

Comunicações por Computador I

<http://marco.uminho.pt/disciplinas/CC-I-MEST/>

MI / CEI

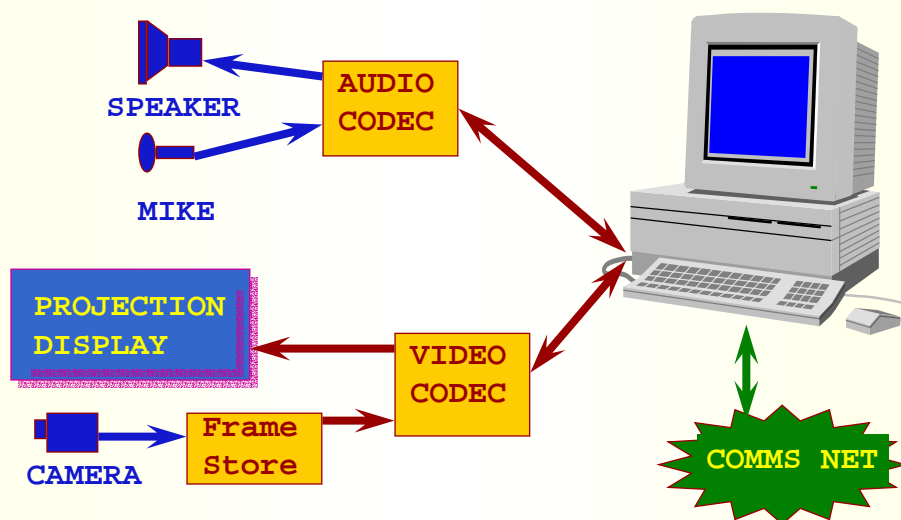
2003/04

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DI/UM – Alexandre Santos

Workstation Multimedia Típica



Convite recebido...

**...bem, realmente não vou falar
de assuntos particulares!**

a não ser que...

Convite recebido...

Ópera Digital

A FCCN, em colaboração com o Gran teatre del Liceu de Barcelona e a Red IRIS (Rede de Investigação e Educação de Espanha), difundem no grande auditório do LNEC, no dia 11 de Dezembro pelas 19:30H a Ópera Wintermärchen de Philippe Boesmans(*), uma coprodução do Gran Teatre del Liceu de Barcelona, Théâtre Royal de la Monnaie e l'Opéra National de Lyon.

A comunicação assentará na rede GÉANT, a infraestrutura de comunicação que interliga as redes de investigação e educação europeias, e que permite níveis de qualidade de serviço e largura de banda muito elevado. Este tipo de serviços de comunicação também são usados para suportar experiências científicas através da Europa numa base regular.



A Vídeodifusão recorrerá às mais avançadas e sofisticadas soluções de Vídeo-conferência, só possíveis através das tecnologias de alta largura de banda e qualidade de serviços existentes:

- Tecnologia DVB (Digital Video Broadcasting) Standard European da Televisão Digital.
- MPEG-2 permitindo o envio de informação de 10 Mbps fornecendo uma imagem de melhor qualidade que o DVD.
- SDI (Serial Digital Interface) 270-sinal Mbit de 6-8 câmaras robot no Teatro.
- Será utilizado na transmissão 5.1 (surround sound) Dolby Digital e equipamento adequado para a reprodução.

Um sistema comercial

- Managing IP Video Streaming Bandwidth

Pilha Protocolar IP

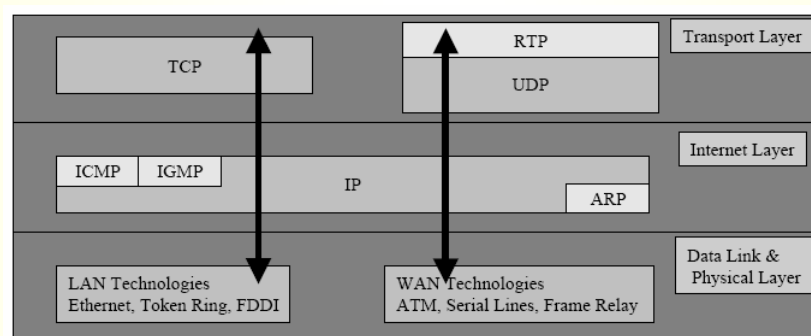


Figure 4 - IP Protocol Stack

Largura de Banda

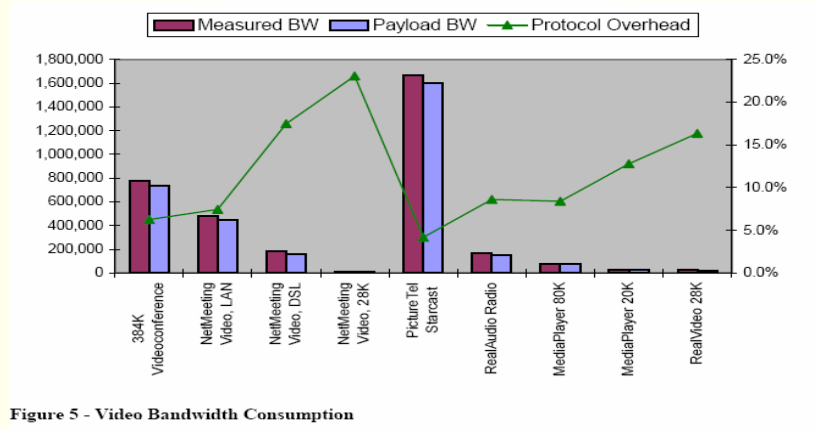


Figure 5 - Video Bandwidth Consumption

Distribuição Multicast (duplicar quando necessário)

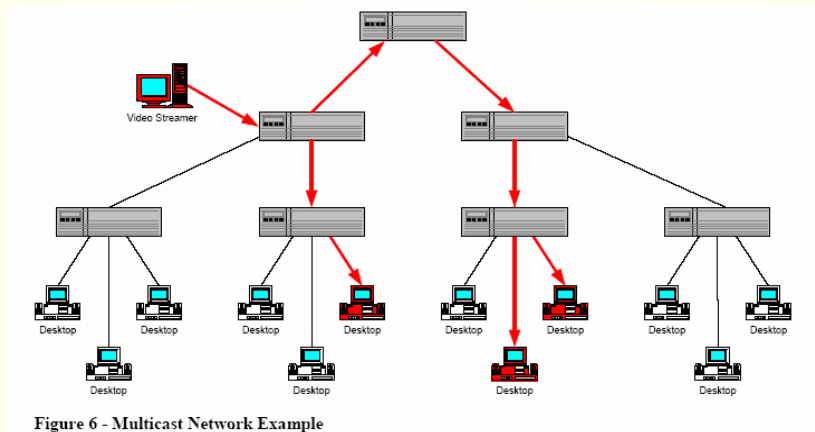
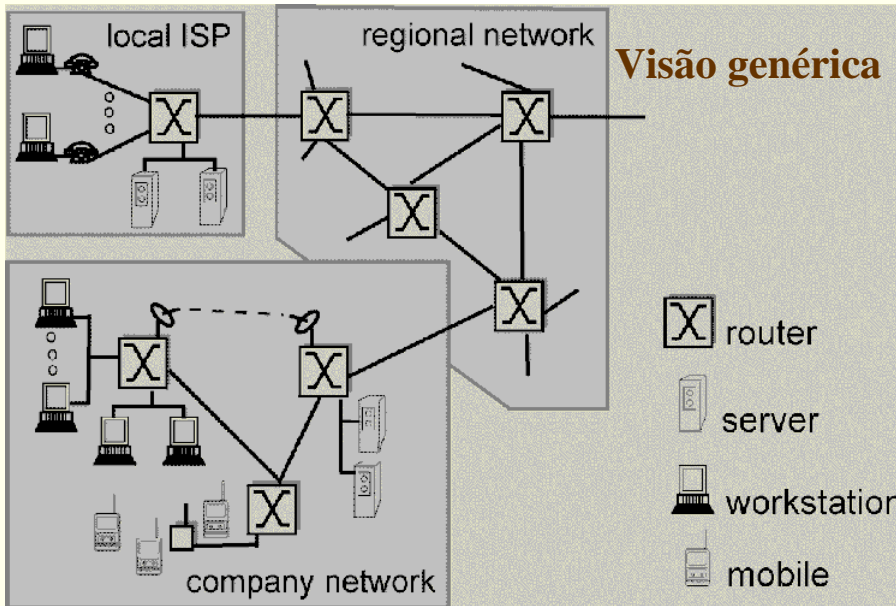
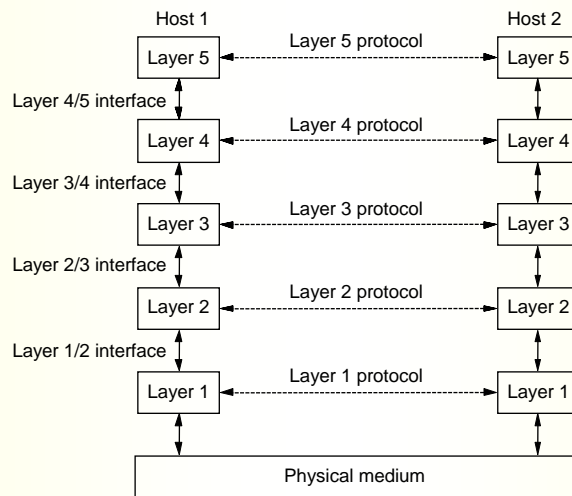


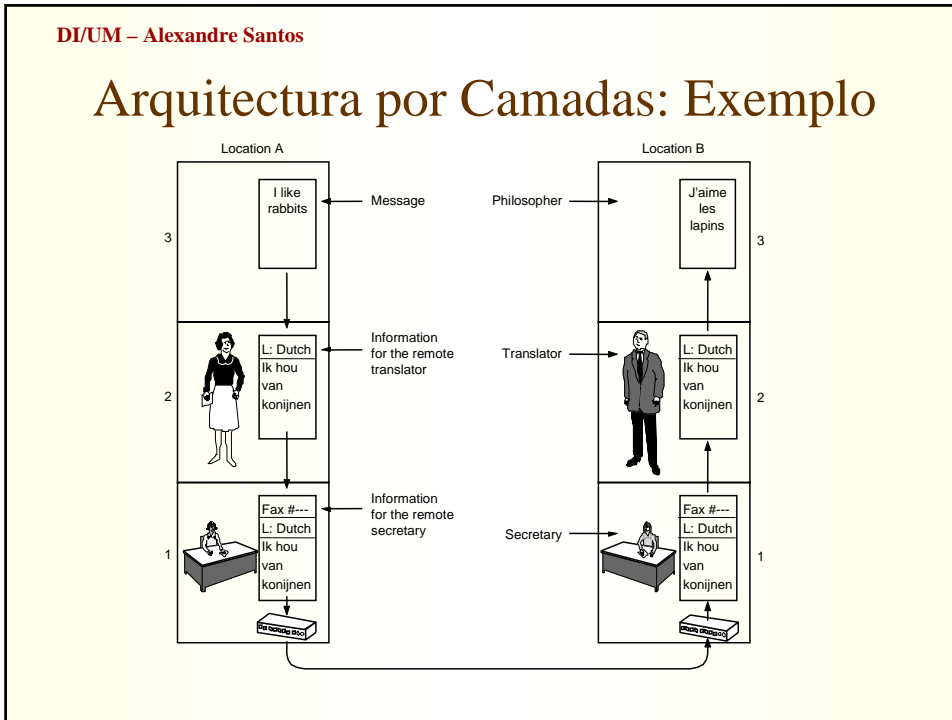
Figure 6 - Multicast Network Example



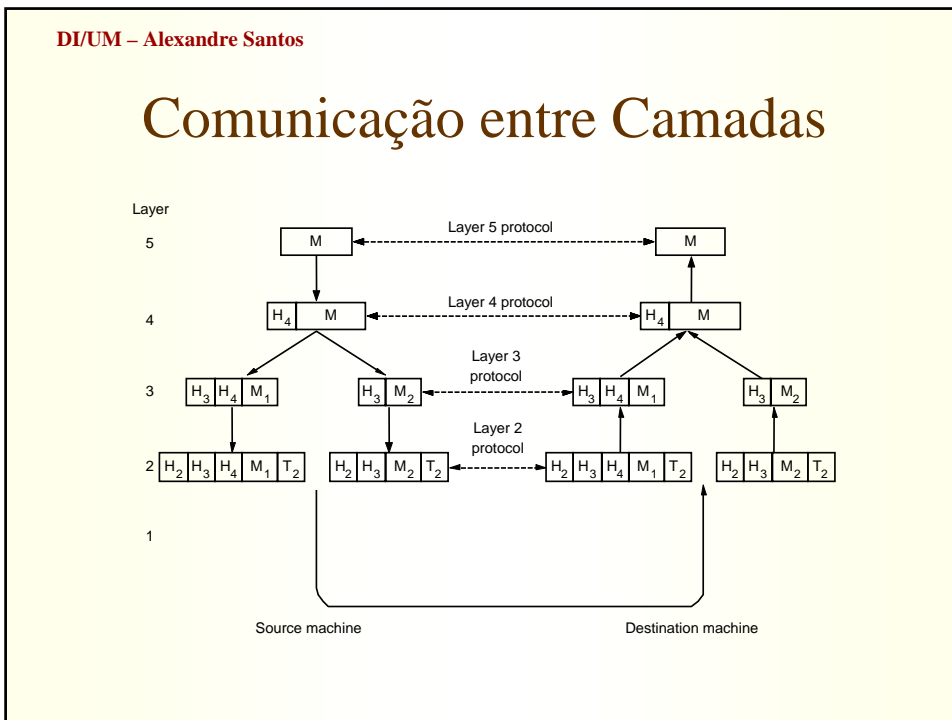
Arquitetura por Camadas



Arquitetura por Camadas: Exemplo



Comunicação entre Camadas



Modelos OSI e TCP/IP

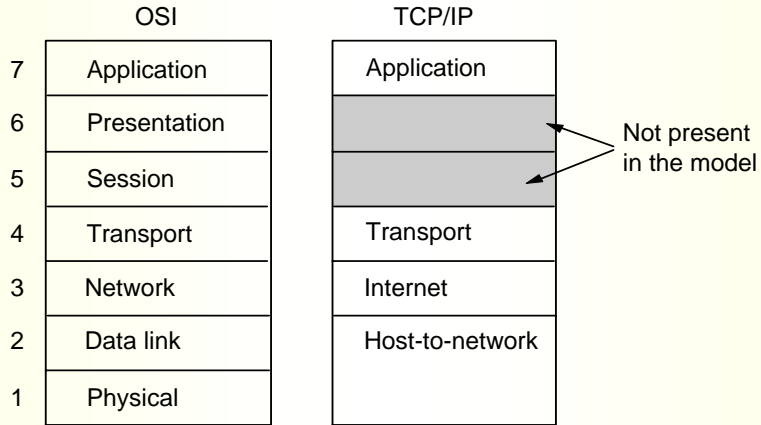
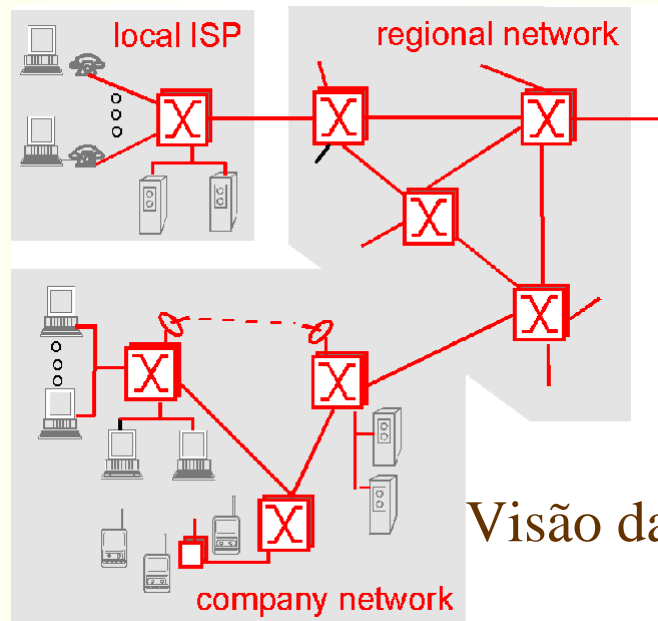
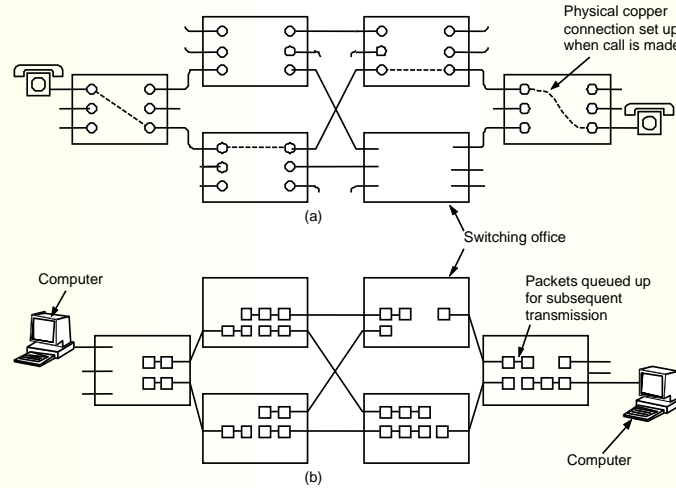


Fig. 1-18. The TCP/IP referencemodel.

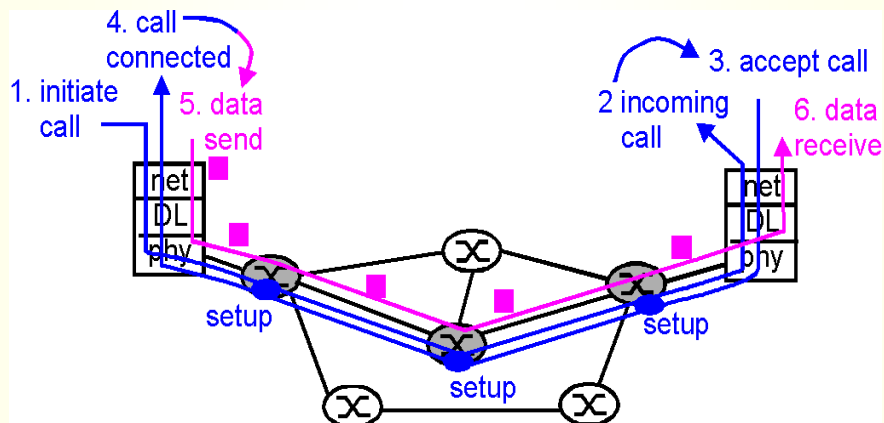


Visão da Rede

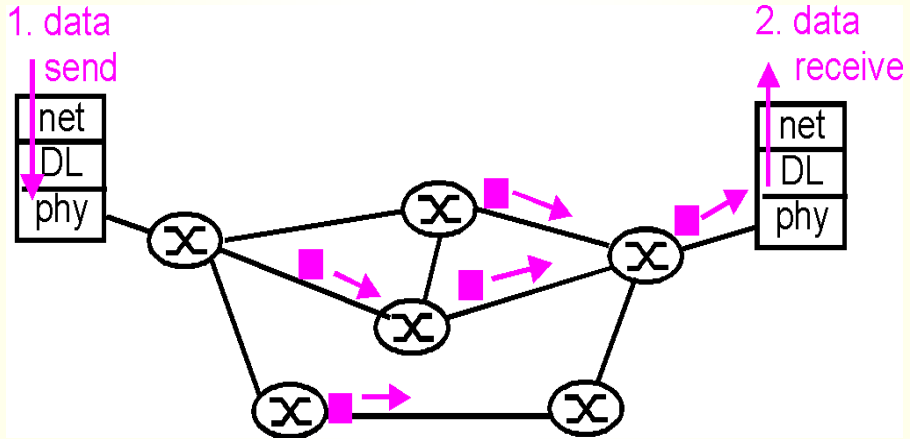
Comutação: Circuitos e Pacotes



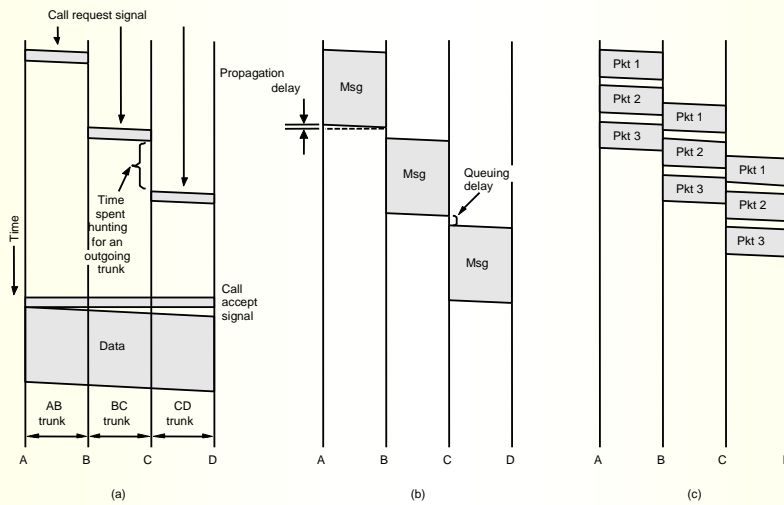
Rede: Circuito Virtual



Rede: Datagramas



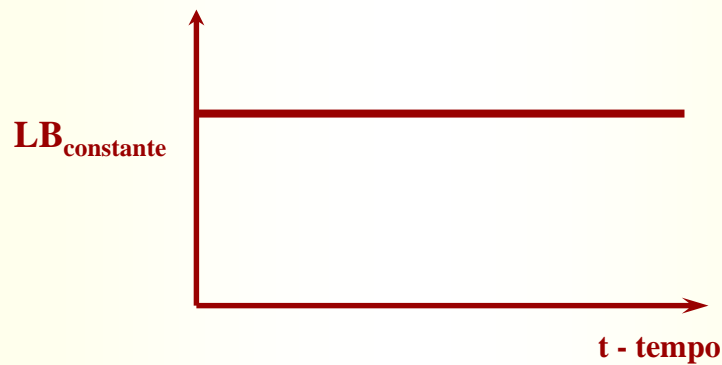
Comutação: Circuito, Mensagem, Pacote



QoS: Quality of Service Qualidade de Serviço

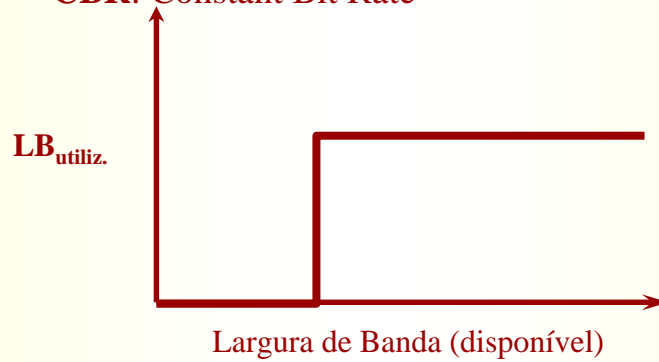
- Sem garantias
 - BE – Best Effort
 - LBE – Less than Best Effort
 - UBR – Unspecified Bit Rate
- Com garantias
 - CBR – Constant Bit Rate
 - VBR – Variable Bit Rate (rt/nrt – real time/no rt)
 - ABR – Available Bit Rate
- **CBR: Constant Bit Rate**

QoS: Qualidade de Serviço (CBR)



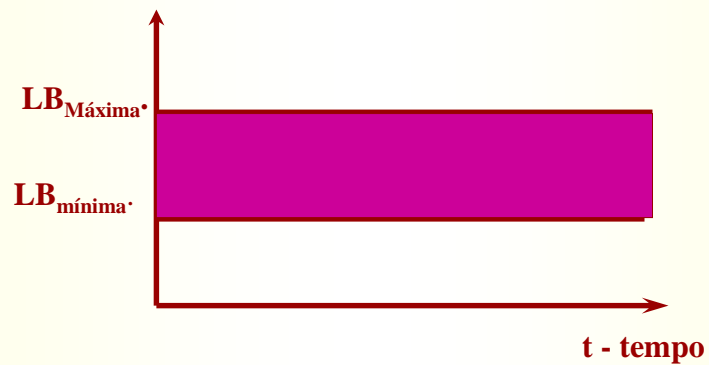
QoS: Qualidade de Serviço (CBR)

- **Largura de Banda**
 - **CBR**: Constant Bit Rate



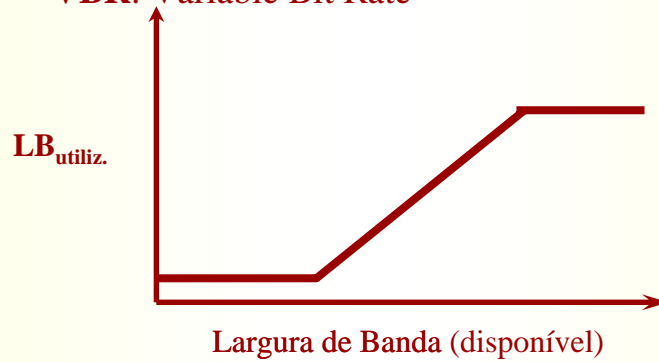
QoS: Qualidade de Serviço (VBR)

- **VBR**: Variable Bit Rate



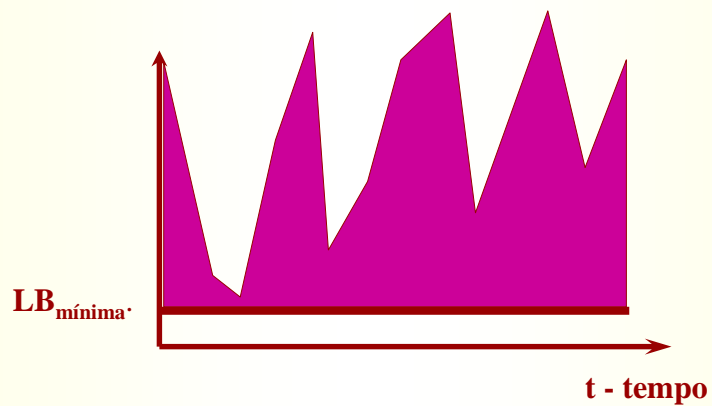
QoS: Qualidade de Serviço (VBR)

- **Largura de Banda**
 - **VBR: Variable Bit Rate**



QoS: Qualidade de Serviço (ABR)

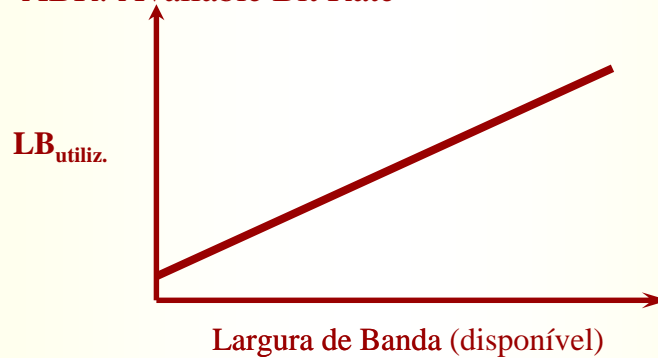
- **ABR: Available Bit Rate**



QoS: Qualidade de Serviço (ABR)

- **Largura de Banda**

ABR: Available Bit Rate



QoS: Qualidade de Serviço (parâmetros temporais)

- **Latência**

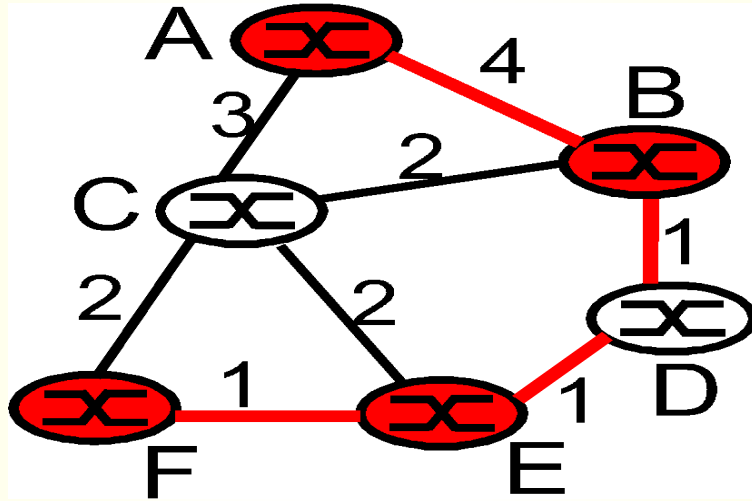
- Round-Trip Delay (cumulativo)

- Atraso de propagação
- Atraso de transmissão
- Atraso de store-and-forward
- Atraso de processamento

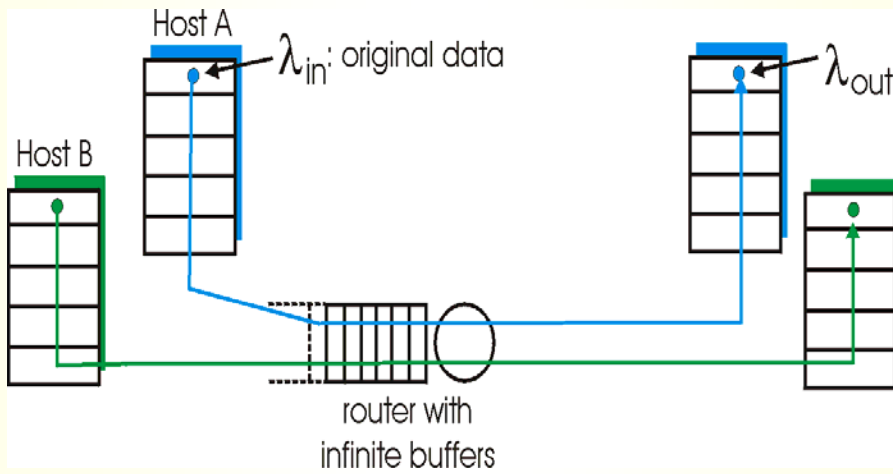
- **Jitter**

- Latência variável (por unidade de informação)

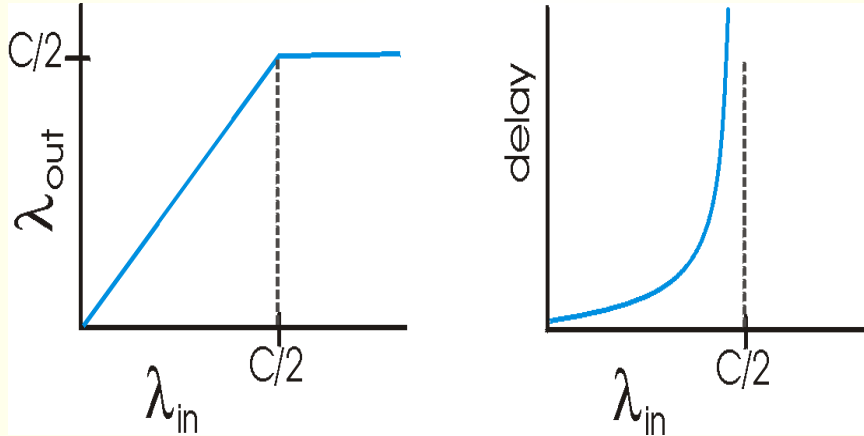
Atrasos no Nível de Rede



Congestão



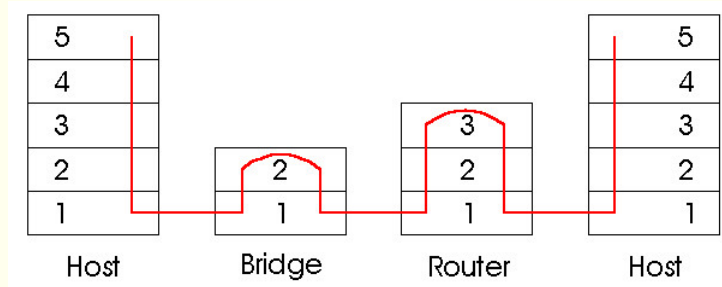
Congestão: LB e Atraso



DI/UM – Alexandre Santos Comparação de Tecnologias

Network Architect.	Service Model	Bandwidth Guarantee	No Loss Guarant.	Ordering	Timing	Congestion indication
INTERNET	Best Effort	None	None	Any order possible	Not maintained	None
ATM	CBR	Guaranteed constant rate	Yes	In order	Maintained	Congestion will not occur
ATM	VBR	Guaranteed rate	Yes	In order	Maintained	Congestion will not occur
ATM	ABR	Guaranteed minimum	None	In order	Not maintained	Congestion indication provided
ATM	UBR	None	None	In order	Not maintained	None

Tecnologias e Equipamentos: Pontes (Nível 2) e Encaminhadores (Nível 3)



Classes de Serviço (ATM)

Class	Description	Example
CBR	Constant bit rate	T1 circuit
RT-VBR	Variable bit rate: real time	Real-time videoconferencing
NRT-VBR	Variable bit rate: non-real time	Multimedia email
ABR	Available bit rate	Browsing the Web
UBR	Unspecified bit rate	Background file transfer

Fig. 5-69. The ATM service categories.

Características Classes de Serviço

Service characteristic	CBR	RT-VBR	NRT-VBR	ABR	UBR
Bandwidth guarantee	Yes	Yes	Yes	Optional	No
Suitable for real-time traffic	Yes	Yes	No	No	No
Suitable for bursty traffic	No	No	Yes	Yes	Yes
Feedback about congestion	No	No	No	Yes	No

Fig. 5-70. Characteristics of the ATM service categories.

Parâmetros de QoS

Parameter	Acronym	Meaning
Peak cell rate	PCR	Maximum rate at which cells will be sent
Sustained cell rate	SCR	The long-term average cell rate
Minimum cell rate	MCR	The minimum acceptable cell rate
Cell delay variation tolerance	CDVT	The maximum acceptable cell jitter
Cell loss ratio	CLR	Fraction of cells lost or delivered too late
Cell transfer delay	CTD	How long delivery takes (mean and maximum)
Cell delay variation	CDV	The variance in cell delivery times
Cell error rate	CER	Fraction of cells delivered without error
Severely-errored cell block ratio	SECBR	Fraction of blocks garbled
Cell misinsertion rate	CMR	Fraction of cells delivered to wrong destination

Fig. 5-71. Some of the quality of service parameters.

Interligações de Rede

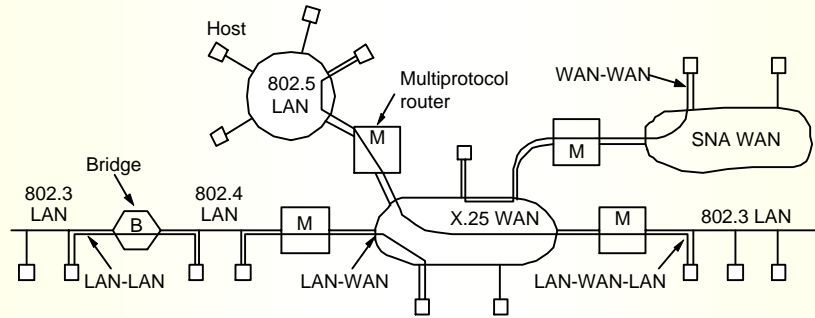


Fig. 5-33. Network interconnection.

Interligações: Túneis

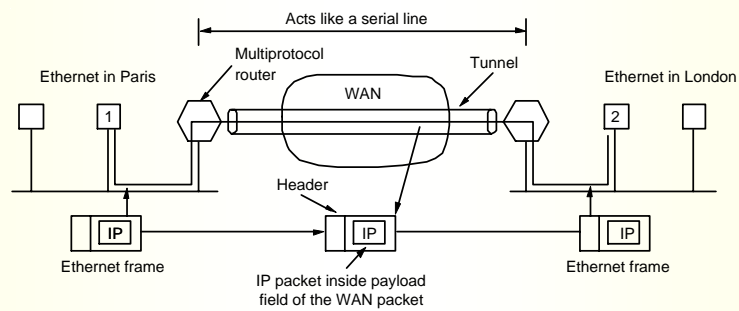


Fig. 5-38. Tunneling a packet from Paris to London.

Internet: Interligação de Redes

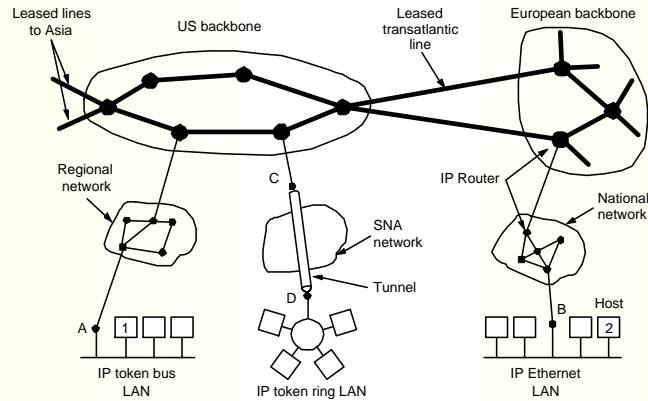


Fig. 5-44. The Internet is an interconnected collection of many networks

Diferentes Serviços de Rede

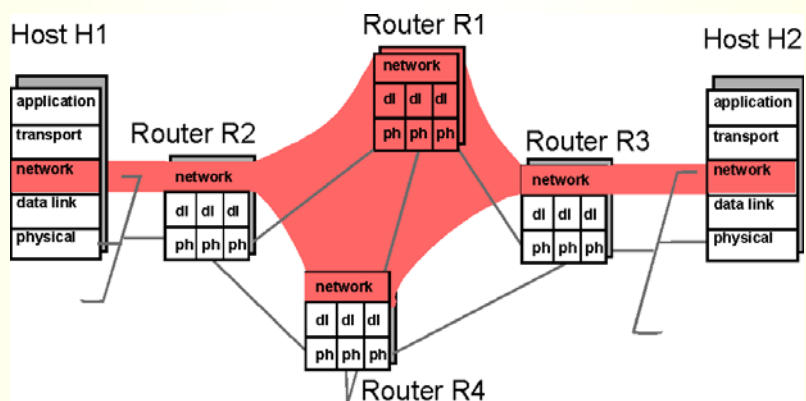
Issue	DQDB	SMDS	X.25	Frame Relay	ATM AAL
Connection oriented	SIM	NÃO	SIM	SIM	SIM
Normal speed (Mbps)	45	45	0.064	1.5	155
Switched	NÃO	SIM	SIM	NÃO	SIM
Fixed-size payload	SIM	NÃO	NÃO	NÃO	NÃO
Max payload	44	9188	128	1600	Variável
Permanent VCs	NÃO	NÃO	SIM	SIM	SIM
Multicasting	NÃO	SIM	NÃO	NÃO	SIM

DI/UM – Alexandre Santos **Comparação de Tecnologias**

Network Architect.	Service Model	Bandwidth Guarantee	No Loss Guarant.	Ordering	Timing	Congestion indication
INTERNET	Best Effort	None	None	Any order possible	Not maintained	None
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ATM	UBR	None	None	In order	Not maintained	None

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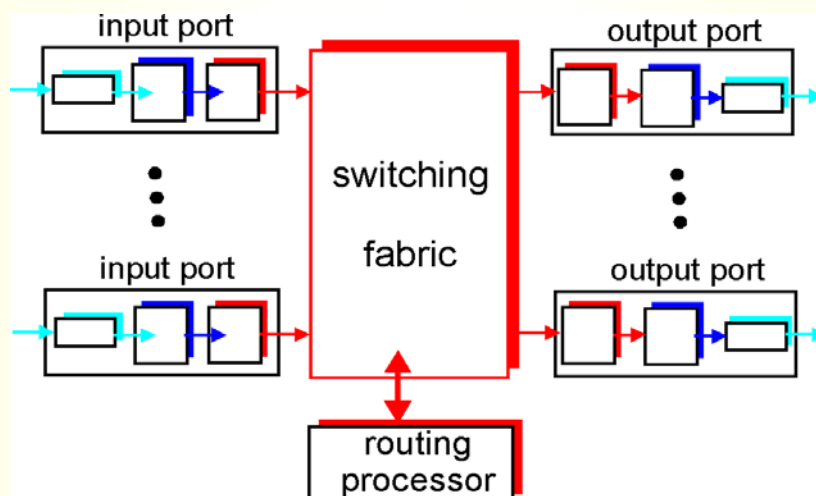
Camada de Rede



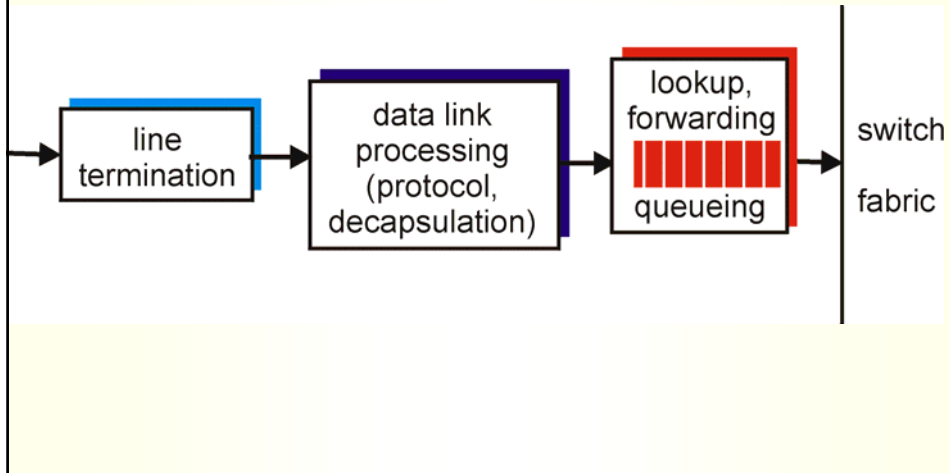
Encaminhadores e Comutadores: Arquitectura

- Portas de Entrada (Input Port) – Ligação física, lógica, inspecção de tabelas, expedição
- Portas de Saída (Output Port) – Armazena datagramas, controlo ligação lógica e transmissão física
- Lógica de Comutação (Switching) – Interliga portas de Entrada e Saída
- Processador de Encaminhamento (Routing Processor) – Protocolos encaminhamento, constroi tabelas de encaminhamento, gestão de funções de rede

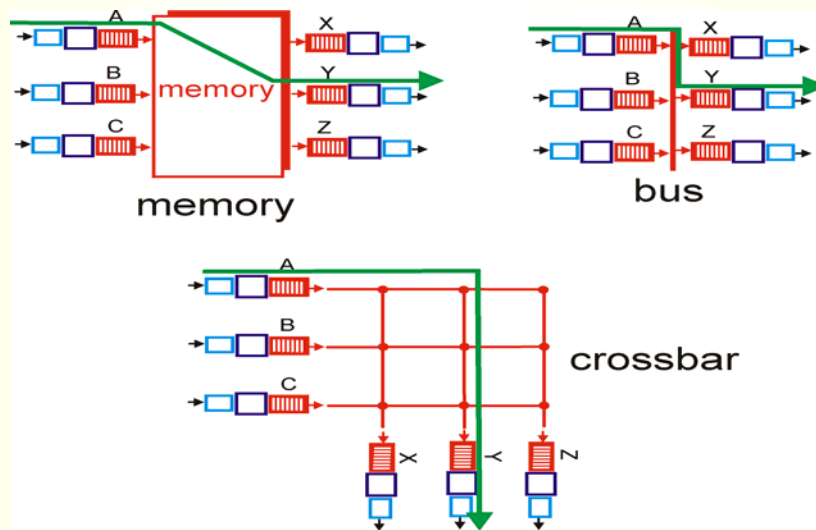
Comutador: Arquitectura geral



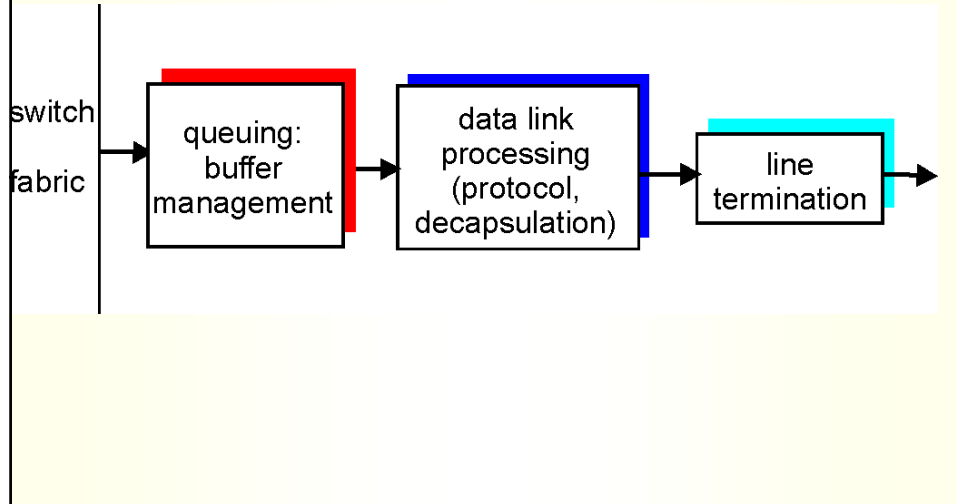
Comutador: Processamento à Entrada



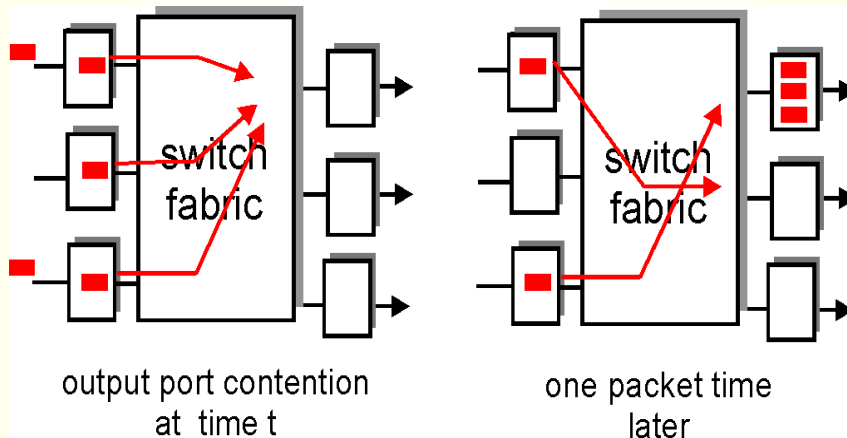
Comutador: Comutação Interna



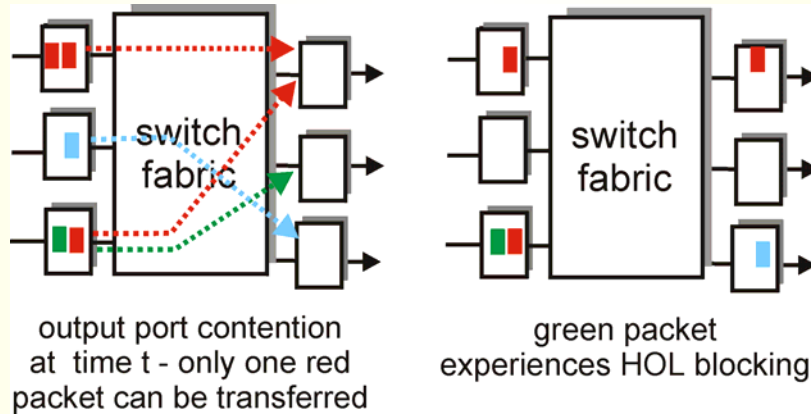
Comutador: Processamento de Saída



Comutador: Filas de Espera e Contenção à Saída



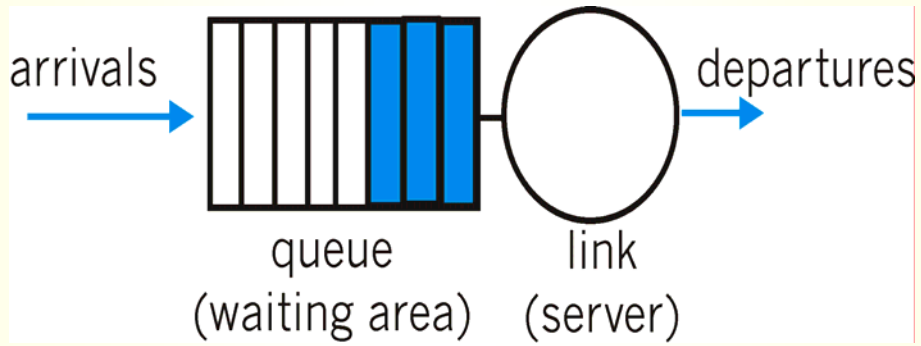
Comutador: Filas de Espera e Contenção à Entrada



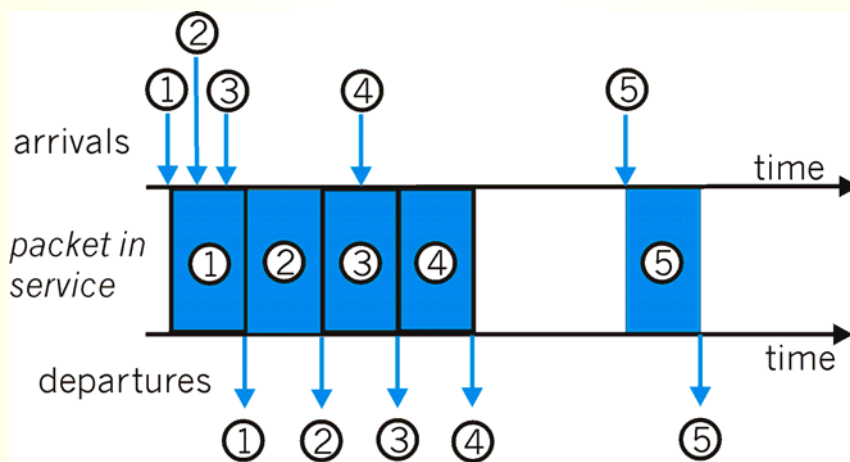
QoS via Escalonamento e Policiamento de Pacotes

- **ESCALONAMENTO:**
 - FIFO (First In First Out)
 - Priority Queuing
 - Round Robin e Weighted Fair Queuing
- **POLICIAMENTO**
 - Leaky Bucket

Escalonamento FIFO



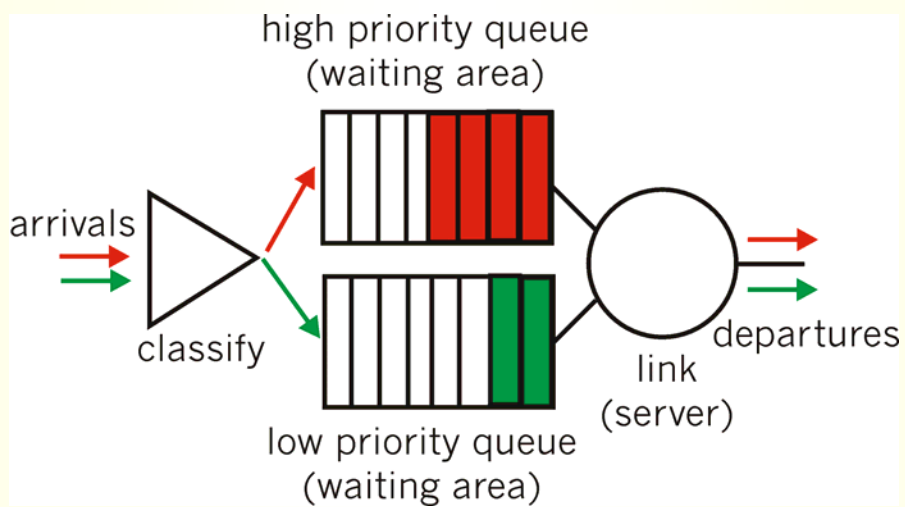
Escalonamento FIFO (2)



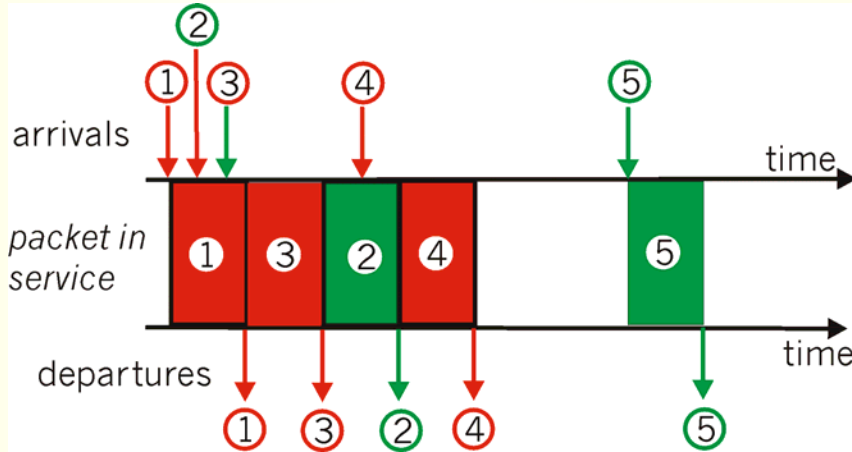
QoS: Filas de Espera e Atrasos

- http://media.pearsoncmg.com/aw/aw_kuros_e_network_2/applets/queuing/queuing.html

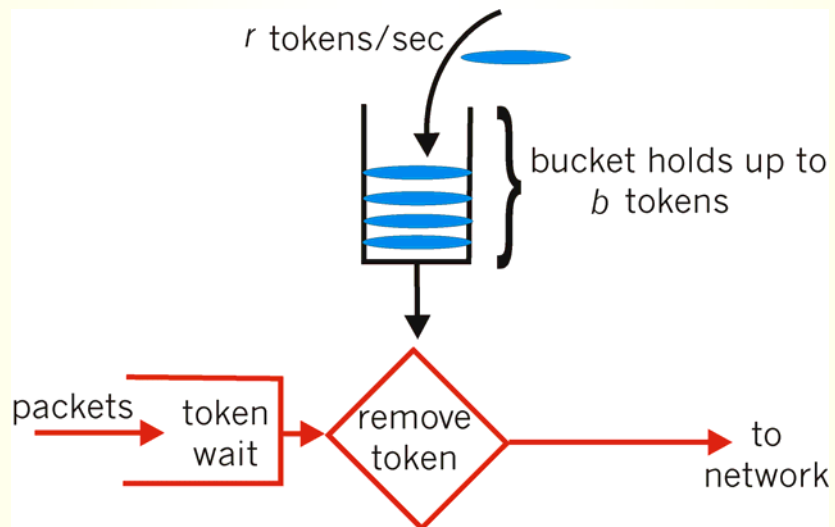
Priority Queuing



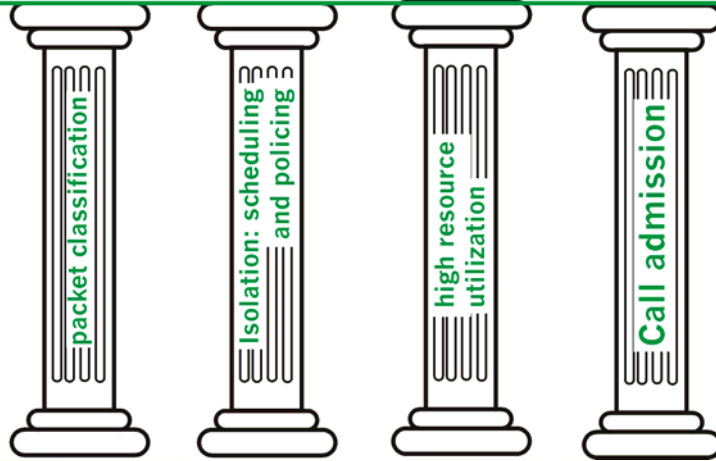
Priority Queuing (2)



Policiamento: Leaky Bucket



QoS for networked applications



Moving Trend of Evolving Telecommunication

Infrastructures (Fonte: ITU, STUDY GROUP 13 – REPORT R 57)

