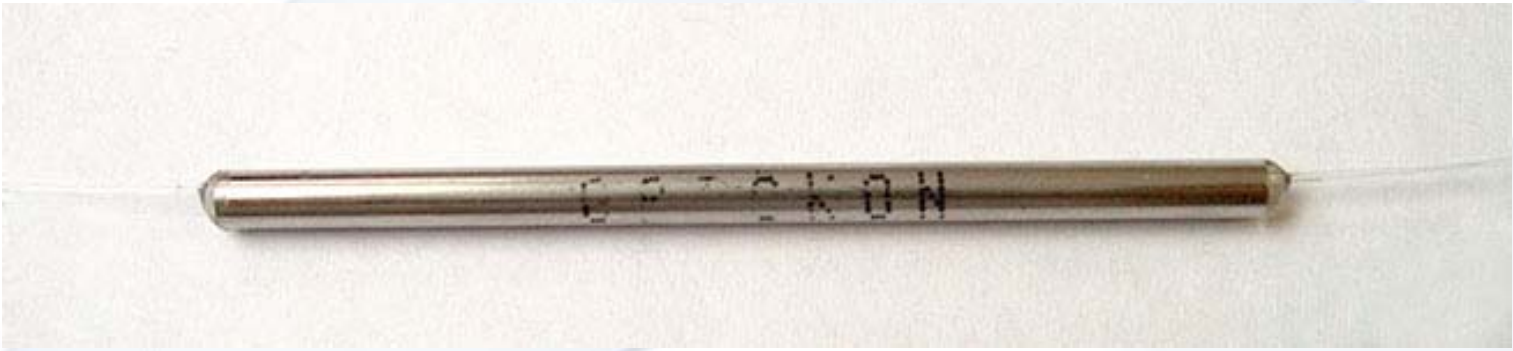
Two different applications over one pair of fiber



WDM

- Packaging:

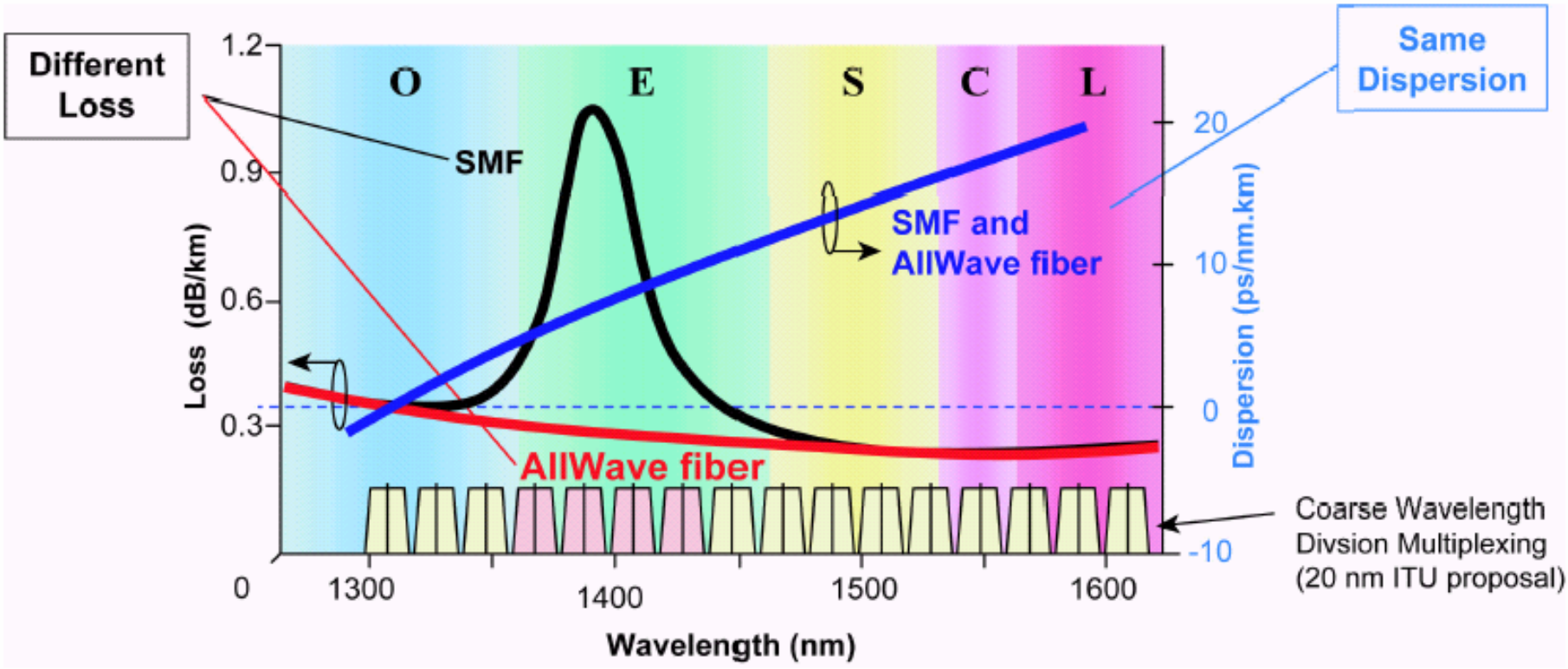
  BFS – base element, grade C only



BFS-Bare fiber 250 μm, standard tube
(stainless steel tube Ø 3 mm, L=54 mm,
fiber length – 1 m)

CWDM

- CWDM - AllWave fiber



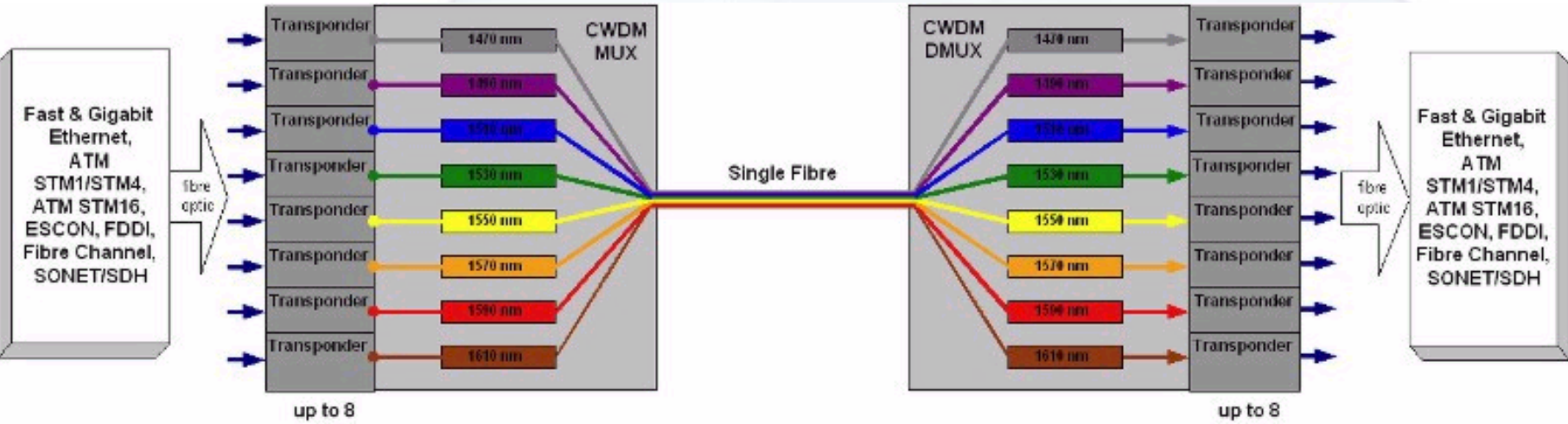
CWDM

CWDM 1x4

- Type: SFCW – 4M – A – CAPM – USC
- Center wavelengths 1510/1530/1550/1570 nm
- Channel spacing 20 nm
- Pass bandwidth > 14 nm
- Insertion loss ≤ 1.5 dB
- Isolation
  - for adjacent channel ≥ 30 dB
  - for non-adjacent channel ≥ 40 dB
- Return loss ≥ 50 dB
- PDL ≤ 0.1 dB
- Max. optical power 300 mW

Metropolitní sítě – vlnové multiplexery

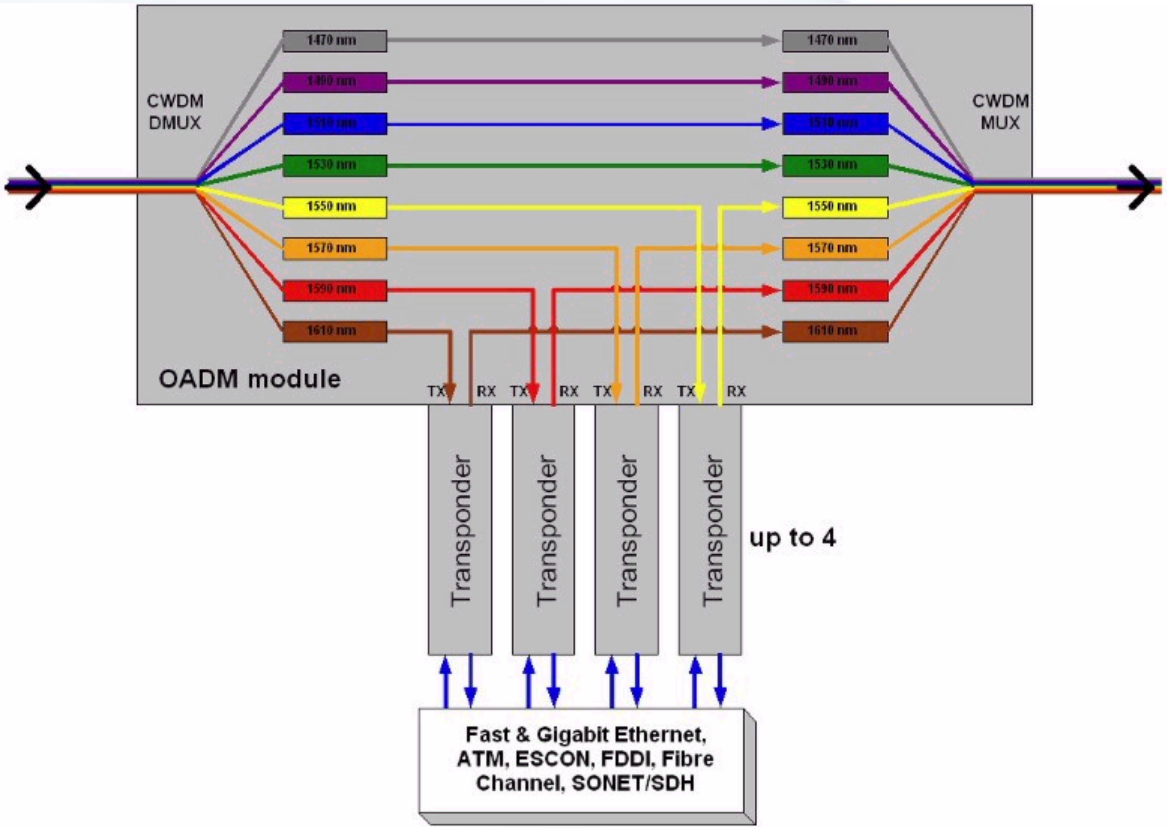
CWDM coarse WDM



Metropolitní sítě – vlnové multiplexery

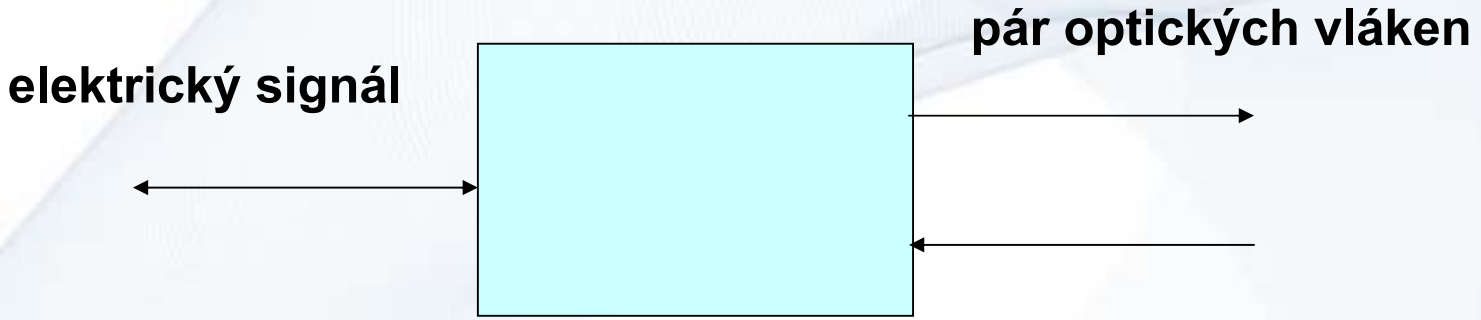
CWDM

OADM
Optical add-drop multiplexer



Media konvertory

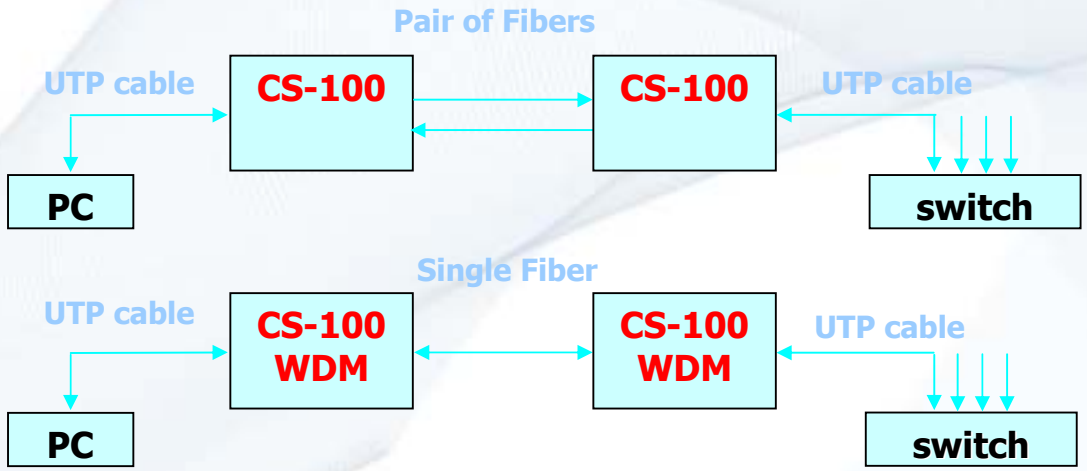
- převádí elektrický signál na optické vlákno



Media konvertory

Media konvertery řady CS-100 :

10/100Base-TX to Optical Fiber



prodloužení Ethernet segmentu nebo LAN na větší vzdálenost

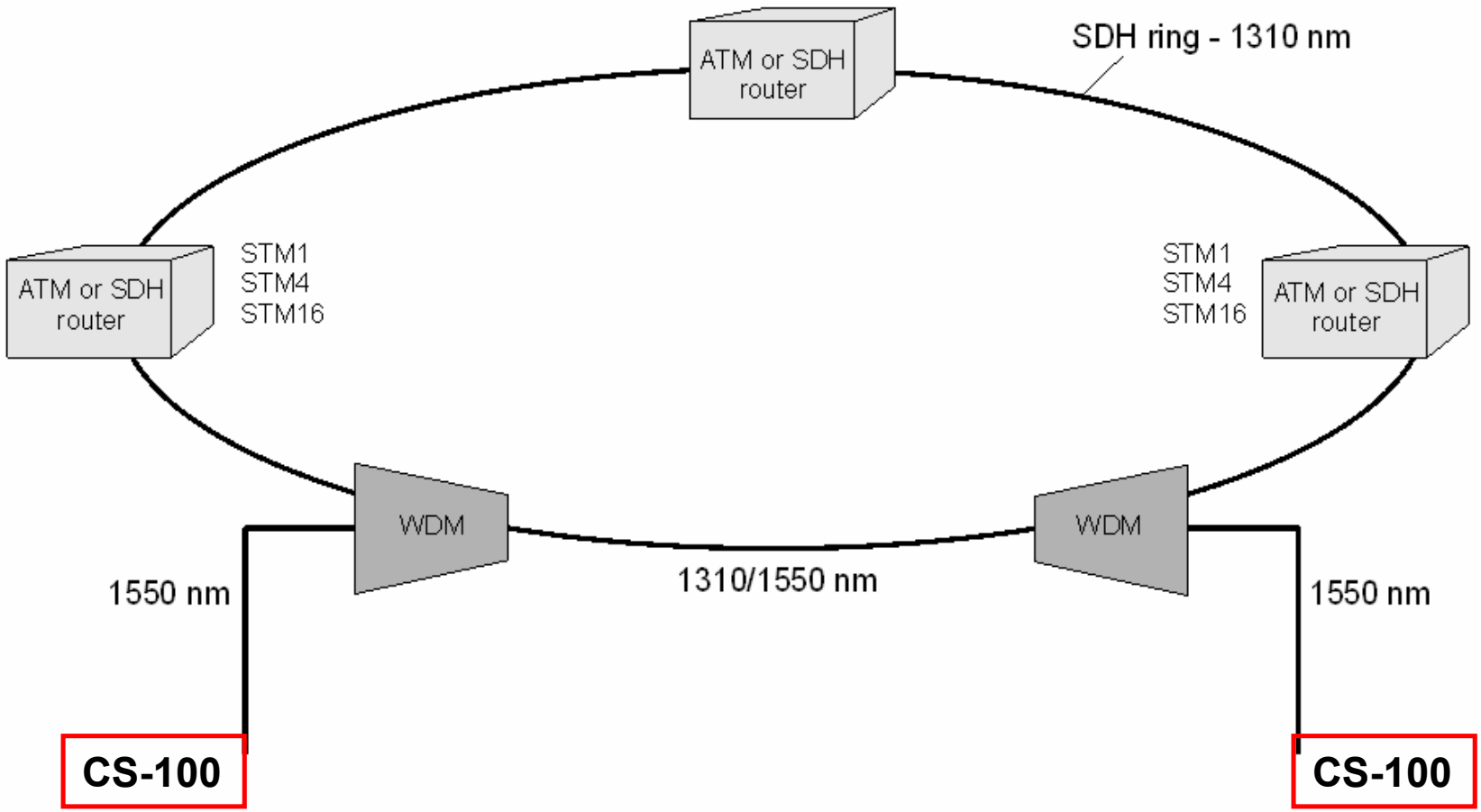
CS-100 konvertory

Norma	IEEE 802.3 **10Base-T** / 802.3u **100Base-TX** **100Base-FX**
Protokol	**CSMA/CD** (Carrier Sense Multiple Access with Collision Detection)
Interface	RJ-45 connector UTP 100-Ohm cable SC (ST) connector MM 62.5(50)/125 µm SM 9/125 µm
Vlnová délka	MM: 1300 nm S3: 1310 nm S5: 1550 nm WDM: W3 TX: 1310 nm; W5 TX: 1550 nm

CS-100 konvertory

Maximální délka segmentu	UTP kabel (10Base-T, 100Base-TX): 100 m Optické vlákno: MM: 2 km, SM 30, 40, 50, 80 or 120 km
Teplotní rozsah	-0 to 70°C (operating) -40 to 85°C (on request)
Napájení	Input: 220 V AC, 50-60 Hz Output rating: 5 V DC, 0.6 A
Rozměry	102 mm x 64 mm x 22 mm (L x W x H) – DC 150 mm x 125 mm x 22 mm (L x W x H) – AC

CS-100 konvertory



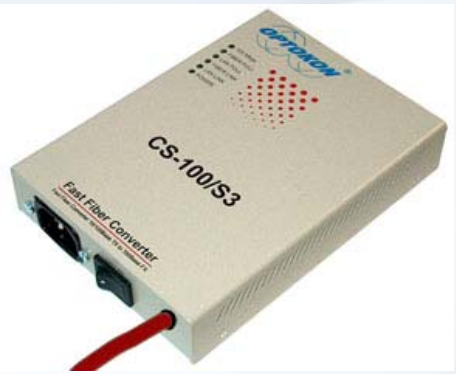
CS-100 konvertory

Media konvertory řady CS-100

Standalone typ

CS-100-A-S3-SC-30-DC

CS-100-A-W3-SC-02-AC



CS-100-A-S3-NC-02-FTTH

CRM3500 konvertory

CRM3500 řada – 3U rám k montáži do 19“ stojanů

- 15 pozic pro moduly 10/100Base-T konvertorů.
- SNMP řídící a dohledová karta
- 2 pozice pro napájecí zdroj 230 V AC
  -36 až 72 V DC

CRM3500 konvertory

CRM3500 řada – 3U rám k montáži do 19“ stojanů

2 typy konvertorů

zásuvný modul

stand alone box

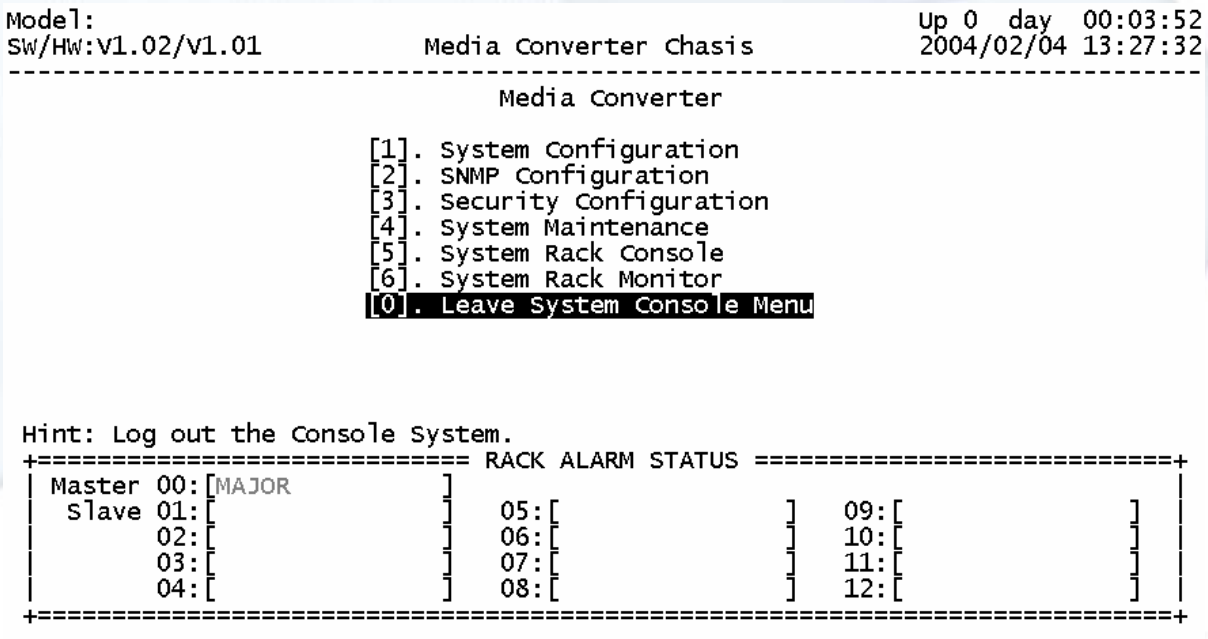
CRM3500 konvertory

Dohled – přímo prostřednictvím RS-232 rozhraní

snadná a rychlá kontrola, nastavení

minimální nároky na dohledový systém

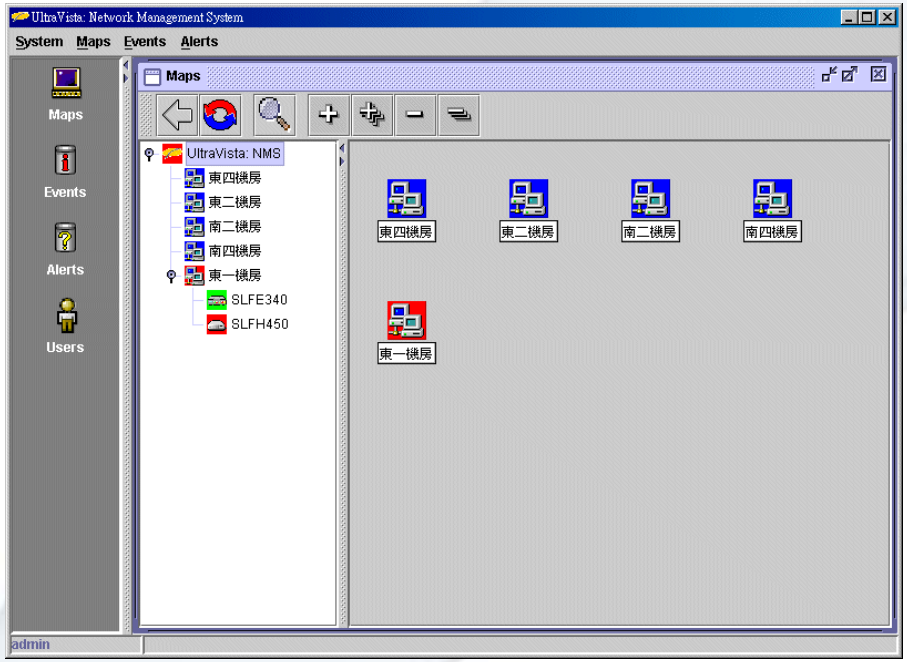
tabulkové menu

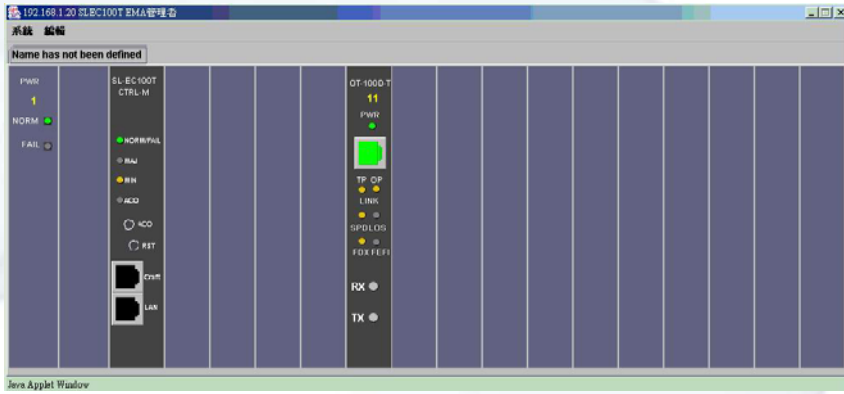


CRM3500 konvertory

Dohled –prostřednictvím web rozhraní

- GUI – grafické rozhraní
- Topologicky uspořádaná mapa dohlíženého systému





- instalované jednotky
- typ každého modulu
- provozní stav každého modulu
- stav UTP linky
- signalizace poruchy na vlákně

GBIC 1310 nm

Gigabit Interface Converters: S125-F3-GB-L-3

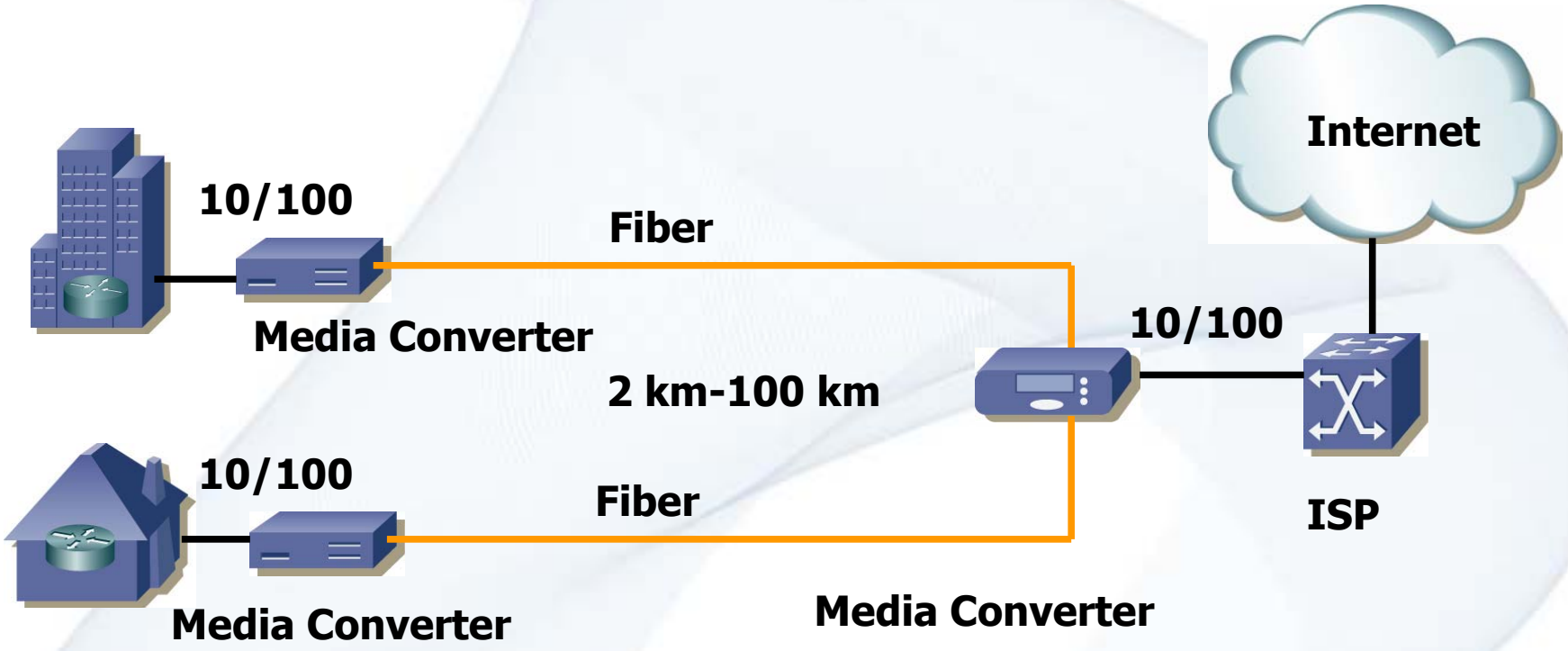
Features:

- Dual Power Supply +5V and +3.3 V
- TTL Loss of Signal Output
- Compliant with specification for ITU-T G.957
- Compliant with specification for IEEE802.3Z/D2
- Single Mode Fiber, SC Duplex Interface
- Class 1 Laser International Safety Standard IEC 825 Compliant
- Low power consumption
- Hot-pluggable
- Temperature Ranges: 0℃ to +70℃

Application:

- ATM switch, SONET / SDH Network
- Bridges/Routers/intelligent hub and concentrators
- Gigabit Ethernet / Fiber Channel

FTTH – vlákno do domu



SG-9224B switch - HW

- 24 10BaseT/100BaseTX auto-negotiation ports
- 2 Gigabit Ethernet ports
- 64 Mega bits buffer memory
- 14K MAC address table
- 4K VLAN table entries
- 256xN IP multicast table
- 1K protocol-based index table and 29 MIB counter per port
- Support 802.3X flow control for Full-Duplex
- collision-based and carrier-based backpressure flow control in Half-Duplex mode

SG-9224B switch - HW

- 16 GB system bandwidth
- 6.5 Mpps package switching transfer rate
- 8.8 Gbps switch fabric bandwidth at full duplex mode
- Store and Forward transmission mode/Broadcast storm control
- Head of Line (HOL) blocking prevention and broadcast storm filtering
- Max. forwarding and /or filtering rate 1,488,100 (1000Mbps) packets per second
- Comply with SNMP V1, V2
- Support MIB I, MIB II, bridge MIB and private MIB
- Illustrative LED for Power, Data, Link/Activity, Speed
- Dimension: 444x258x49 mm

SG-9224B switch - SW

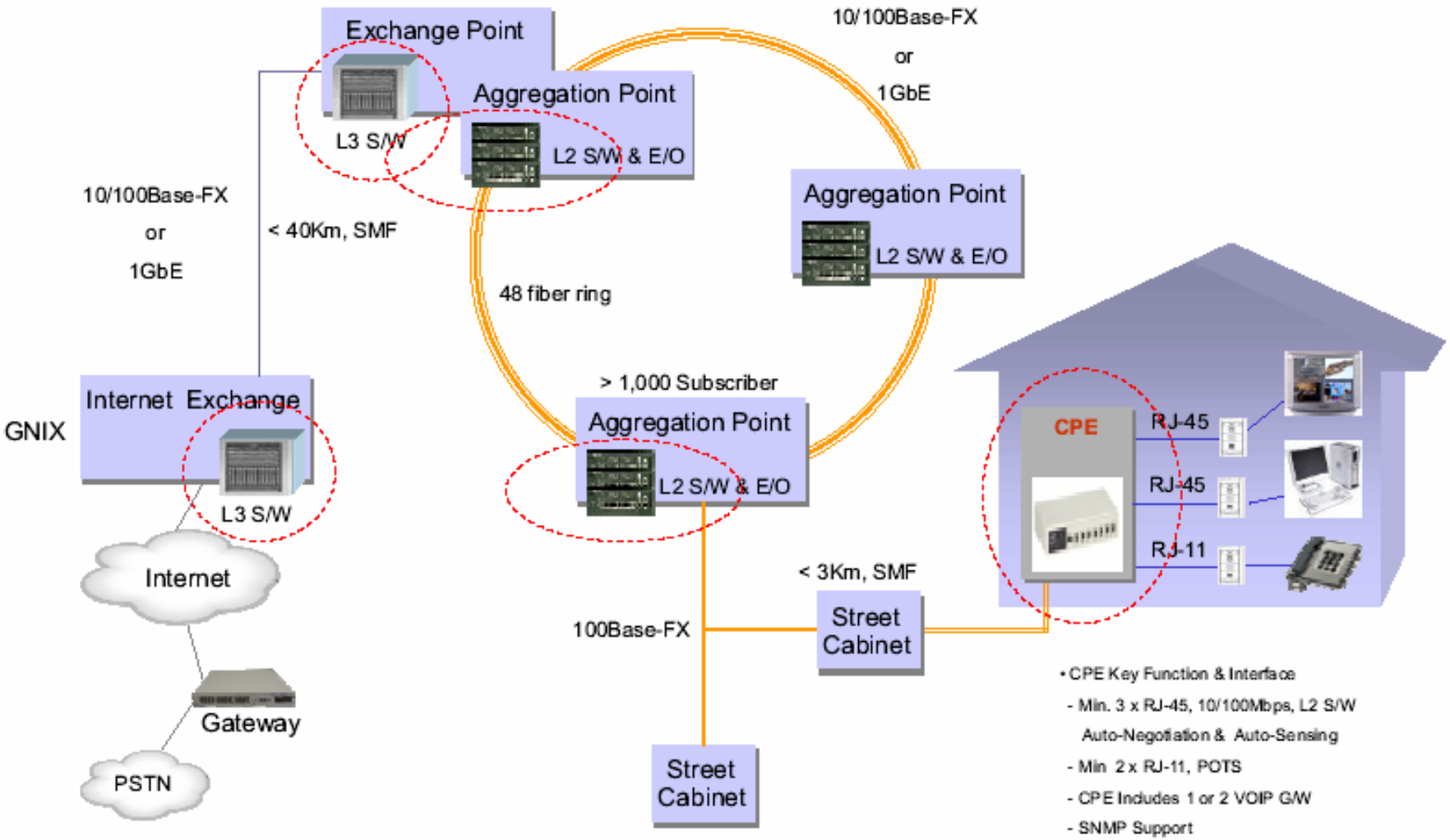
- 802.1x security protocol Support network access control
- VLAN
  - GVRP protokol support
  - Up to 7 trunks configuration
  - Protocol base configuration
  - Up to 1024 group port base configuration
  - up to 4095 tag VLAN configuration
  - hybrid mode configuration
- Port Control
  - Bandwidth control (100 k/unit)
  - Port transmitting control (Speed, Full/Half duplex)
  - Port statistics
  - Port mirroring

Další služby

- Data Ethernet 10/100 Mbit/s
- VOIP IP telefonie
  - CallManager – signalizační server, (na PC serveru)
  - hovor – nejkratší cestou
  - IP telefon (nebo pouze SW)
- Video IP-TV, Digital TV
  - video kodeky 2-3 Mbit/s jeden video kanál

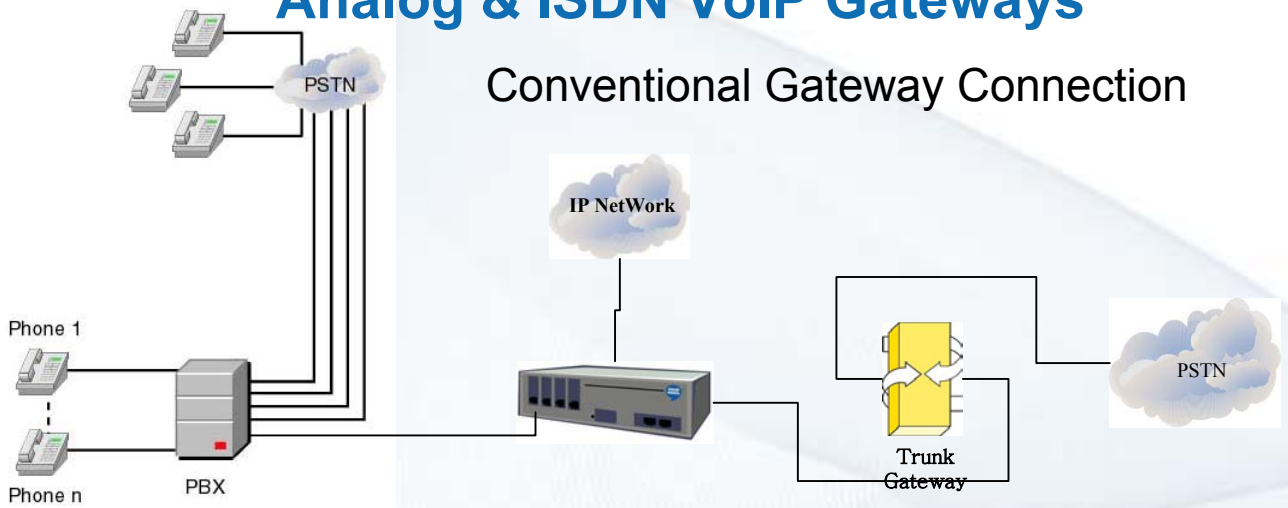
Vše vyjádřeno jedním pojmem – **Triple Play**

Další služby

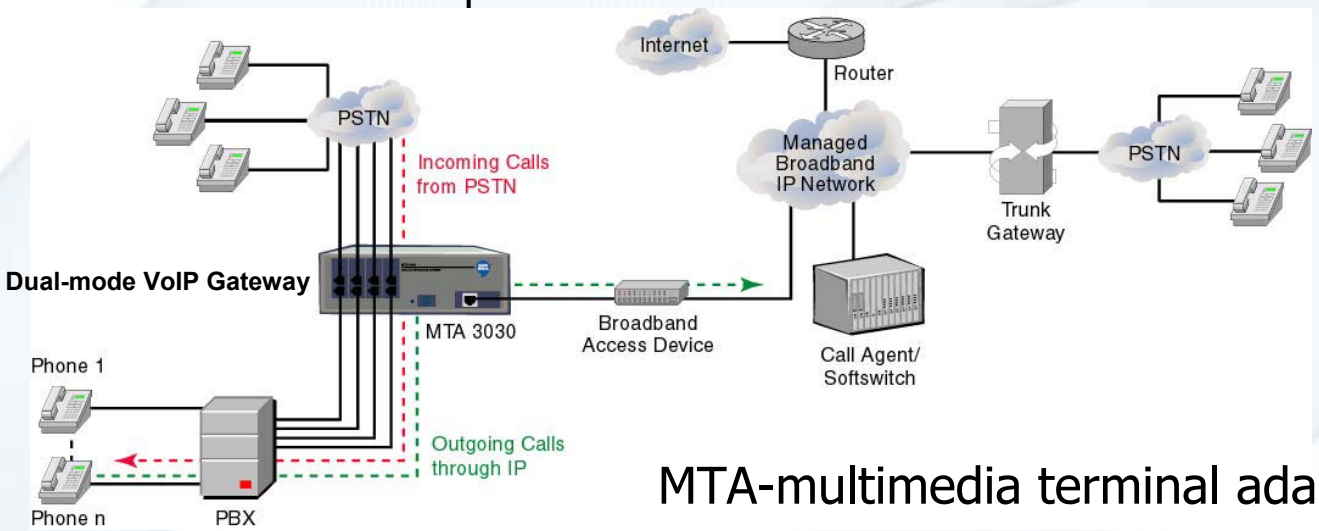


Dual-Mode VoIP Gateways for the Enterprise Market – Analog & ISDN VoIP Gateways

Conventional Gateway Connection

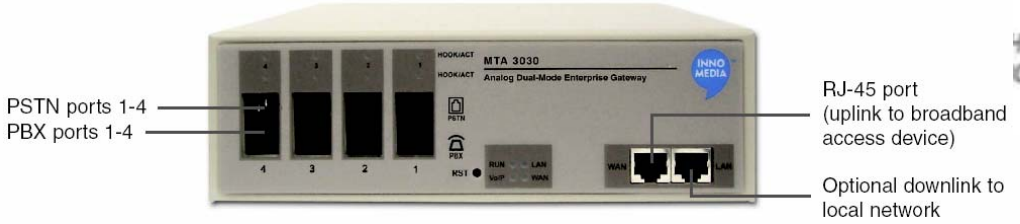


New enterprise voice communication with Dual-Mode gateways



MTA-multimedia terminal adapter

FEATURES



Intelligent Switching Between The PSTN And PBX Ports For Handling PSTN Or IP Calls

The MTA 3030 can intelligently and dynamically switch PSTN and VoIP calls based on the availability of the PBX ports. For example, while PBX ports A1 and A2 (see Figure 2) are busy making VoIP calls and/or PSTN calls, an incoming PSTN phone call coming from PSTN port B1, will intelligently be switched by the MTA 3030 to either PBX ports A3 or A4, depending on their availability.

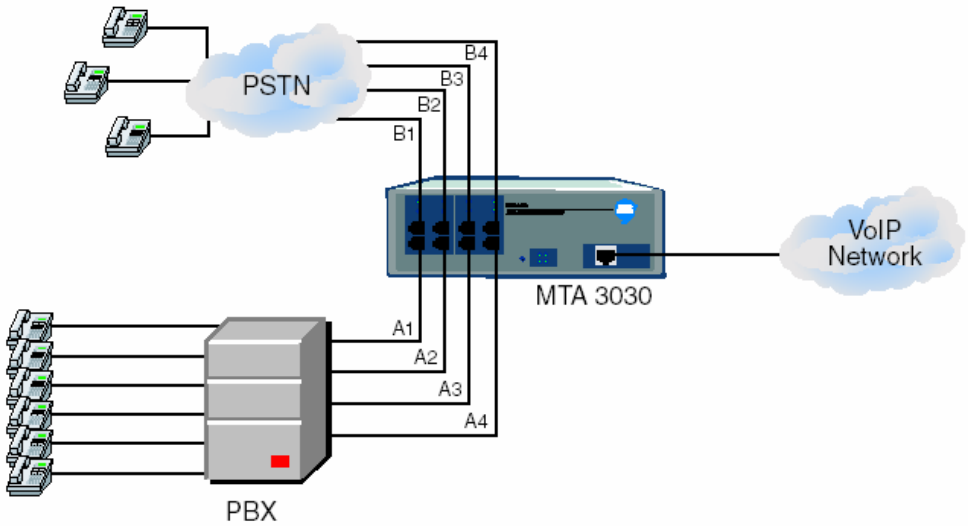


Figure 2 - Intelligent Switching and PSTN Fallback

Designed For Greater Call Reliability - PSTN Fallback If Power Failure Or IP Network Down

The MTA 3030 is designed to provide high telephony reliability, assuring that calls will always be connected by passing calls through to PSTN in the event of an IP connection interruption, VoIP network unavailable, or even a total power failure. For example, if VoIP calls cannot be made via PBX A1 - A4 ports (see Figure 2), calls originated from A1 - A4 will be switched to PSTN ports B1 - B4.

FEATURES

Intelligent Switching Between The PBX and PSTN Ports

The MTA 3040 can intelligently and dynamically switch PSTN and VoIP calls based on the availability of the PBX ports. For example, while PBX port A1 (see Figure 2) is busy making VoIP calls and/or PSTN calls, an incoming PSTN phone call coming from PSTN port B1, will intelligently be switched by the MTA 3040 to PBX port A2. In addition, the Line Group feature offers further control over the interfaces by allowing the user to exclusively associated a PSTN interface with a PBX interface. For example, when Line Grouping is enabled, PBX interface A1 will only accept calls arriving from PSTN interface B1. Likewise, PBX interface A2 is exclusively associated with PSTN interface B2. This functionality is helpful in situations when one of the PBX interfaces is reserved for a specific user, such as an Executive or Manager.

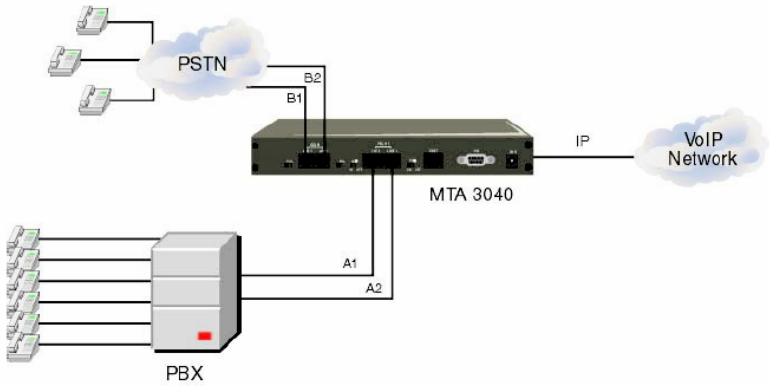


Figure 2 - Intelligent Switching and PSTN Fallback

Designed For Greater Call Reliability - PSTN Fallback If IP Network Down

The MTA 3040 is designed to provide high telephony reliability, assuring that calls will always be connected by passing calls through to PSTN in the event of an IP connection interruption, or if the VoIP system is unavailable. For example, if VoIP calls cannot be made via PBX A1 - A2 ports (see Figure 2), calls originated from these ports will be switched to PSTN ports B1 - B2.

Provides Web Interface For Monitoring Port Status, Call Detail Records, And Uploading Firmware

The Web GUI allows the administrator to perform various functions on the unit. The real-time status of any port on the MTA 3040 can be accessed through any browser. Detailed call records (CDR) can be displayed for any calls made since the last time the device was rebooted. Finally, firmware updates are easily performed via the web-browser interface.

Flexible DigitMap To Direct Call To IP Or PSTN

A DigitMap is a dialing plan resident in the MTA 3040 used for detecting and switching calls to PSTN as defined by the broadband service providers. For example, calls to emergency numbers (911, 110, etc.), directory assistance (411, 104, etc.), toll-free numbers (800, 005, etc.), or any other designated area codes will pass through to PSTN once the user dials these numbers. It can also be used for least-cost call routing if a proper DigitMap associated with cost factors is entered into the MTA 3040.

IP Videophone Features

- Full screen Video display
- Privacy mode for hiding own image
- Remote and self view toggle and PIP
- Video out connectivity to TV or VCR
- Additional camera or video input
- Video Input selection and toggle
- PAL and NTSC format support
- No-activity Screen Saver
- Web-based management
- Caller ID Display
- Hands-free Speaker Phone
- Full digital volume control for speakerphone, handset and ringer
- Last number redial
- Speaker and handset mute
- Build-in phonebook
- Incoming and outgoing call history
- Incoming call ringer light

Broadband VoIP CPE Devices Offer Flexible System Interoperability and Platform Support