

Ethernet

(Camada Enlace)

Prof. Dr. Luiz Arthur Feitosa dos Santos



luiz.arthur.feitosa.santos@gmail.com

<https://luizsantos.github.io/>

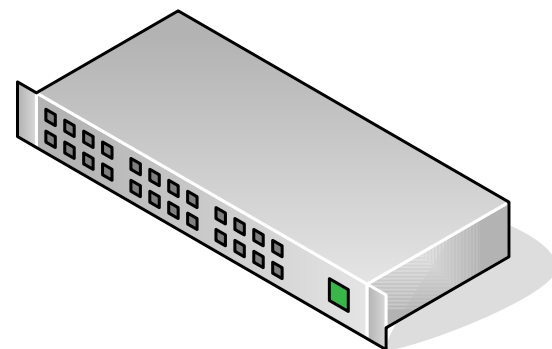
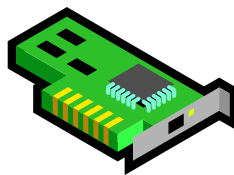


Ethernet

Modelo TCP/IP

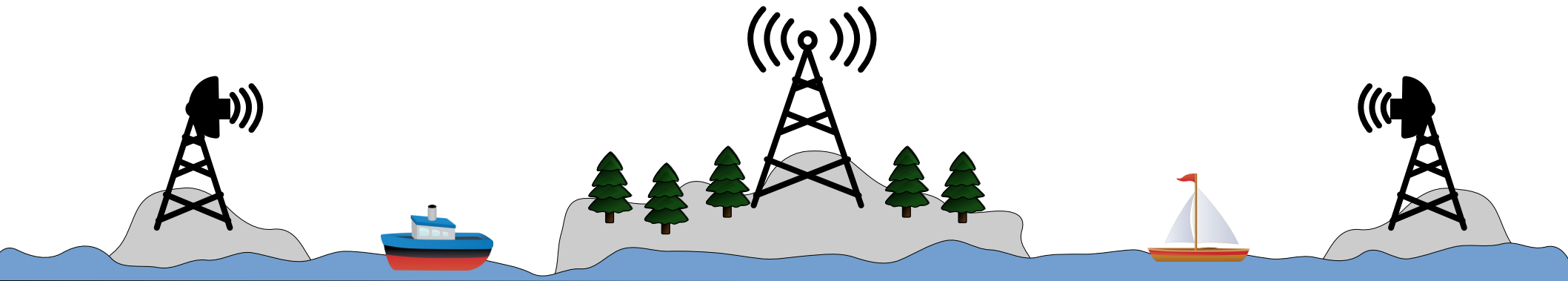


- Detecção de erros;
- Controle de acesso ao meio;
- Endereçamento físico;
- Impedir que *hosts* mais rápidos inundem de informações *hosts* mais lentos.



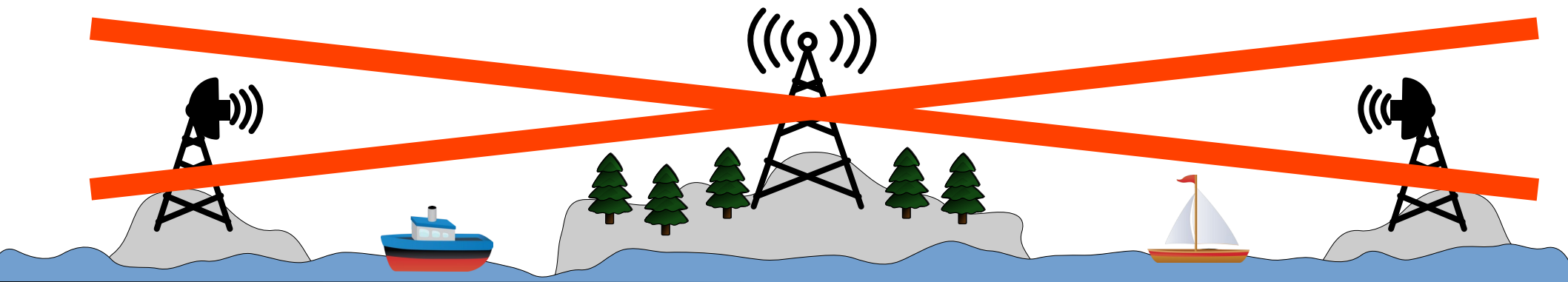
Ethernet

- Padrão mais usado no mundo (~90%), no que se refere a LAN com fio;
- Também chamado de IEEE 802.3;
- Virou referência, então é muito importante entender:
 - Formato do quadro Ethernet;
 - Controle de acesso ao meio;
- Foi idealizado a partir de uma rede sem fio (ALOHANET).



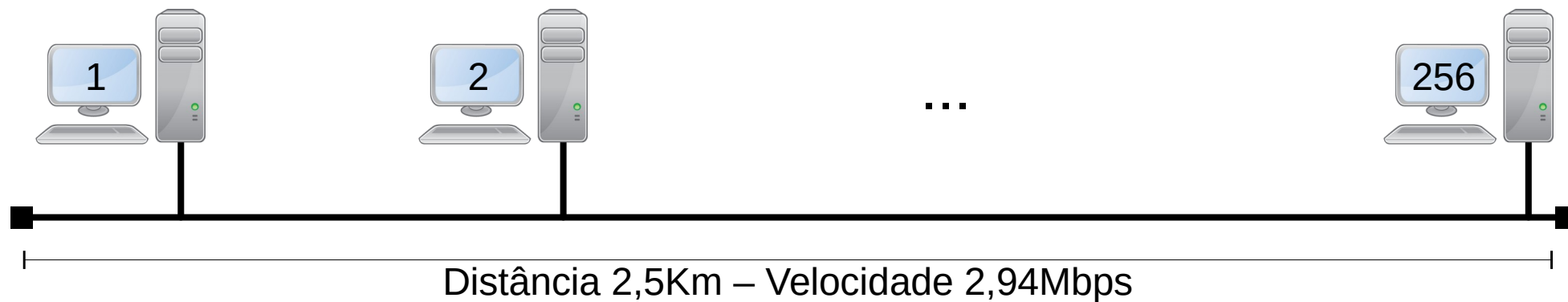
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Ethernet

Início da Ethernet:



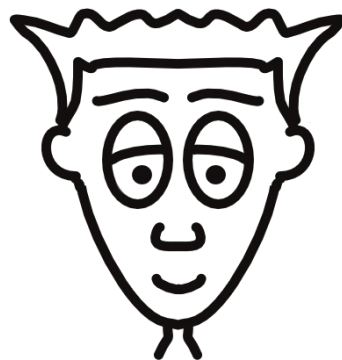
Ethernet

Mas é muito lento!!!



Ethernet

Mas é muito lento!!!



Calma que houveram evoluções...

Mas vamos ver outros detalhes primeiro!

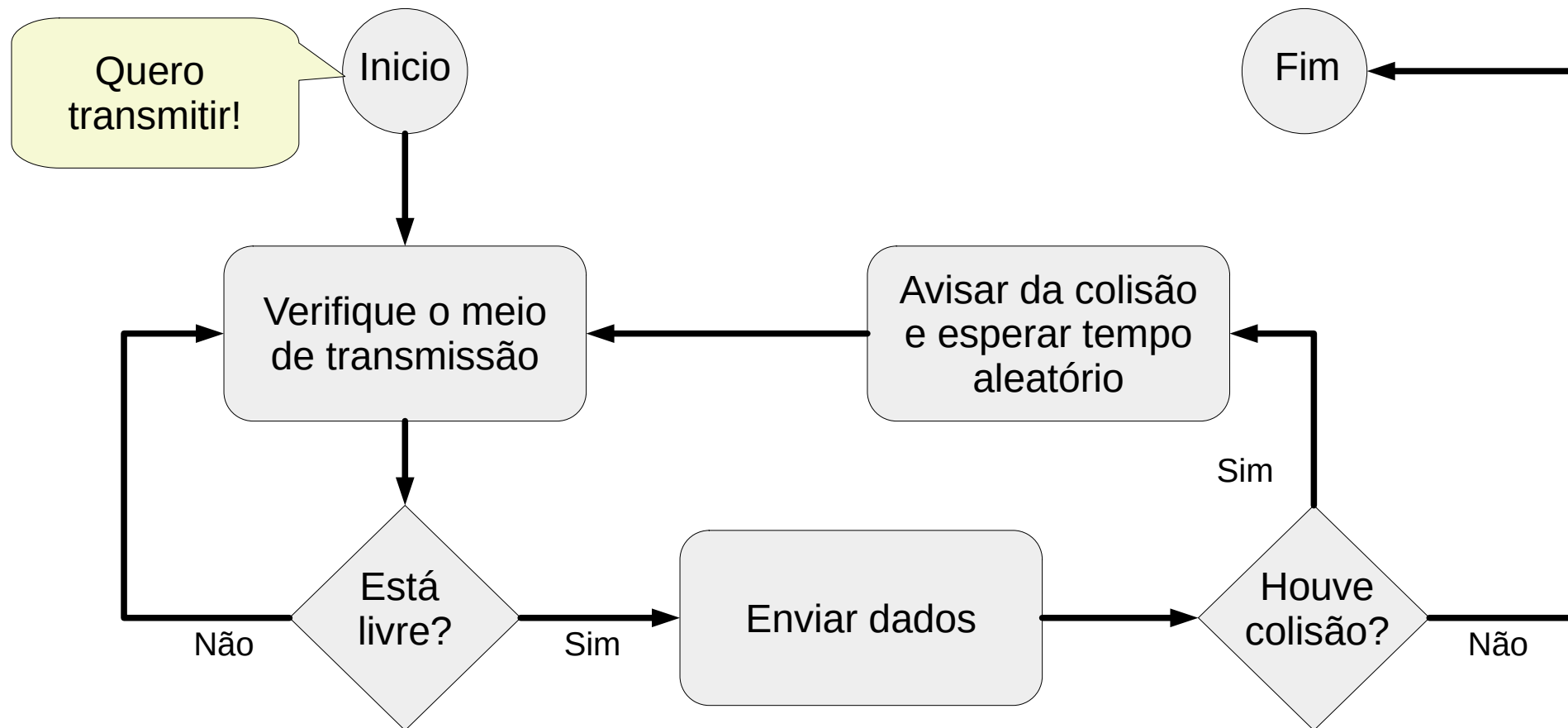
Ethernet

Controle de acesso ao meio Ethernet: CSMA/CD

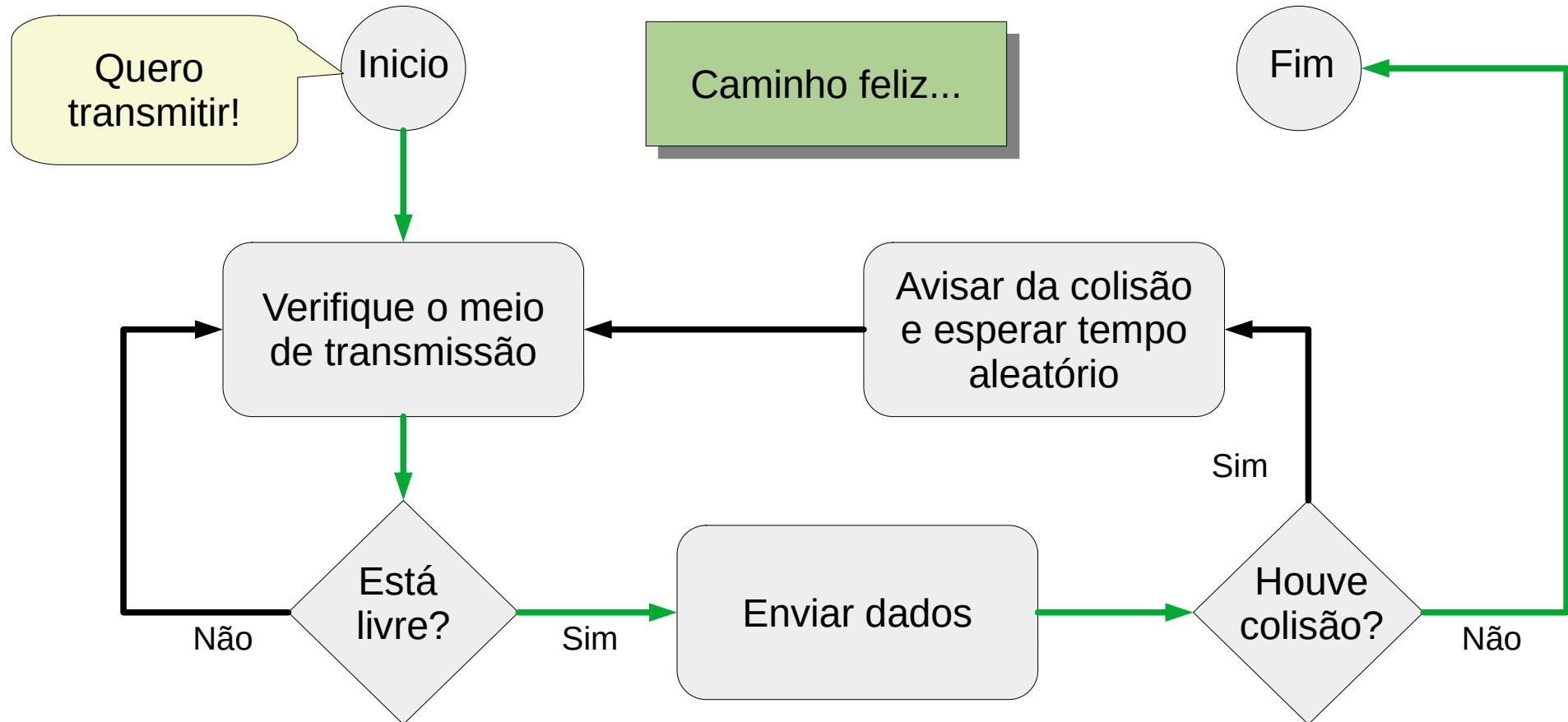


Quem pode transmitir?
Como evitar colisão?

CSMA/CD

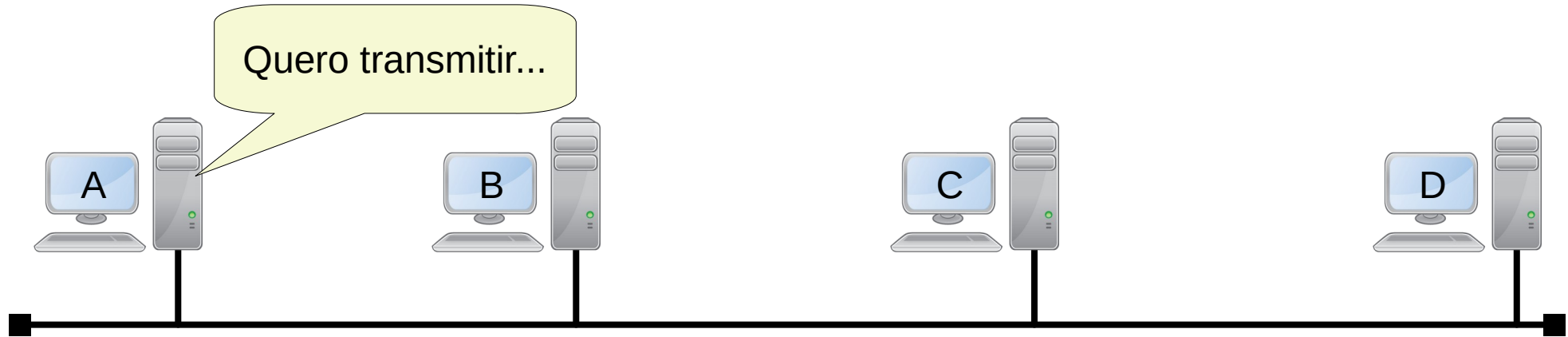


CSMA/CD



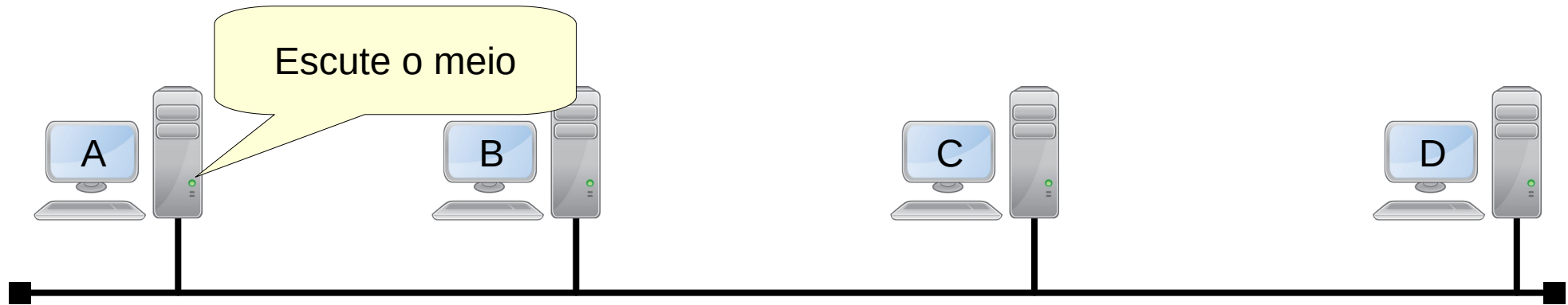
Ethernet

Controle de acesso ao meio Ethernet: CSMA/CD



Ethernet

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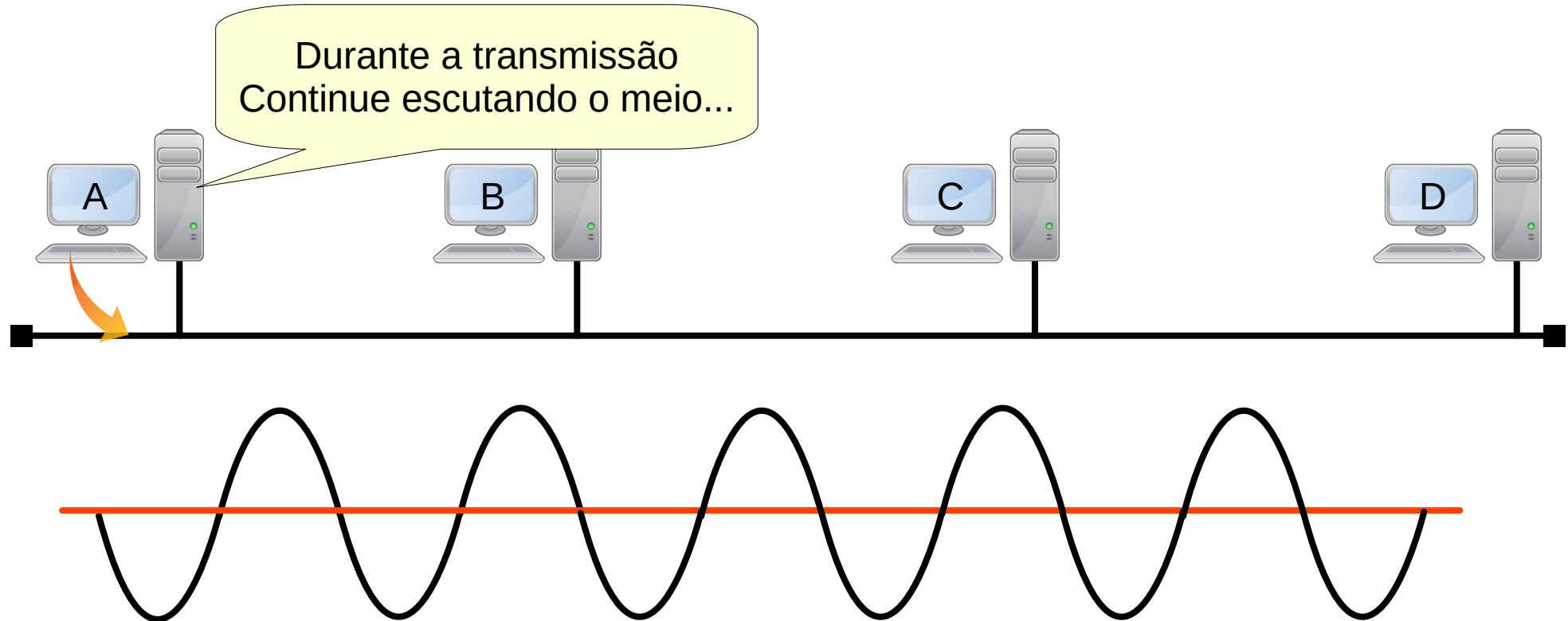
Ethernet

Controle de acesso ao meio Ethernet: CSMA/CD



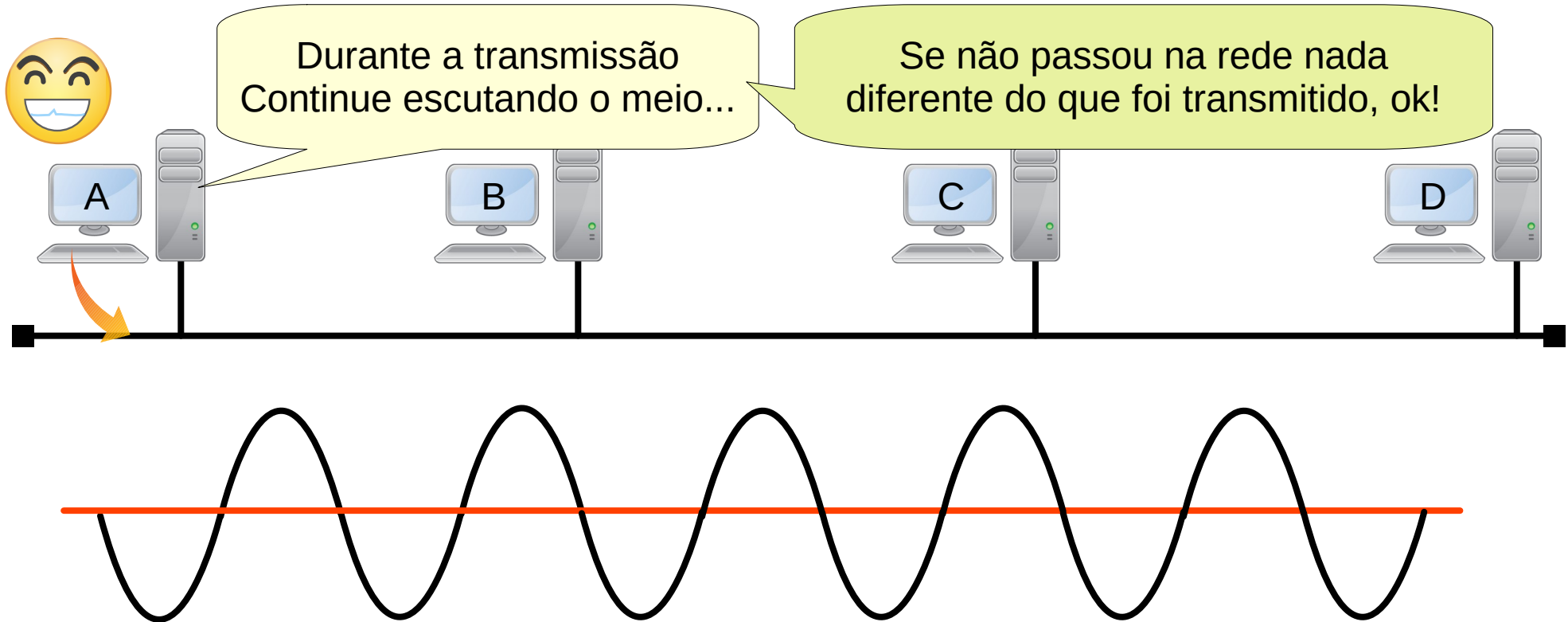
Ethernet

Controle de acesso ao meio Ethernet: CSMA/CD



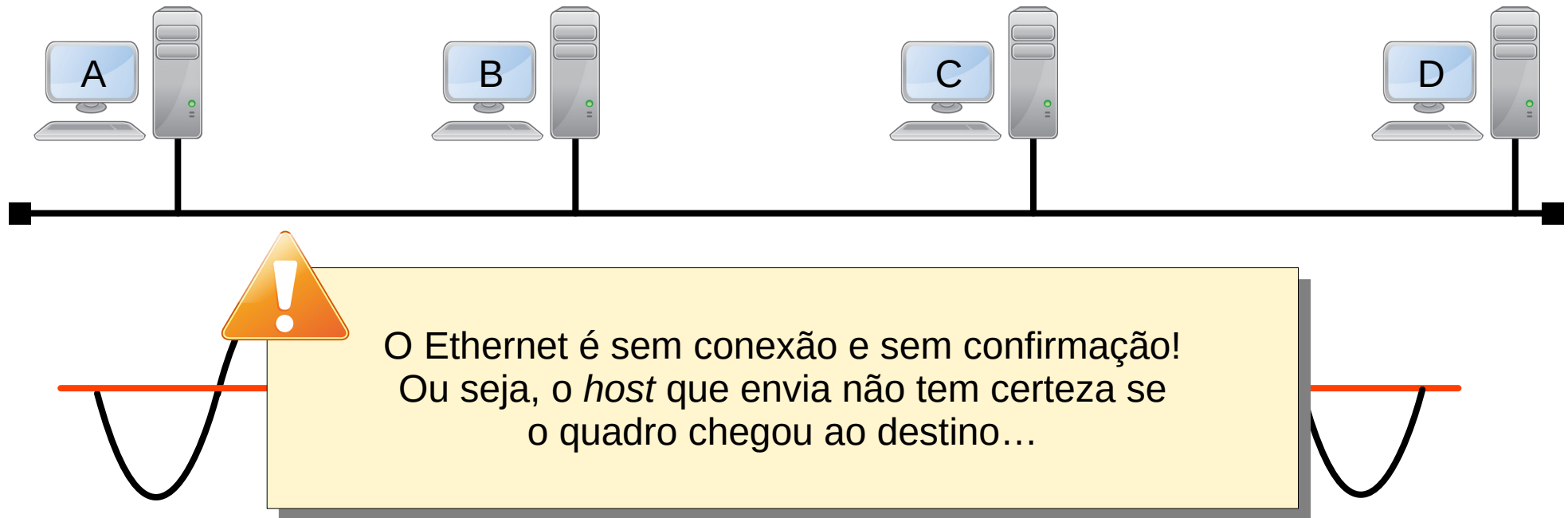
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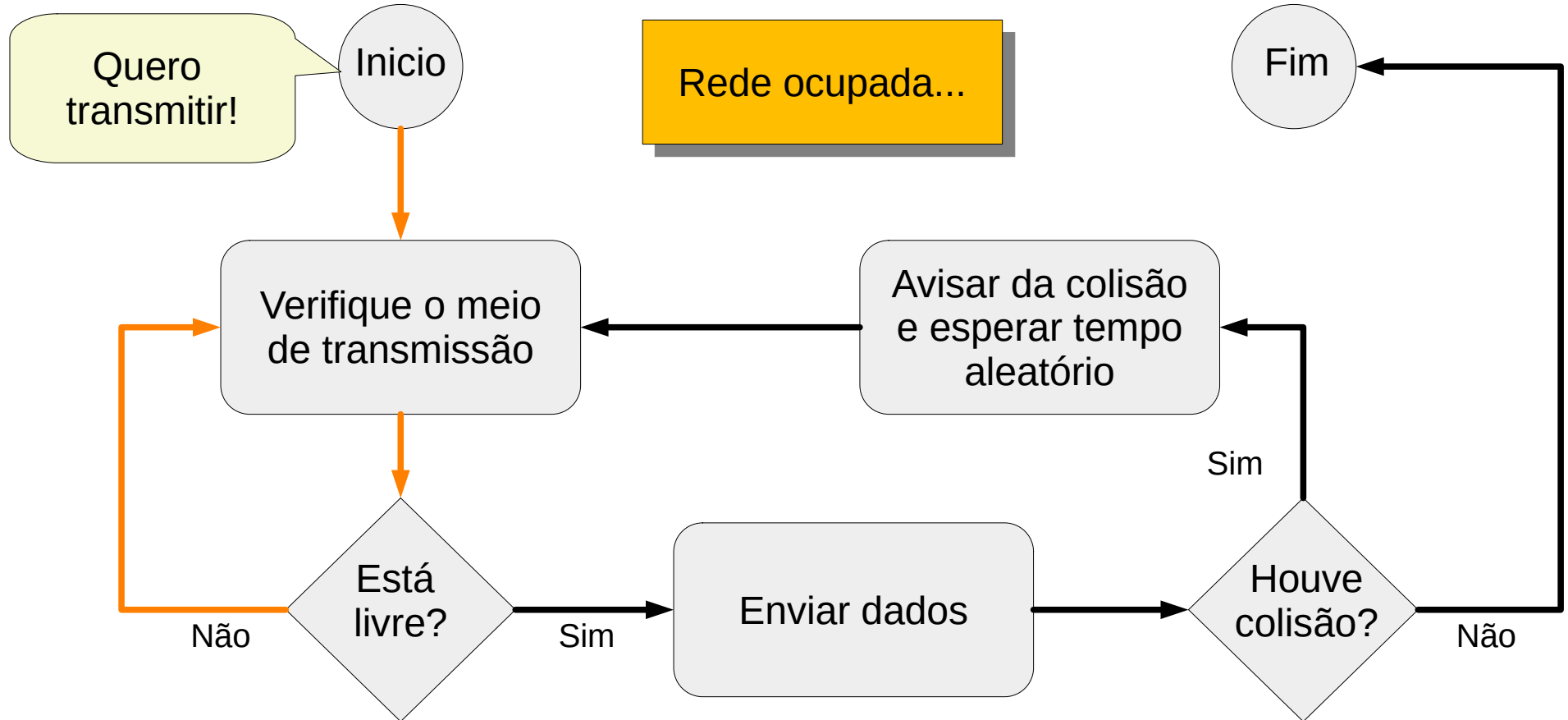


Ethernet

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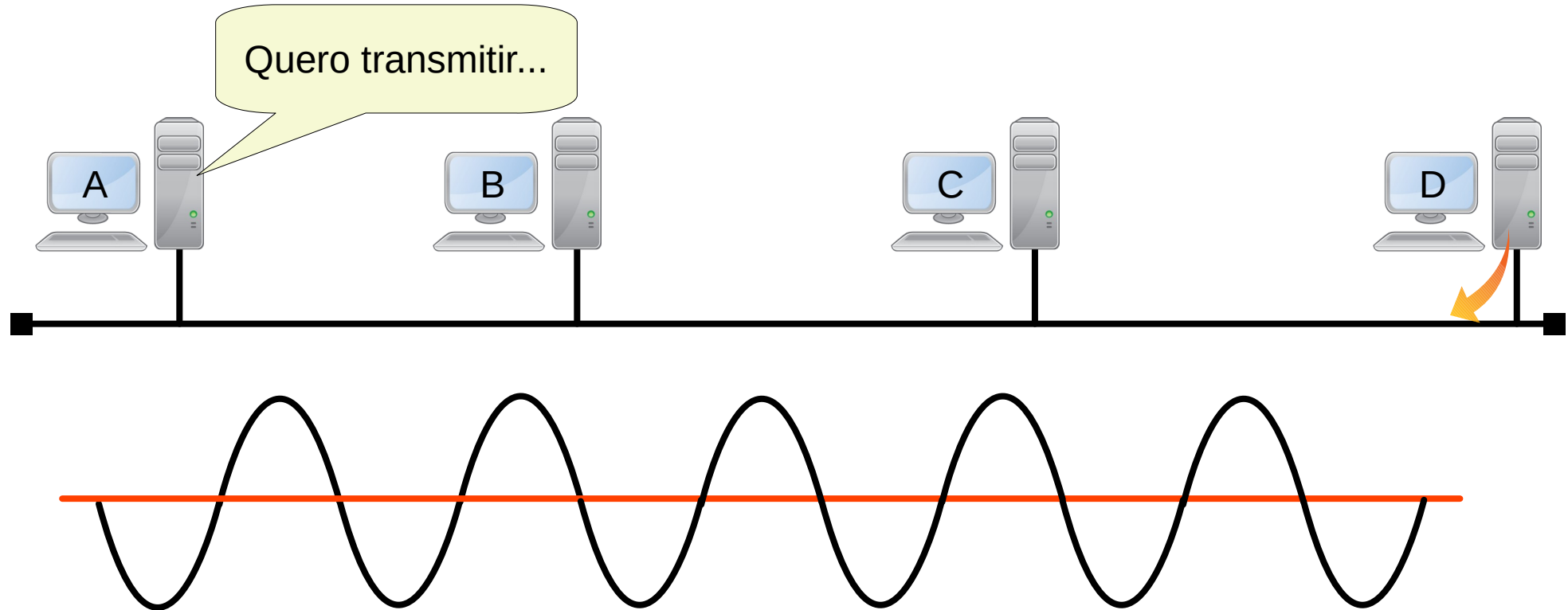


CSMA/CD



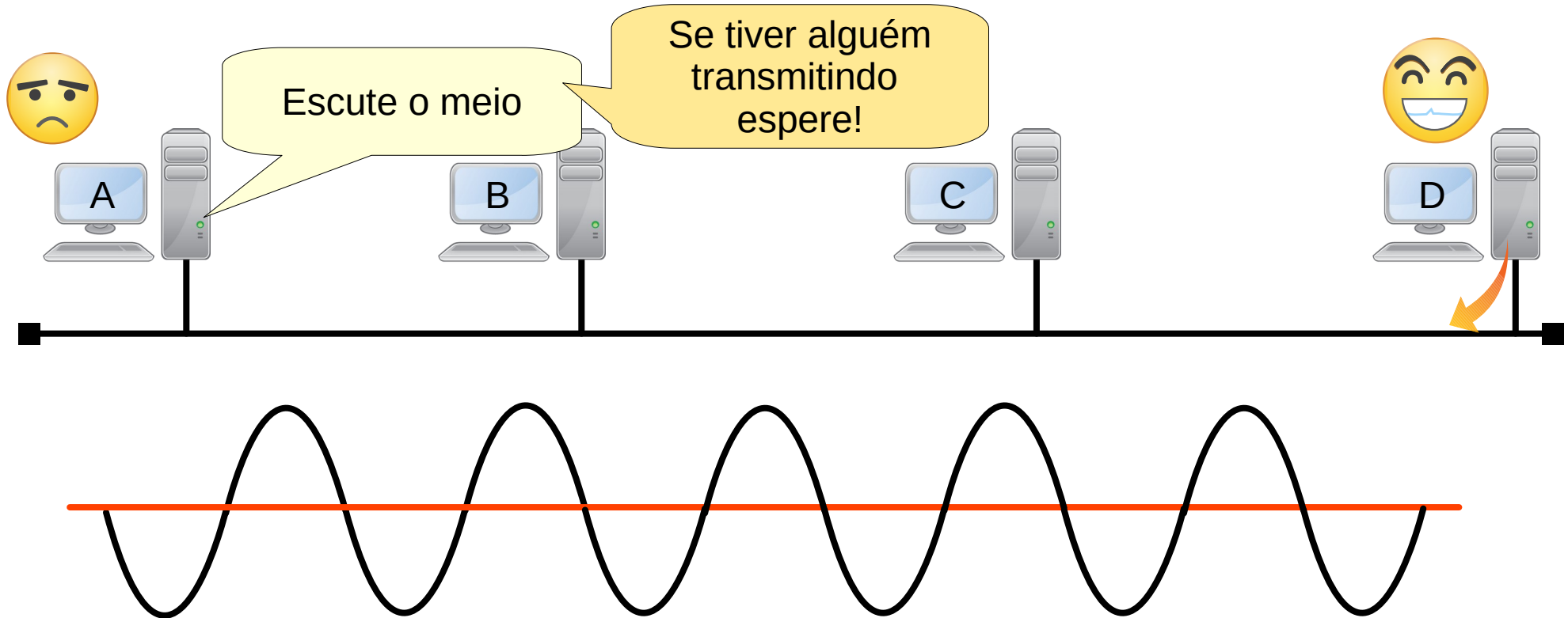
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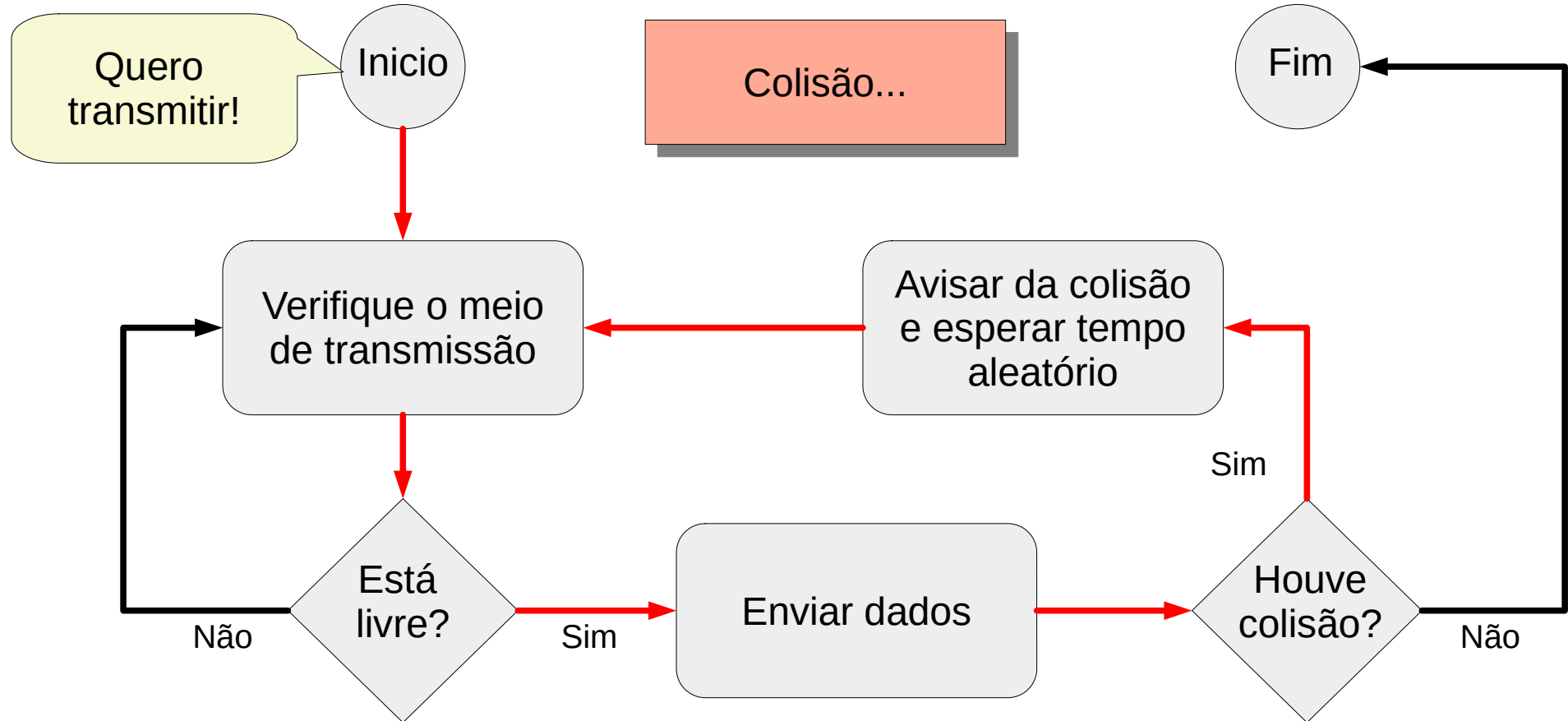


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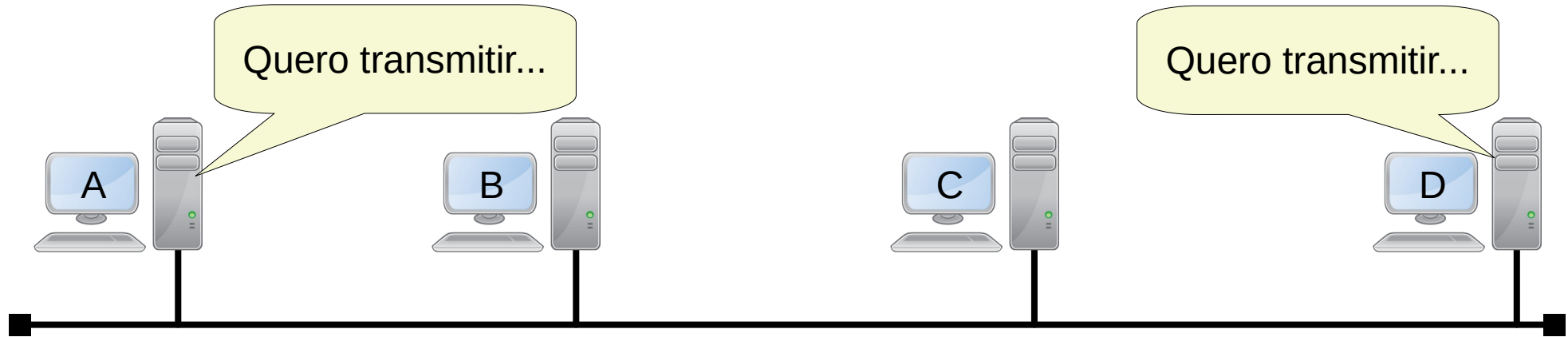


CSMA/CD



Ethernet

Controle de acesso ao meio Ethernet: CSMA/CD



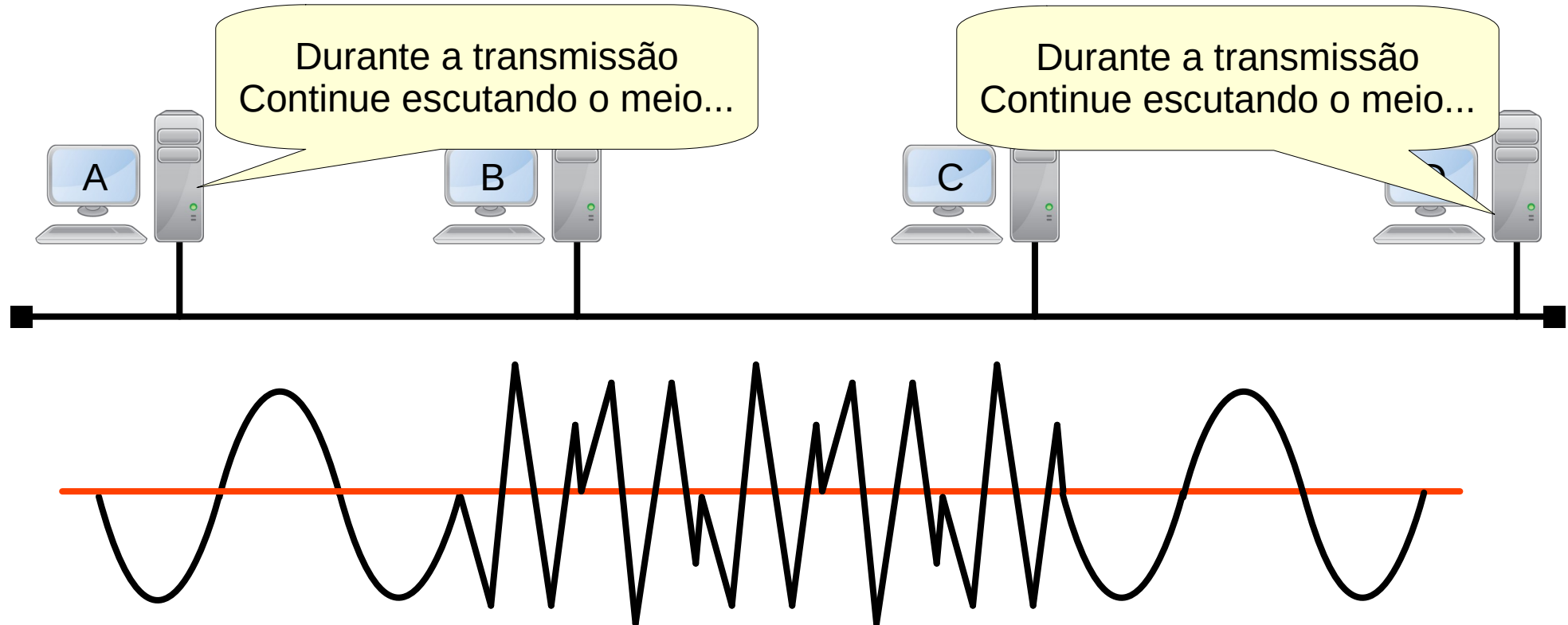
Ethernet

Controle de acesso ao meio Ethernet: CSMA/CD



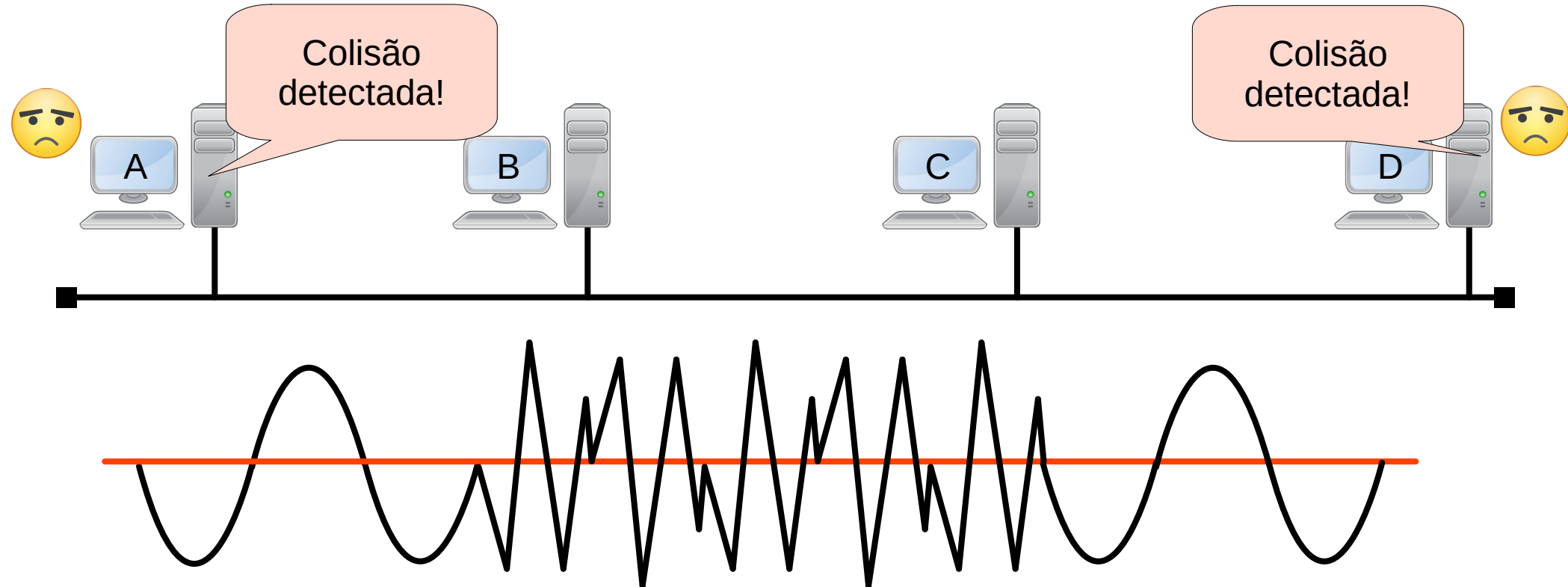
Ethernet

Controle de acesso ao meio Ethernet: CSMA/CD



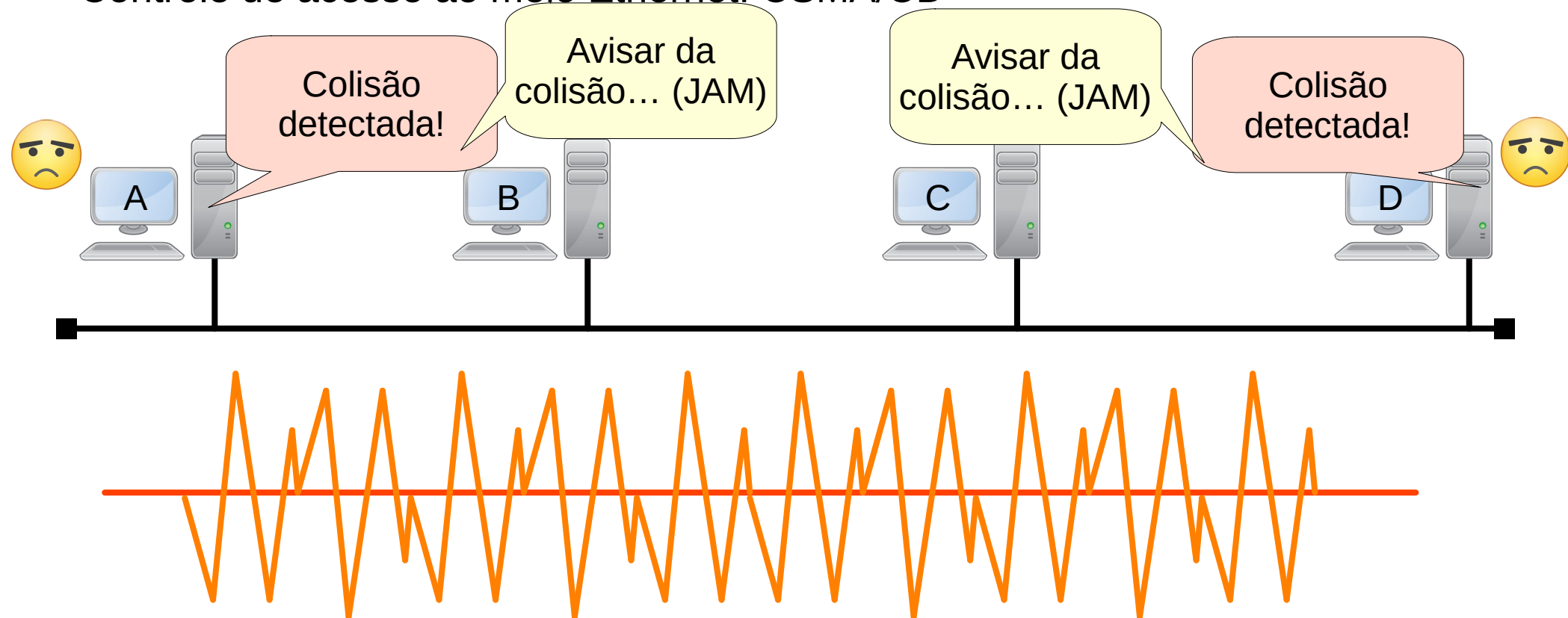
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Controle de acesso ao meio Ethernet: CSMA/CD



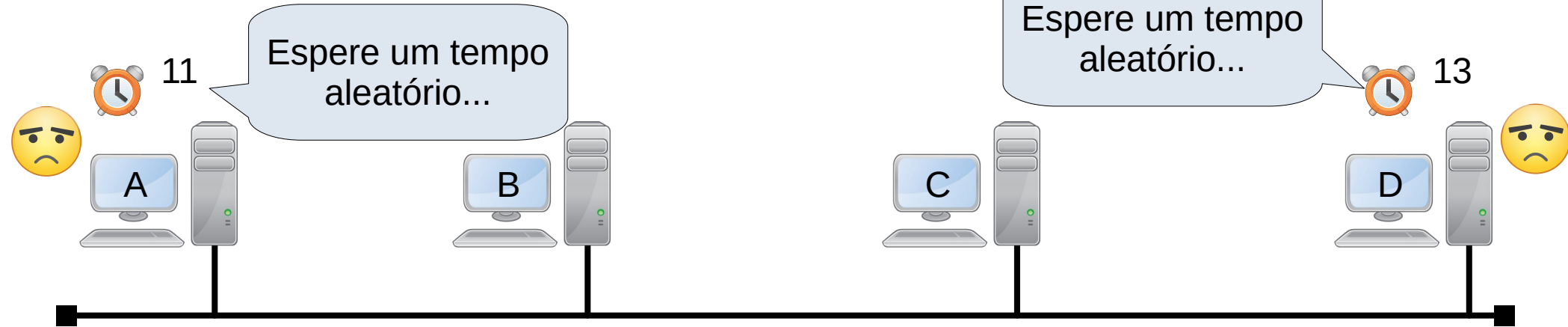
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Controle de acesso ao meio Ethernet: CSMA/CD



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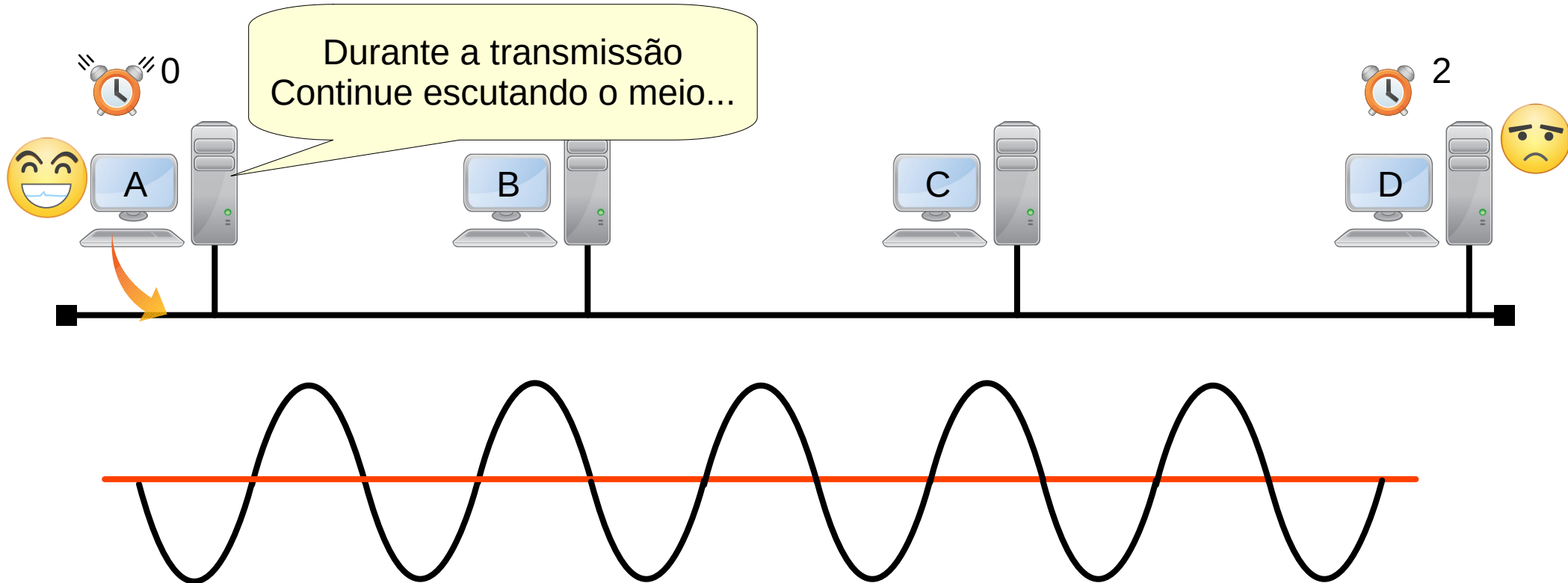
Ethernet

Controle de acesso ao meio Ethernet: CSMA/CD



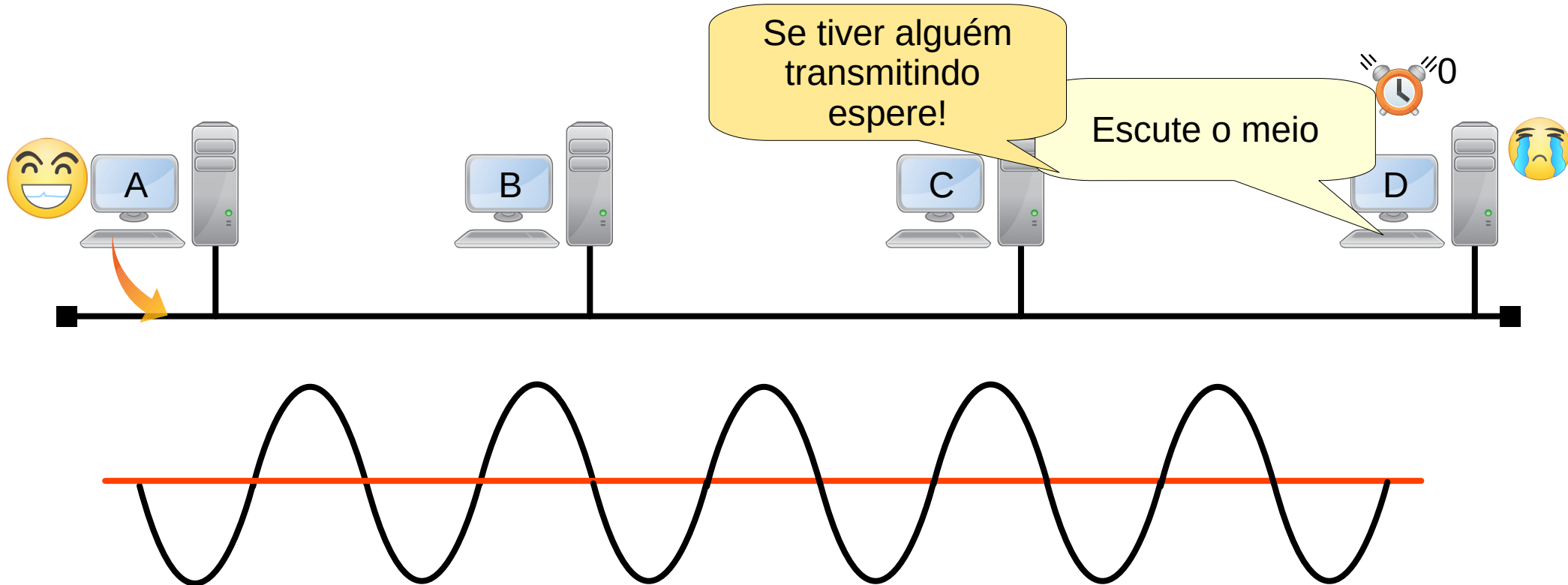
Ethernet

Controle de acesso ao meio Ethernet: CSMA/CD



Ethernet

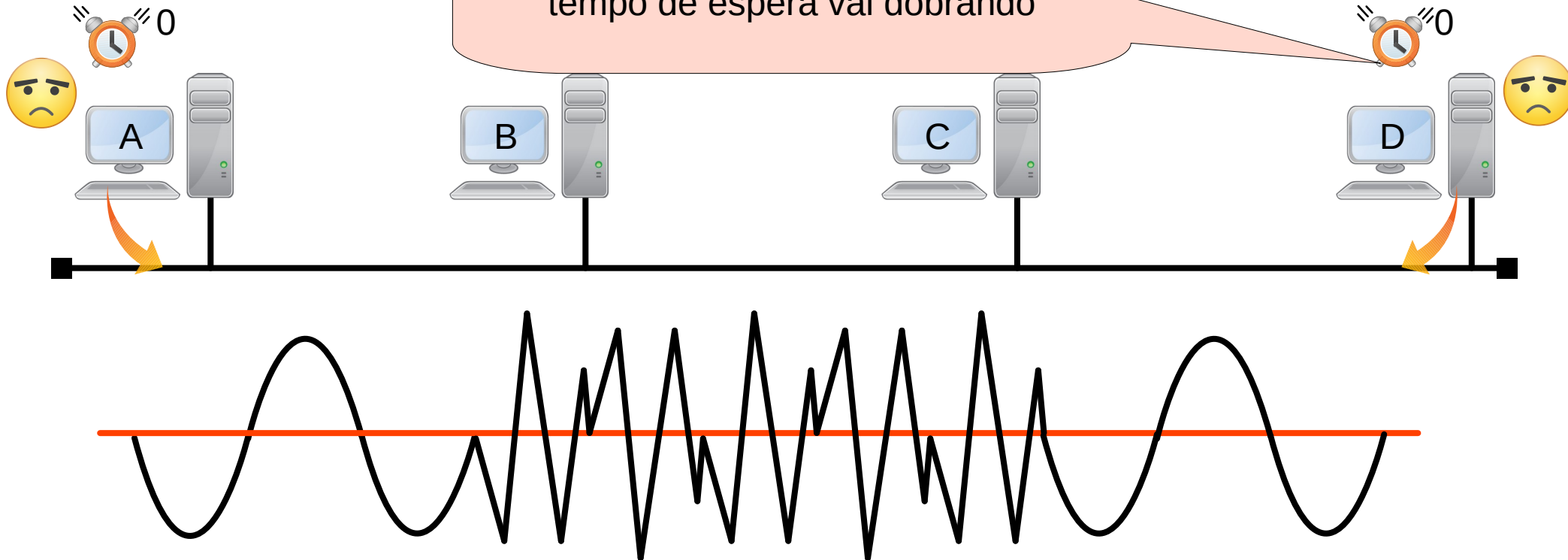
Controle de acesso ao meio Ethernet: CSMA/CD



Ethernet

Controle de acesso a

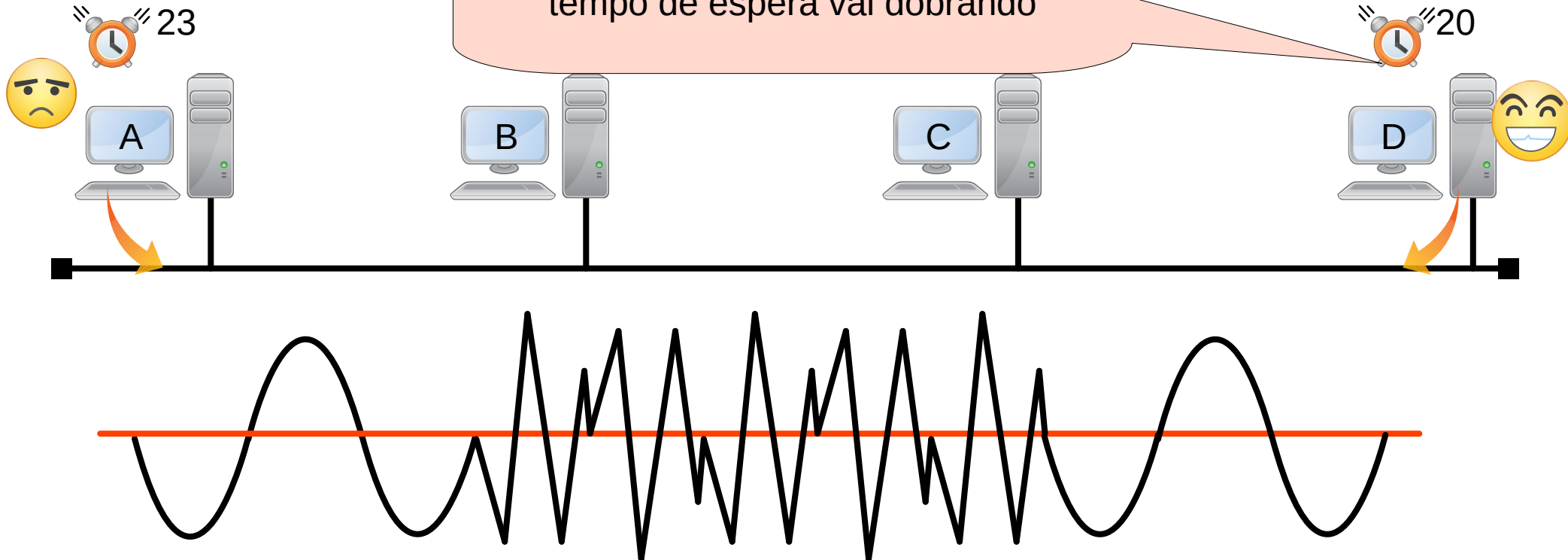
- Caso a colisão persista o tempo de espera vai dobrando



Ethernet

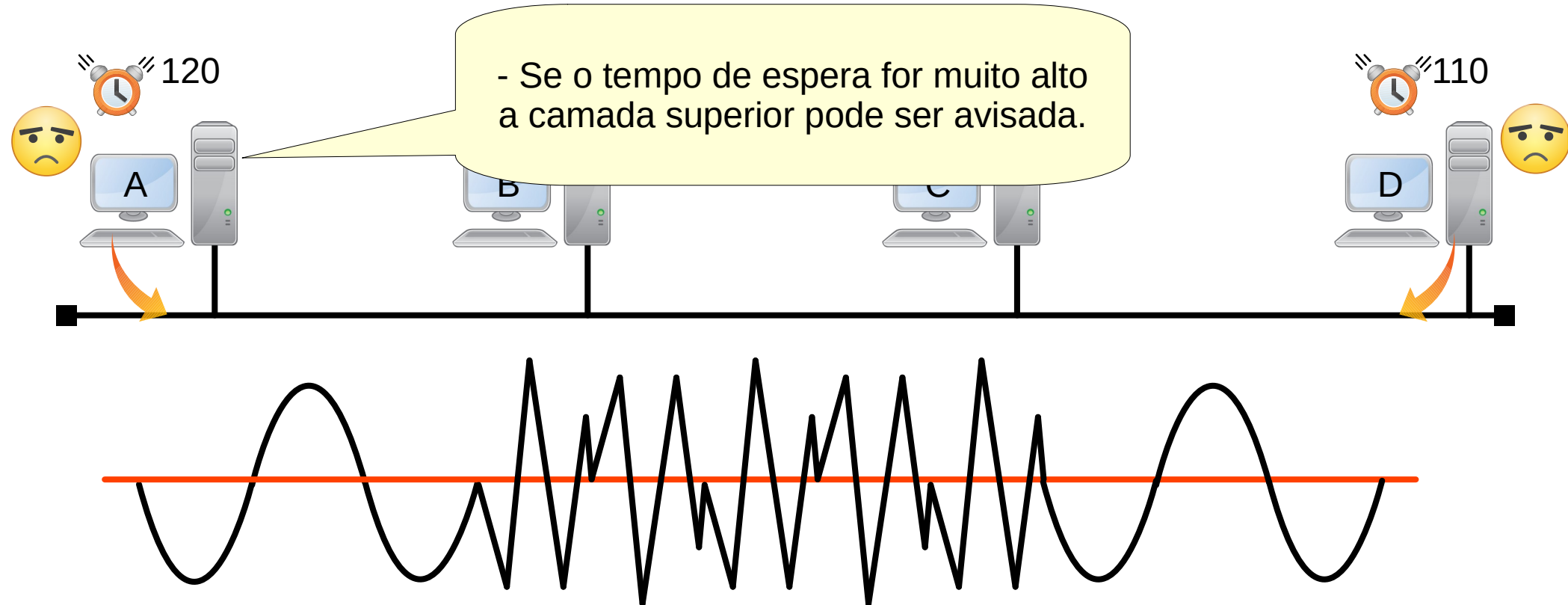
Controle de acesso a

- Caso a colisão persista o tempo de espera vai dobrando



Ethernet

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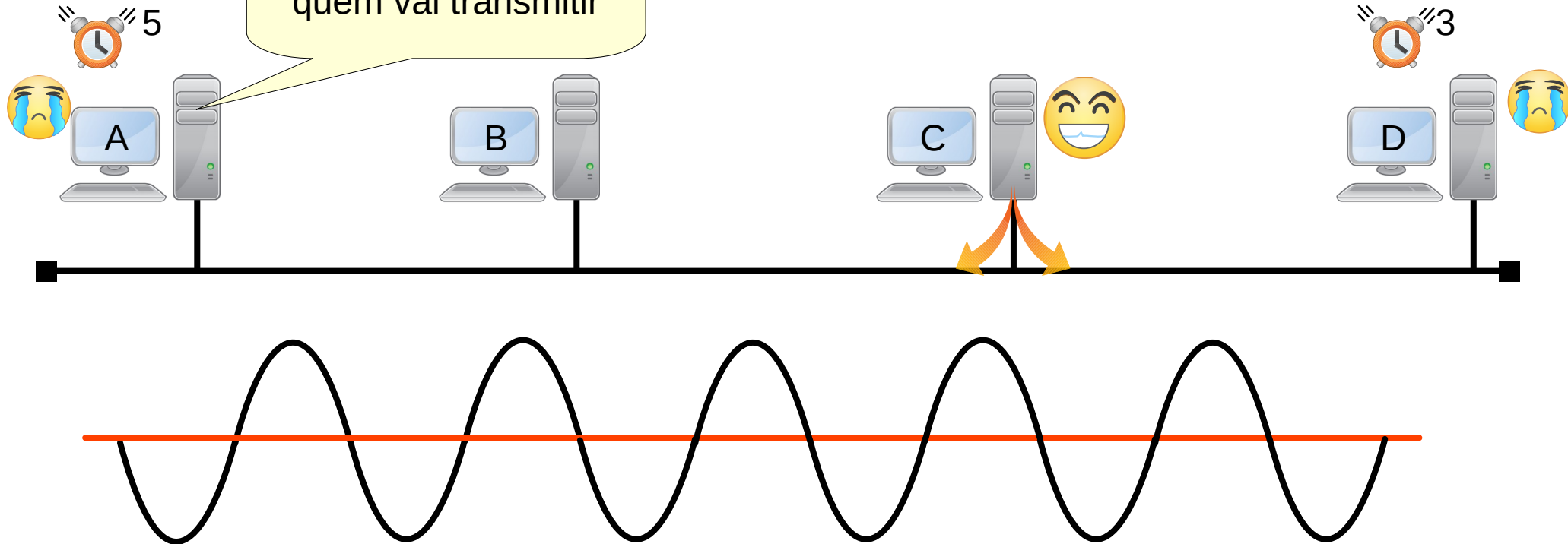


Ethernet

Controle d

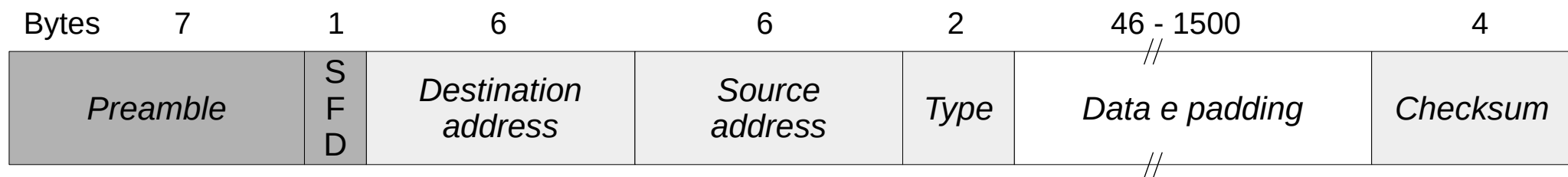
ernet: CSMA/CD

- Não há garantia de quem vai transmitir



Ethernet

Quadro Ethernet:



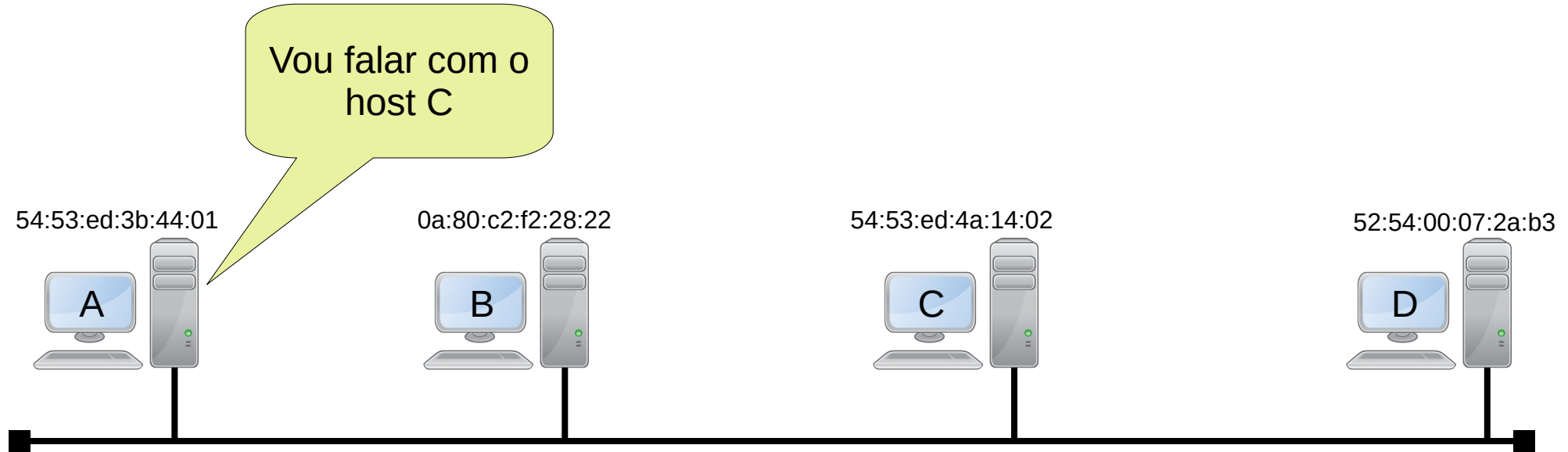
Camada Física

- Preambulo: 10101010...
- SFD: 10101011

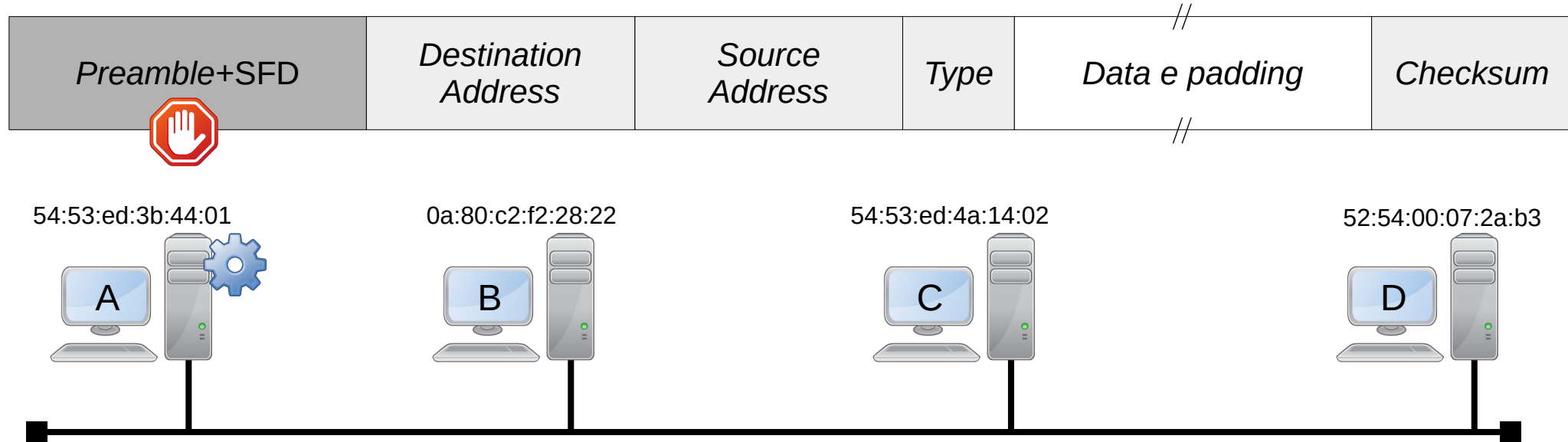
Camada Enlace

Tamanho máximo do quadro: 64 bytes
Tamanho mínimo do quadro: 1518 bytes

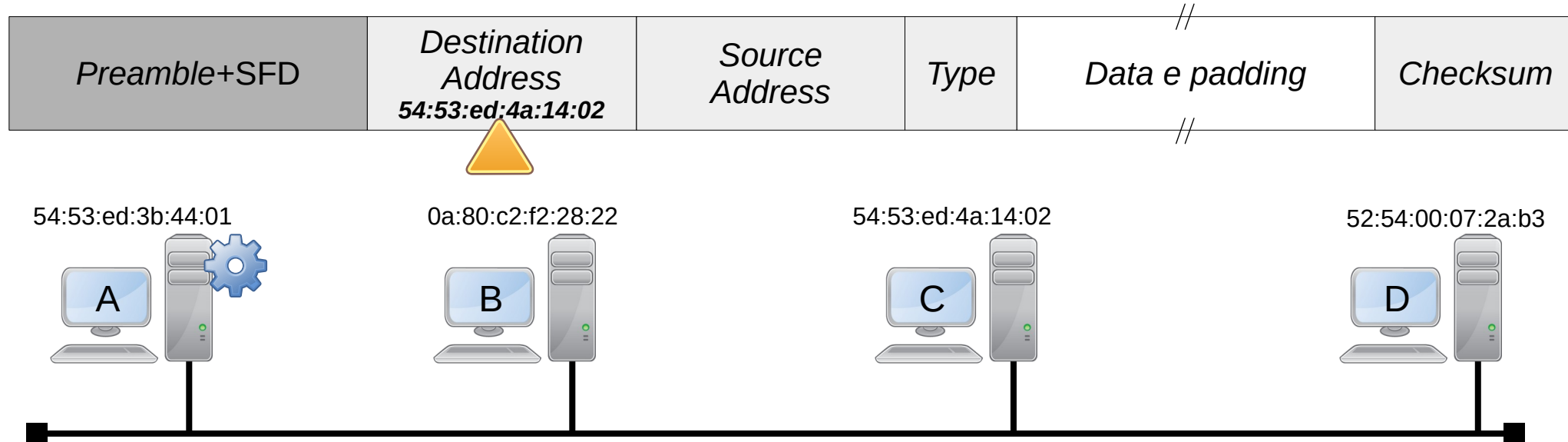
Ethernet



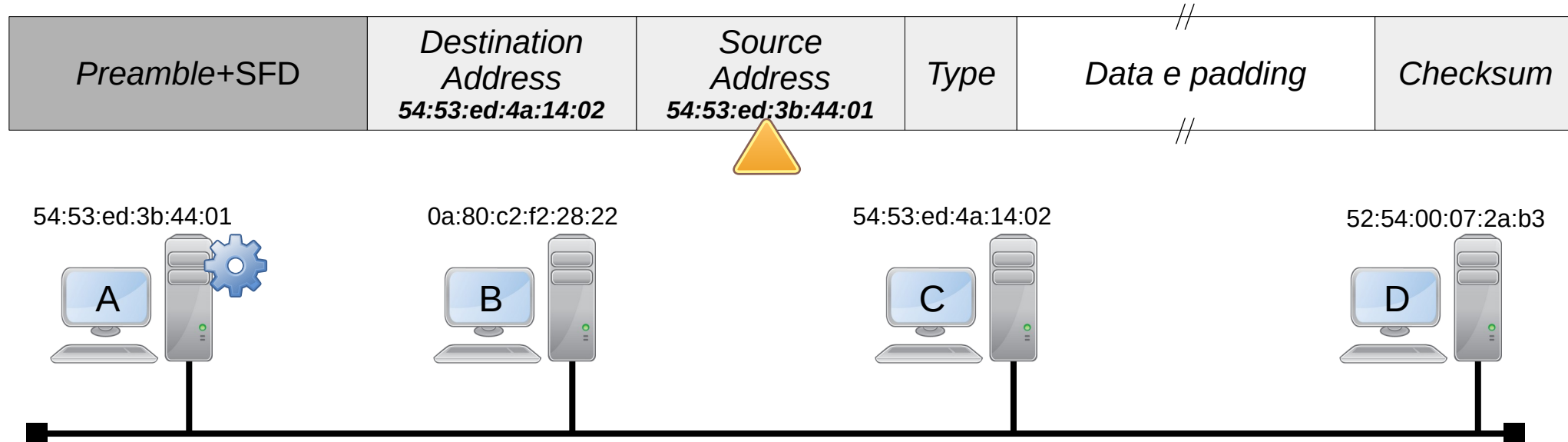
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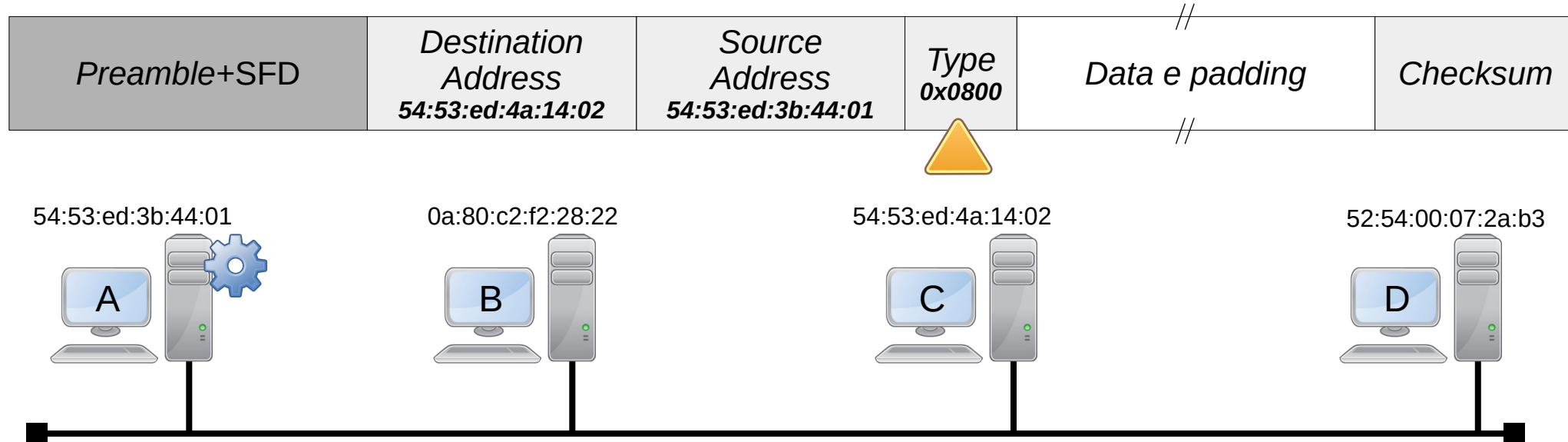
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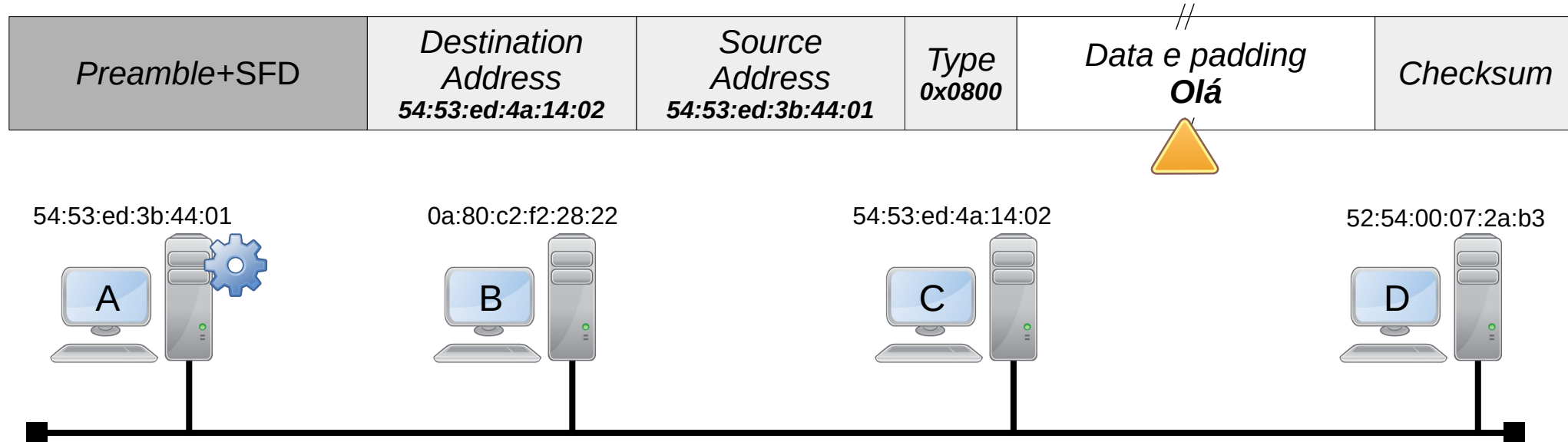
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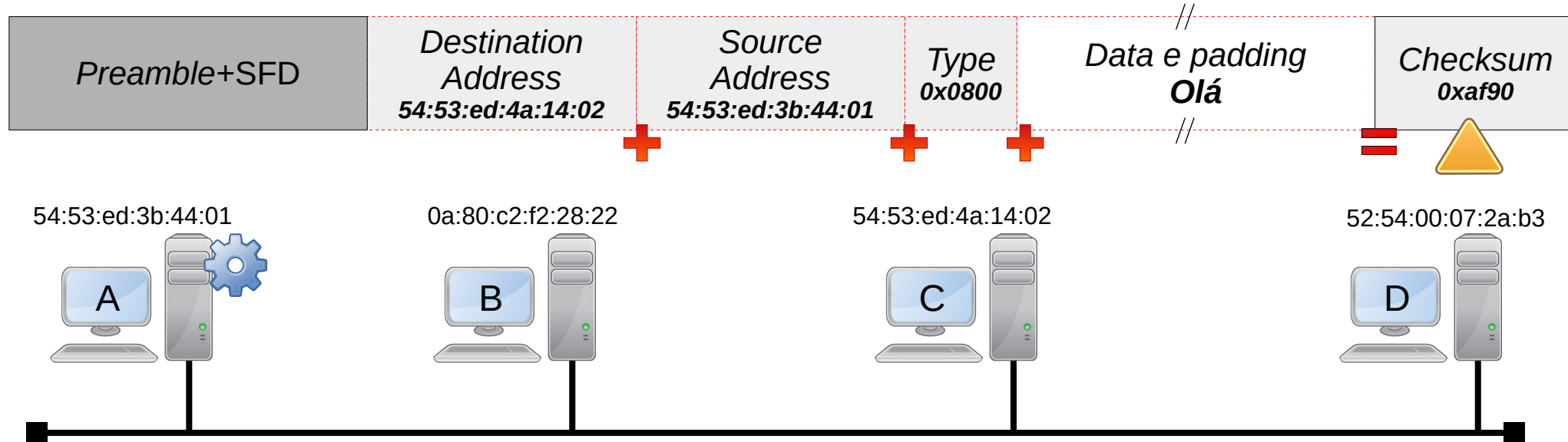
Ethernet



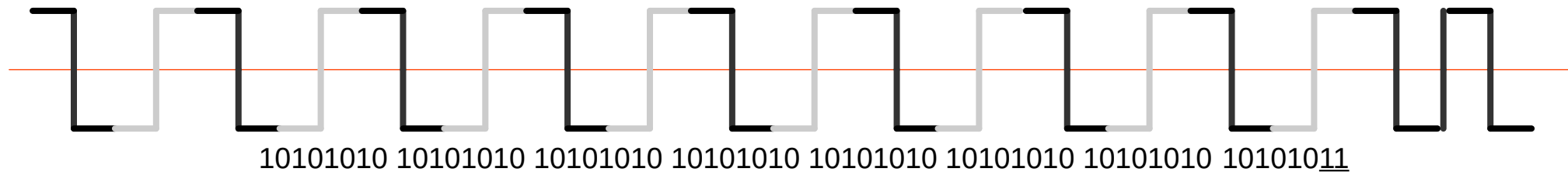
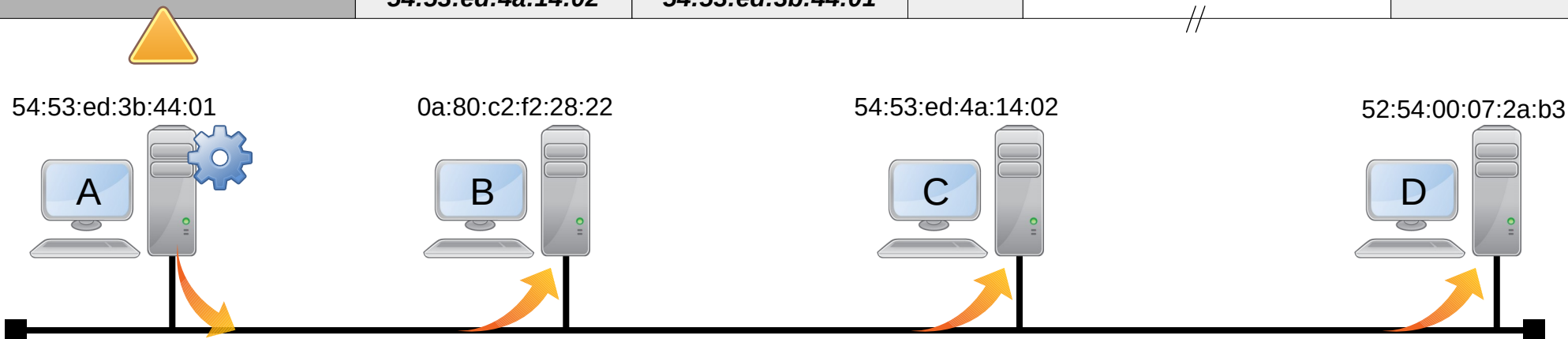
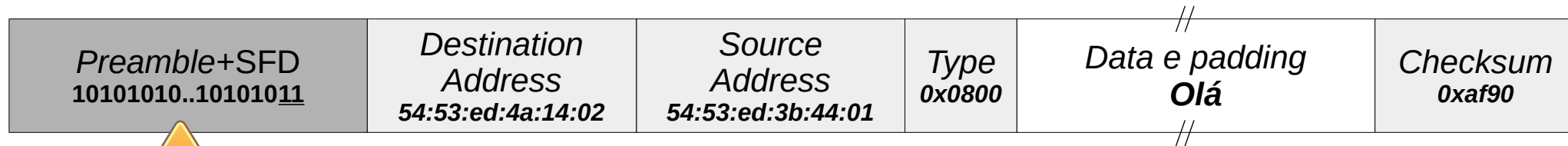
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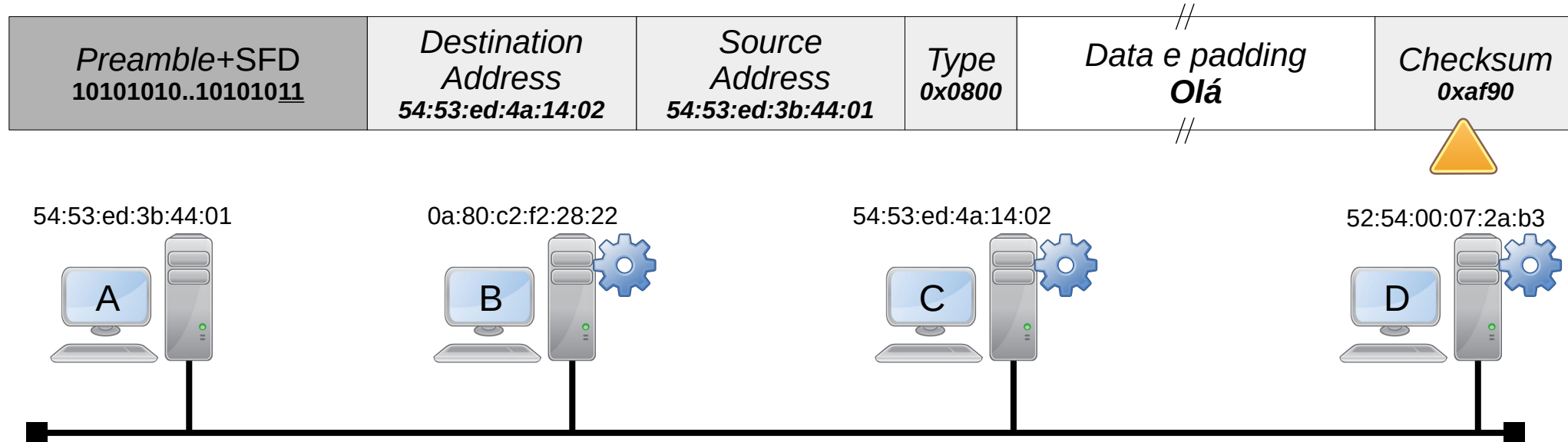
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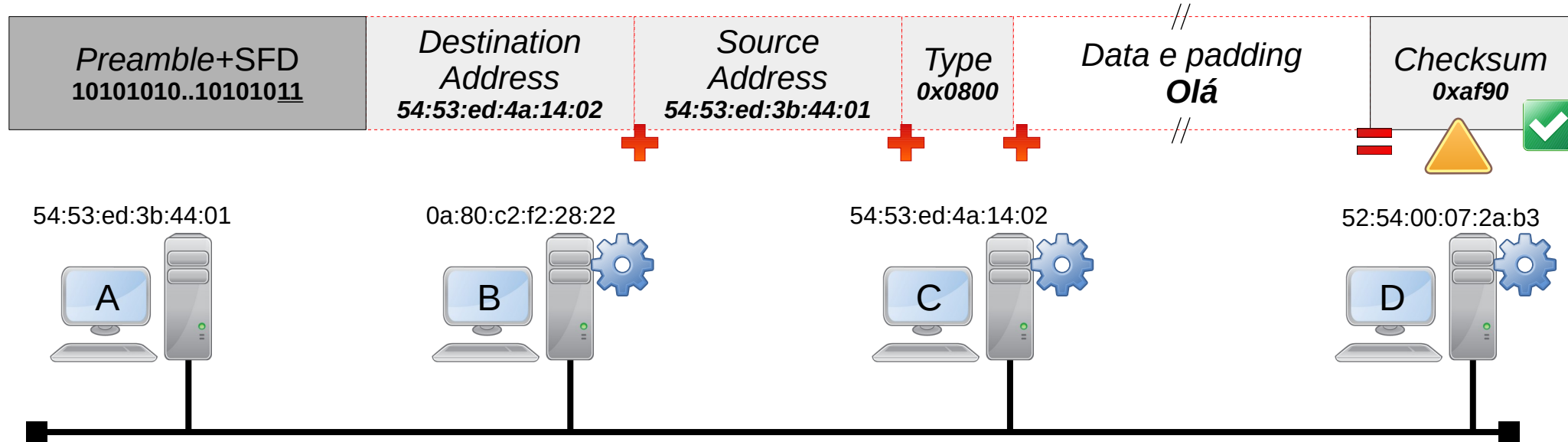
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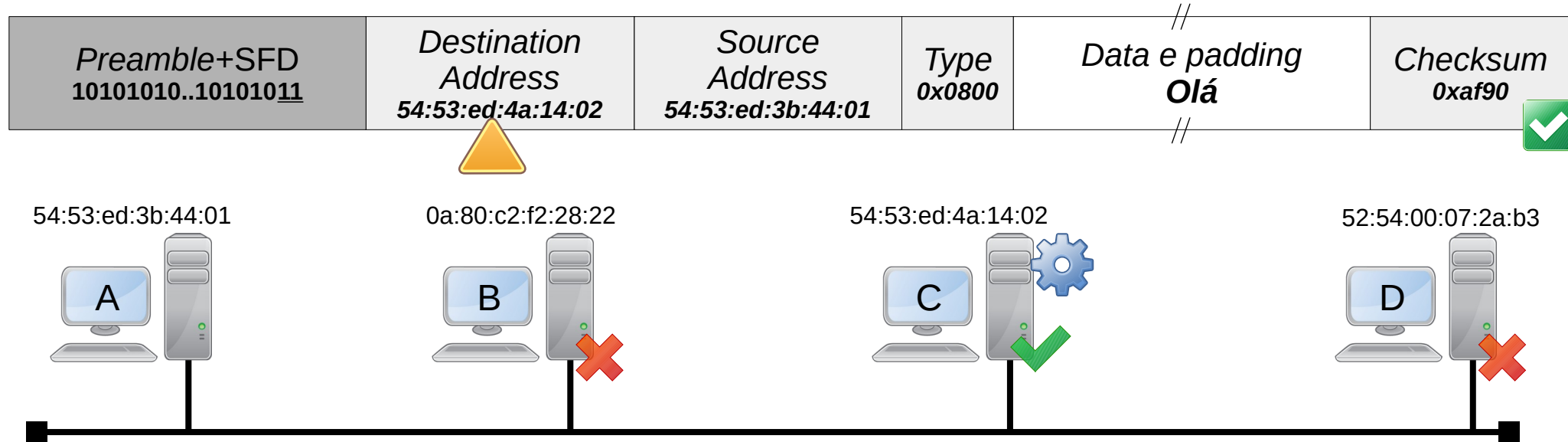
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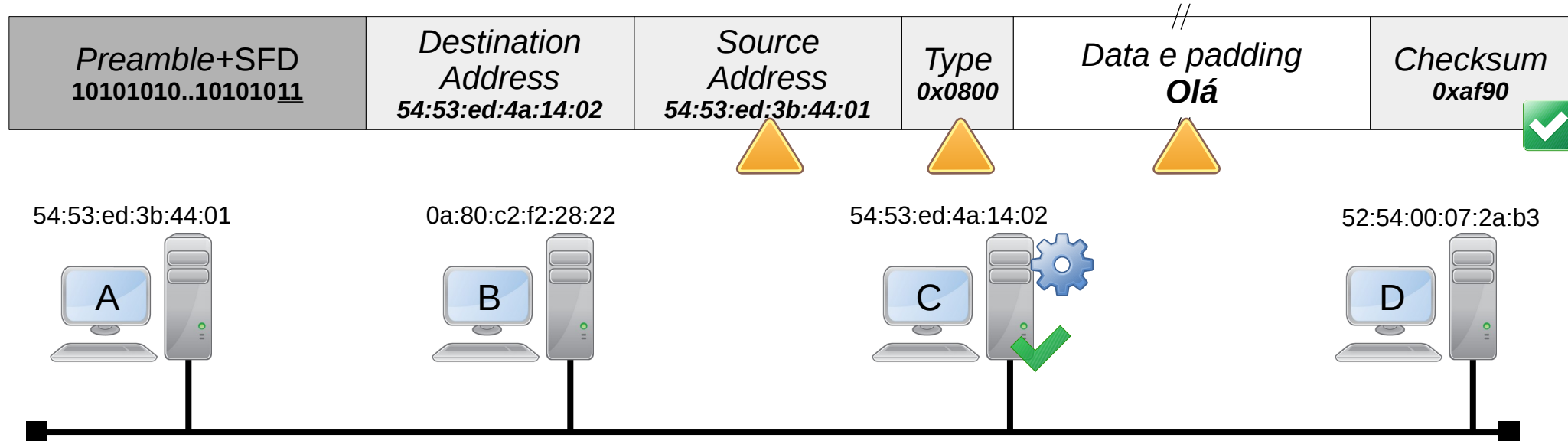
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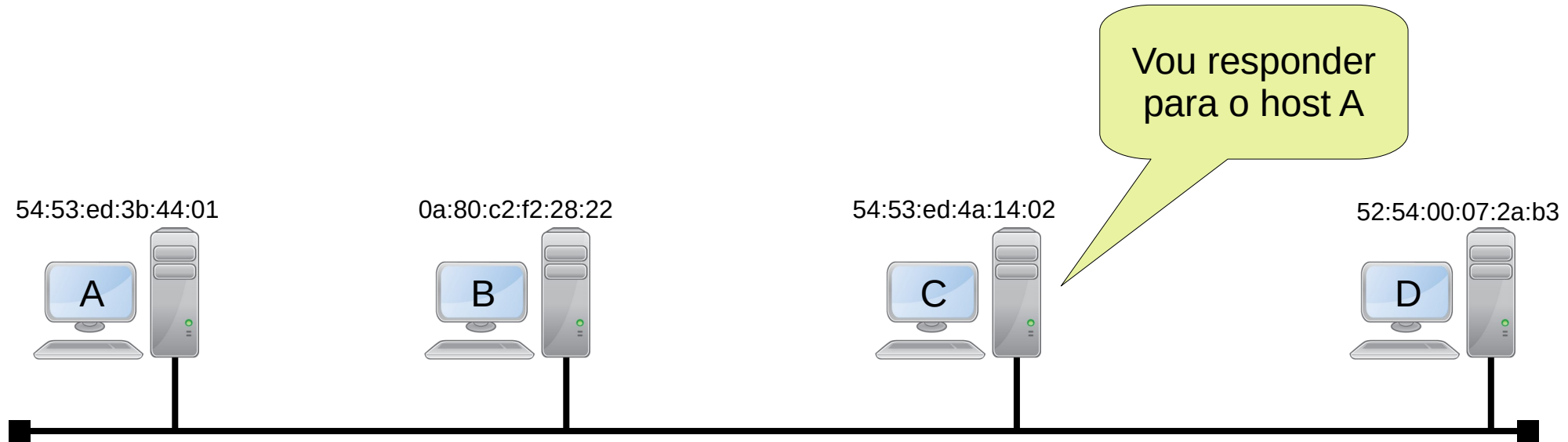
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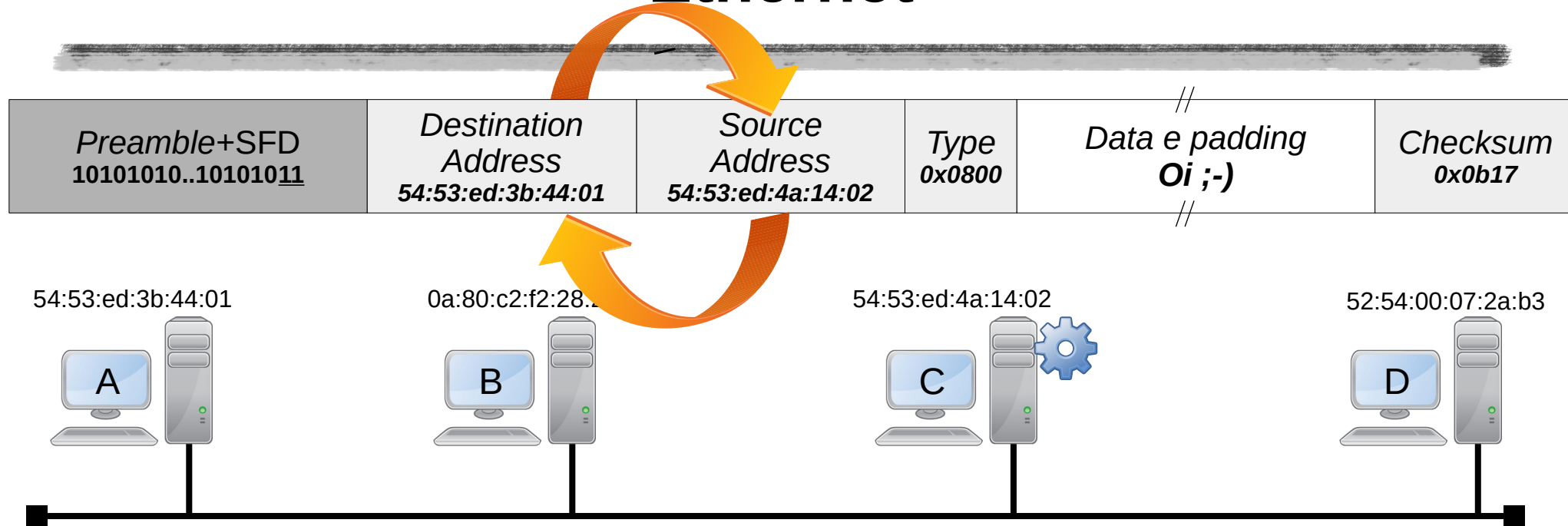
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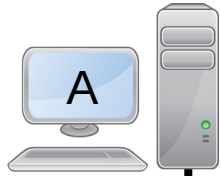
Ethernet



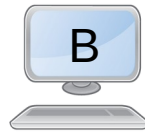
Ethernet

Preamble+SFD 10101010..101010 <u>11</u>	Destination Address 54:53:ed:3b:44:01	Source Address 54:53:ed:4a:14:02	Type 0x0800	// Data e padding Oi ;-) //	Checksum 0x0b17
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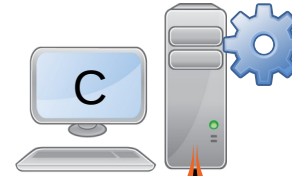
54:53:ed:3b:44:01



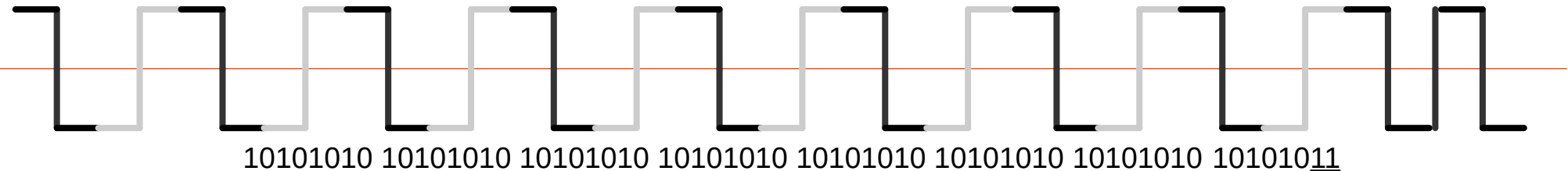
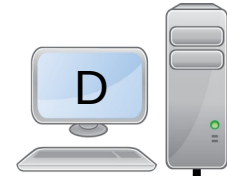
0a:80:c2:f2:28:22



54:53:ed:4a:14:02



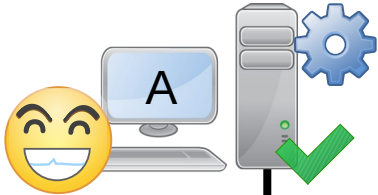
52:54:00:07:2a:b3



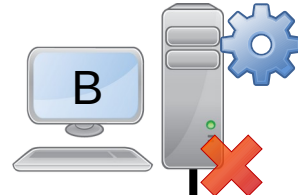
Ethernet

<i>Preamble+SFD</i> 10101010..10101011	<i>Destination Address</i> 54:53:ed:3b:44:01	<i>Source Address</i> 54:53:ed:4a:14:02	<i>Type</i> 0x0800	<i>Data e padding</i> Oi ;-)	<i>Checksum</i> 0x0b17
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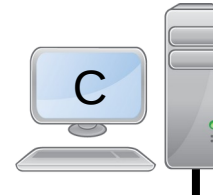
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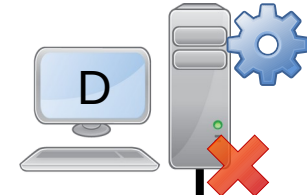
0a:80:c2:f2:28:22



54:53:ed:4a:14:02



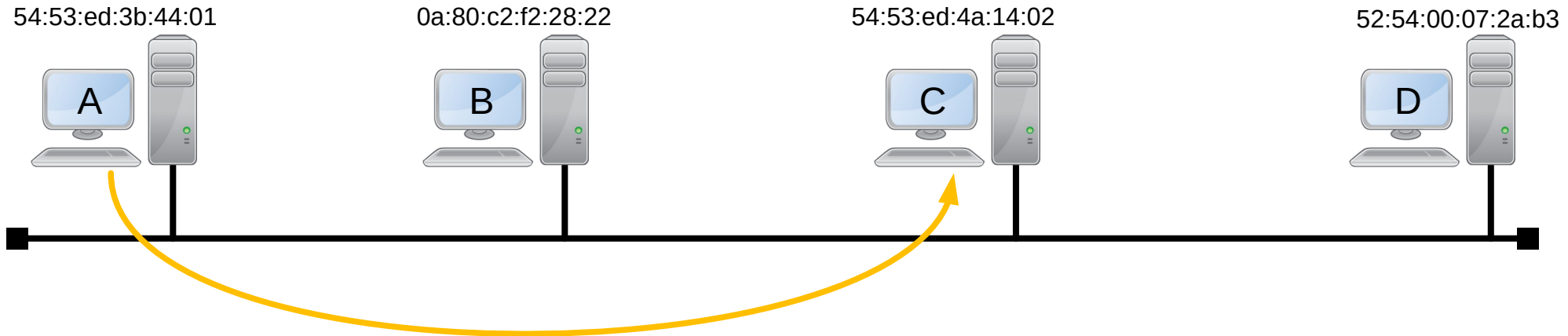
52:54:00:07:2a:b3



Ethernet

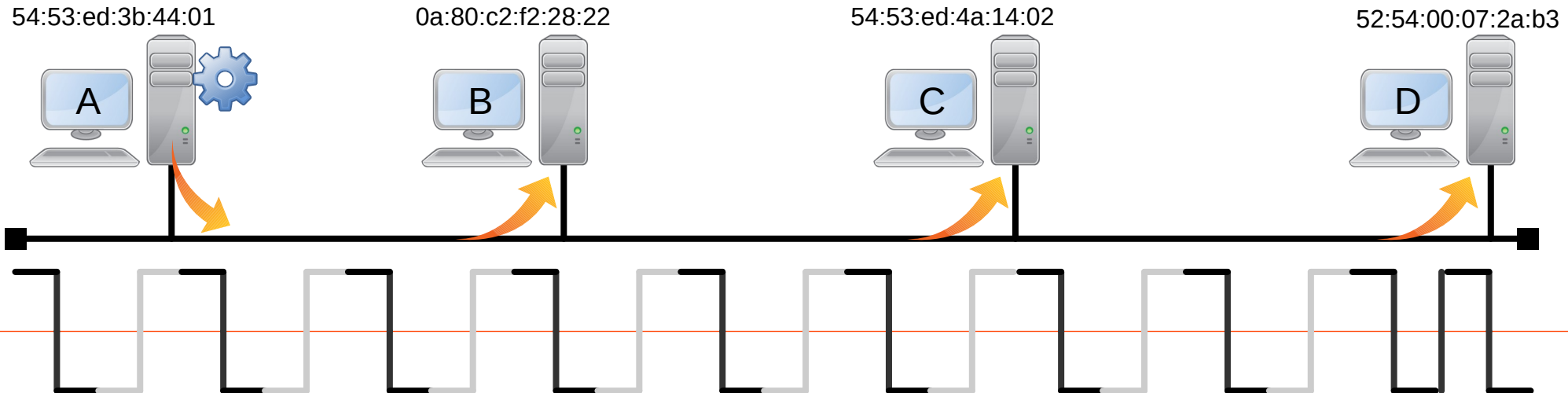
Endereços: **unicast**, *multicast* e *broadcast*.

Preamble+SFD	Destination Address	Source Address	Type	//	Checksum
	54:53:ed:4a:14:02	54:53:ed:3b:44:01		//	



Ethernet

Endereços: **unicast**, *multicast* e *broadcast*.

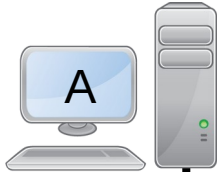


Ethernet

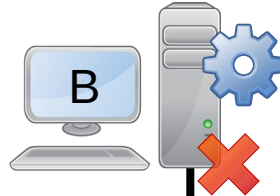
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Preamble+SFD	Destination Address	Source Address	Type	//	Checksum
	54:53:ed:4a:14:02	54:53:ed:3b:44:01		Data e padding	

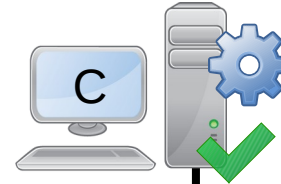
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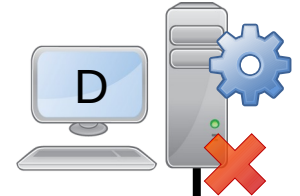
0a:80:c2:f2:28:22



54:53:ed:4a:14:02



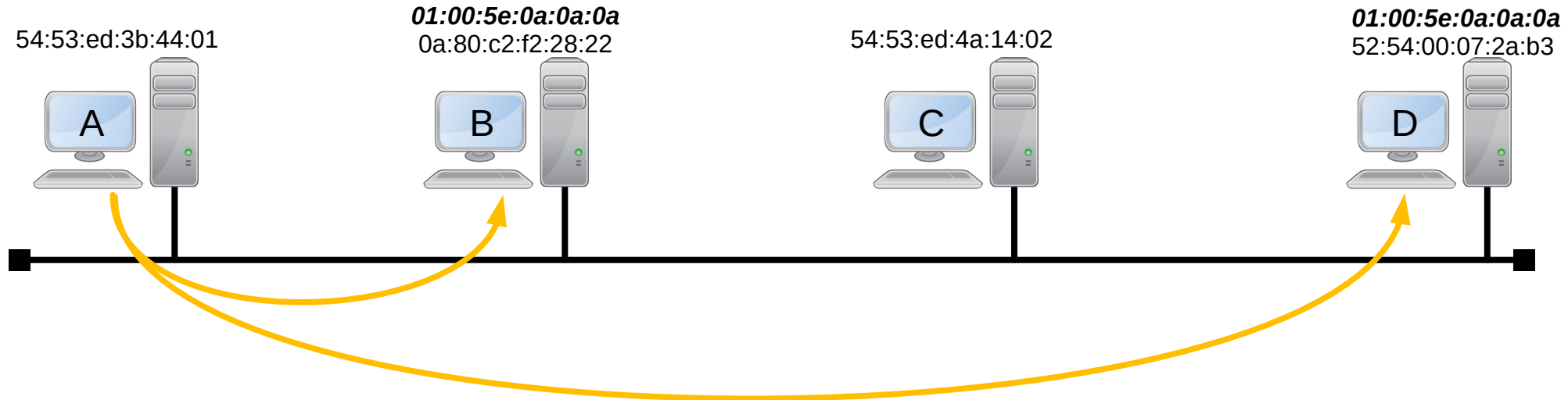
52:54:00:07:2a:b3



Ethernet

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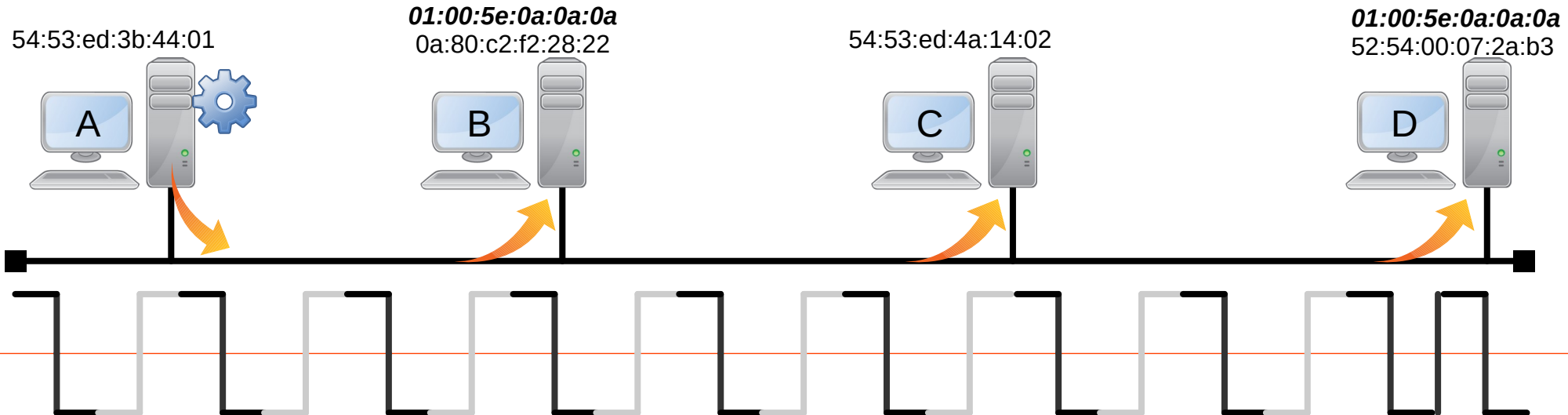
Preamble+SFD	Destination Address	Source Address	Type	//	Checksum
	01:00:5e:0a:0a:0a	54:53:ed:3b:44:01		Data e padding	



Ethernet

Endereços: *unicast*, ***multicast*** e *broadcast*.

Preamble+SFD	Destination Address	Source Address	Type	//	Checksum
	01:00:5e:0a:0a:0a	54:53:ed:3b:44:01		//	

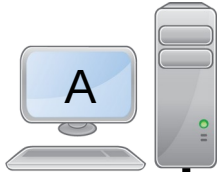
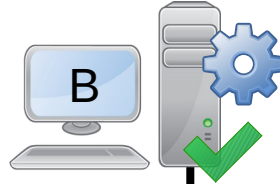


Ethernet

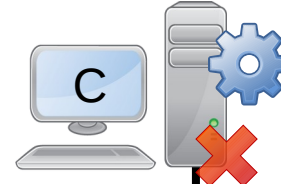
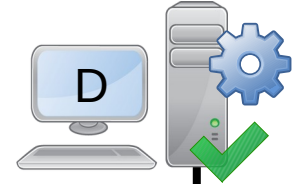
Endereços: *unicast*, ***multicast*** e *broadcast*.

Preamble+SFD	Destination Address	Source Address	Type	//	Checksum
	01:00:5e:0a:0a:0a	54:53:ed:3b:44:01		Data e padding	
				//	

54:53:ed:3b:44:01

**01:00:5e:0a:0a:0a**
0a:80:c2:f2:28:22

54:53:ed:4a:14:02

**01:00:5e:0a:0a:0a**
52:54:00:07:2a:b3

Ethernet

Como saber se o endereço é unicast, *broadcast* ou *multicast*?



Ethernet

Se o bit de mais baixa ordem do primeiro octeto for 0 o endereço é *unicast*, se for 1 é *multicast/broadcast*.

0 0 0 0 0 0 0 1 **01**

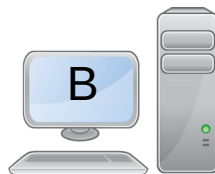
0 0 0 0 0 0 0 0 **00**

0 1 0 1 1 1 1 0 **5e**

0 0 0 0 1 0 1 0 **0a**

0 0 0 0 1 0 1 0 **0a**

0 0 0 0 1 0 1 0 **0a**



01:00:5e:0a:0a:0a
0a:80:c2:f2:28:22

0a 0 0 0 0 1 0 1 0

80 1 0 0 0 0 0 0 0

c2 1 1 0 0 0 0 1 0

f2 1 1 1 1 0 0 1 0

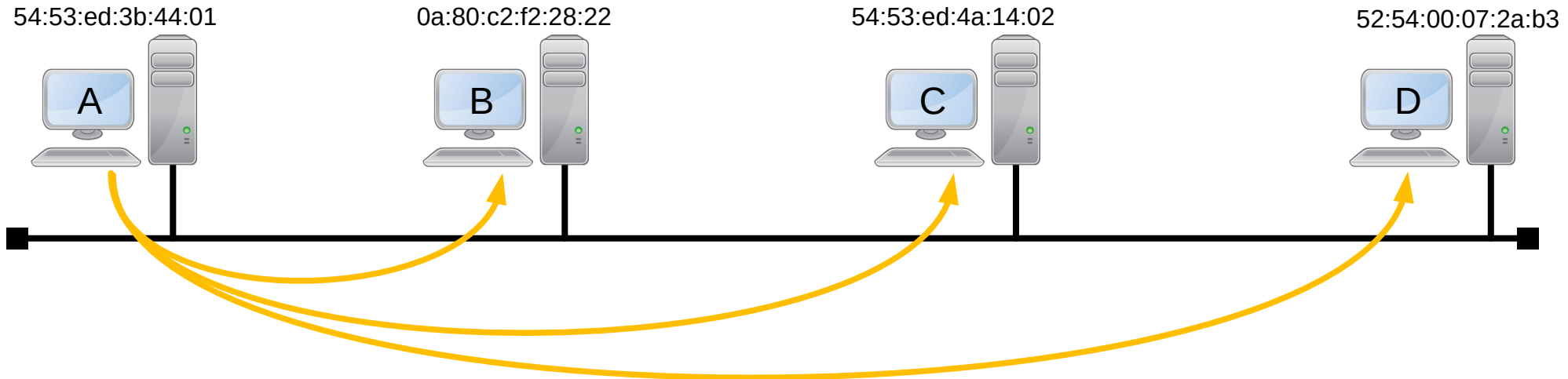
28 0 0 1 0 1 0 0 0

22 0 0 1 0 0 0 1 0

Ethernet

Endereços: *unicast*, *multicast* e ***broadcast***.

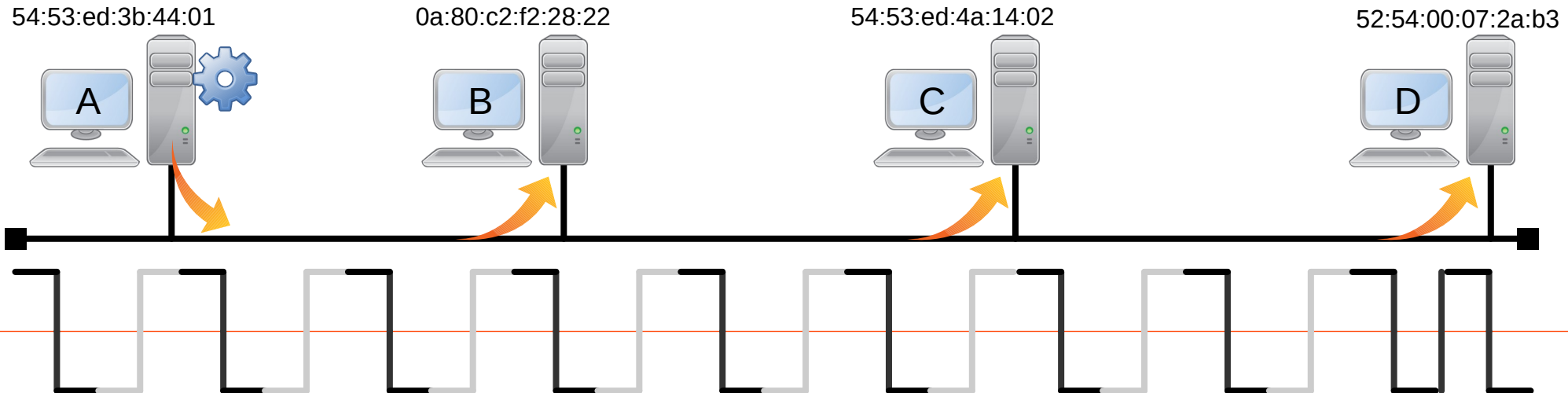
Preamble+SFD	Destination Address	Source Address	Type	//	Checksum
	ff:ff:ff:ff:ff:ff	54:53:ed:3b:44:01		Data e padding	



Ethernet

Endereços: *unicast*, *multicast* e ***broadcast***.

Preamble+SFD	Destination Address	Source Address	Type	//	Checksum
	ff:ff:ff:ff:ff:ff	54:53:ed:3b:44:01		Data e padding	
//					

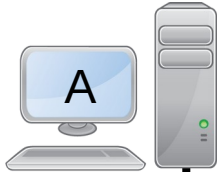


Ethernet

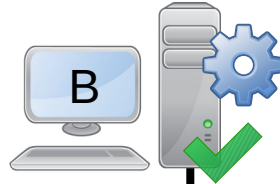
Endereços: *unicast*, *multicast* e ***broadcast***.

Preamble+SFD	Destination Address	Source Address	Type	//	Checksum
	ff:ff:ff:ff:ff:ff	54:53:ed:3b:44:01		Data e padding	

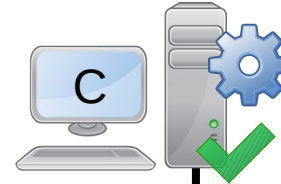
54:53:ed:3b:44:01



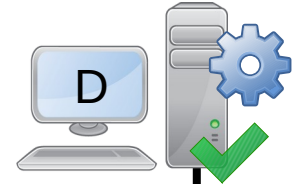
0a:80:c2:f2:28:22



54:53:ed:4a:14:02



52:54:00:07:2a:b3



Ethernet

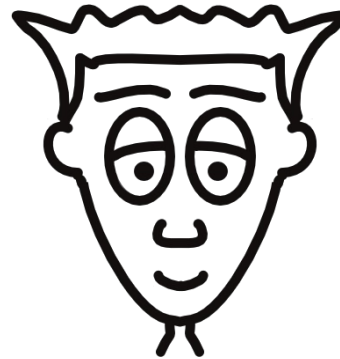
Evolução:

Nome Comercial	IEEE	Velocidade	Alguns Detalhes
Ethernet	802.3	10Mbps	Ano ~1980 - 10Base2 (500m), 10Base5 (185m), 10Base-T (100m), 10Base-F (2Km) – Manchester.
Fast Ethernet	802.3u	100Mbps	Ano ~1990 – 100Base-TX (Cat 5, 4B/5B, 100m), 10Base-FX (4B/5B+MLT-3 – 185m - fibra), 100Base-T4 (Cat 3, 8B/6T+NRZ-I – utiliza 4 pares, 100m).
Gigabit Ethernet	802.3z	1.000Mbps (1Gbps)	Ano ~1998 – 1000BaseSX (550m, 8B/10B+NRZ - fibra), 1000BaseLX (5Km, 8B/10B+NRZ - fibra), 1000BaseCX (25m 8B/10B+NRZ, STP), 1000BaseT4 (100m 4D-PAM5).
10 Gigabit Ethernet	802.3an 802.3en	10.000Mbps (10Gbps)	Ano ~2002 – 10GBase-SR (>300m - fibra), 10GBase-LR (10km - fibra), 10GBaseER (40Km - fibra), 10GBaseCX4 (15m, 4 pares), 10BaseT (100m, 4 pares UTP Cat 6a).

Ethernet

Conclusão:

O padrão Ethernet é o mais utilizado no mundo das redes de computadores locais com fio. Assim, é muito importante saber o seu controle de acesso ao meio, o formato do quadro e sua evolução.



Depois isso vai ser útil para entender Switching e VLAN...

Obrigado!!!

Prof. Dr. Luiz Arthur Feitosa dos Santos



luiz.arthur.feitosa.santos@gmail.com

<https://luizsantos.github.io/>

Links e referencias na descrição do vídeo