Switching Method for Multiservice Network

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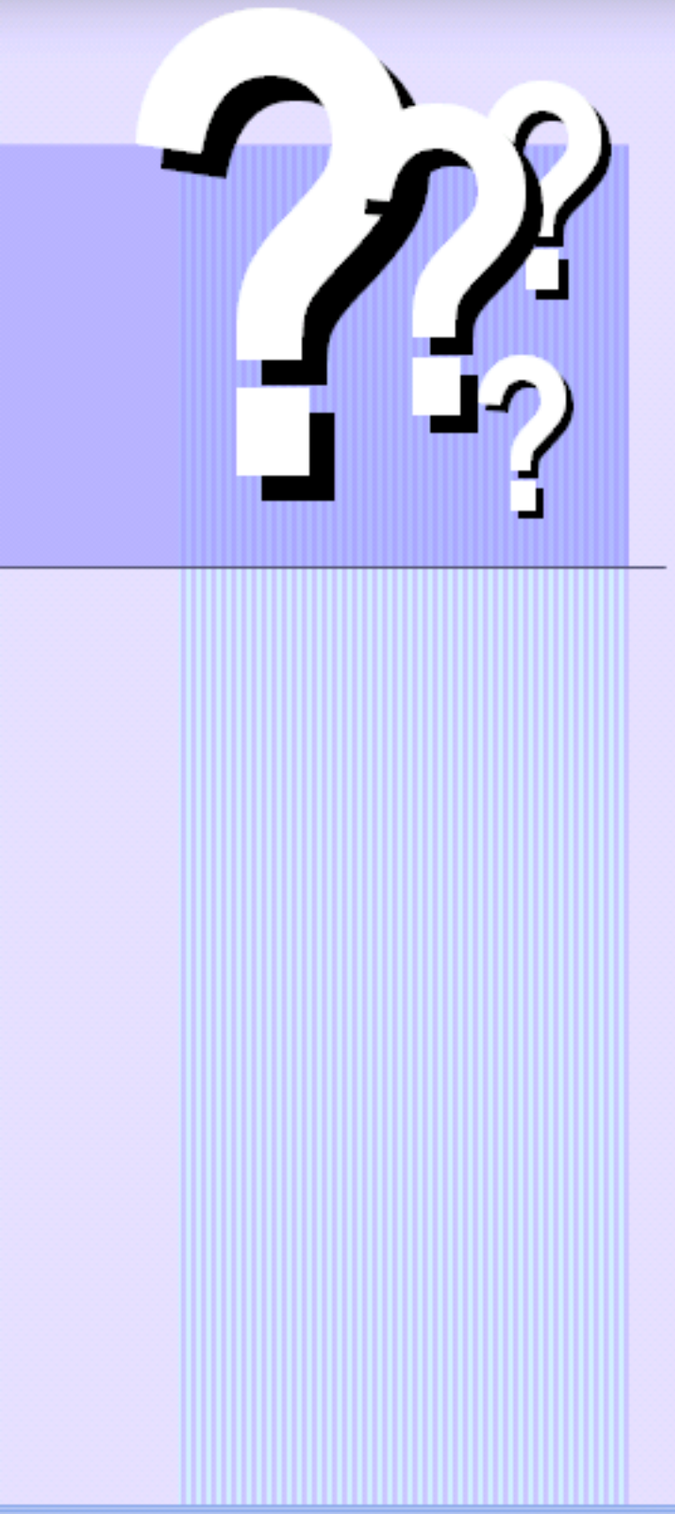
What Is To Be Discussed

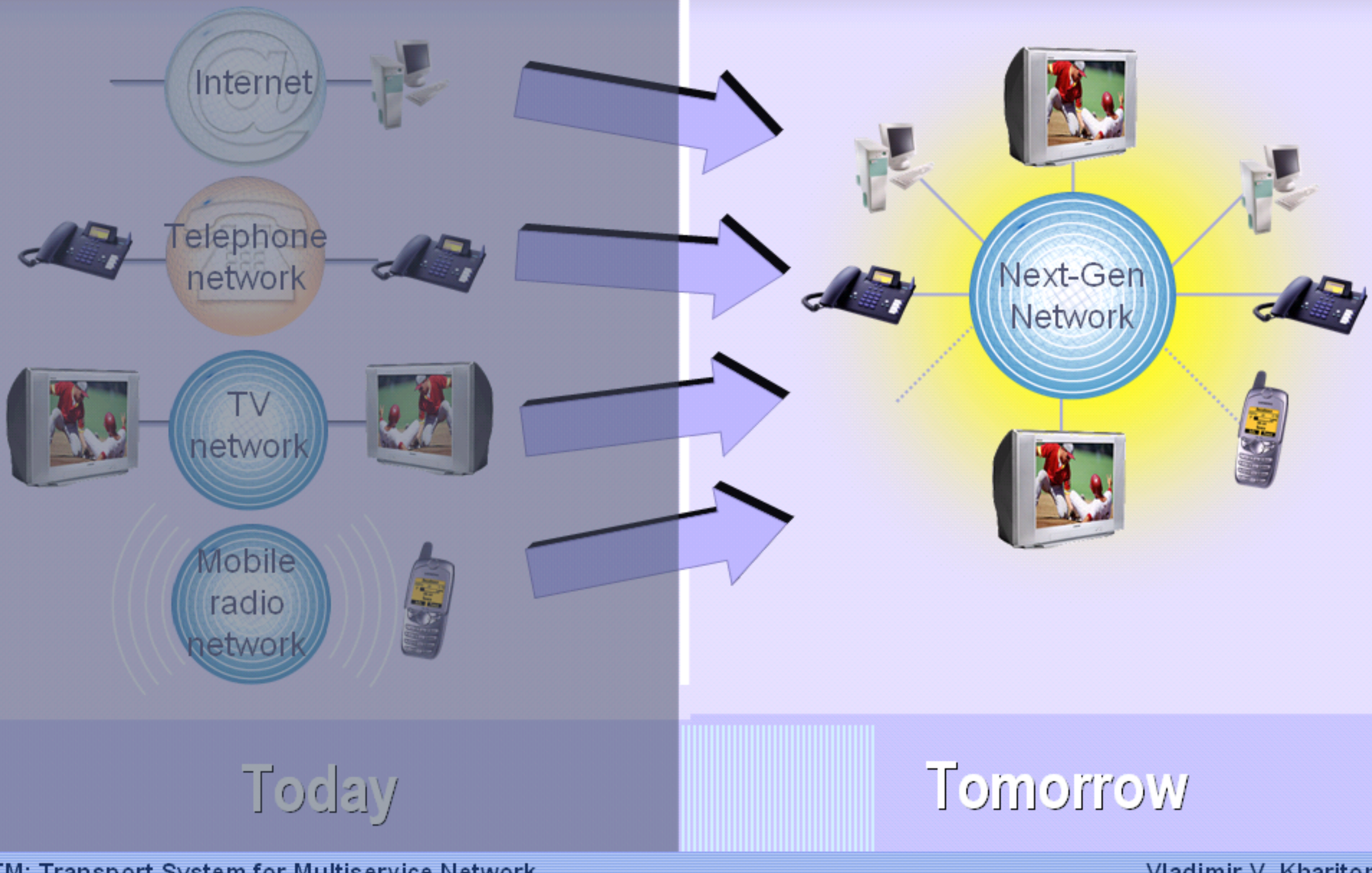
Presentation contains:



- Modern telecommunication networks
  - PSTN, Mobile, Data communications. Internet,
  - Network technologies convergence
- The idea of next generation multiservice network
  - The requirements of different kinds of traffic
  - IP and ATM as NGN technologies
- Overview of existing switching methods
  - PS, CS and Hybrid Switching
- General Approach to Switching
  - Data block
  - Multiplexing Interval
- Introducing “Block Switching” Method
- Summary

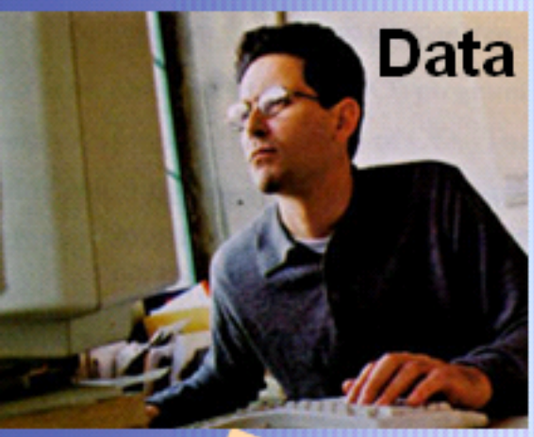
Network Convergence

One global network for everything



Traffic Parameters and Requirements

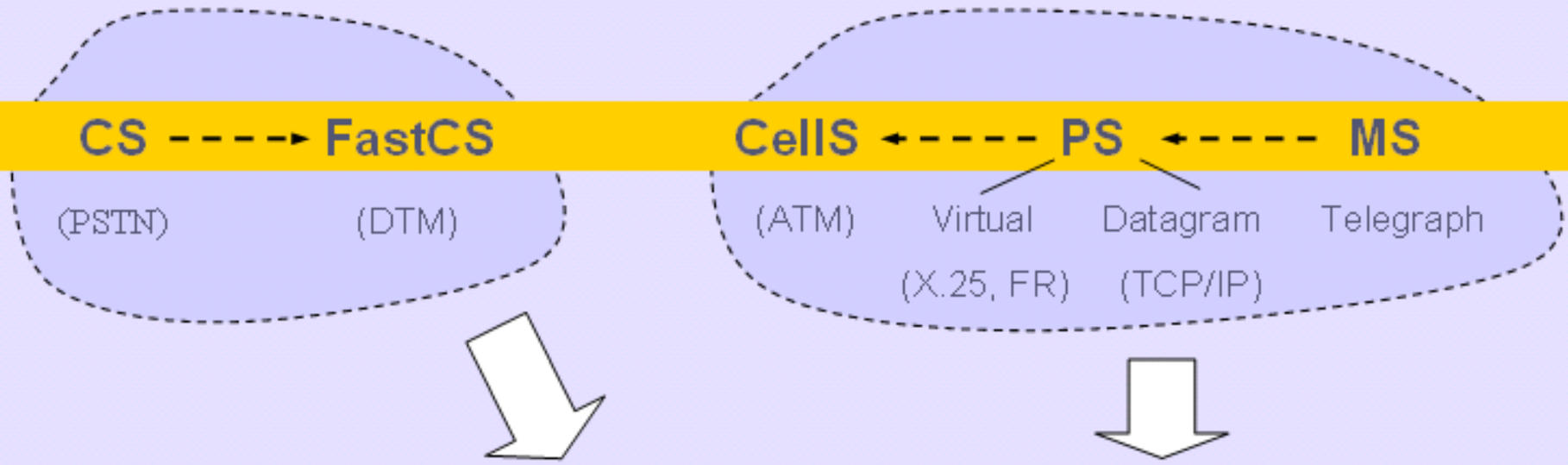
Different types of traffic produce different demands to network



- Data transmission rate
  - Peak rate
  - Average rate
  - The burst coefficient
  - ...
- Data block size
- Communication session duration
- QoS parameters:
  - Delay and jitter
  - Loses
- Data block size
  - Packetization delay (data accumulation)
- Security

Switching Methods

Switching method is a basement of any network technology



Transmission method	Synchronous, no queues	Asynchronous, queues
Overload behavior	Refuse in service	Increase of delay, packet loses, because of queues overflow
QoS	Simple	Complex
Overheads	Channel resources	Headers, header processing, queues managements, traffic shaping
Channel resources distribution flexibility	Poor	Good

Cell Switching: ATM

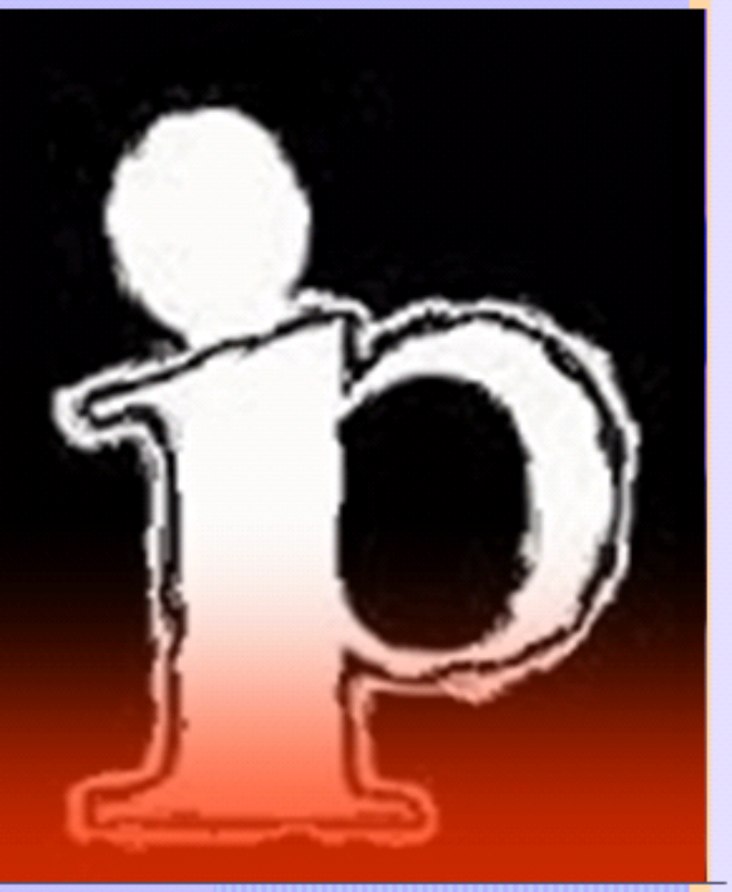
Created to eliminate shortcomings of packet switching

Asynchronous Transfer Mode

- Features:
  - Connection-oriented
  - Short packets, fixed length - cells
  - Four basic classes of service: A, B, C, D
- Advantages
  - Can transmit traffic of different kinds
  - Initially supports QoS
- Disadvantages
  - Based on packet switching => QoS are not native
  - High speed of transmission required
  - Large overheads
    1. Headers (48 bytes data / 5 byte header)
    2. Hardware overheads: complex equipment
  - Complicated and thus expensive equipment
  - Datagram mode is not supported (emulated)
  - Complicated integration with other technologies
  - Standardization still in progress

Internet Protocol

Datagram protocol being adapted to emulate Circuit Switching



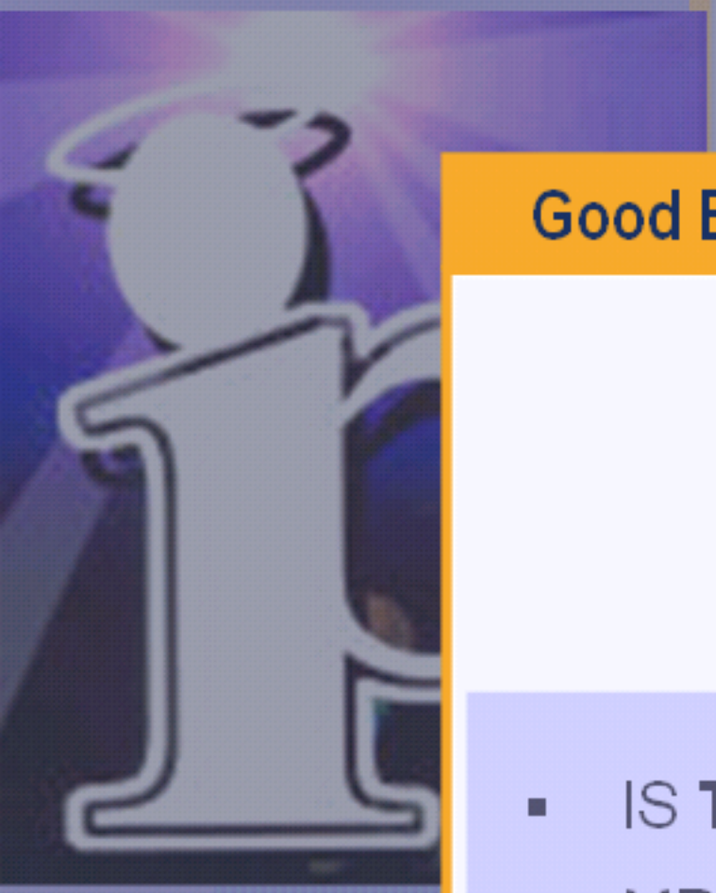
- "Everything over IP" and "IP over everything"
- Advantages
  - Can work over many network technologies
  - Widely spread
  - Good bandwidth utilization (?)
- Disadvantages
  - Not multiservice, but MONOSERVICE Network
  - Based on datagram mode (connectionless mode)
  - "Emulation, Emulation, Emulation!"
    IP does not support – it emulates
  - Emulation of virtual connections (RSVP, etc)
  - Enormous overheads while transmitting real-time traffic (emulation of Circuit Switching by using datagram mode)
  - IP network is not transparent for traffic: jitter, loses
  - Poor security. Requires additional mechanisms

IntServ | DiffServ | MPLS

Internet Protocol

Datagram protocol being adapted to emulate Circuit Switching

- "Everything over IP" and "IP over everything"
- Advantages



IP Over Ever
Everything Over IP!

many network technologies

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– Poor security. Requires additional mechanisms

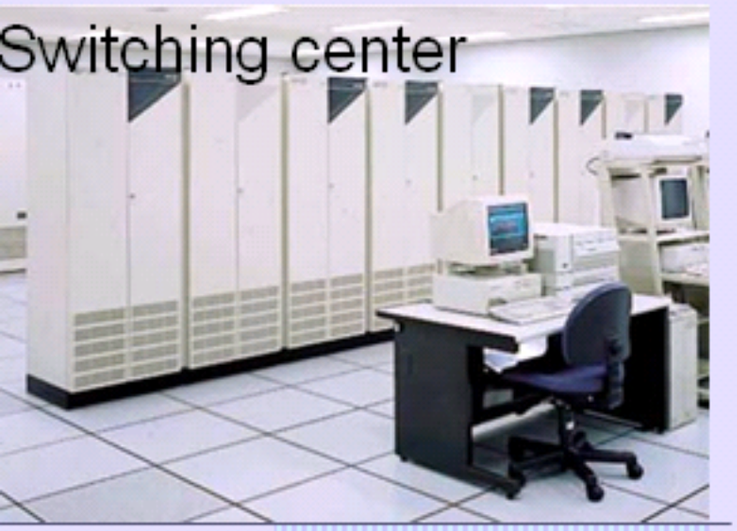
IntServ | DiffServ | MPLS

Good Bandwidth Utilization!

- IS **THIS** GOOD?
- MPLS, IP, TCP/UDP, RTP => Header can be many times longer than data

Circuit Switching

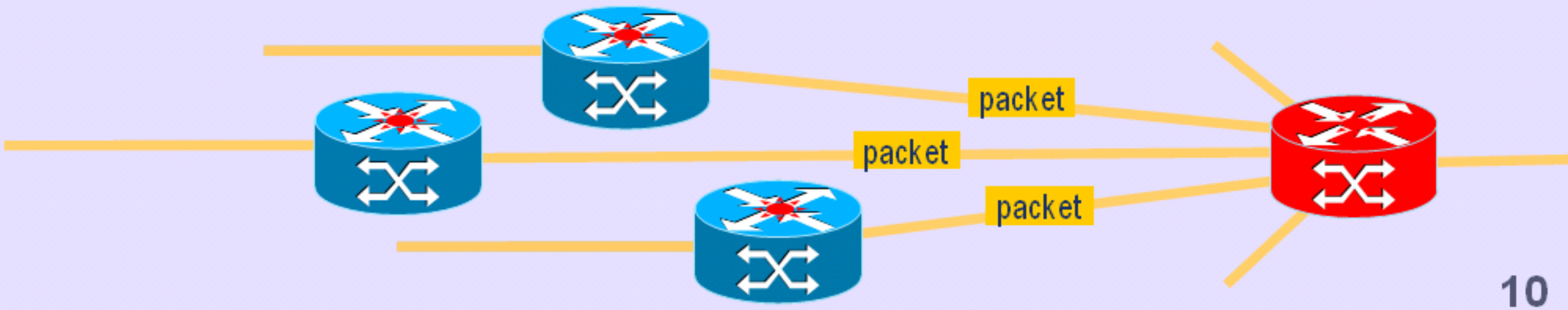
Traditionally used in PSTN



- Used in PSTN, narrow-band ISDN
- Advantages
  - Ideal conditions for real-time traffic
  - Simplicity
  - Requires minimal network equipment resources
  - Native support for QoS
  - Guaranteed QoS
- Shortcomings
  - Poor bandwidth utilization
  - Difficultly in support for wide data rate ranges
- DTM
  (Dynamic synchronous Transfer Mode)

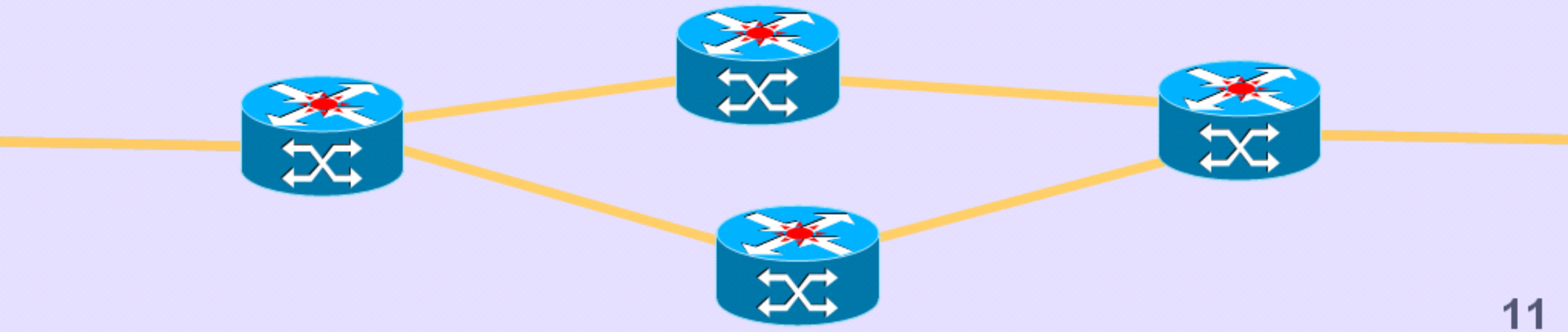
Comparison of CS and PS

- Main limitation of Packet Switching – absolute asynchronous
  - No matter what QoS mechanisms are used, no time transparency can be provided
  - Traffic is not structured while passing through network
  - Best effort mechanism is used. Is it good?
  - Each switch/router behaves independently of the entire network: no synchronization at all
  - The myth that PS provides higher delay than CS



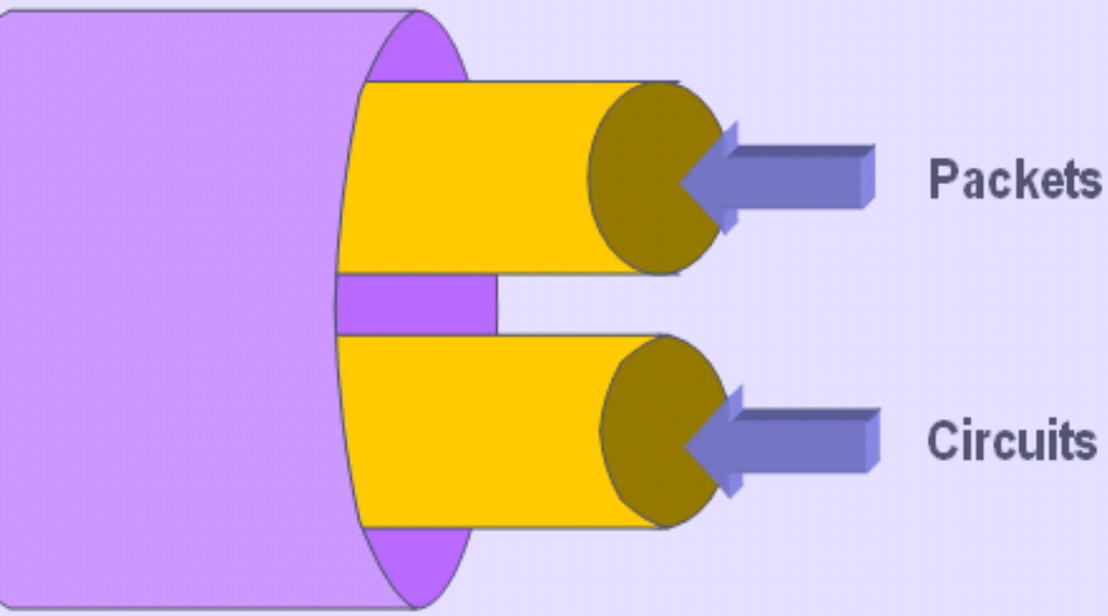
Comparison of CS and PS

- Circuit Switching – absolute synchronousness
  - Traffic is strictly structured while passing through network => no jitter, no loses, no queues even in case of 100% load
  - All switches handle traffic together, because of strict synchronization
  - Network is 100% time transparent
  - Bad bandwidth utilization (?)



Hybrid Switching

Why not to use Hybrid Switching?

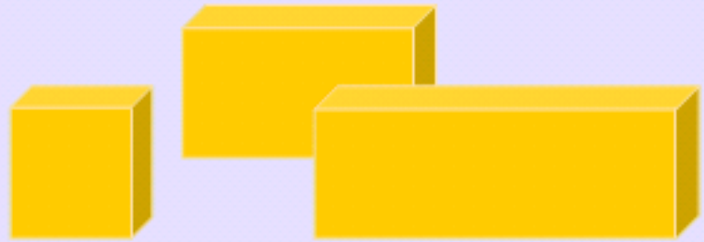


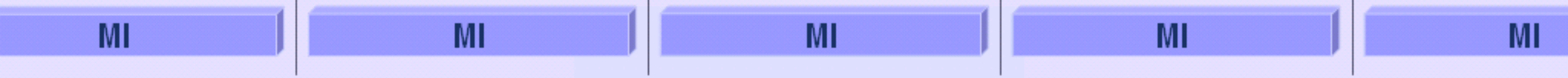
- Appeared long time ago and well-known
- What is Hybrid switching
  - Nothing new: Just combination of two switching methods
  - Just redistributes bandwidth between CS and PS
  - Dynamic bandwidth redistribution
- Disadvantages
  - Requires complex equipment: combination of CS and PS

General Approach to Switching

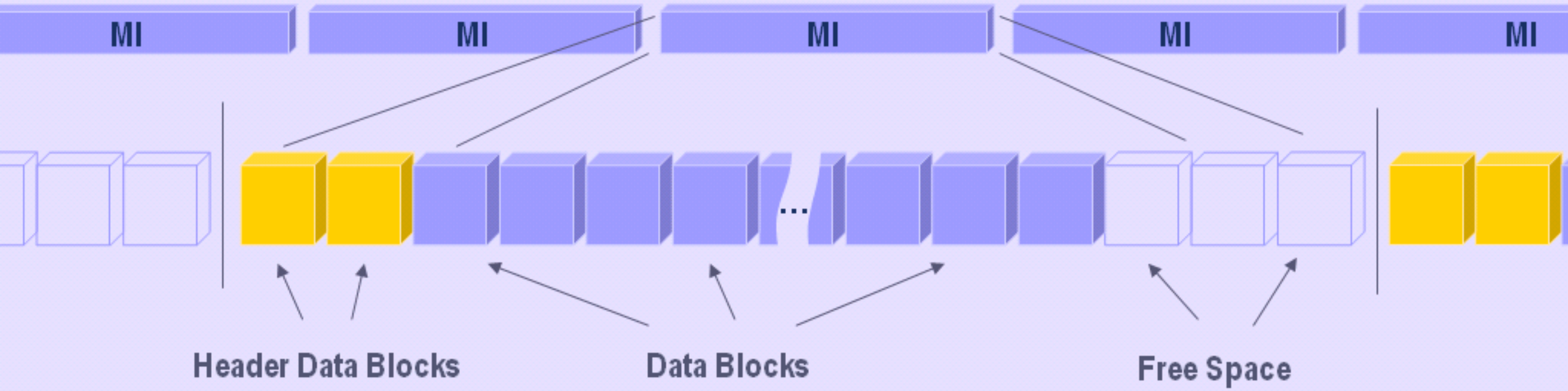
Each switching method is based on this general approach

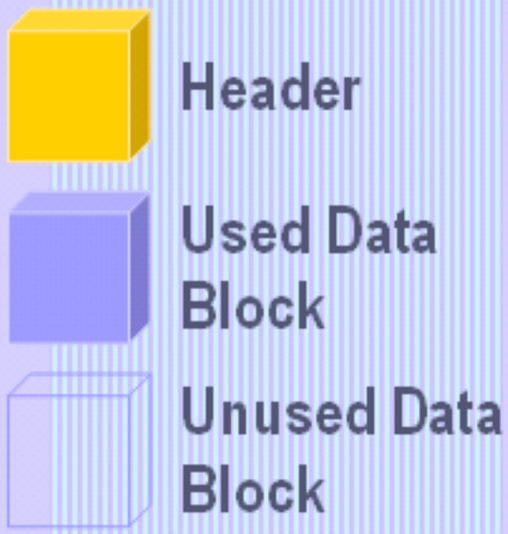
- Block switching approach was invented by Dr. Vladimir K. Kharitonov in 2000
- Introducing DATA BLOCK (DB)
  - Atomic switching unit
  - IP: variable size, header
  - ATM: fixed size, header
  - PSTN: fixed size (8 bytes), no header
- Introducing MULTIPLEXING INTERVAL (MI)
  - Time interval during which all queued data blocks are being sent.
  - The structuring unit in network
  - CS: MI is of fixed length of 125 micro seconds
  - Inside M.I. statistical multiplexing can be done
  - IP/ATM and other PS: Multiplexing interval is not defined, thus the structuring is poor





Block Switching Over Synchronous Environment

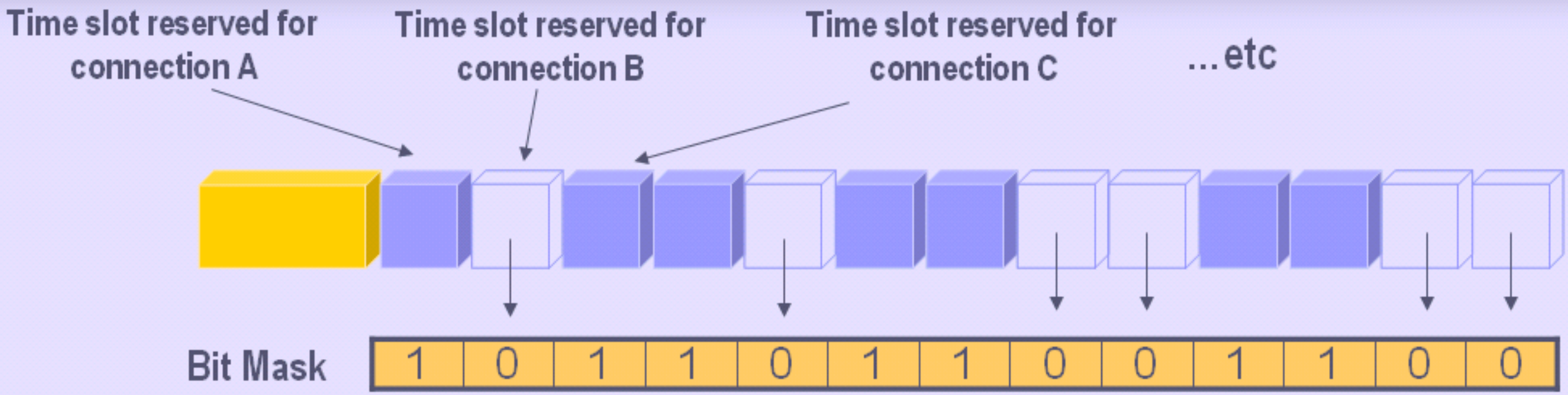


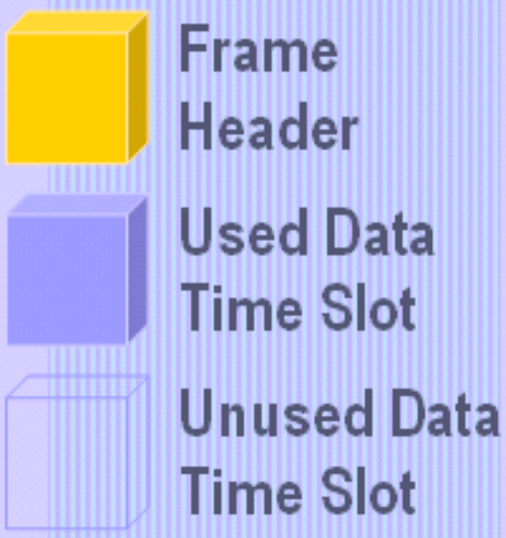


- Time is divided into MI
  - Basic frame length at edge and core networks: 125μs
- Data block – atomic switched unit
  - Control information is separated from data
  - Header Data blocks, Data

Block Switching Over Synchronous Environment

The way Block Switching can be implemented in synchronous environment

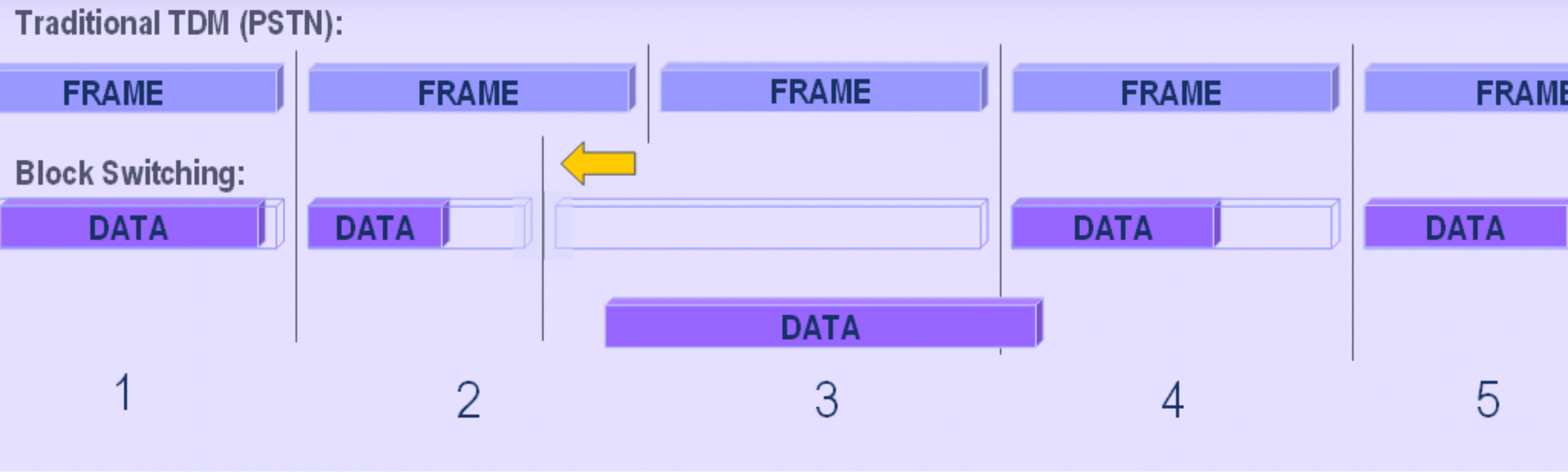




- Similar to circuit switching used in PSTN
  - Based on synchronous environment
- Similar to packet switching
  - Uses statistical multiplexing

Variable Frame Length

Traffic bursts smoothes mechanism



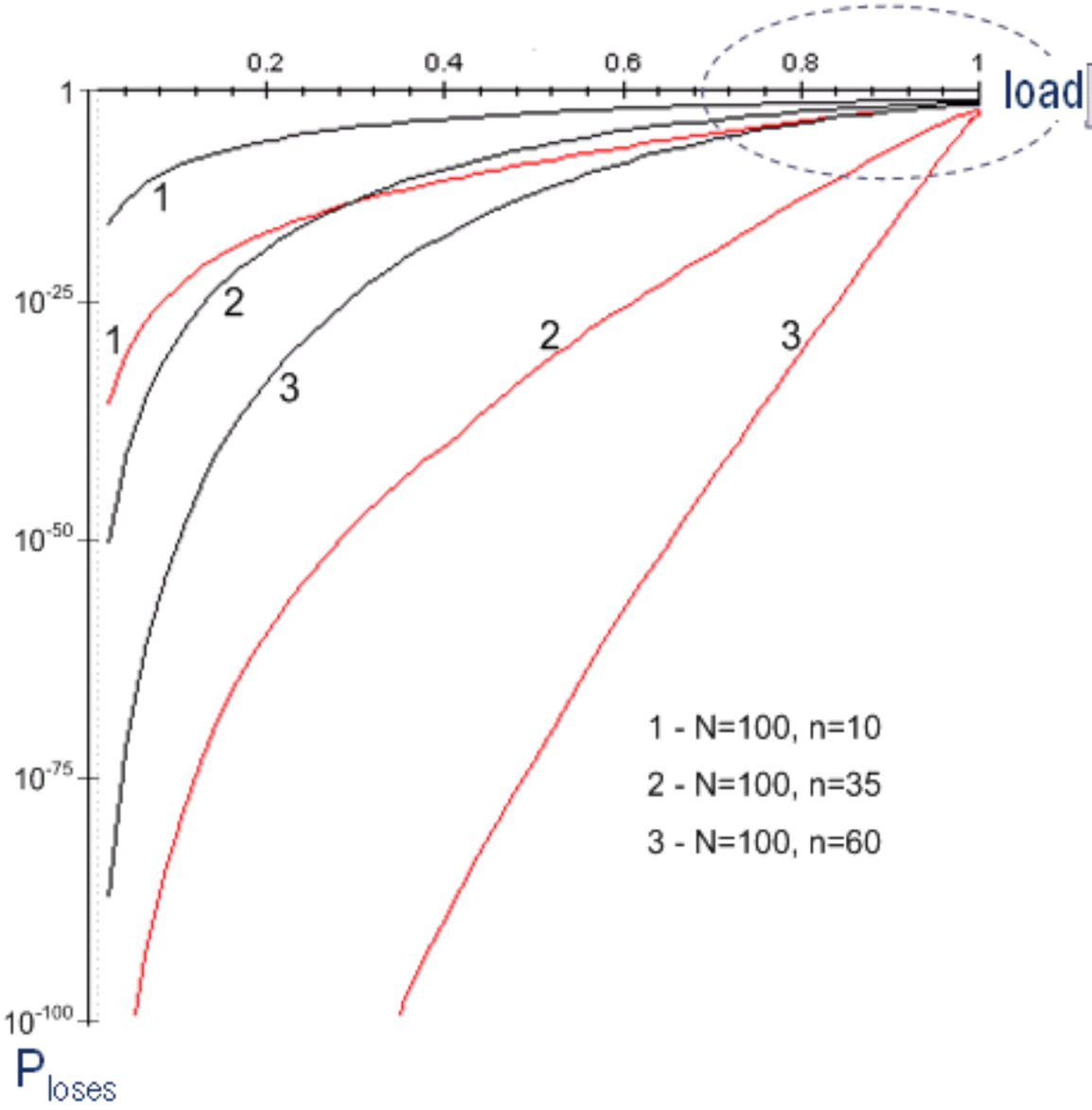
FRAME TDM frame

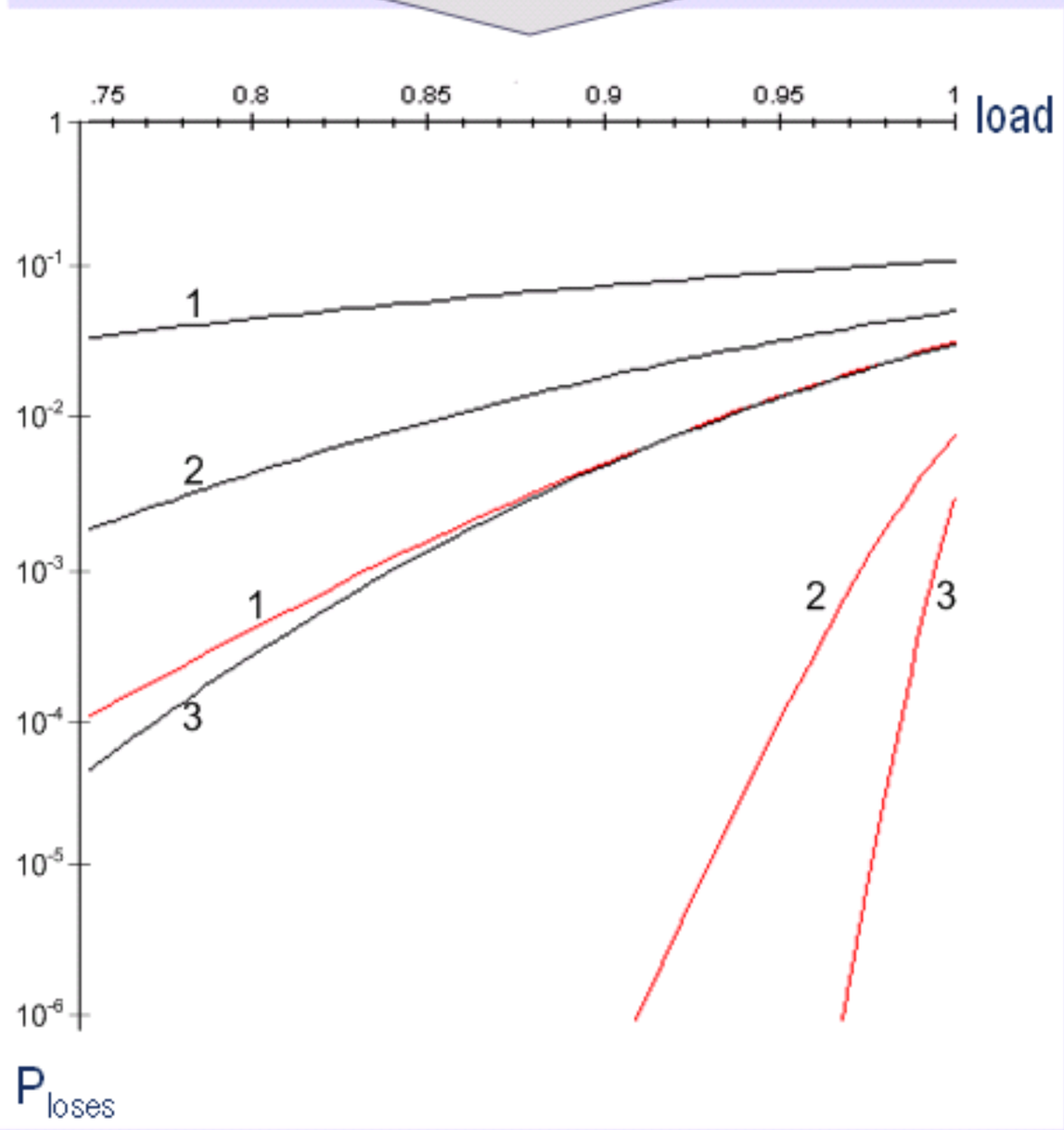
MI

DATA Data blocks

- TDM:
  - Strict Synchronous
  - Frame size of fixed length
- Block Switching:
  - Quasi-synchronous
  - The length of frame varies to smooth traffic bursts
  - Oriented to low-speed channels

Multiplexing Interval of Variable Length





Block Switching in Asynchronous Environment

Structures traffic using packet switching mechanisms (for example IP)

- Traditional PS: absolutely asynchronous
- Best effort mechanism

- Multiplexing interval and PS network
  - Introducing traffic structureness in asynchronous environment
  - MI header mark (special packet or even a field in packet header)
  - Variable MI length
- Minimal equipment modifications (!)

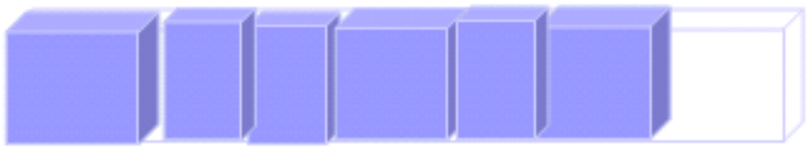
How Does It Work?

Simple description of switching within MI

Inside Switch

Input M.I. 1

Output M.I.



Input M.I. 2

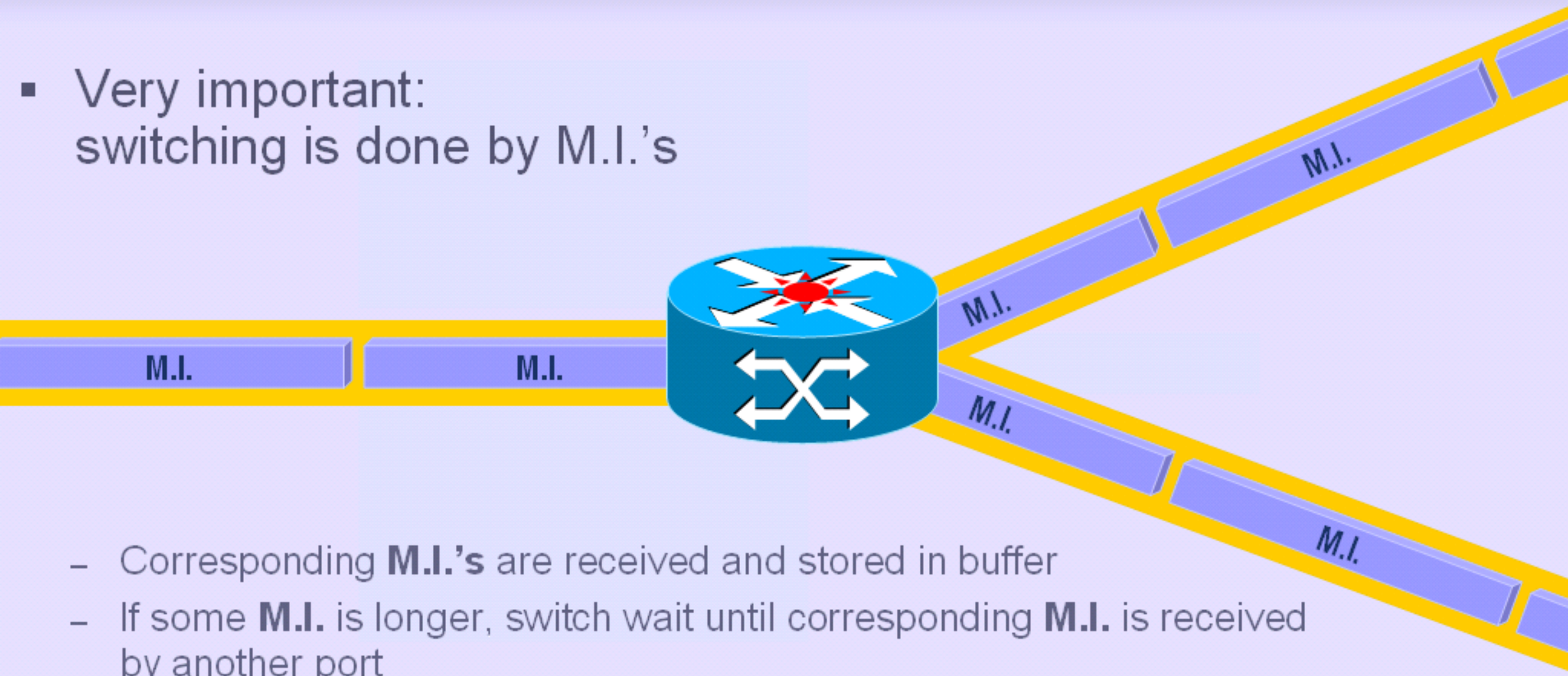
Data Blocks of the buffered M.I.'s are switched according to switching table (or routing table if we speak about M.I. in IP), thus output M.I. is formed and placed into output buffer

- Output M.I. are formed and placed into output buffer
- Output M.I. are transmitted

How Does It Work?

Simple description of switching within MI

- Very important:
  switching is done by M.I.'s



- Corresponding **M.I.'s** are received and stored in buffer
- If some **M.I.** is longer, switch wait until corresponding **M.I.** is received by another port
- According to switching table (or routing table if we use IP) data blocks are switched
- Output M.I. are formed and placed into output buffer
- Output M.I. are transmitted

How Does It Work?

Simple description of switching within MI

- Very impo
  switching

M.I.

– Correspon
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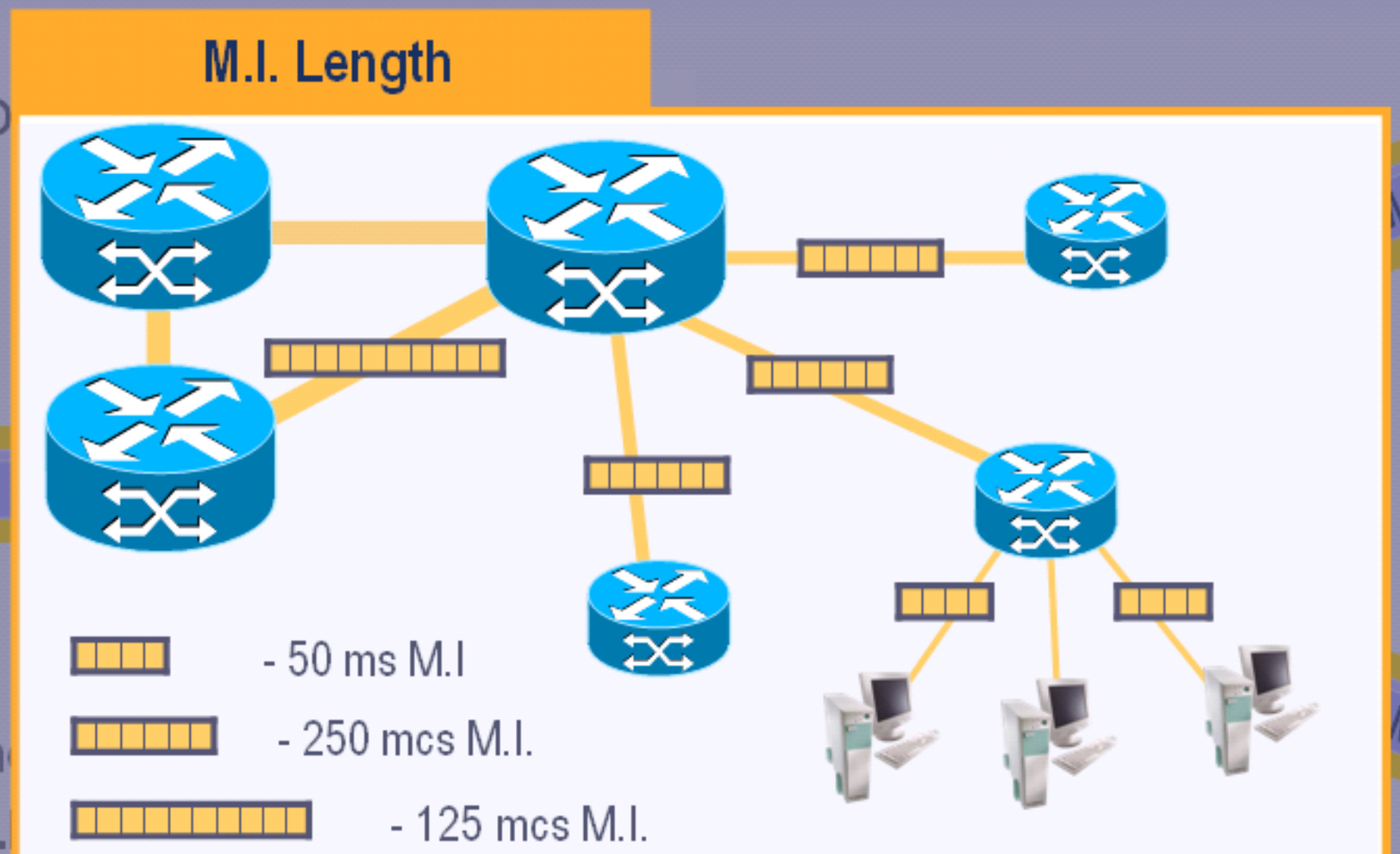


The length of M.I. (in time) may vary all over the network.
Access network – long M.I. for better multiplexing
Core network – short M.I. for low switching delay

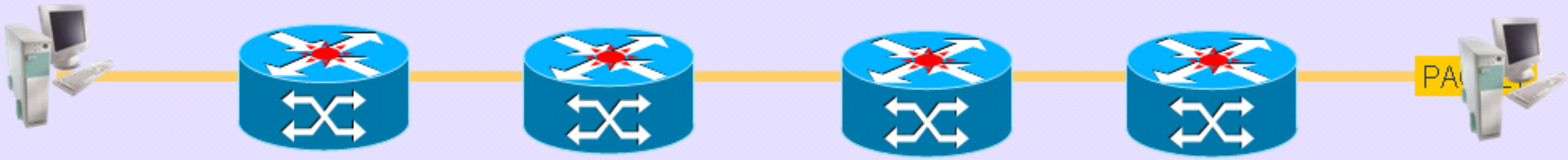
M.I.

M.I.

What Is the Price?

We win traffic structuring, but what do we loose?

PS-based Network

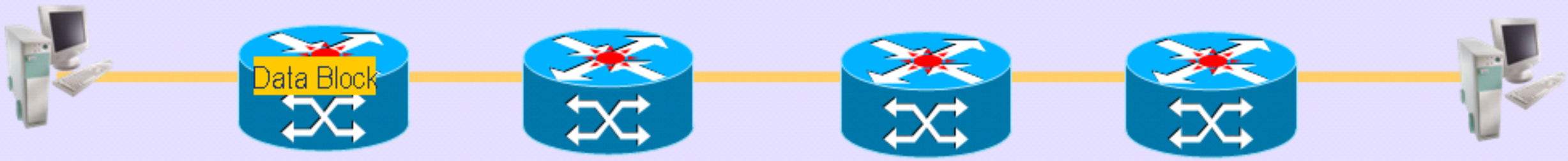


- Myth “Delay in PS network is higher than in CS one” – It is not correct
  - Network with low load – packet is transferred with speed of light (we do not take into consideration switching delay)
  - When network load increases – queues appear
  - Queues lead to jitter

What Is the Price?

We win traffic structuring, but what do we loose?

Block Switching Network



- Switching is done by Multiplexing Intervals
  - MI is buffered on each network hop, so data block cannot be transmitted just after it is received
- In case of low network load we CAN transmit data block faster, but we DON'T
- What is the price?
  - No matter, how network is loaded, switching delay remain constant

What Is the Price?

We won traffic structuring, but what do we loose?

Switching Delay

PS Networks: switching delay is not constant. Depends on network load.

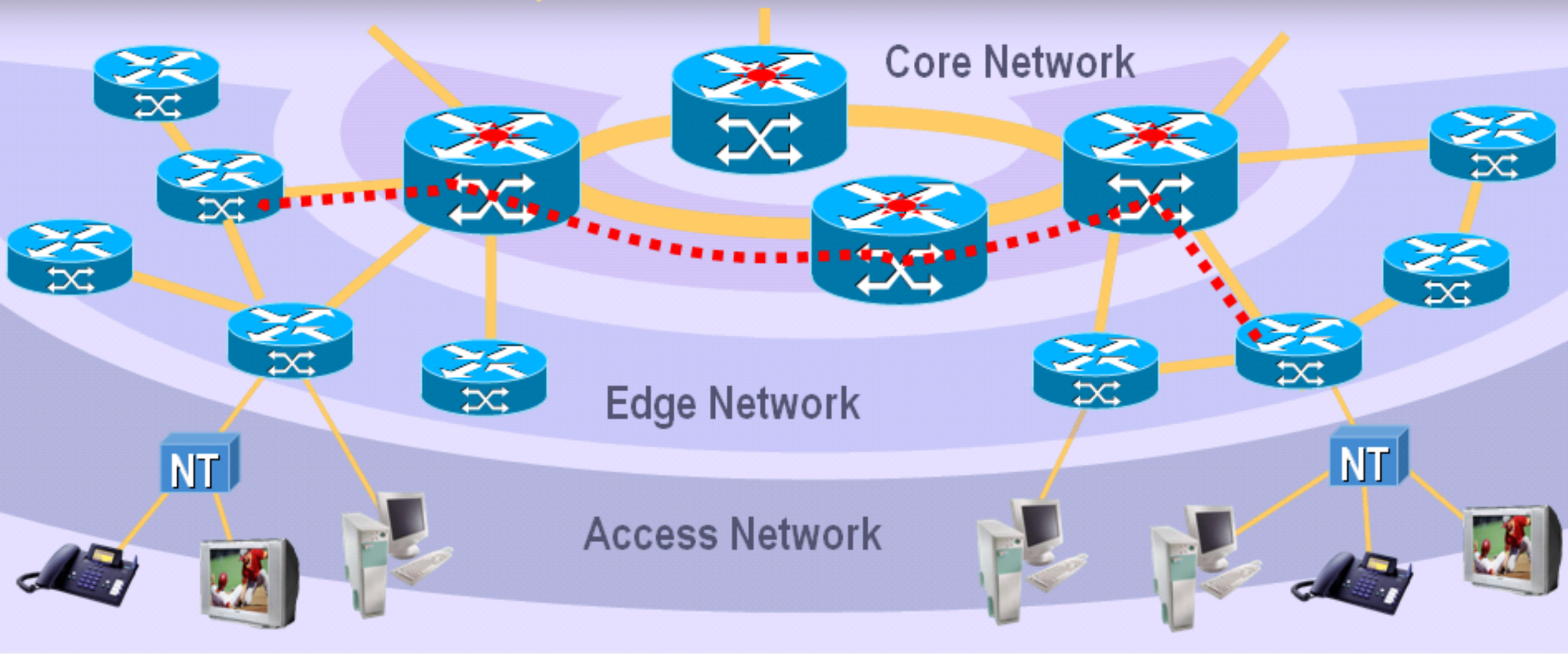
Block switching: switching delay is determined by the length of Multiplexing interval. Delta function. Does not depend on network load

What is the price?

- No matter, how network is loaded, switching delay remain constant

Multilayer Network Base on BS

Initially has facilities to be used as end-to-end network



Core network switch

Edge network switch

Network Termination

- **Layers**
  - Edge Network (distribution layer))
  - Core Network
  - Access Network
- **Each layer has its own MI**

Block Switching Benefits

Simple and powerful, Native QoS support

Synchronous Asynchronous Transfer Mode

- **Network is time-transparent**
- Network is invariant to traffic structure
- Native QoS Support. No emulation
  - QoS is guaranteed by technology nature
  - Low switching delay (determined by MI length)
  - No jitter
- Can handle QoS traffic even in case of almost 100% load
- Very good bandwidth utilization
- Can be used both on synchronous and asynchronous environment
  - (GSM improvement!)
- Can work over low speed channels
- This idea resulted in SATM technology

Block Switching Benefits

Simple and powerful, Native QoS support

- **Network is time-transparent**
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- Can work over low speed channels
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Block Switching

- SATM Group
- 5 years of development
- Block switching approach was patented in Russia in 2003
- Preparing additional feature patents
- Preparing US patent

Synchronous Asynchronous Transfer Mode

Summary

Synchronous Asynchronous Transfer Mode

Thank you!

- Network technologies convergence.
  The problem of building global multiservice network
- Switching methods: circuit and packet switching
- ATM, IP or.. ? The requirements to NG Network
- Block Switching for next generation network
  - Powerful and flexible
  - Time-transparency
  - Native QoS mechanisms, guaranteed QoS
  - Low overheads
  - Wide speed range support

SATM

Synchronous Asynchronous Transfer Mode Technology

contact us:

www.satm-tech.com