

Camada Enlace

(Introdução)

Prof. Dr. Luiz Arthur Feitosa dos Santos



luiz.arthur.feitosa.santos@gmail.com

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

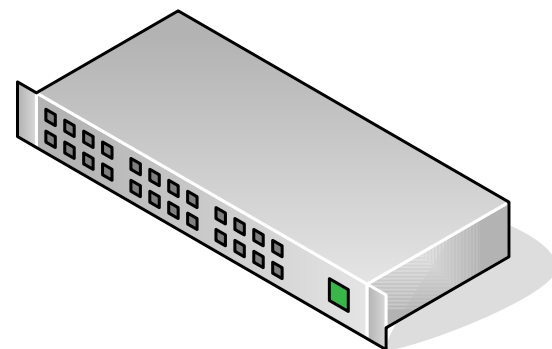
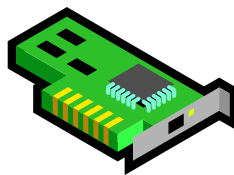


Camada de Enlace

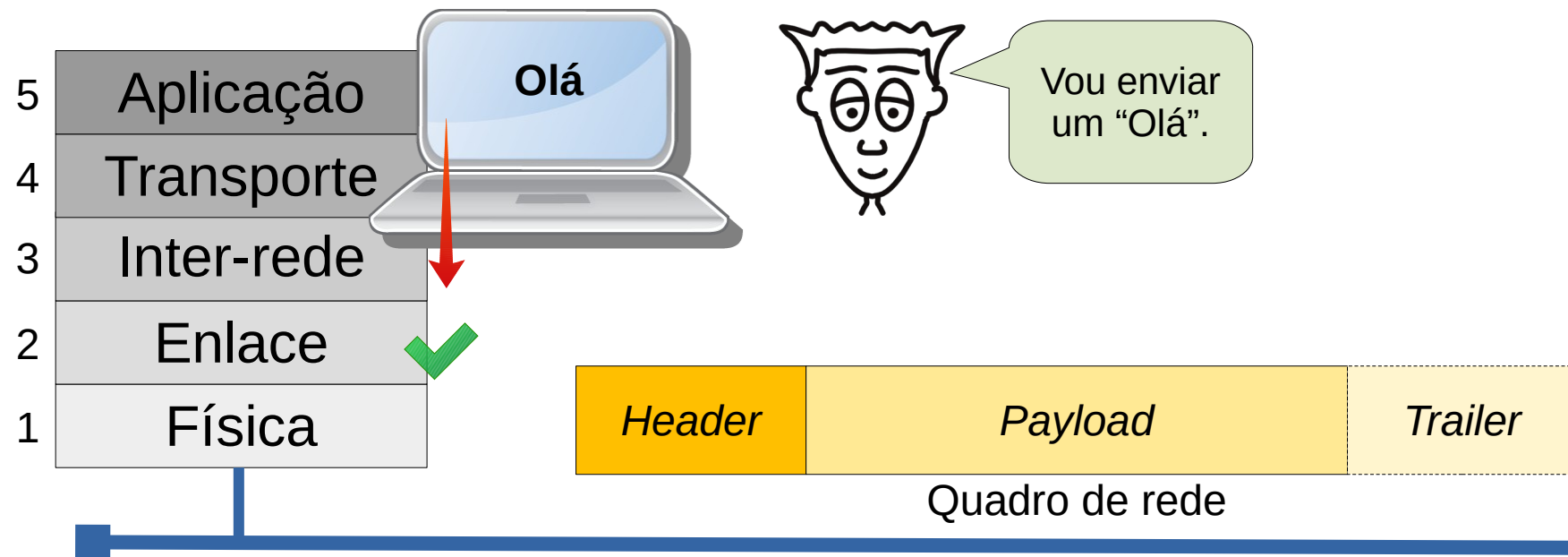
Modelo TCP/IP



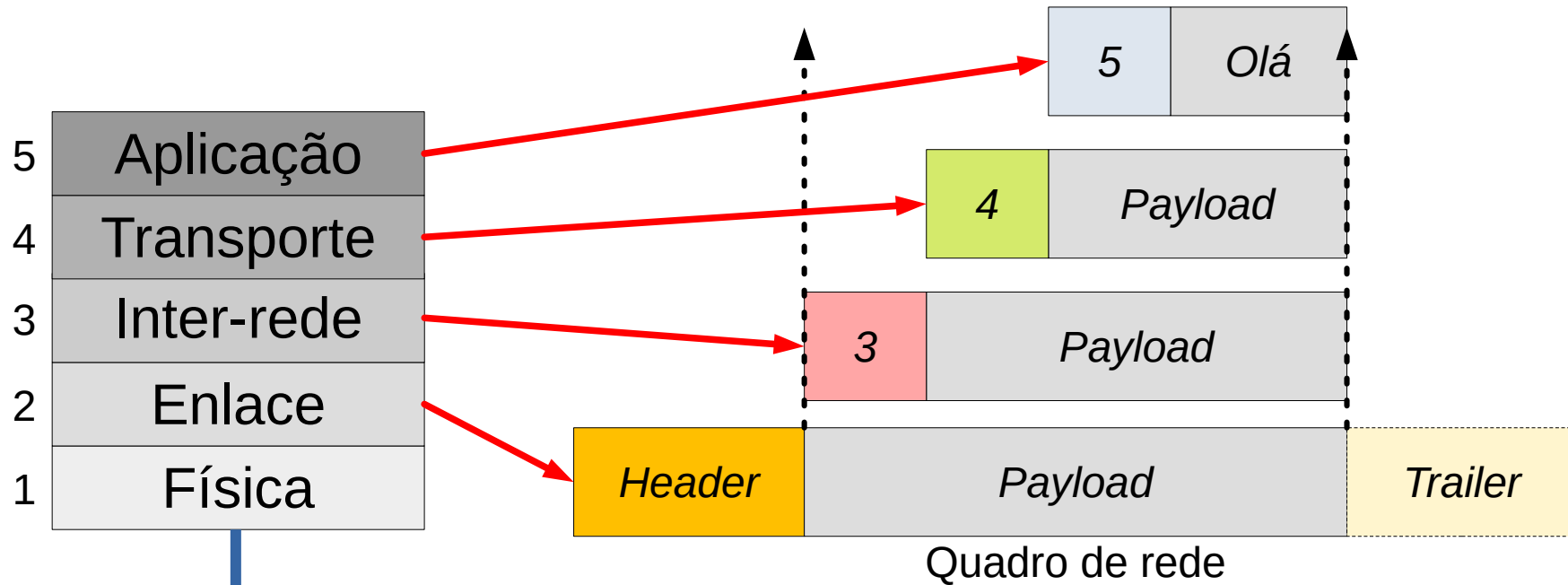
- Detecção de erros;
- Controle de acesso ao meio;
- Endereçamento físico;
- Impedir que *hosts* mais rápidos inundem de informações *hosts* mais lentos.



Camada de Enlace

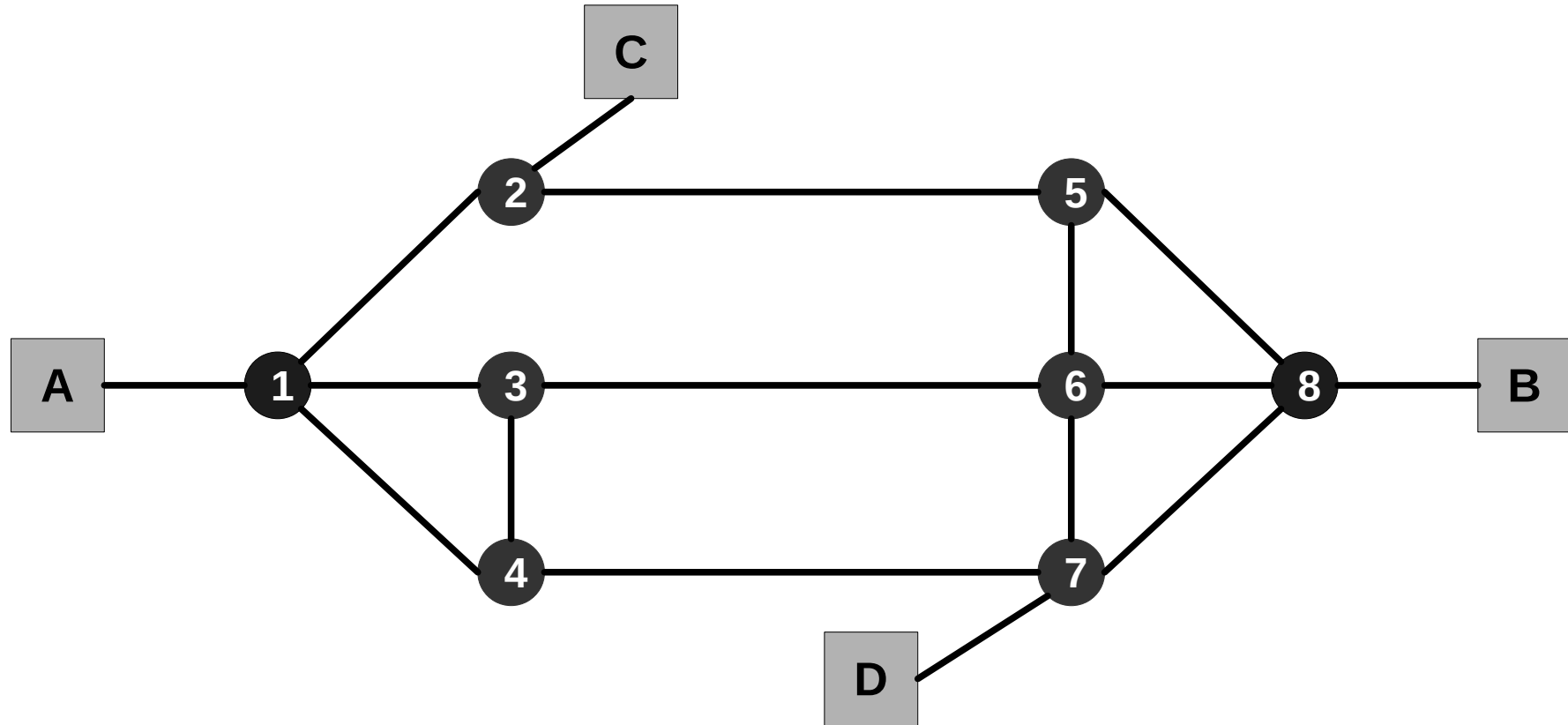


Camada de Enlace



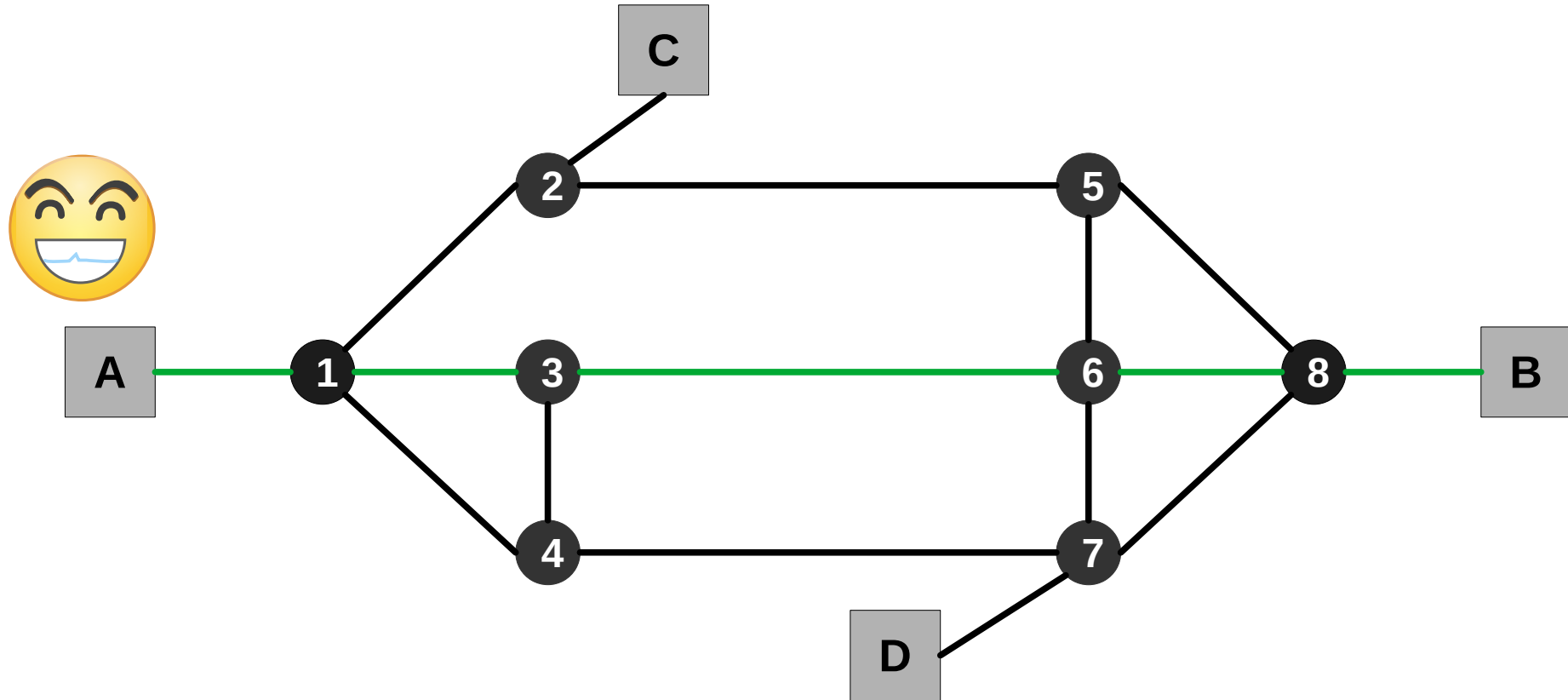
Comutação por Pacotes x Circuitos

Comutação por Circuito:



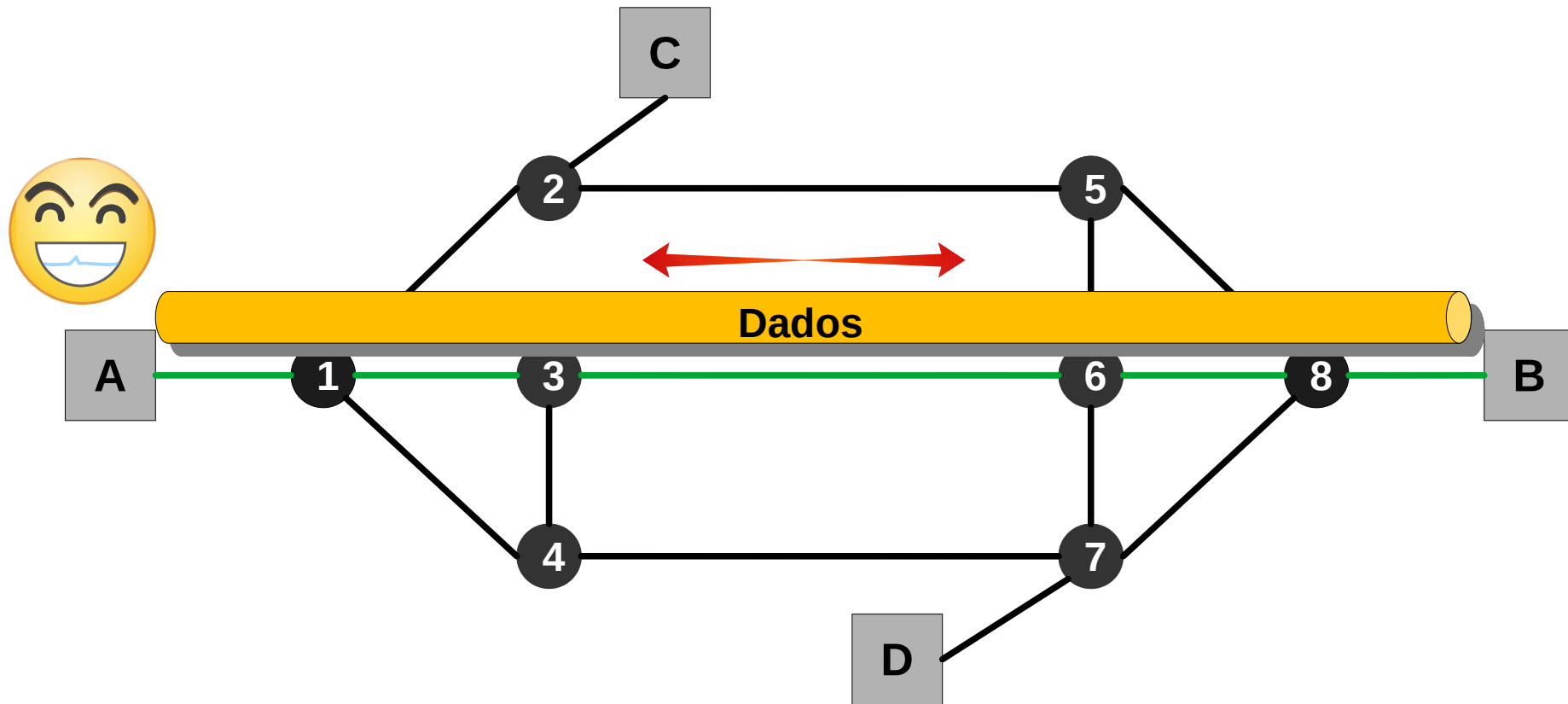
Comutação por Pacotes x Circuitos

Comutação por Circuito:



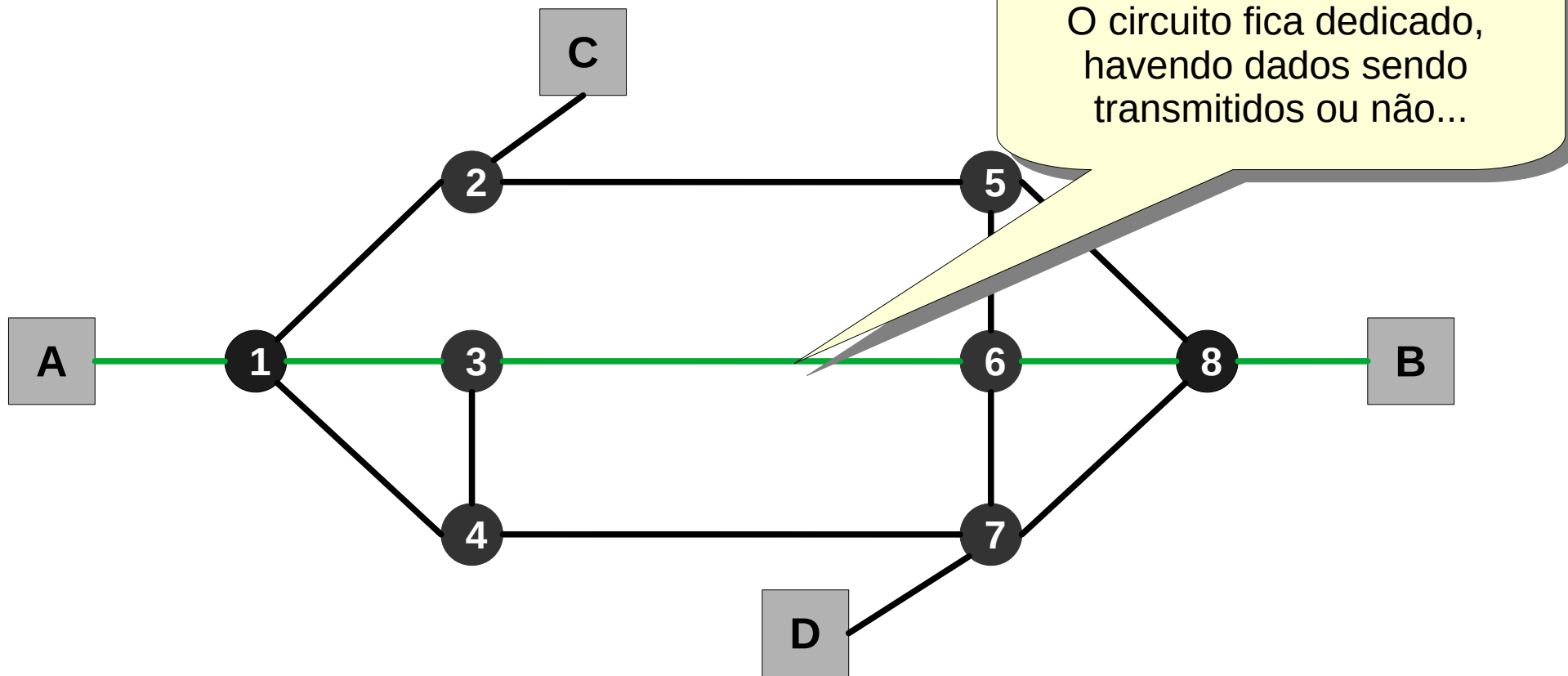
Comutação por Pacotes x Circuitos

Comutação por Circuito:



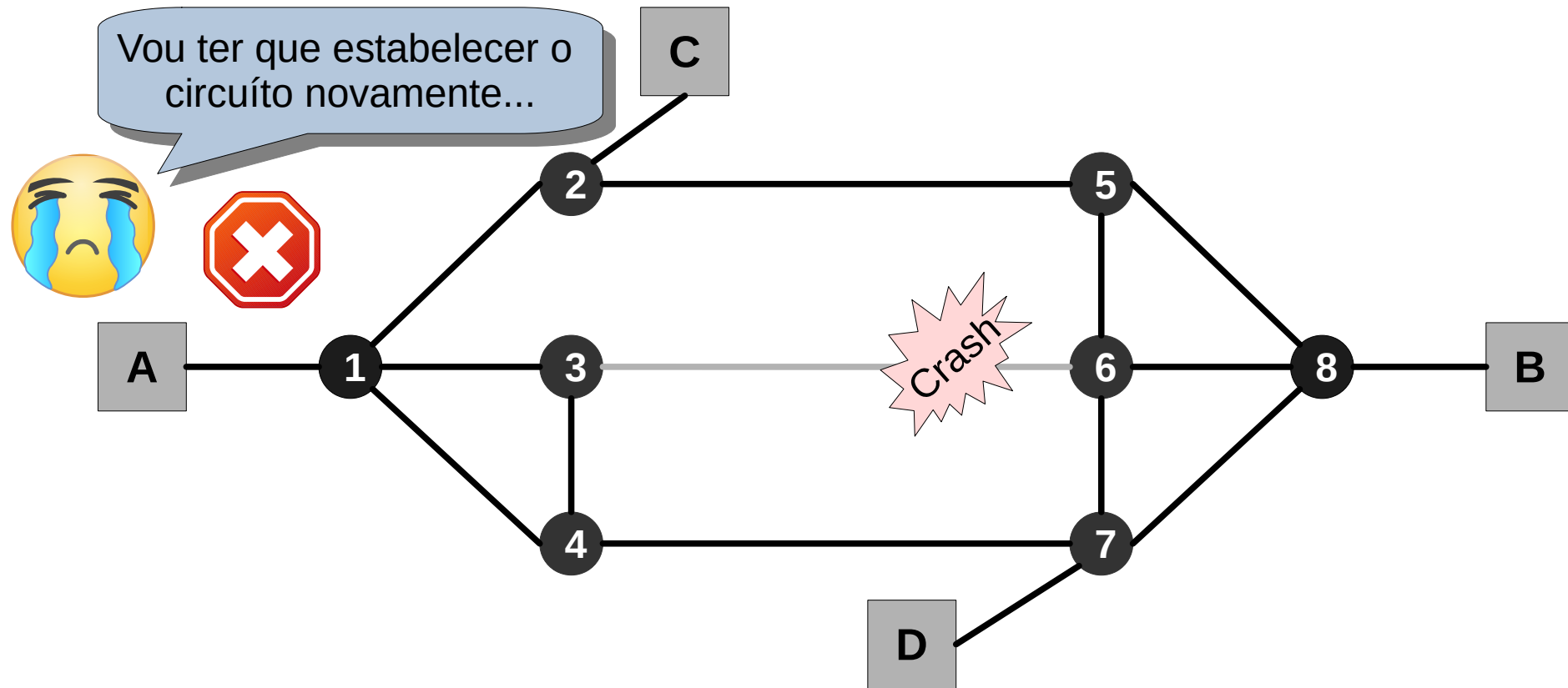
Comutação por Pacotes x Circuitos

Comutação por Circuito:



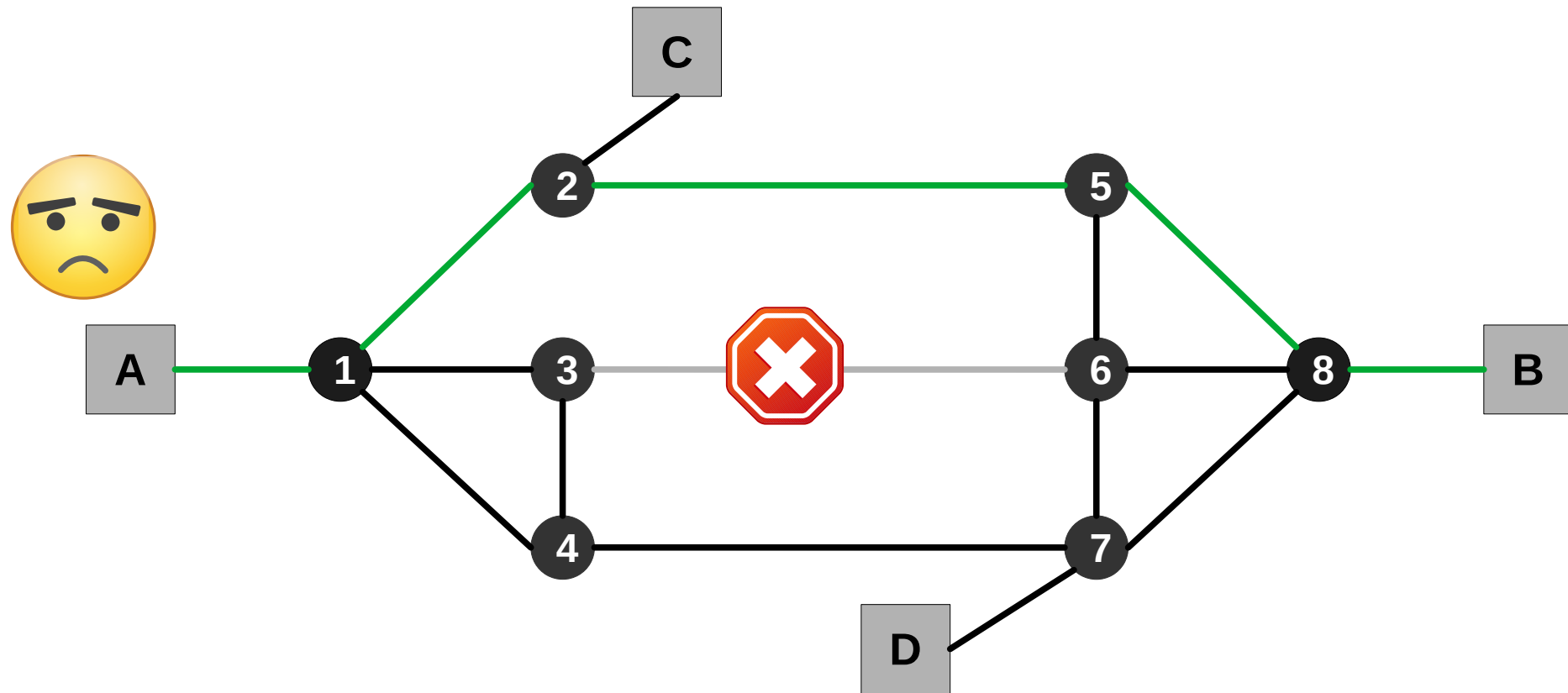
Comutação por Pacotes x Circuitos

Comutação por Circuito:



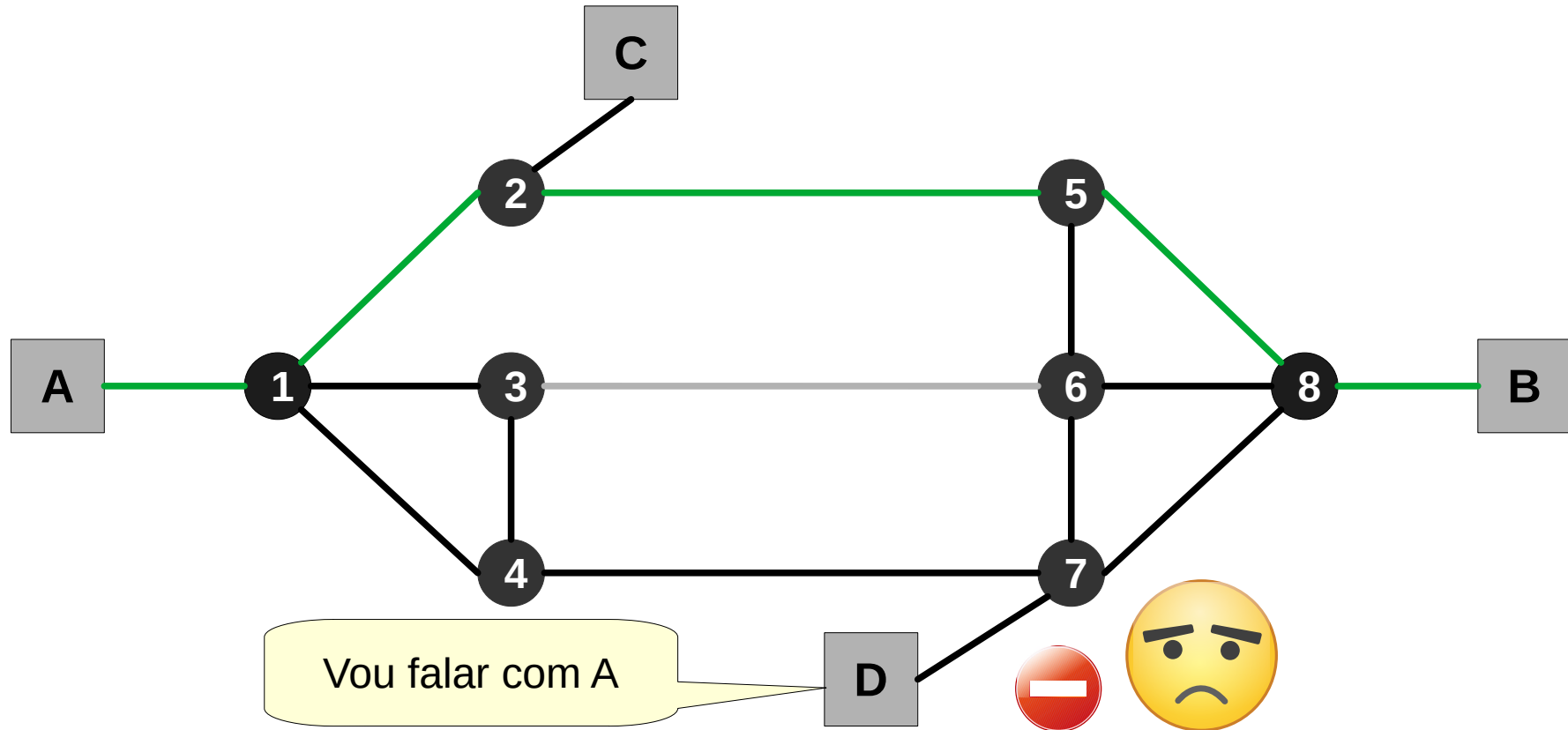
Comutação por Pacotes x Circuitos

Comutação por Circuito:



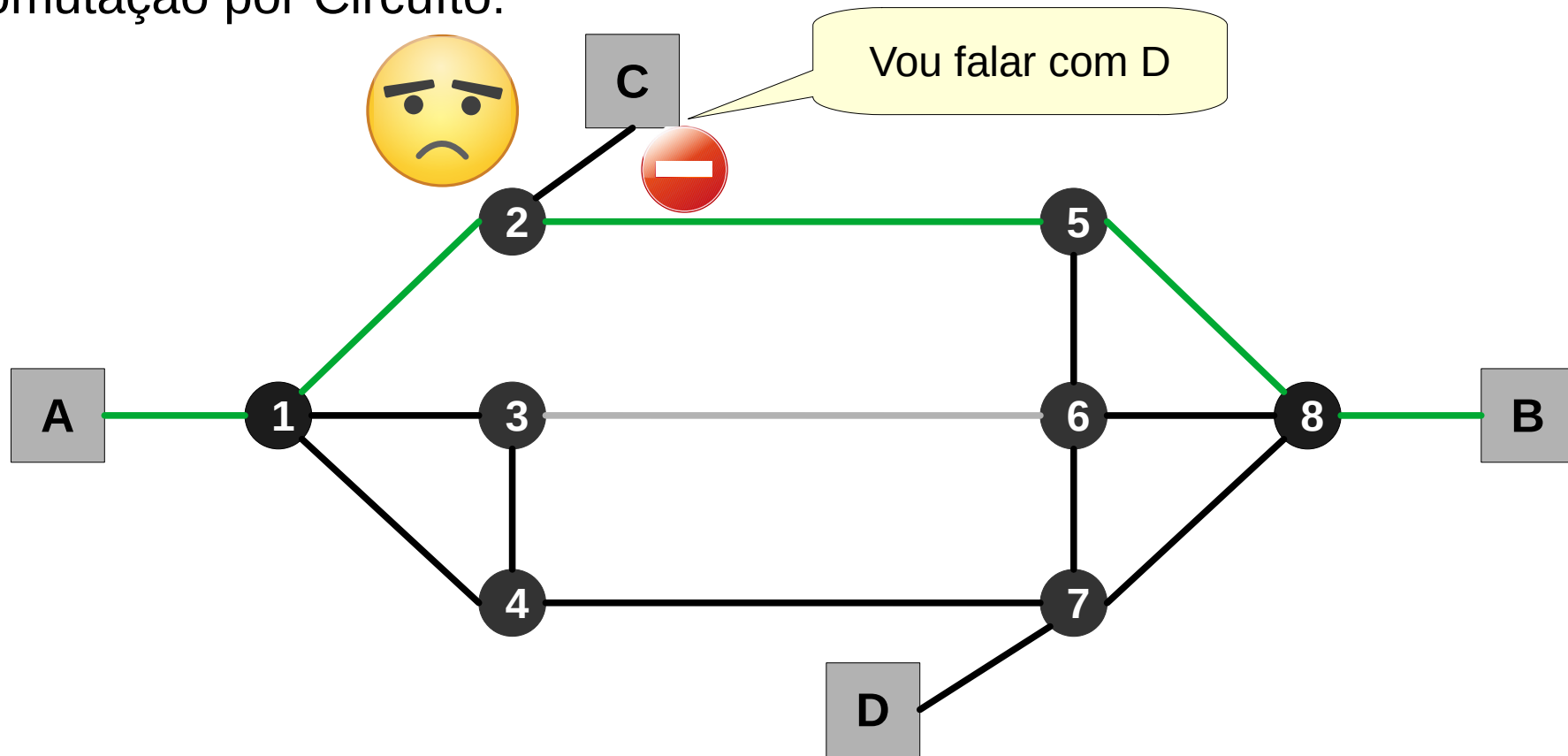
Comutação por Pacotes x Circuitos

Comutação por Circuito:



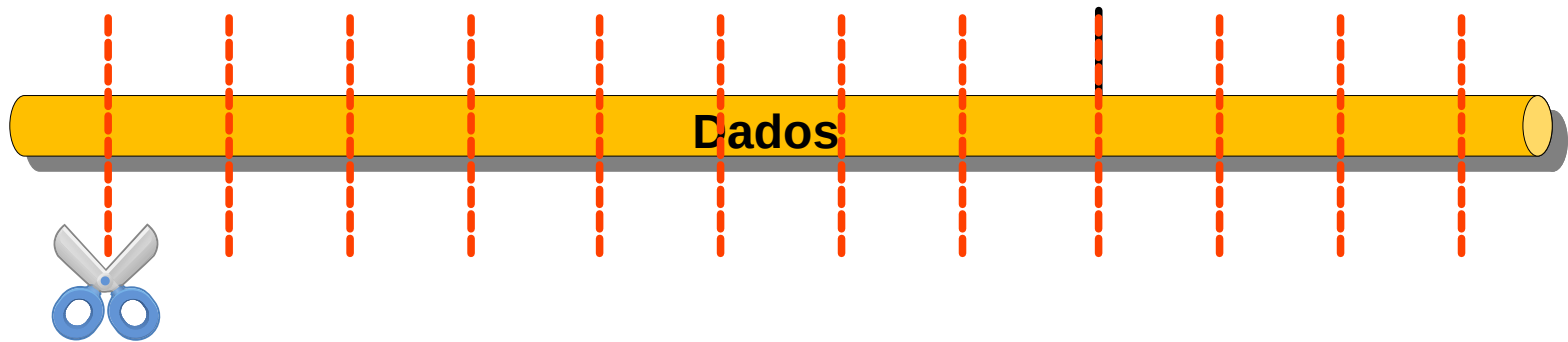
Comutação por Pacotes x Circuitos

Comutação por Circuito:



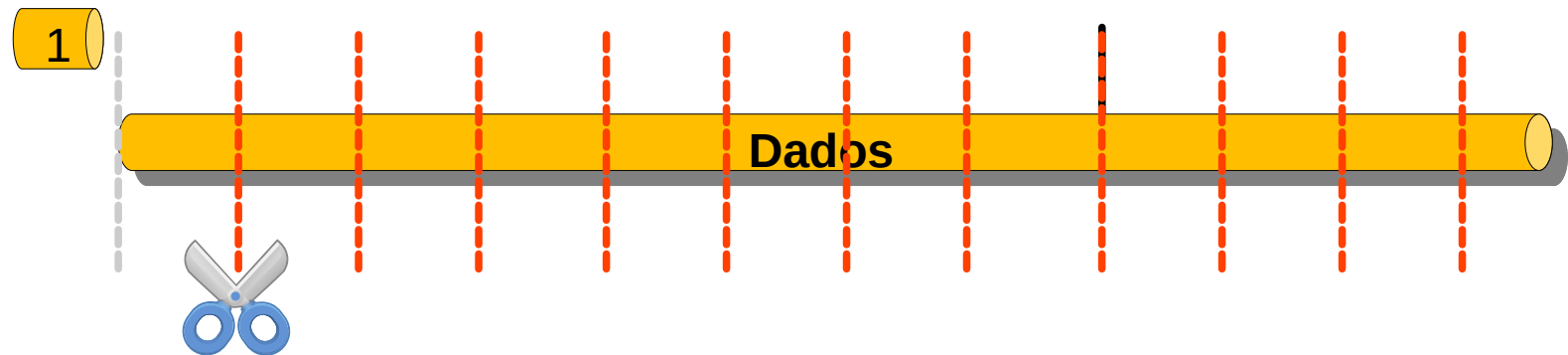
Comutação por Pacotes x Circuitos

Comutação por Pacotes:



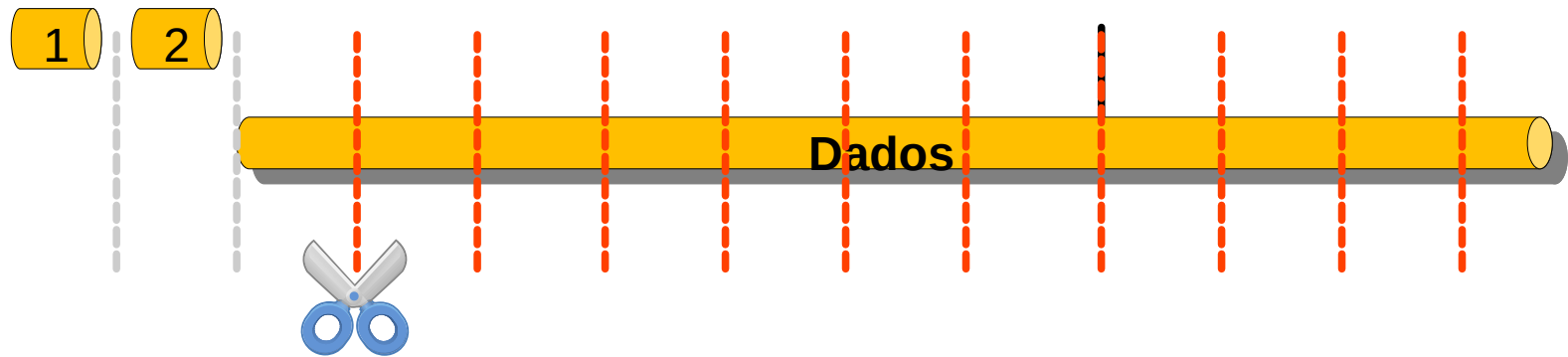
Comutação por Pacotes x Circuitos

Comutação por Pacotes:



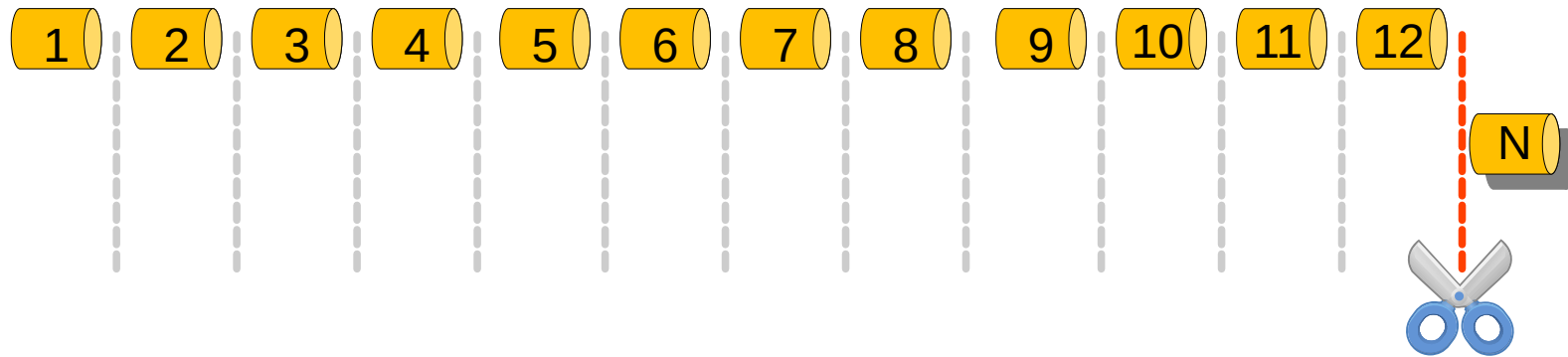
Comutação por Pacotes x Circuitos

Comutação por Pacotes:



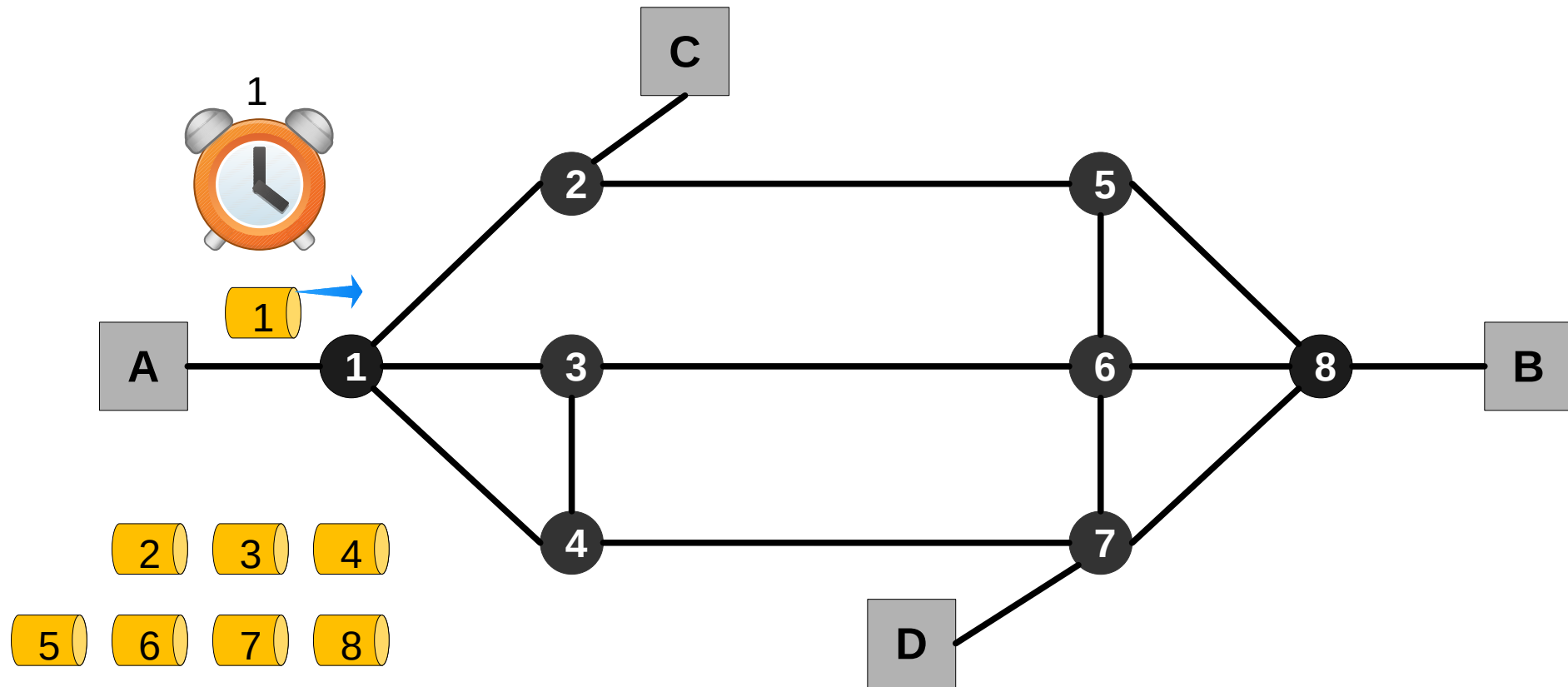
Comutação por Pacotes x Circuitos

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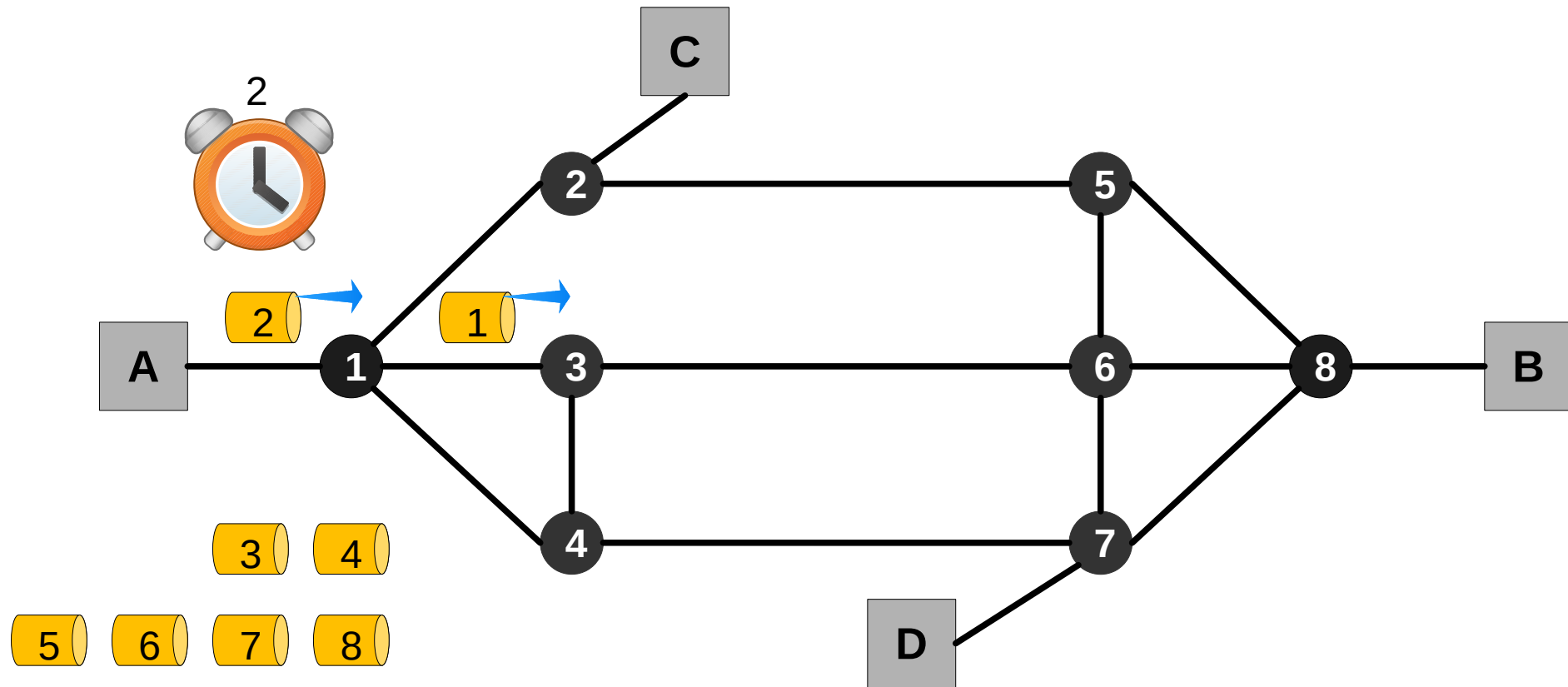
Comutação por Pacotes x Circuitos

Comutação por **Pacotes**:



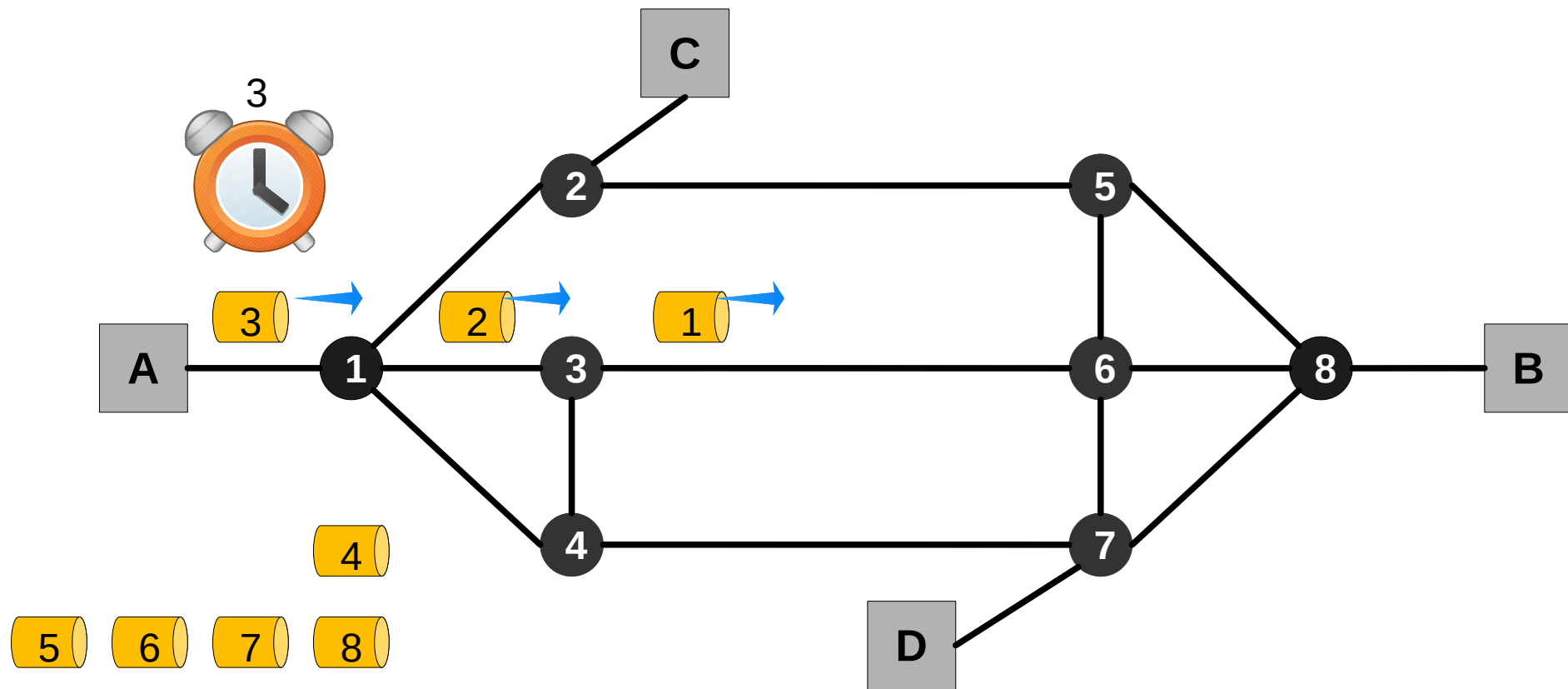
Comutação por Pacotes x Circuitos

Comutação por **Pacotes**:



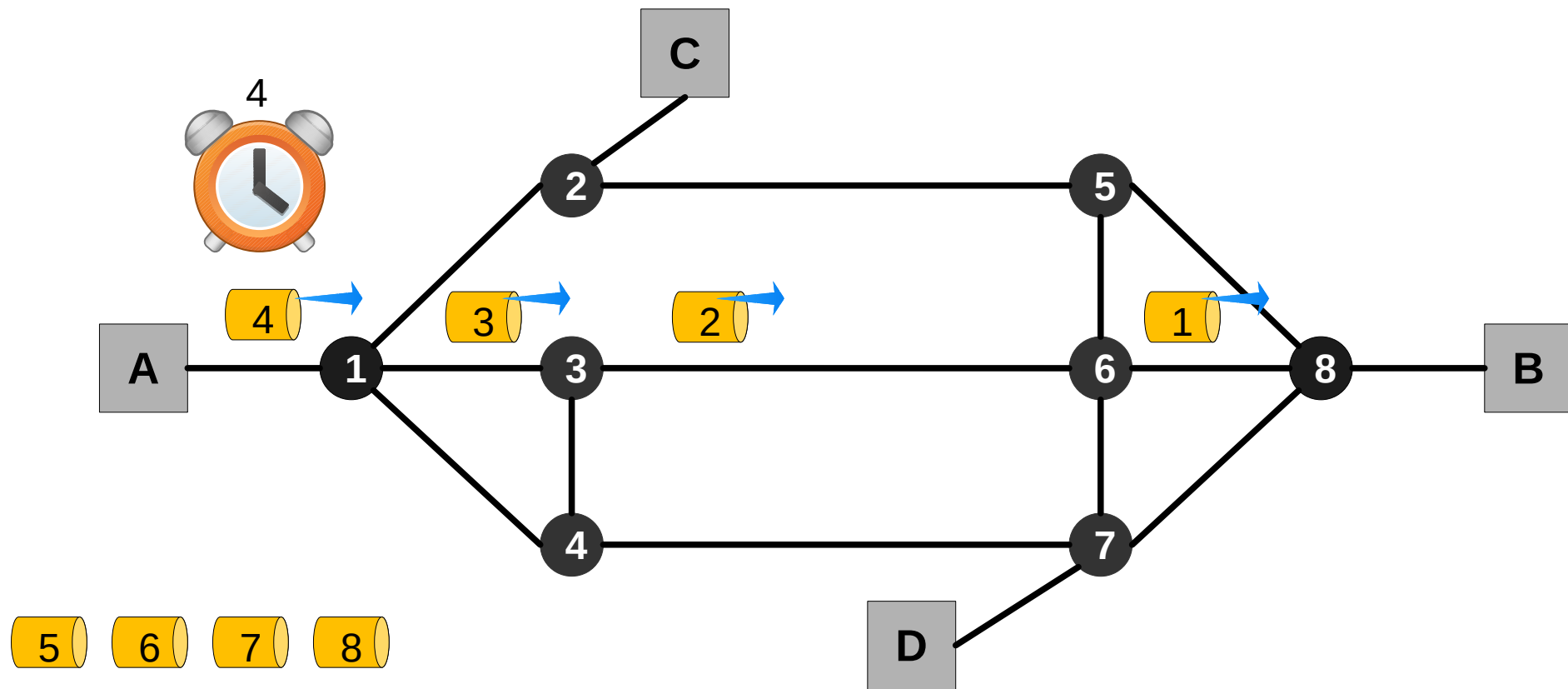
Comutação por Pacotes x Circuitos

Comutação por **Pacotes**:

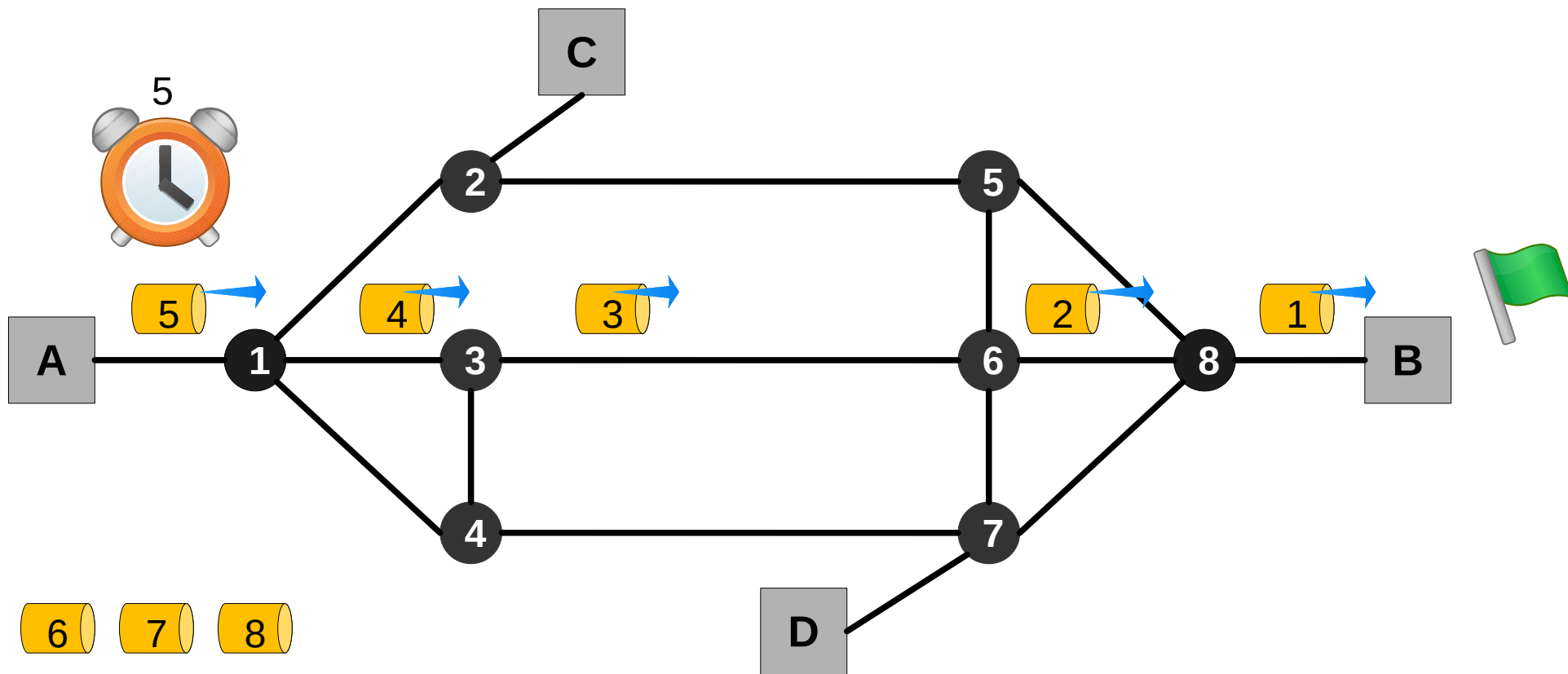


Comutação por Pacotes x Circuitos

Comutação por **Pacotes**:

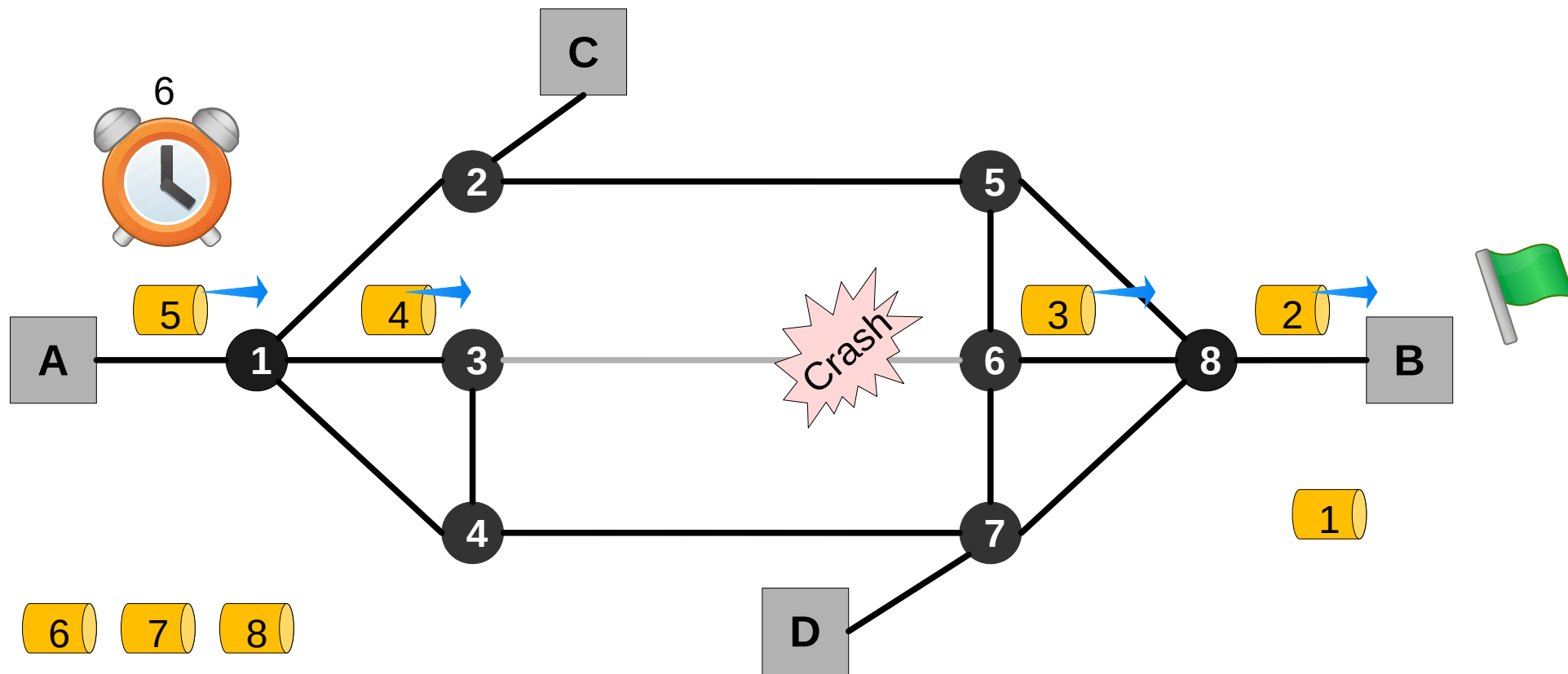


Comutação por Pacotes:



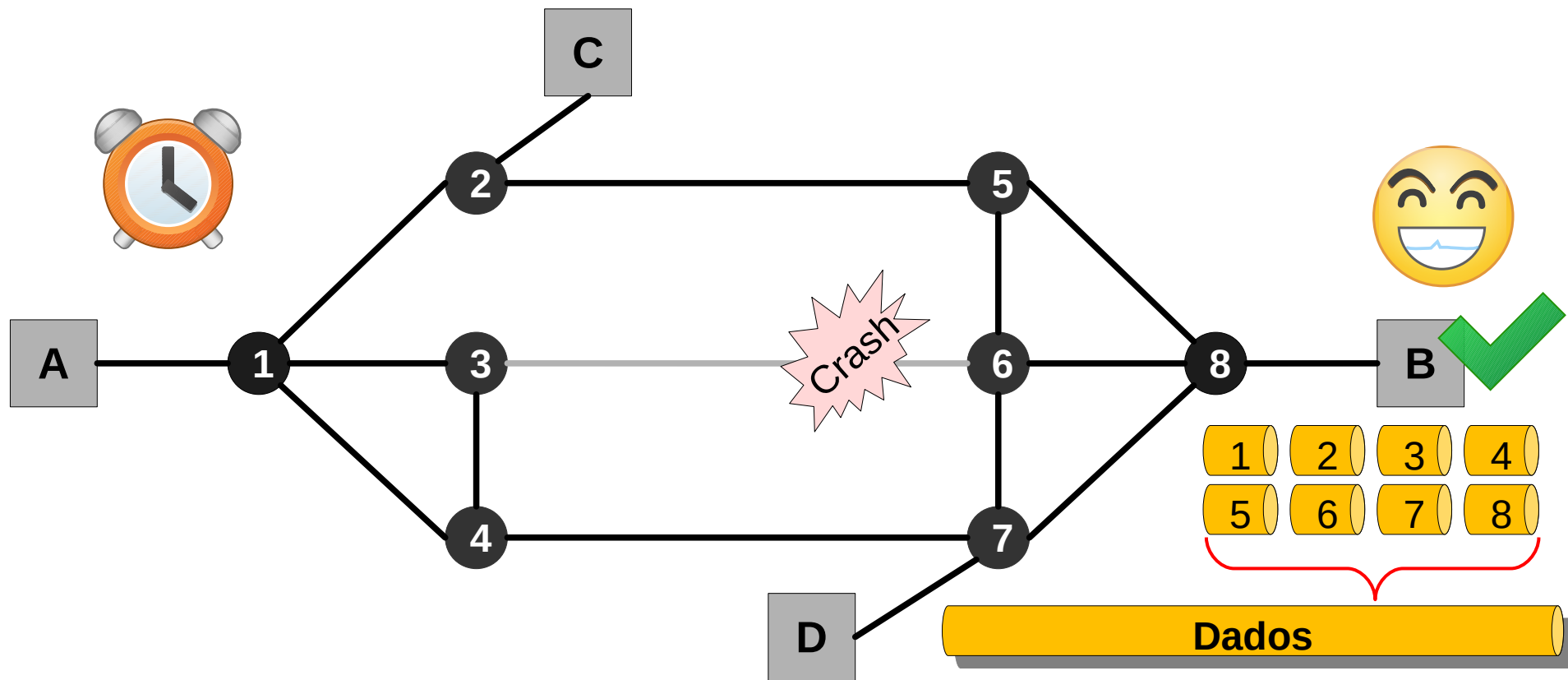
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Comutação por **Pacotes**:



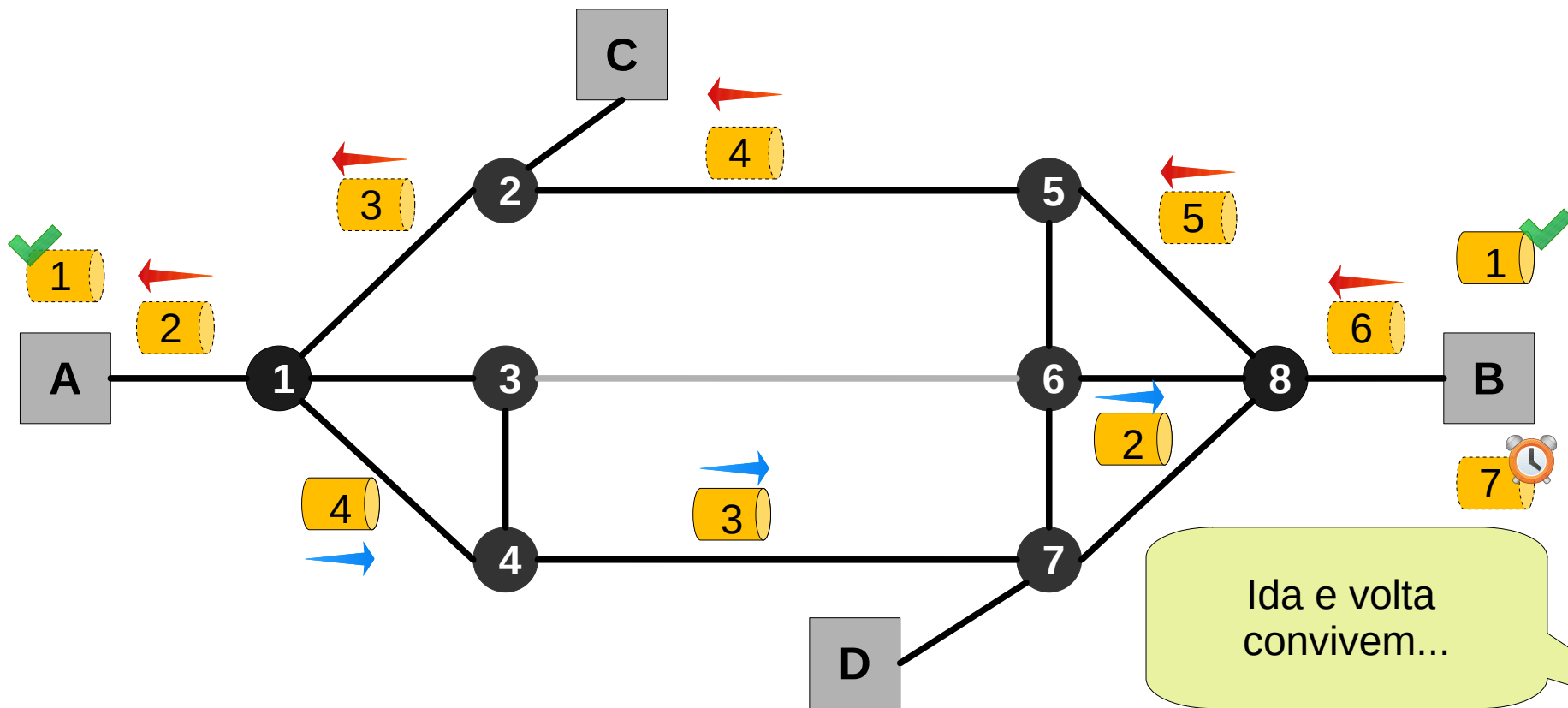
Comutação por Pacotes x Circuitos

Comutação por **Pacotes**:



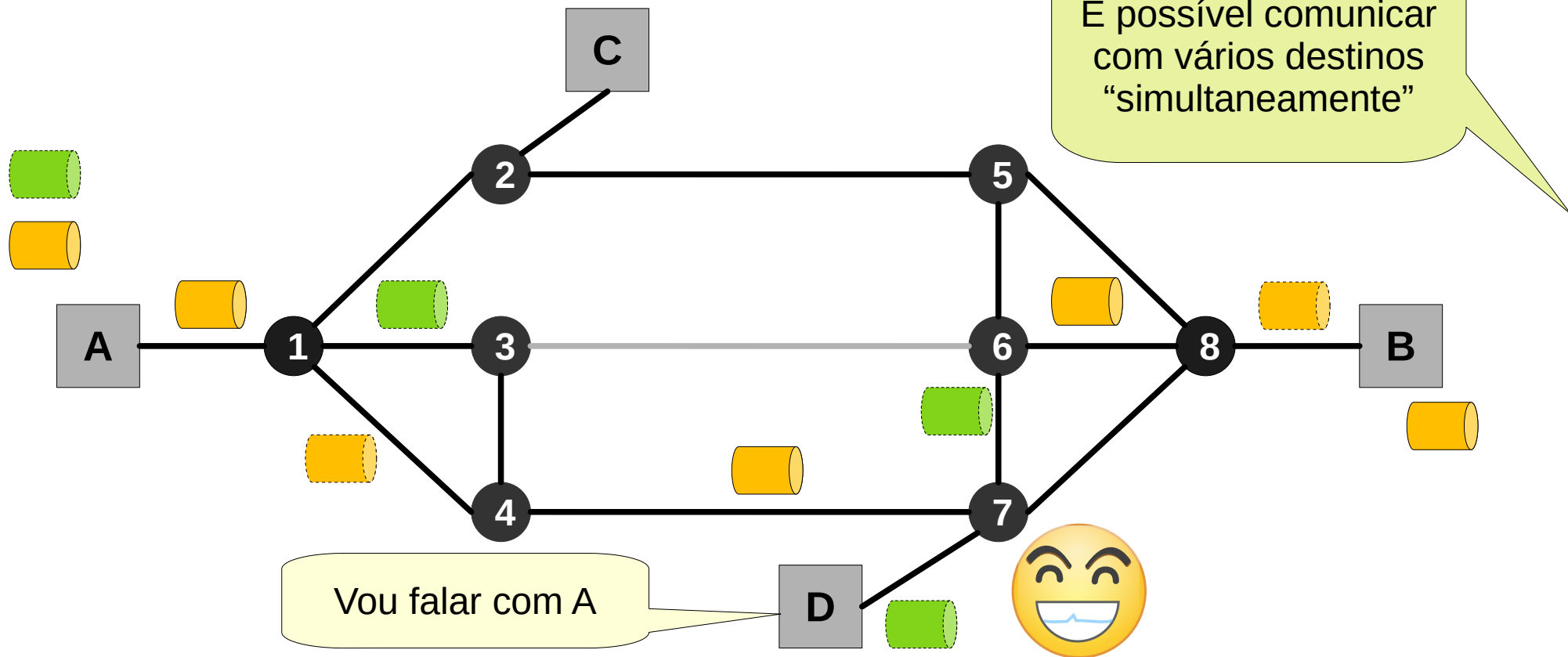
Comutação por Pacotes x Circuitos

Comutação por **Pacotes**:



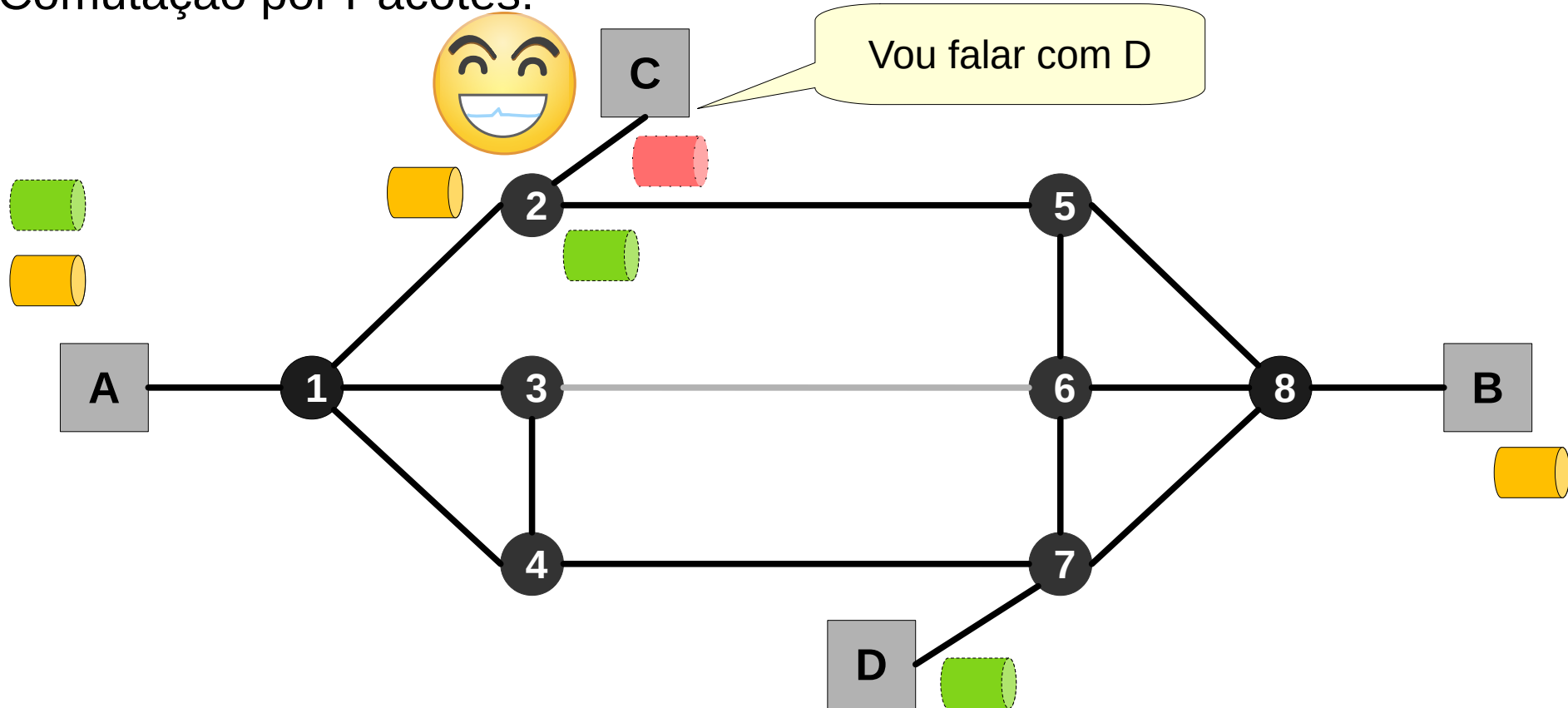
Comutação por Pacotes x Circuitos

Comutação por Pacotes:



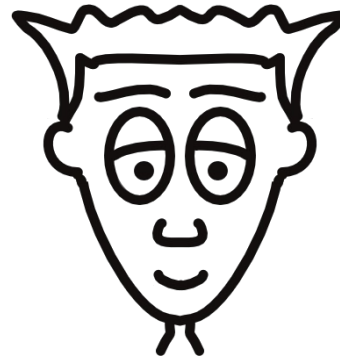
Comutação por Pacotes x Circuitos

Comutação por Pacotes:



Camada de Enlace

Entendi... comutação por pacote é muito melhor!!!



Camada de Enlace

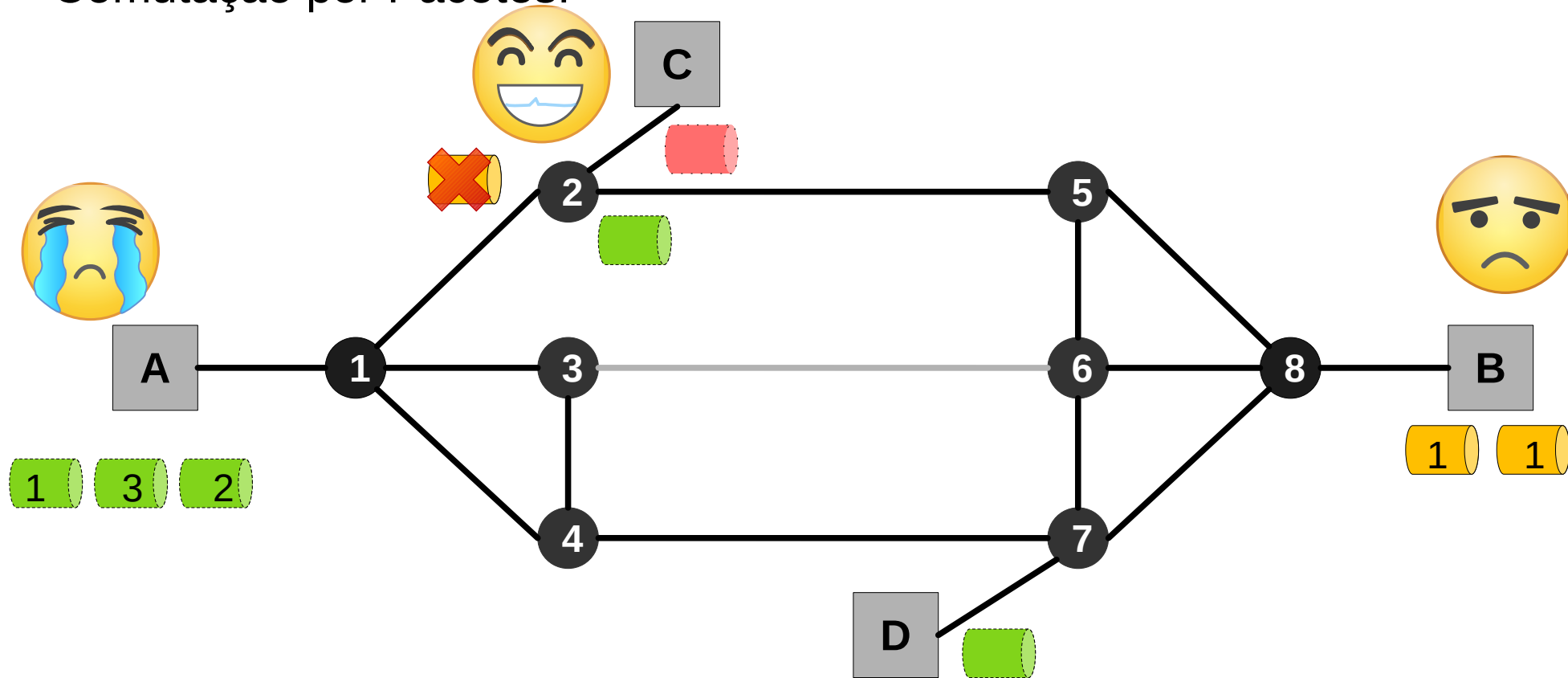
Entendi... comutação por pacote é muito melhor!!!



Tudo na vida tem vantagens e desvantagens!

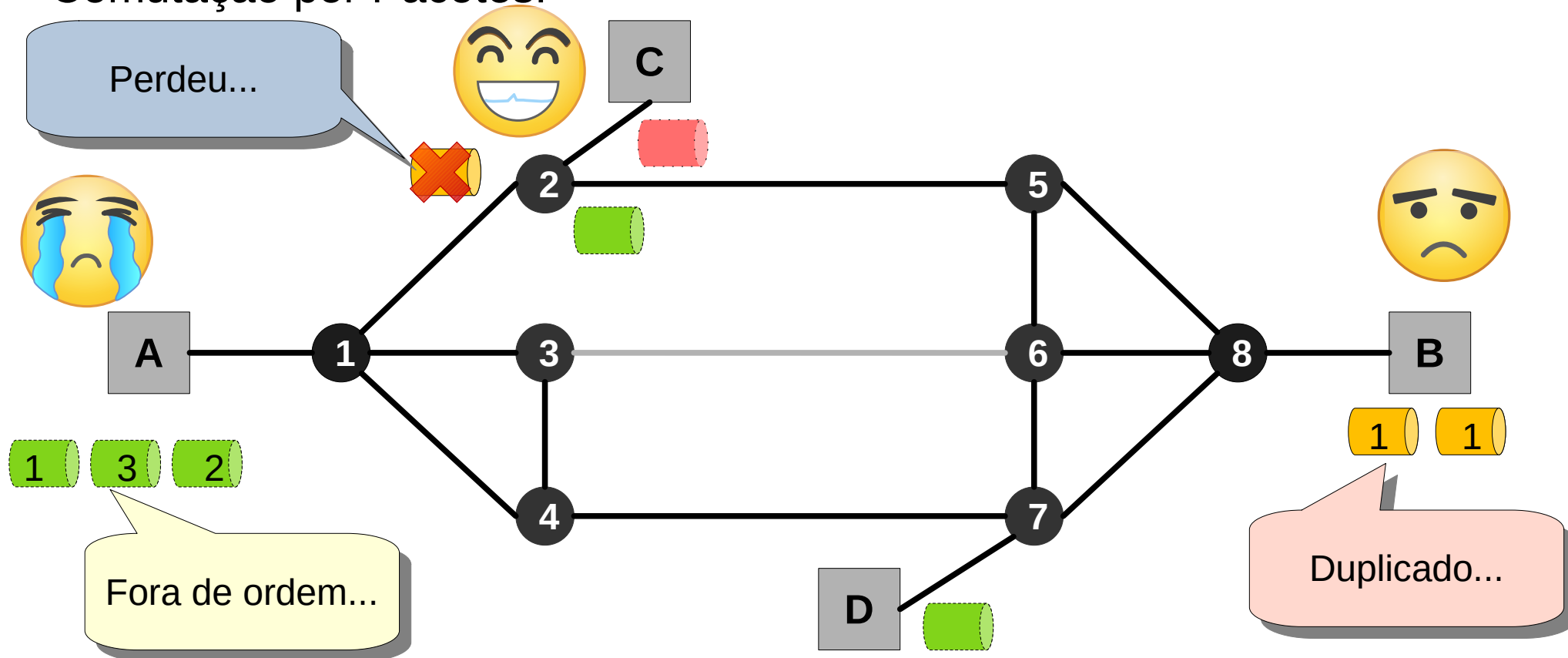
Comutação por Pacotes x Circuitos

Comutação por Pacotes:



Comutação por Pacotes x Circuitos

Comutação por Pacotes:

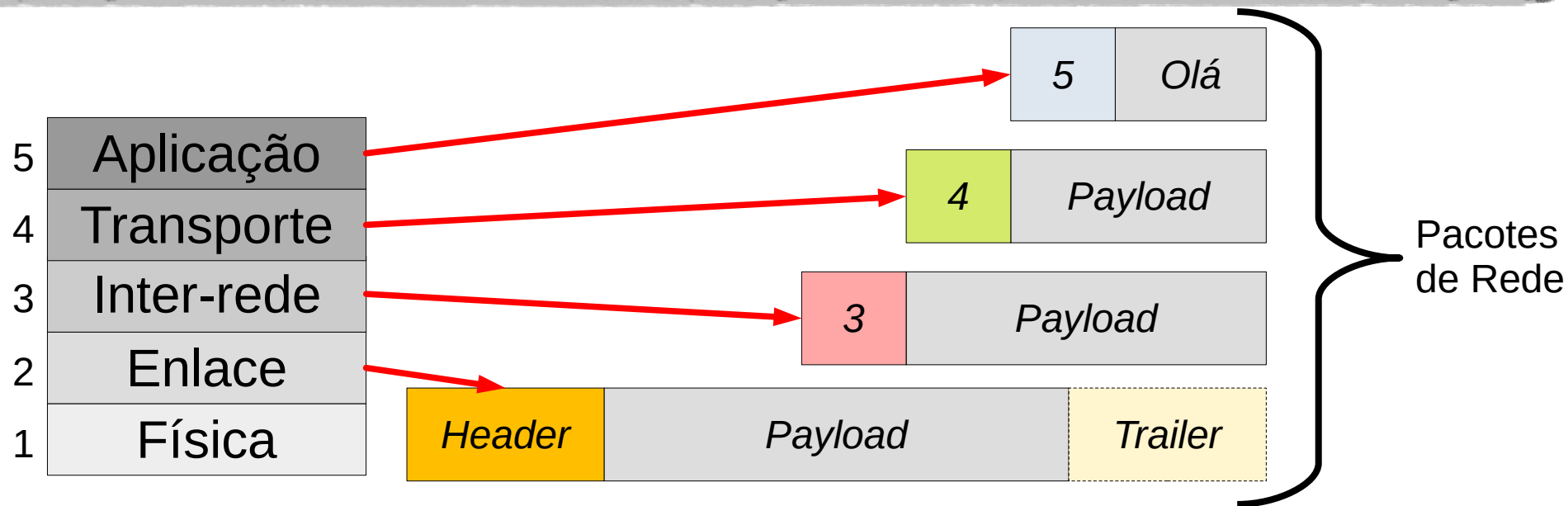


Camada de Enlace

Okay, tanto comutação por pacotes quanto circuito possui **vantagens e vantagens**, mas **redes de computadores** normalmente **utilizam comutação por pacotes!**



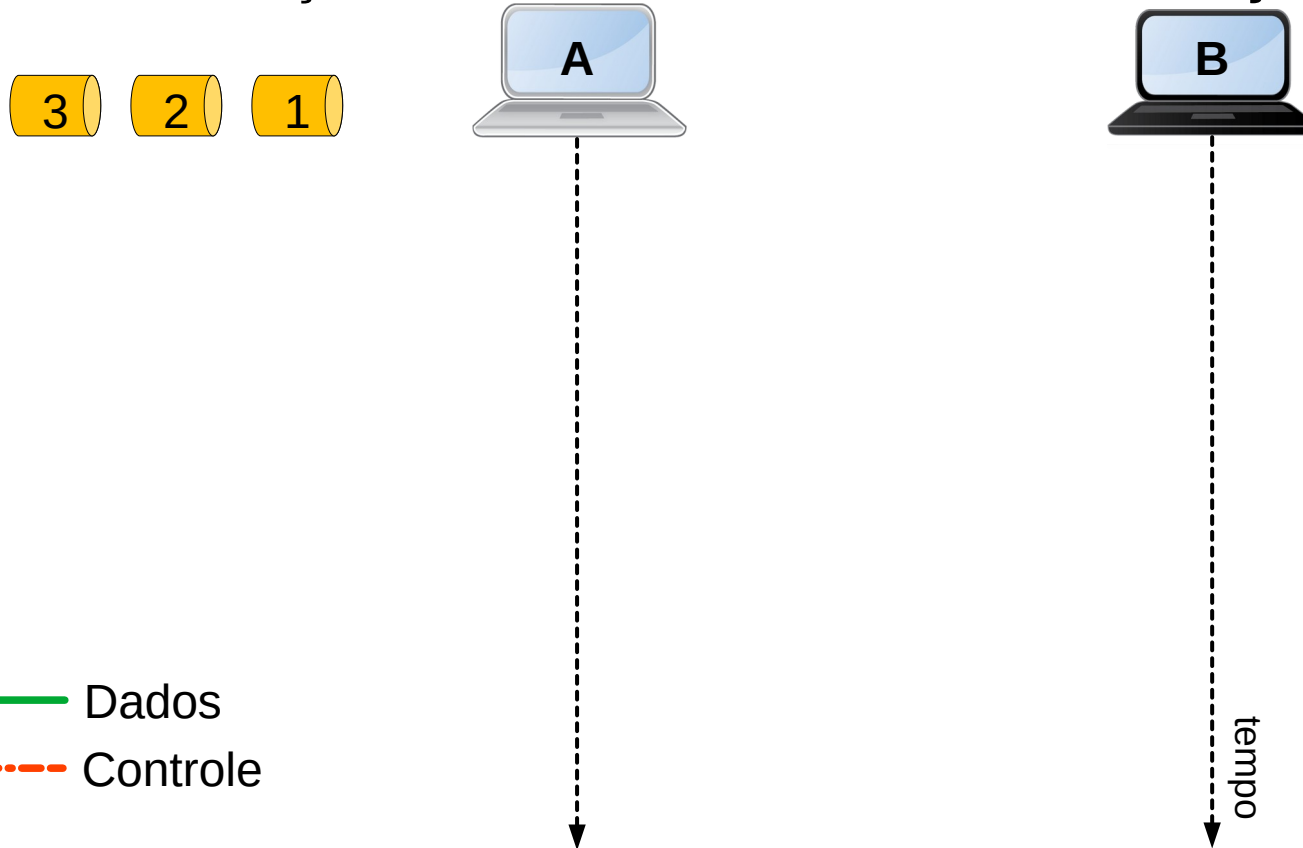
Camada de Enlace



Por isso podemos chamar a informação em qualquer camada de pacote de rede...

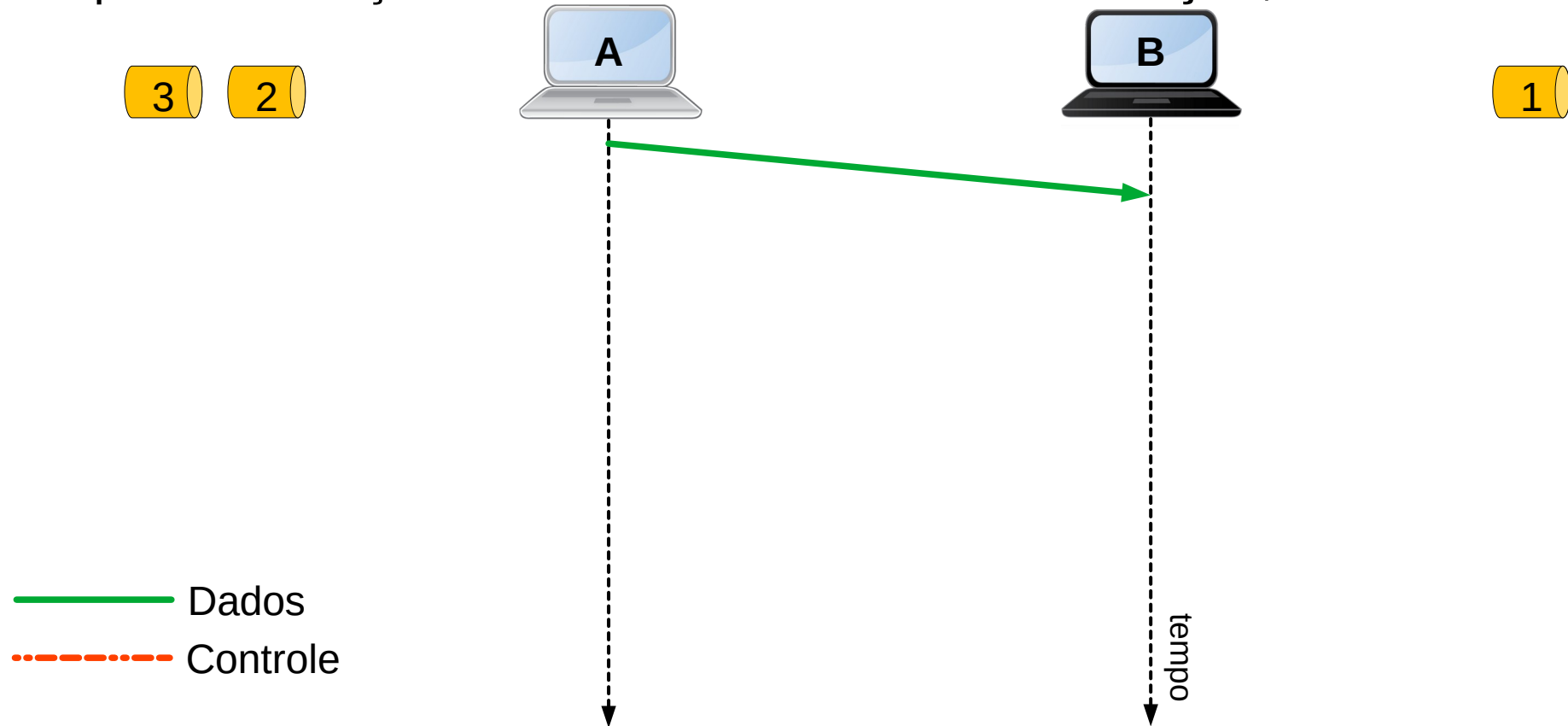
Camada de Enlace

Tipos de serviços: **Sem conexão e sem confirmação;**



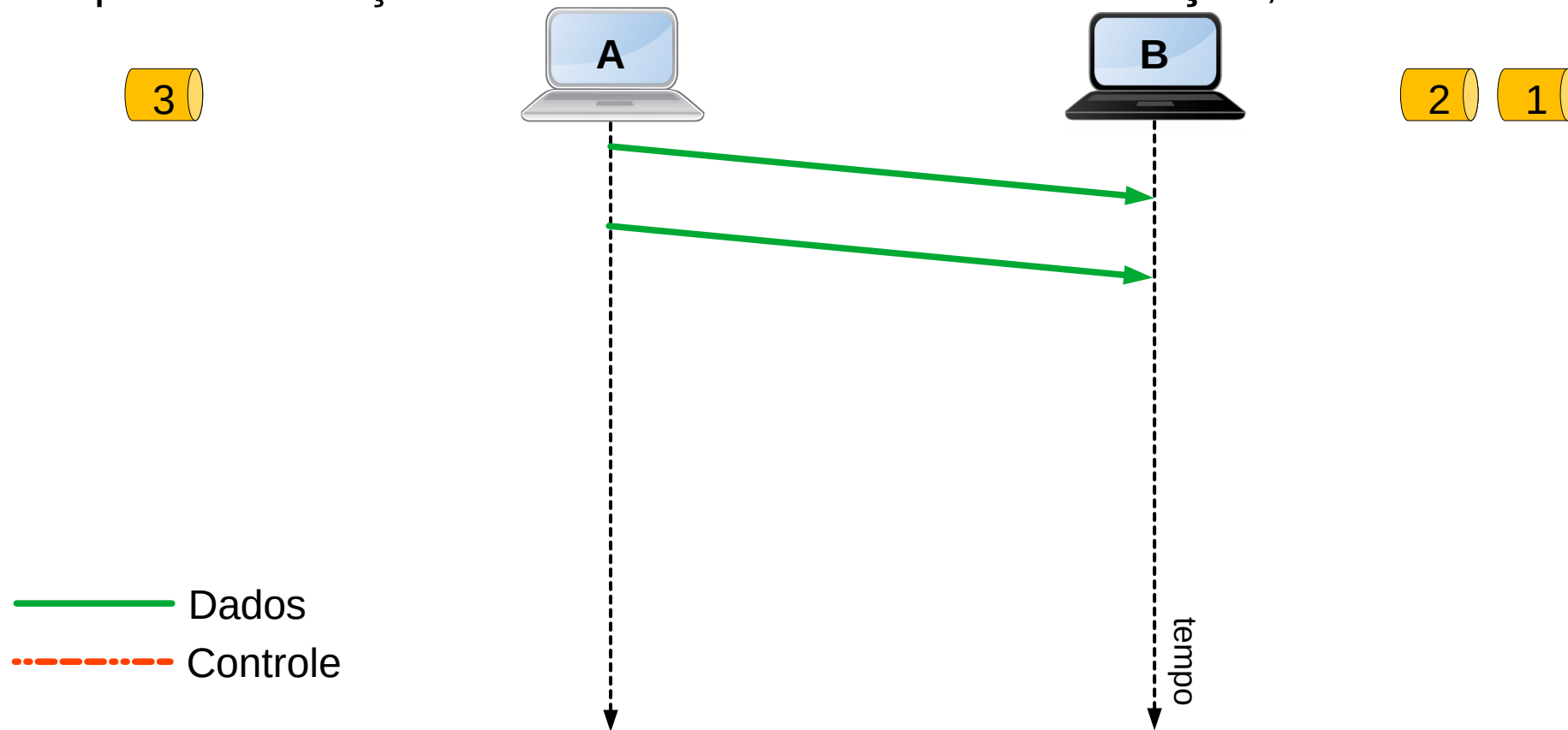
Camada de Enlace

Tipos de serviços: **Sem conexão e sem confirmação;**



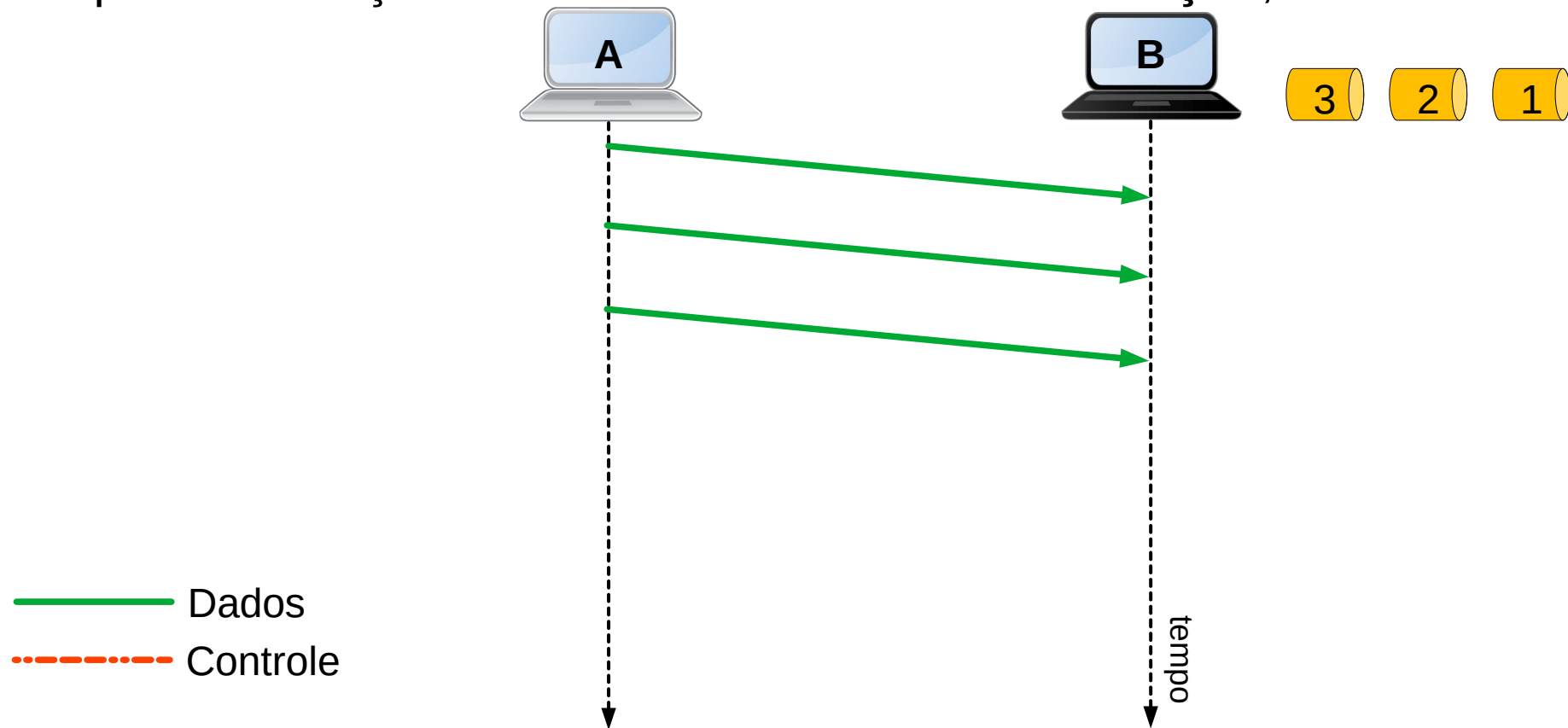
Camada de Enlace

Tipos de serviços: **Sem conexão e sem confirmação;**



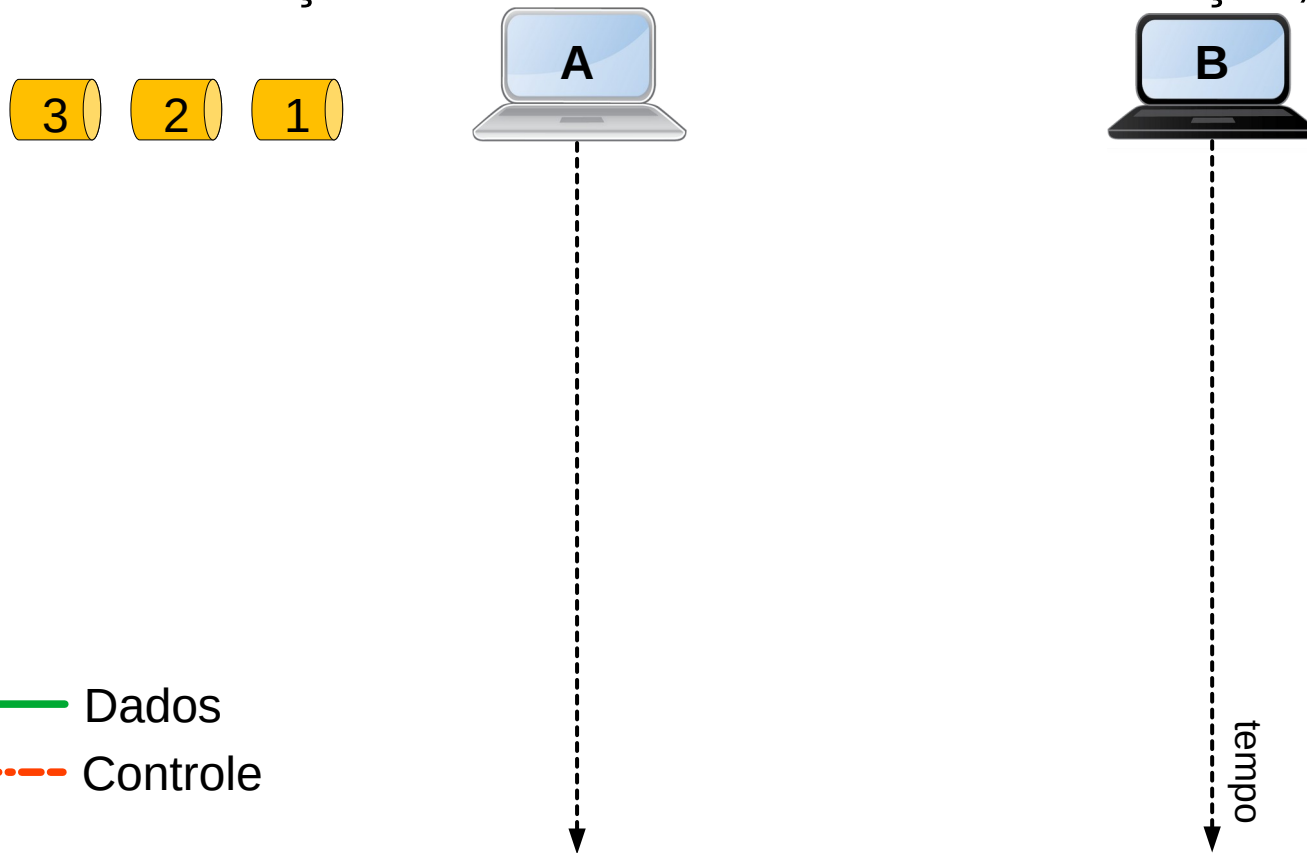
Camada de Enlace

Tipos de serviços: **Sem conexão e sem confirmação;**



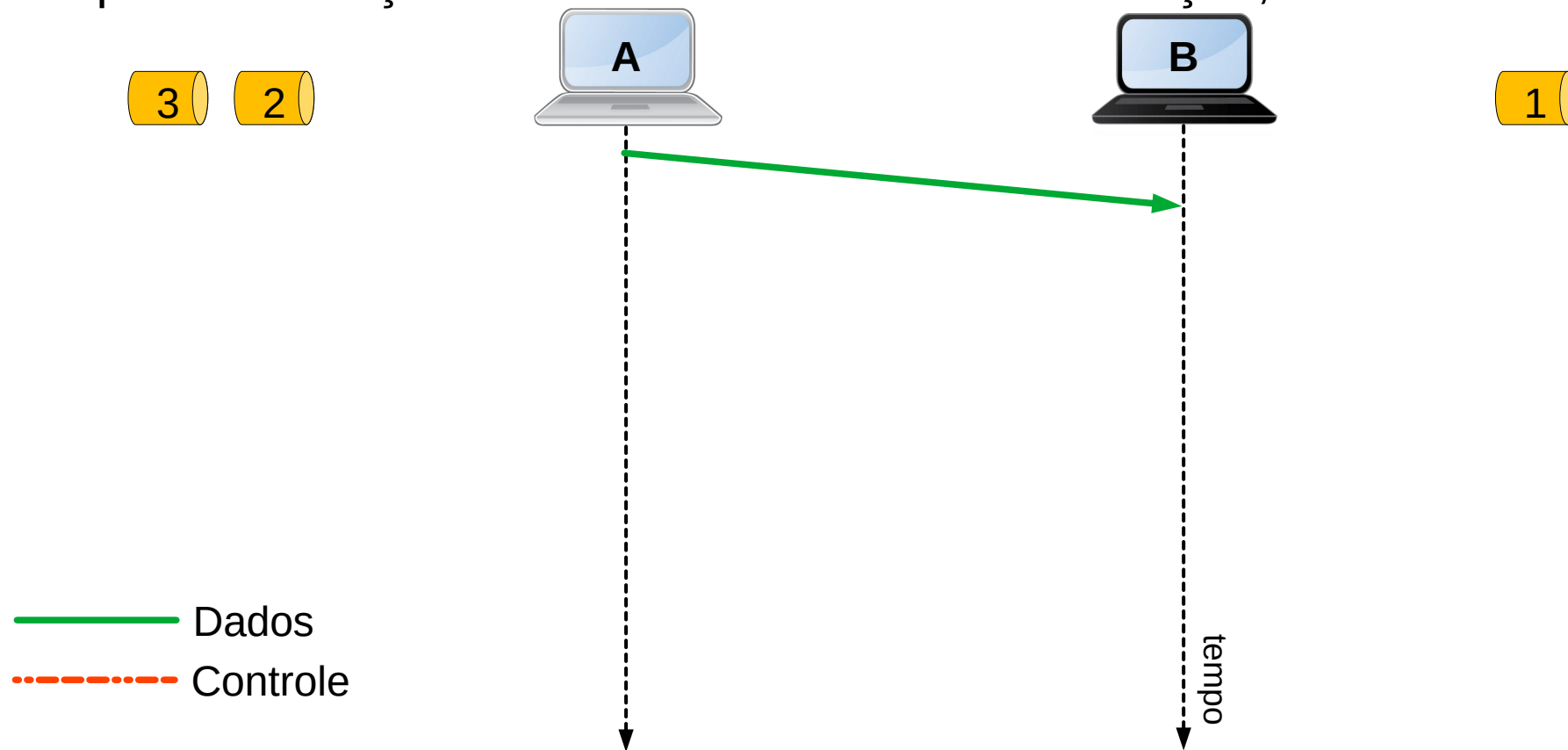
Camada de Enlace

Tipos de serviços: Sem conexão e **com** confirmação;



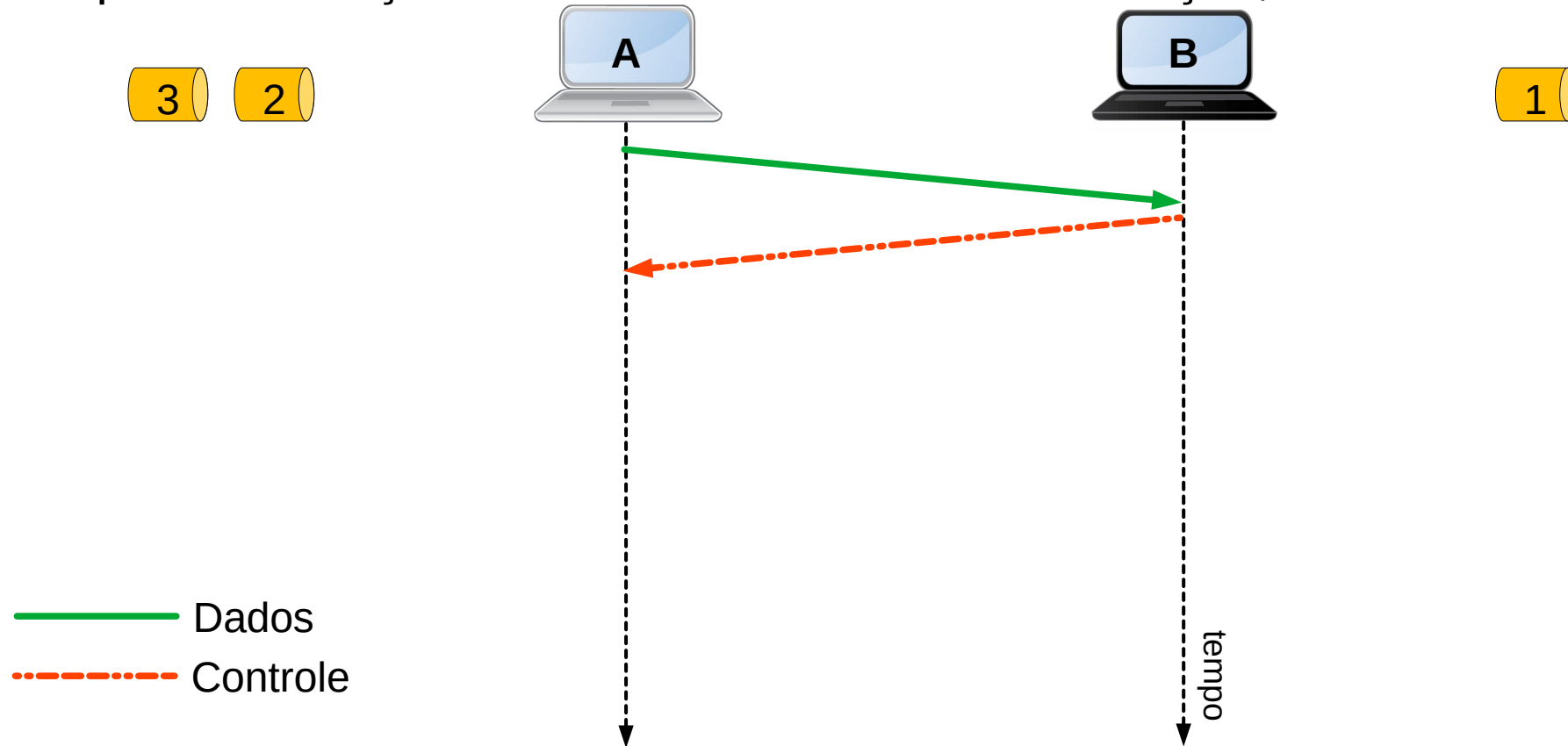
Camada de Enlace

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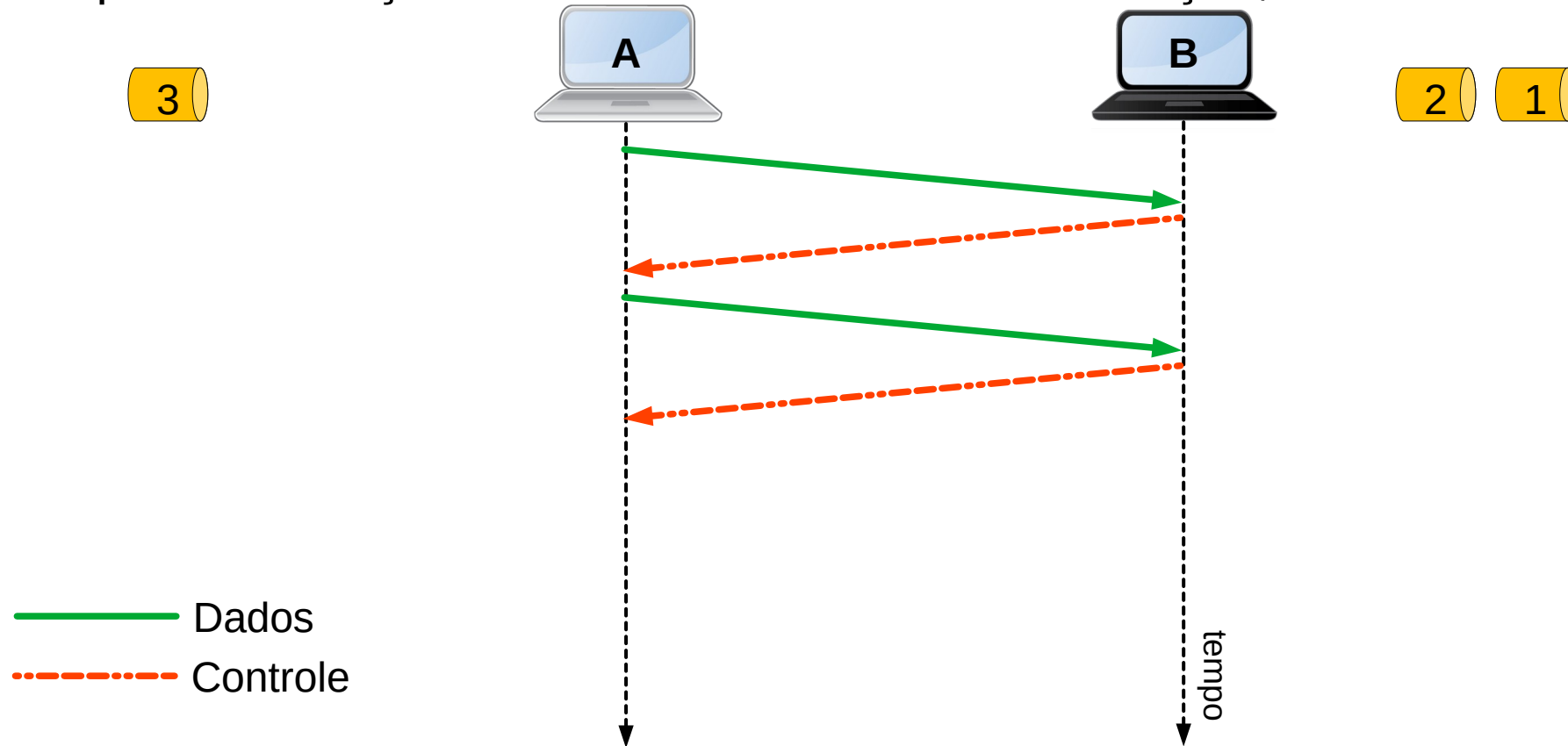
Camada de Enlace

Tipos de serviços: Sem conexão e **com** confirmação;



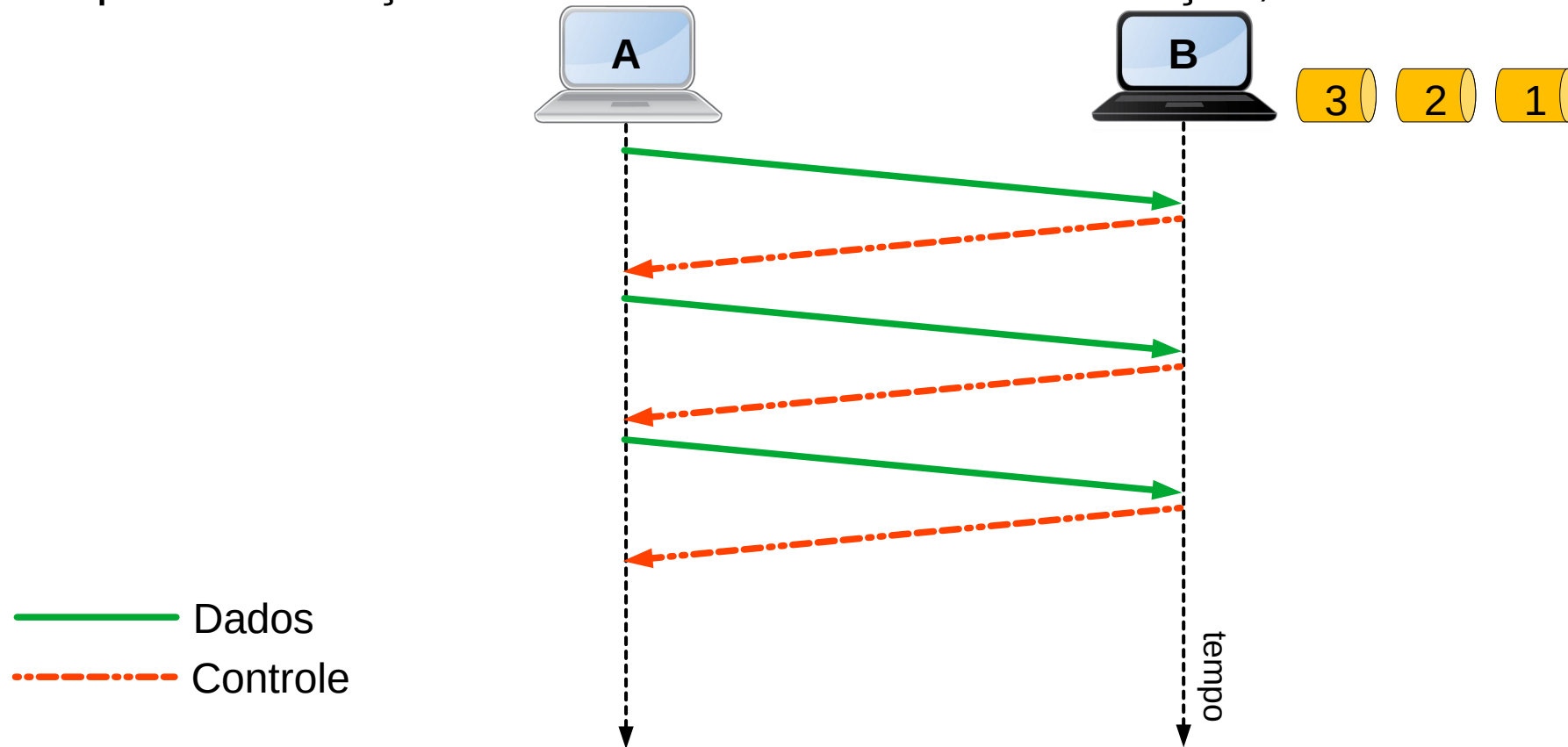
Camada de Enlace

Tipos de serviços: Sem conexão e **com** confirmação;



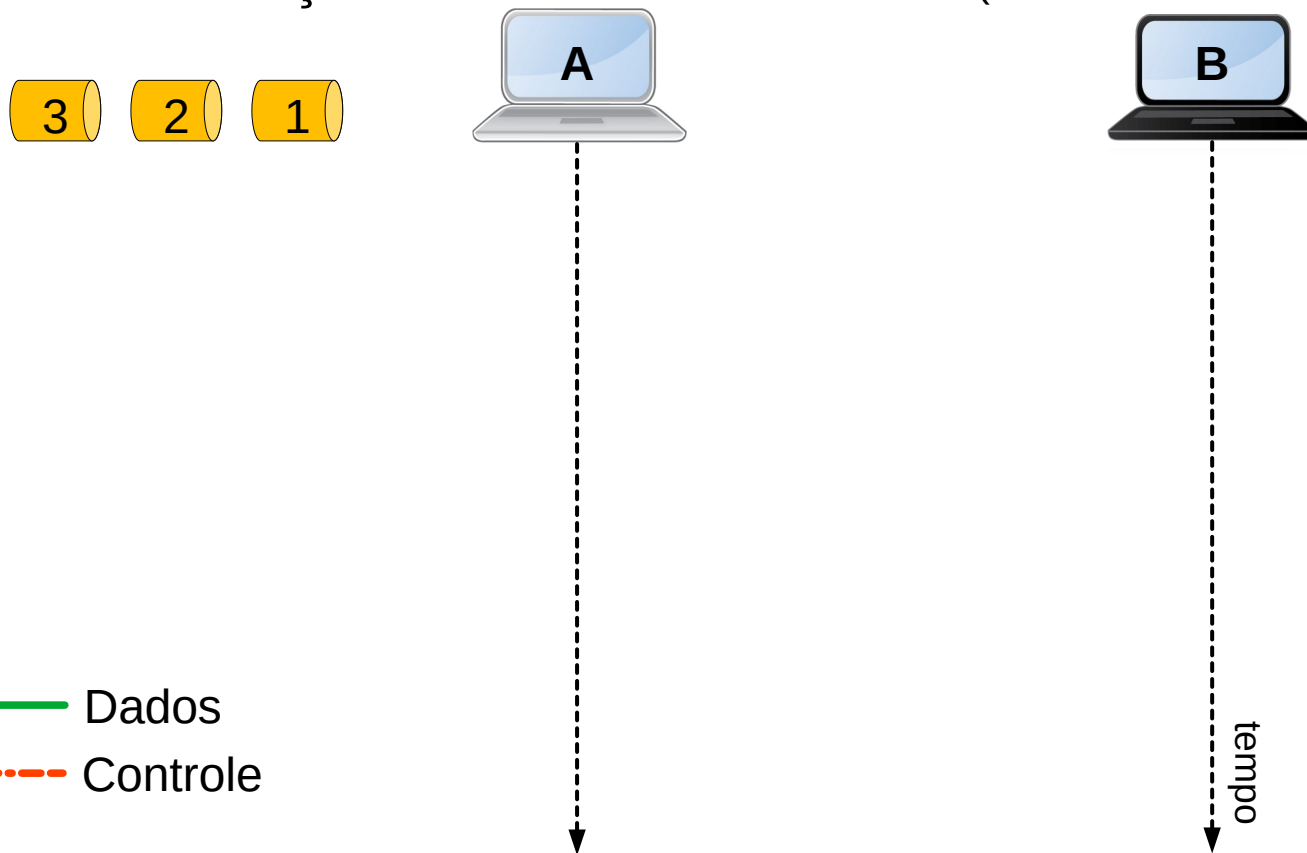
Camada de Enlace

Tipos de serviços: Sem conexão e **com** confirmação;



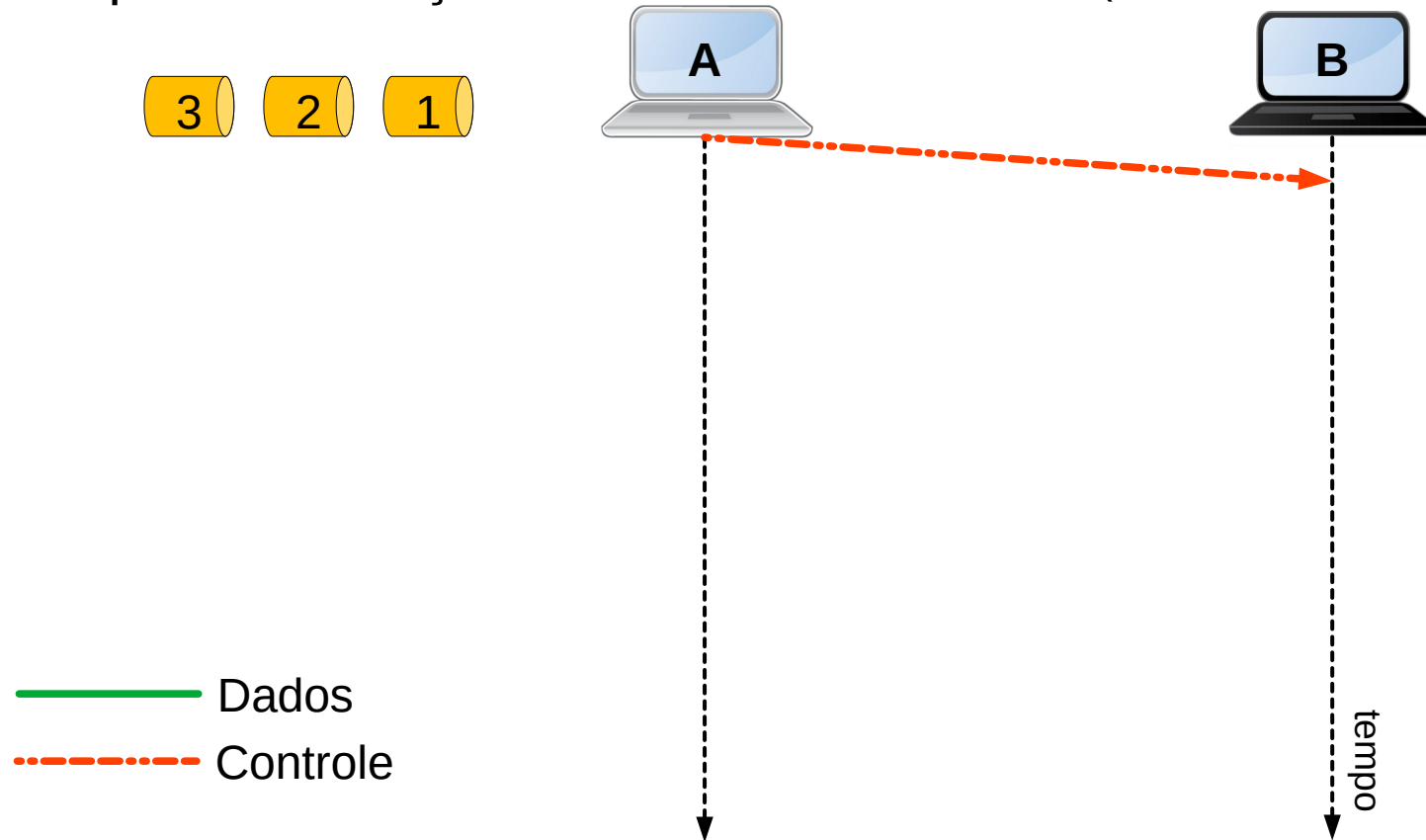
Camada de Enlace

Tipos de serviços: Orientado à conexão (com conexão e com confirmação);



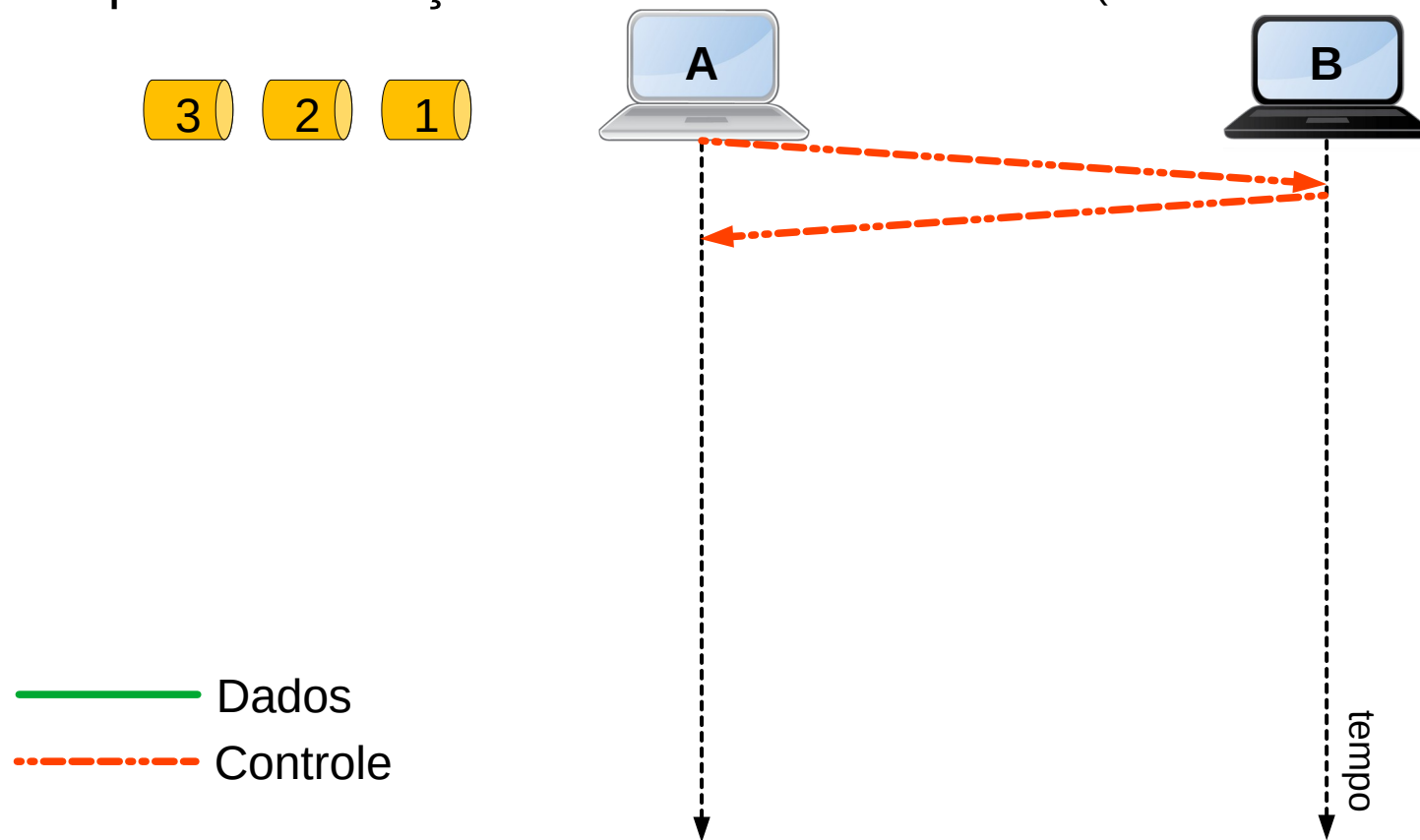
Camada de Enlace

Tipos de serviços: Orientado à conexão (com conexão e com confirmação);



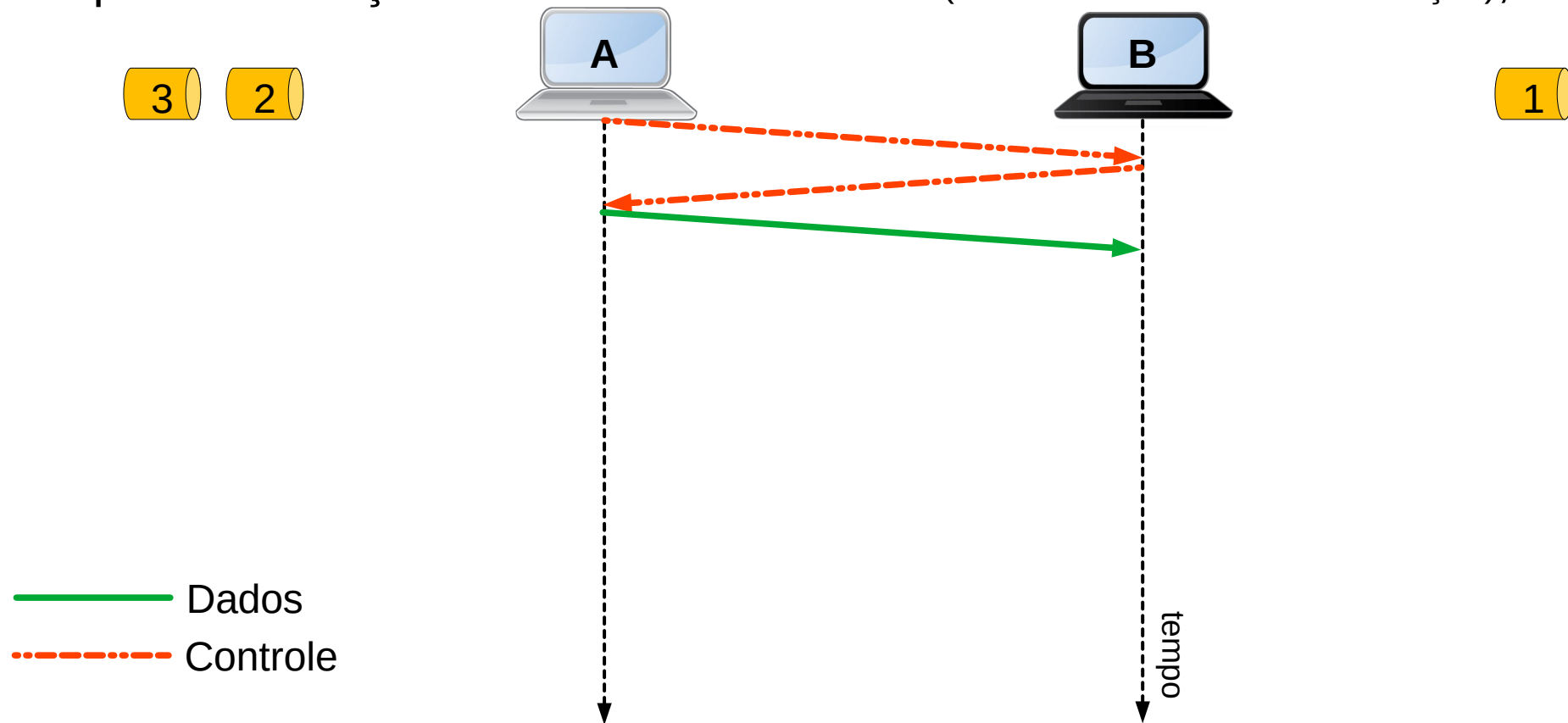
Camada de Enlace

Tipos de serviços: Orientado à conexão (com conexão e com confirmação);



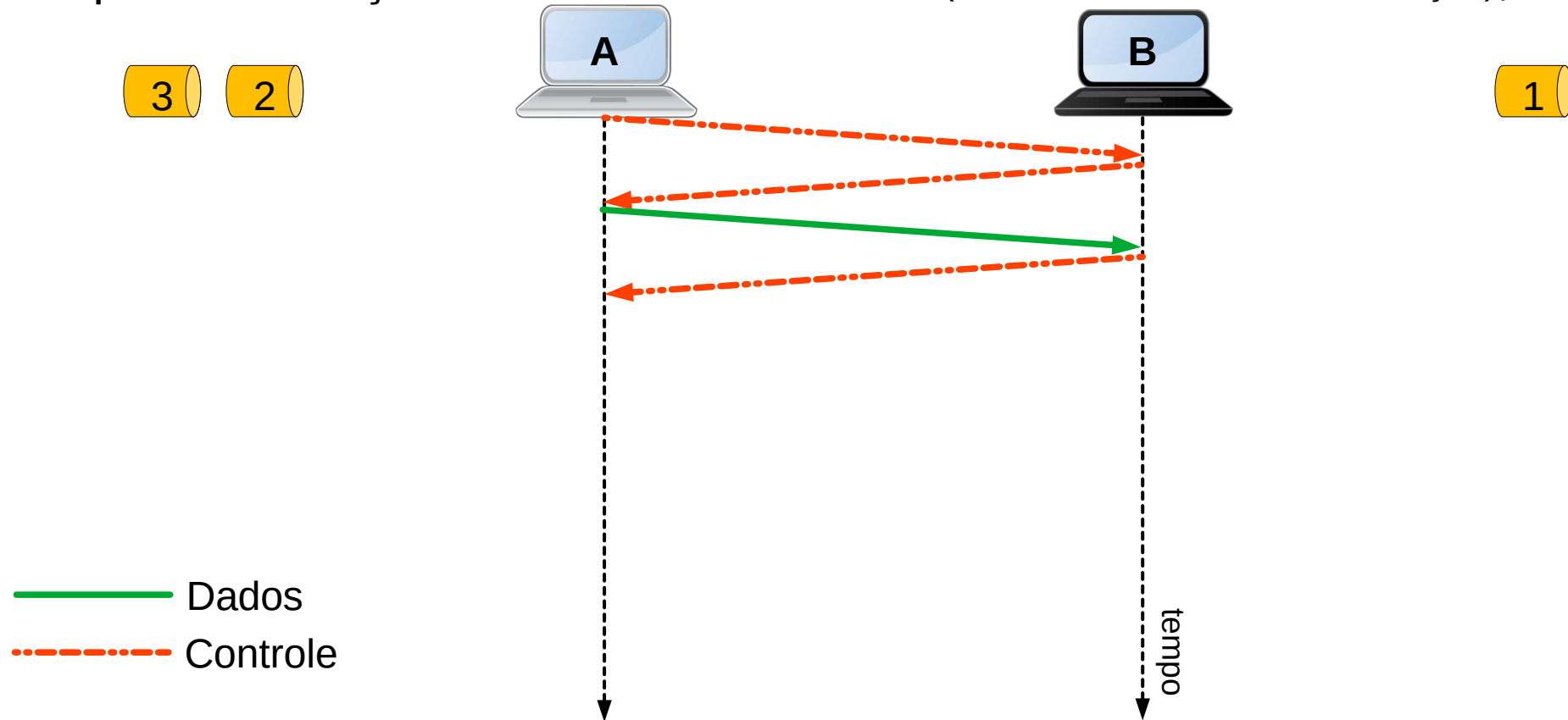
Camada de Enlace

Tipos de serviços: Orientado à conexão (com conexão e com confirmação);



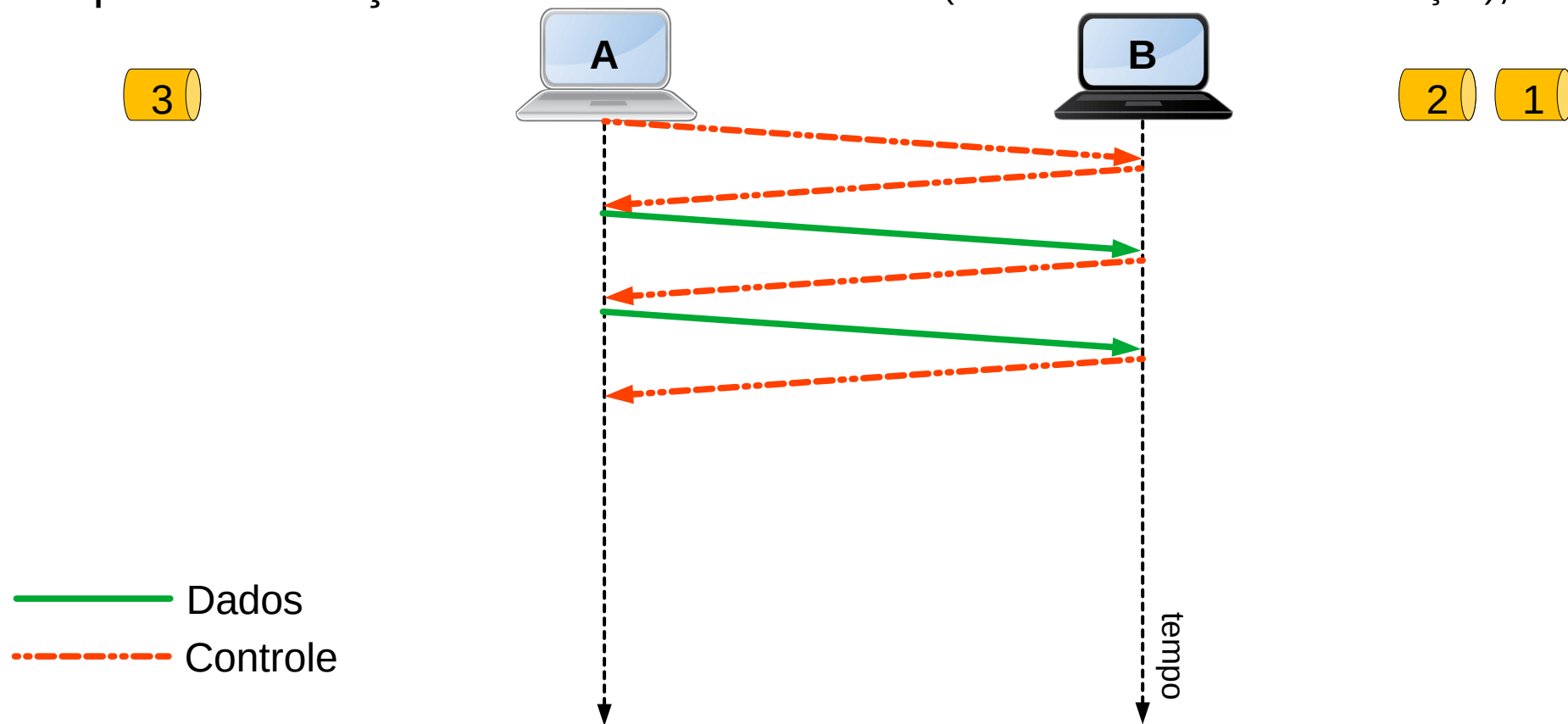
Camada de Enlace

Tipos de serviços: Orientado à conexão (com conexão e com confirmação);



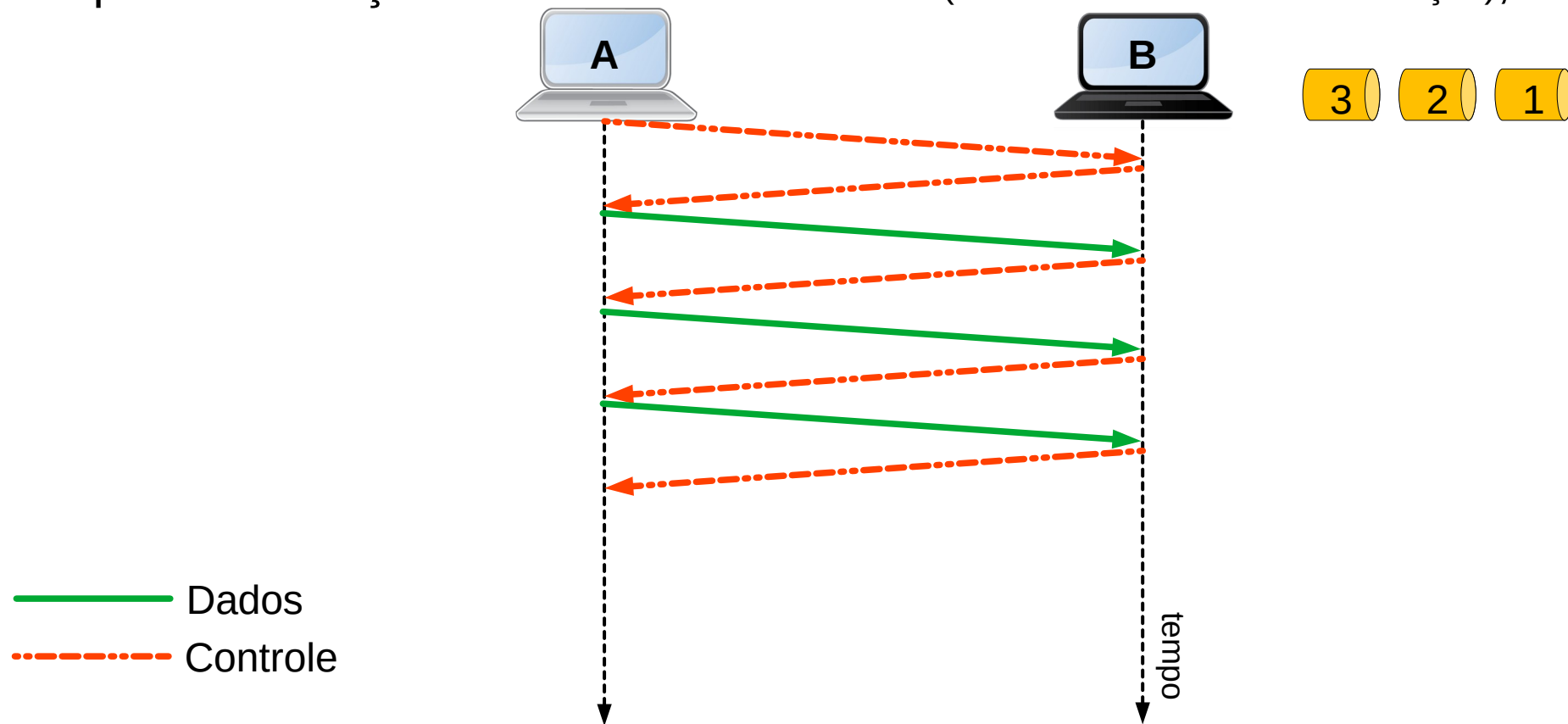
Camada de Enlace

Tipos de serviços: Orientado à conexão (com conexão e com confirmação);



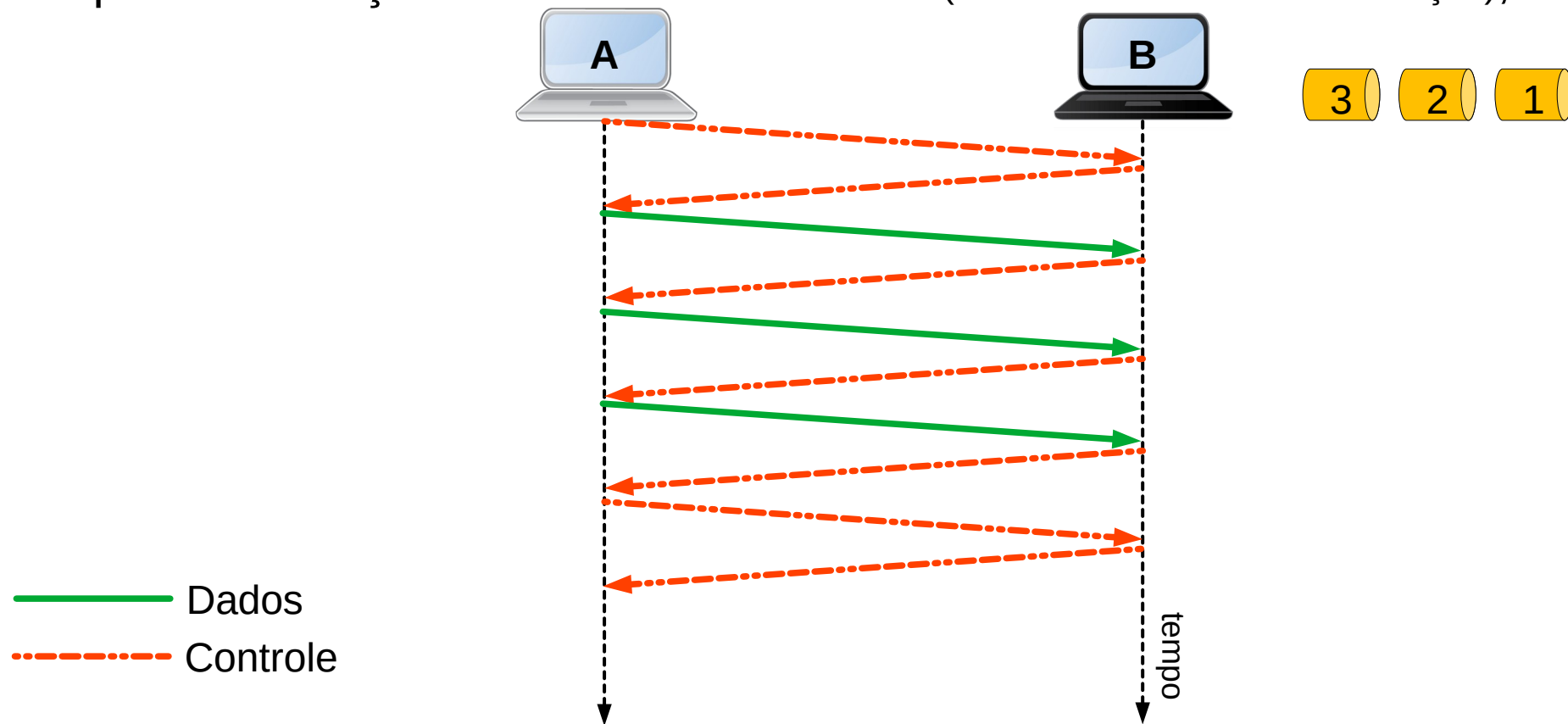
Camada de Enlace

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Camada de Enlace

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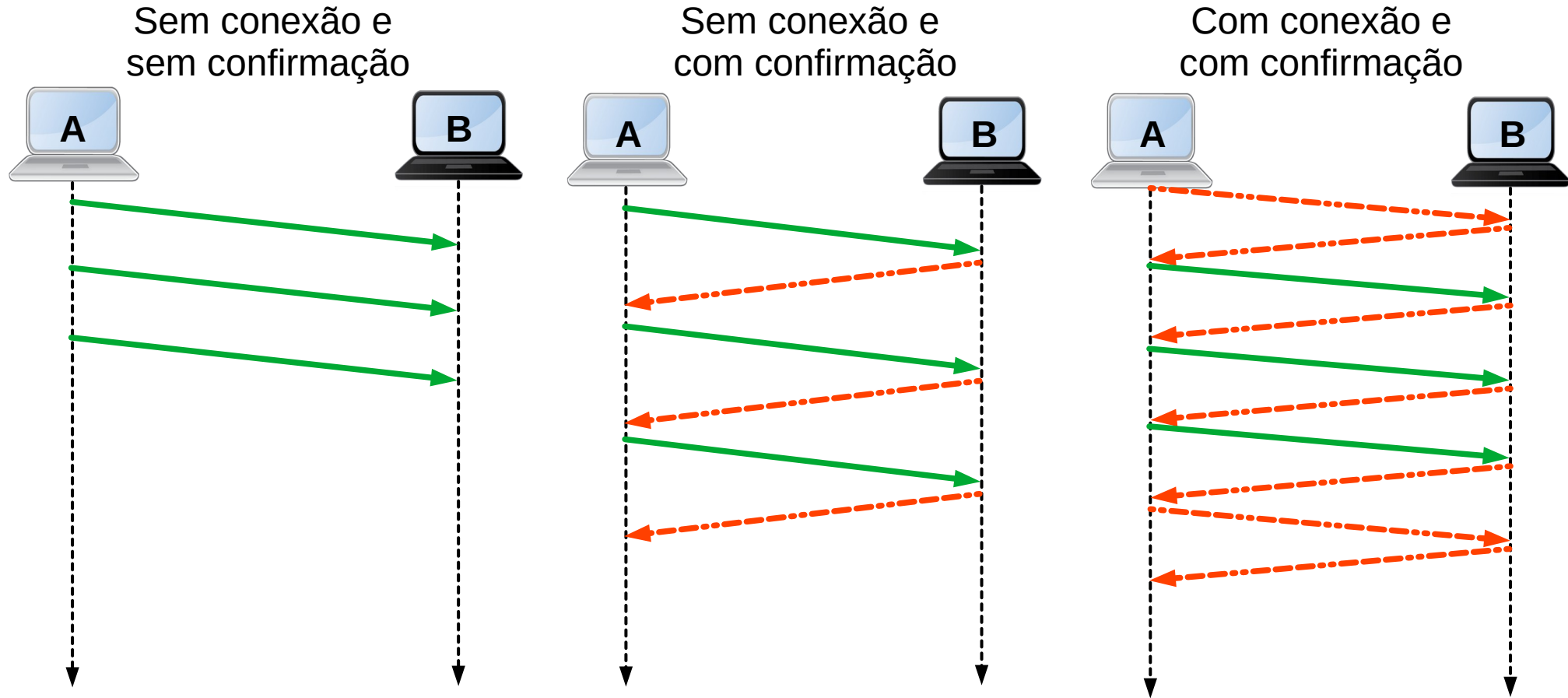


Camada de Enlace

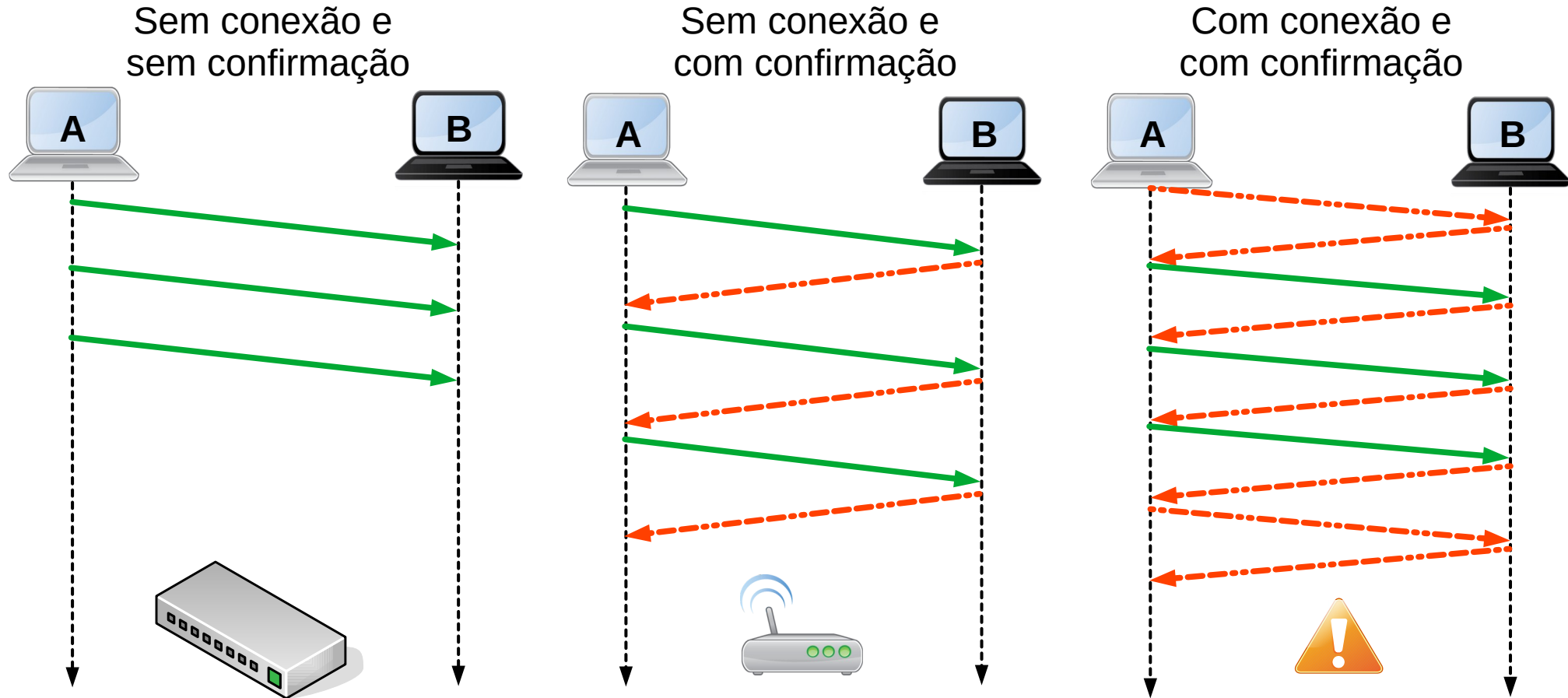
Qual é o método mais utilizado? (vantagens/desvantagens)



Camada de Enlace



Camada de Enlace



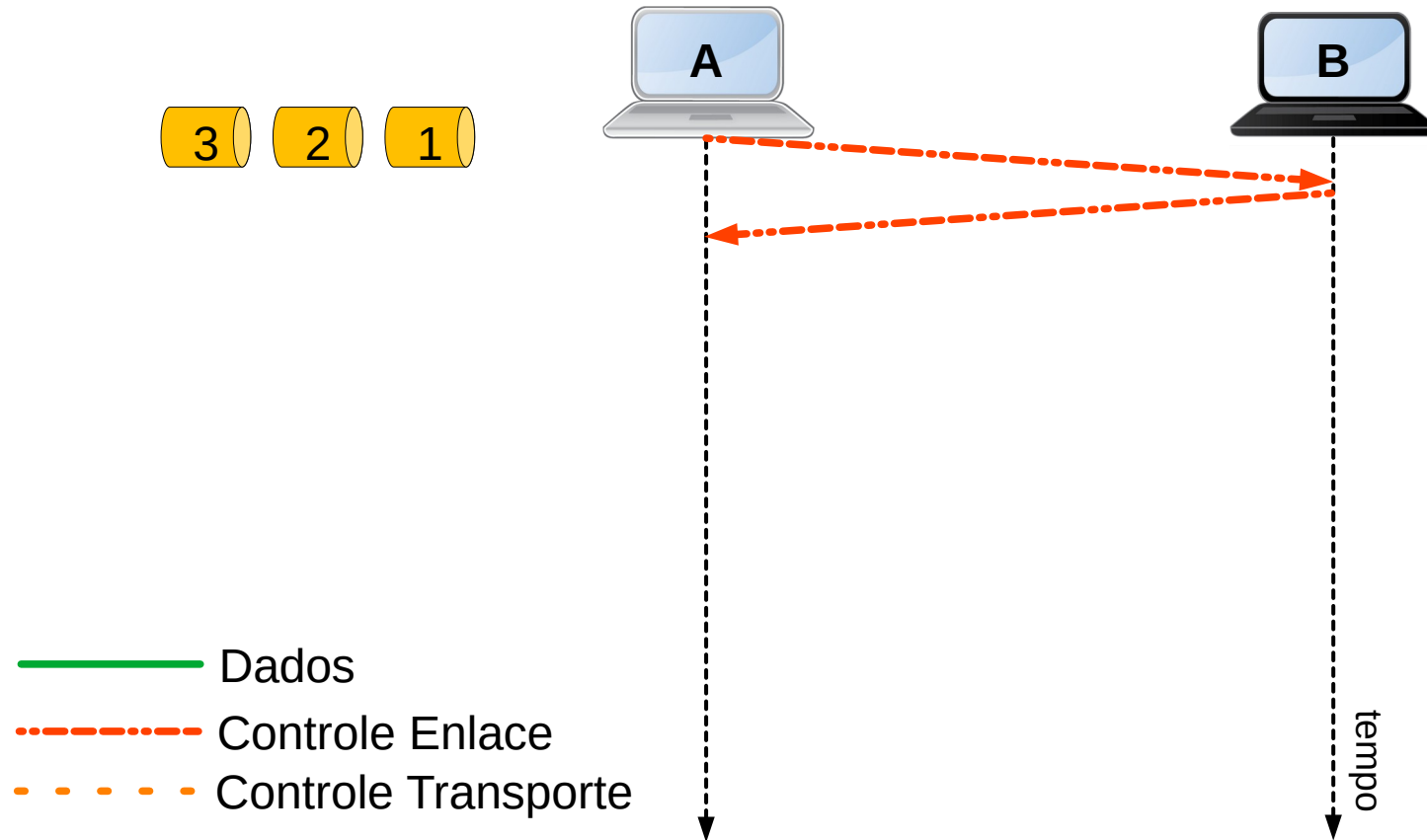
Camada de Enlace

Não entendi o motivo da Camada de Enlace normalmente não ser orientado à conexão!!!

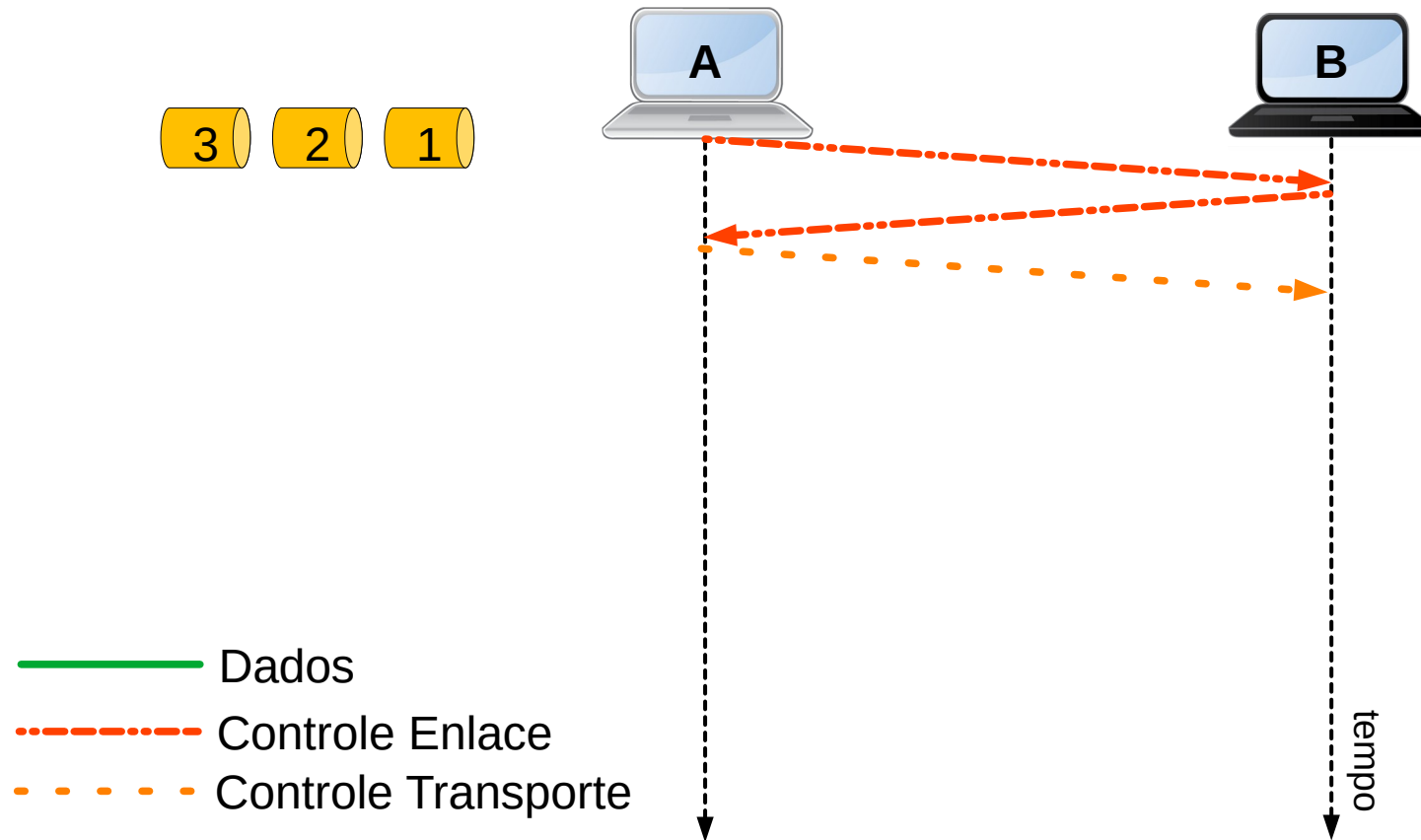


Camada de Enlace

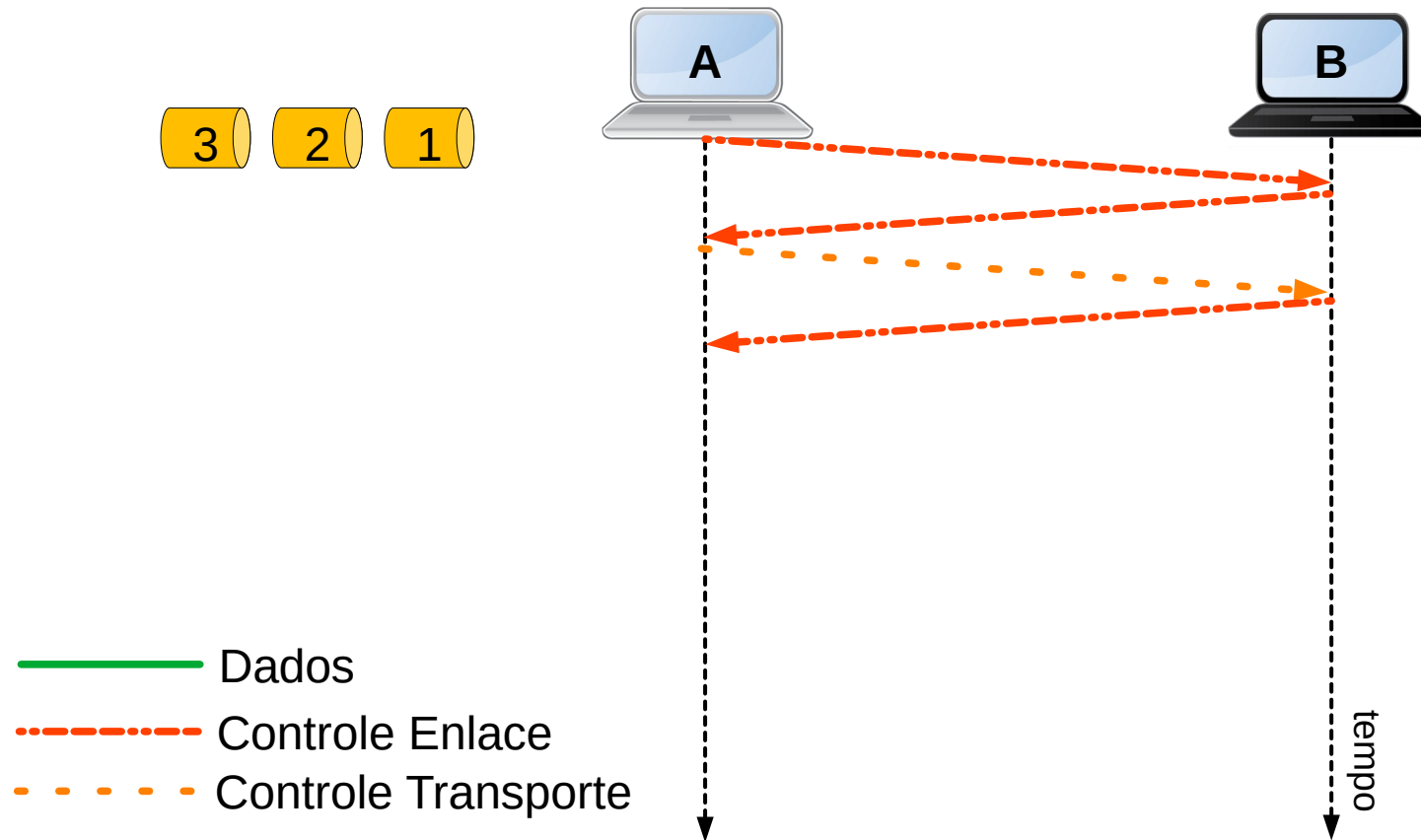
Primeiro motivo: *Overhead*, já que é difícil “desativar” a Camada de Transporte.



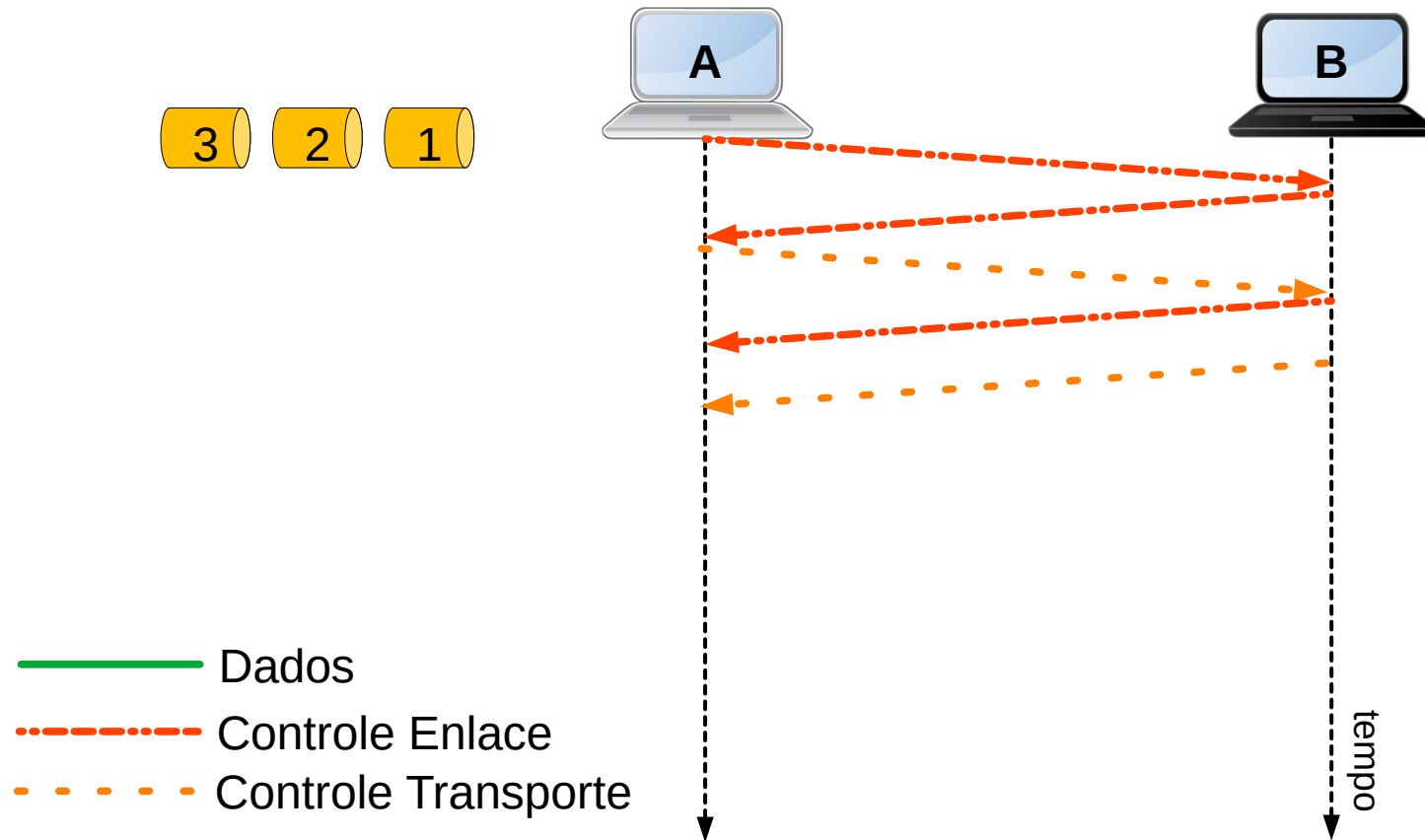
Camada de Enlace



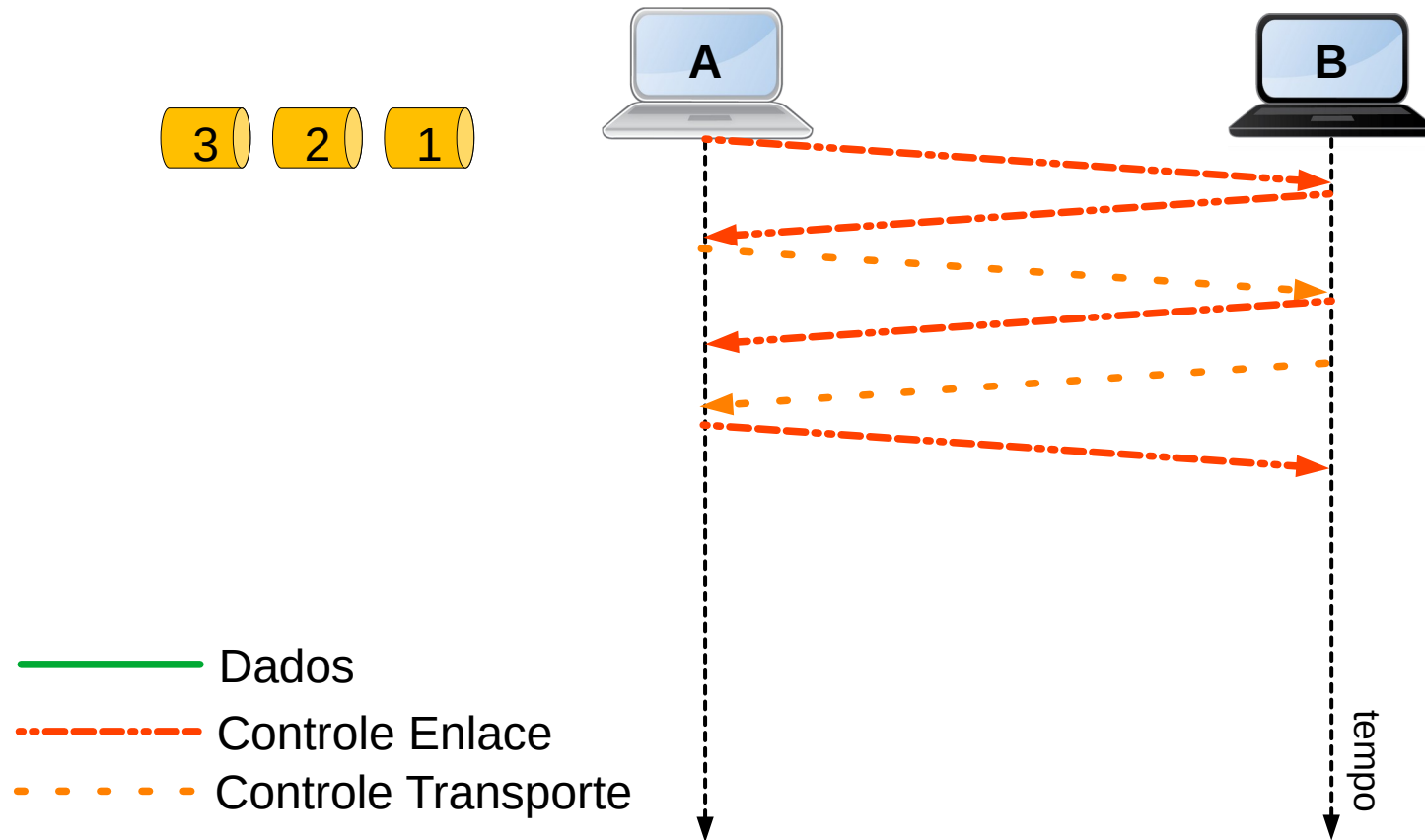
Camada de Enlace



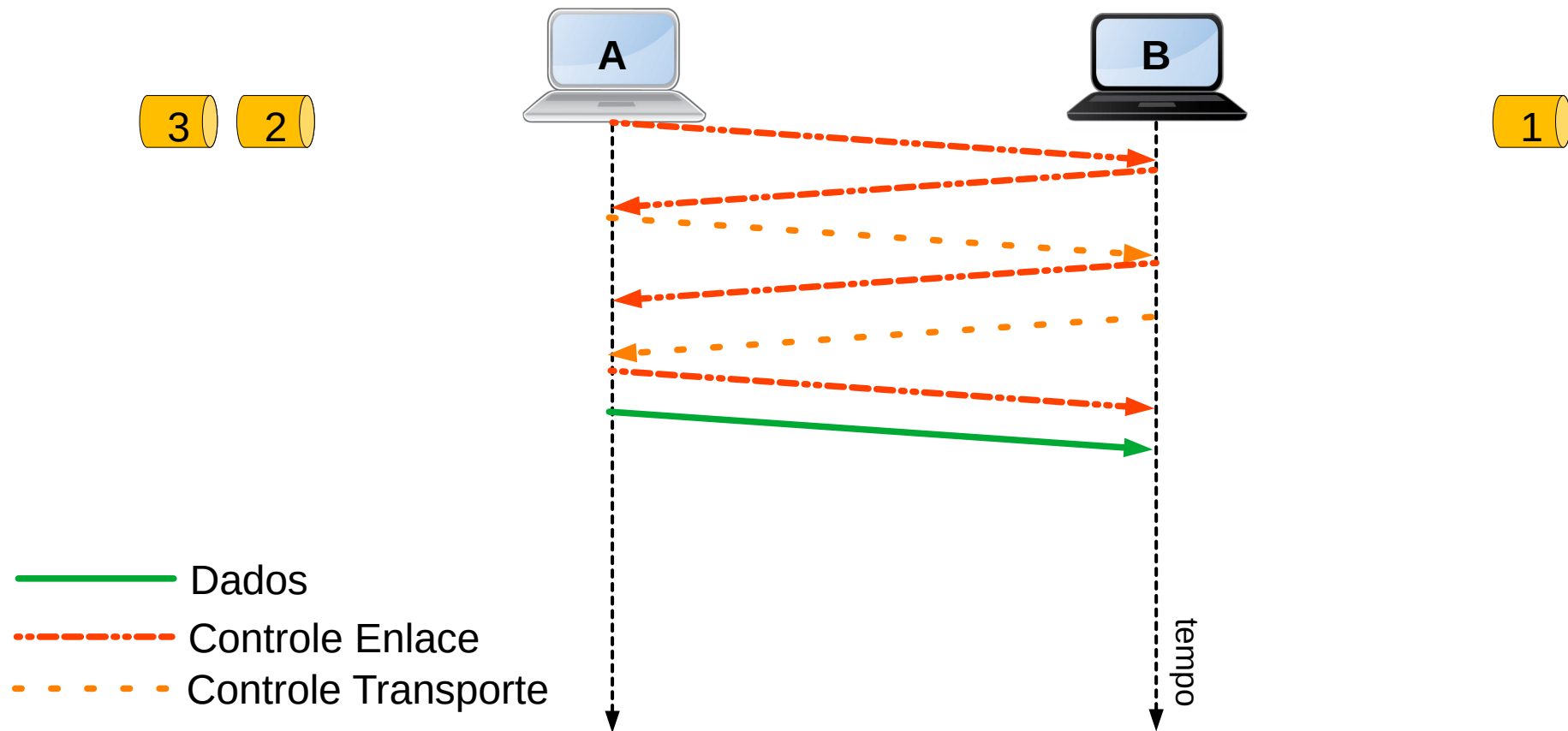
Camada de Enlace



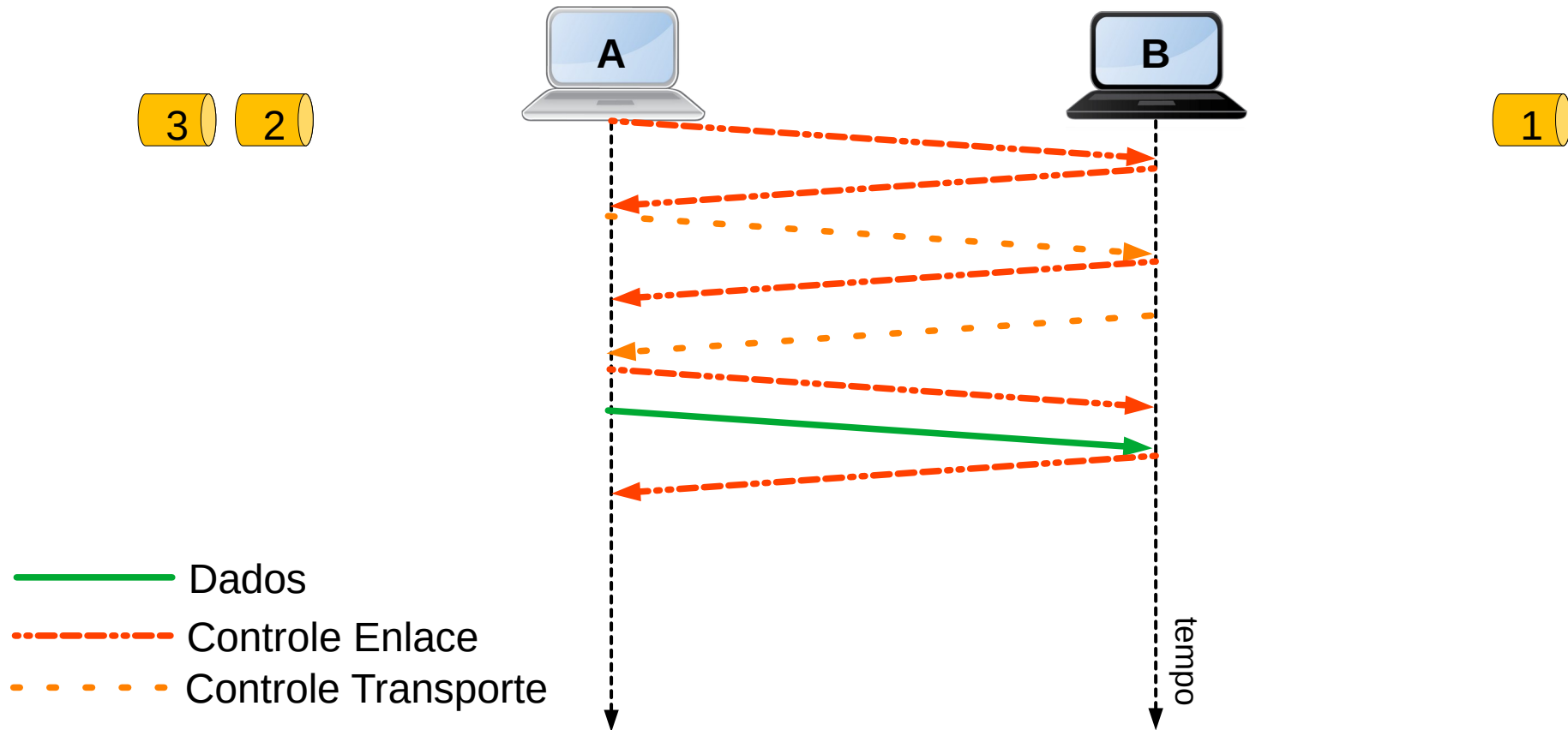
Camada de Enlace



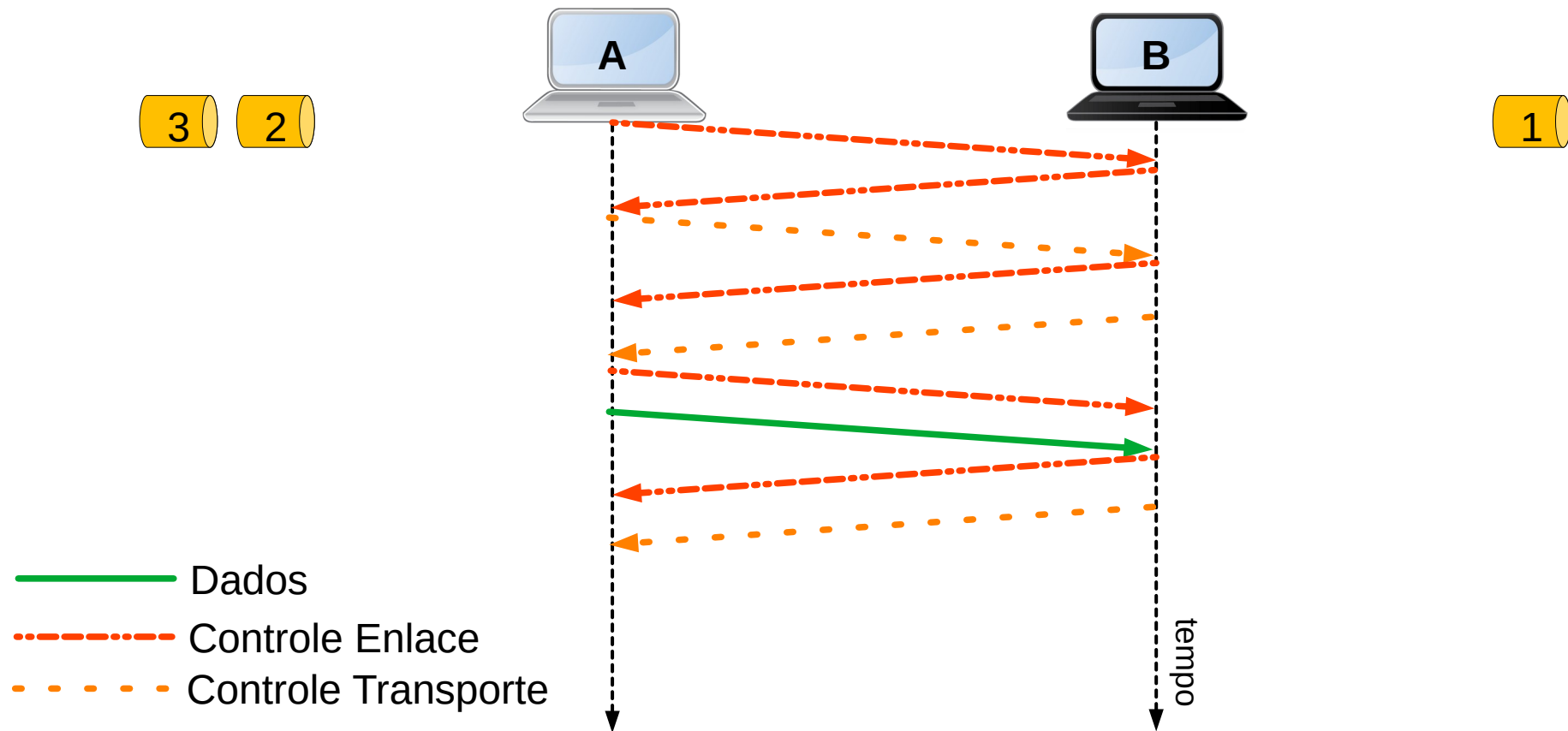
Camada de Enlace



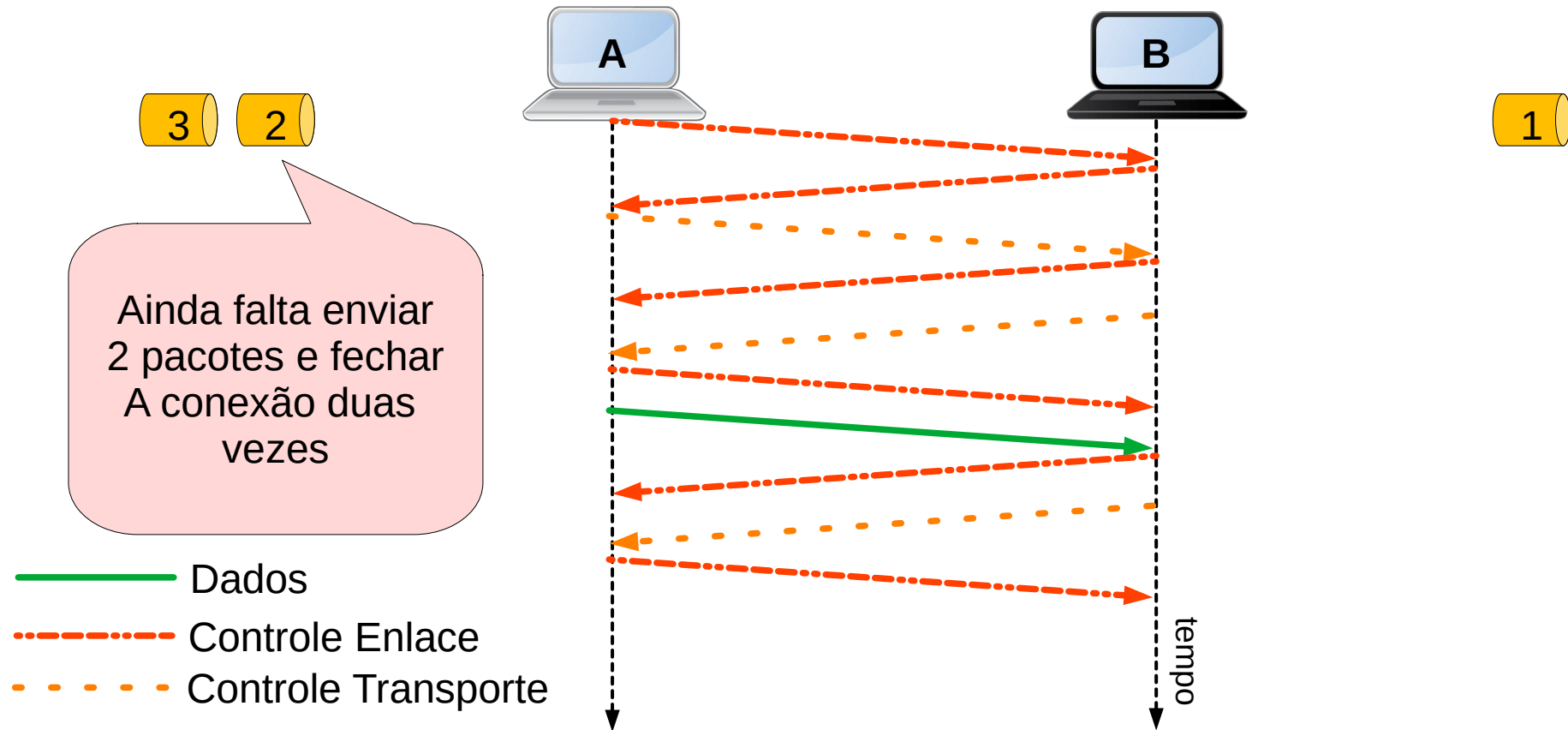
Camada de Enlace

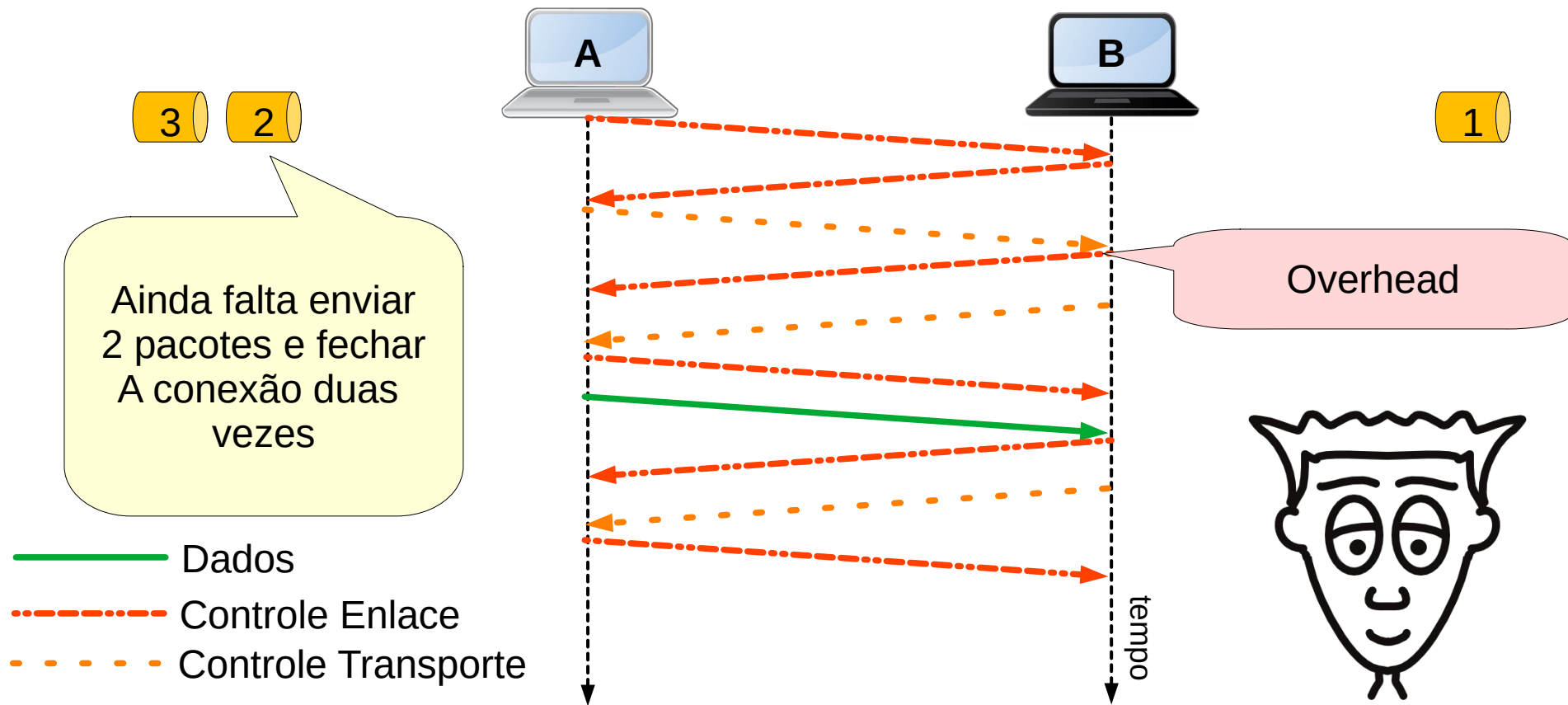


Camada de Enlace



Camada de Enlace

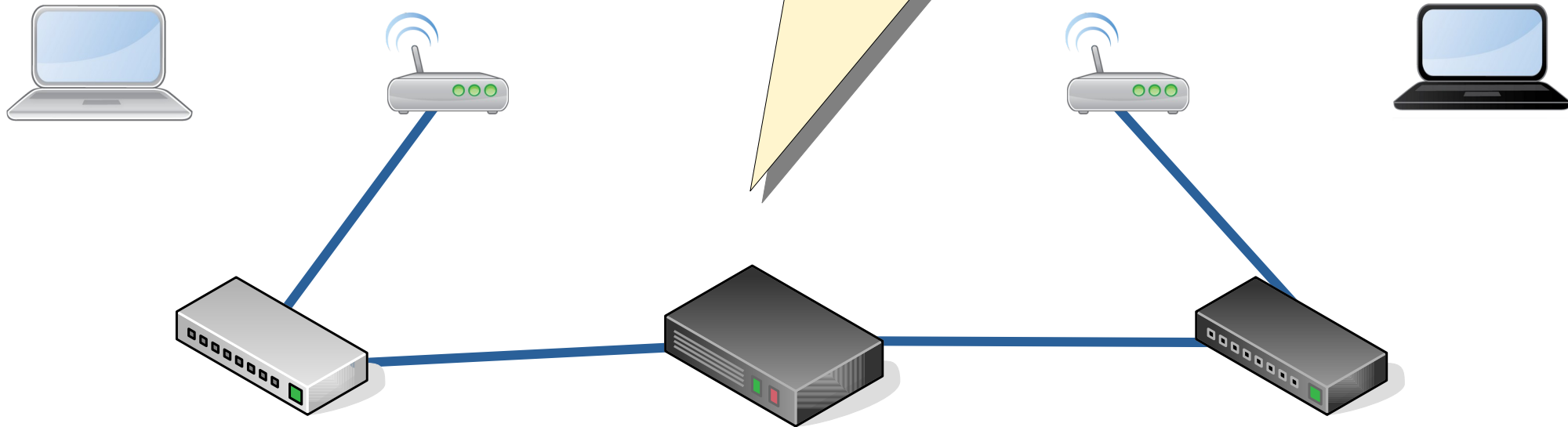




Camada de Enlace

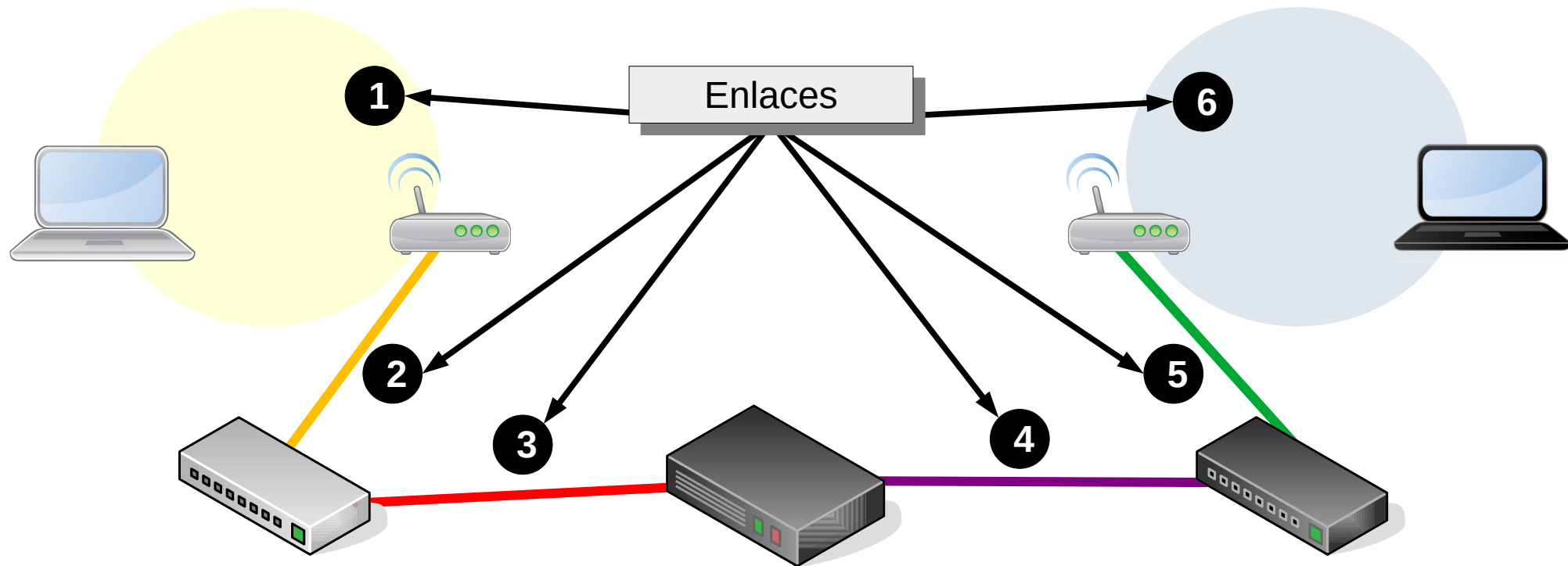
Outro motivo: Não dá para garantir que os enlaces serão iguais até o fim.

Quantos enlaces tem nesta rede?



Camada de Enlace

Outro motivo da existência da Camada de Transporte:

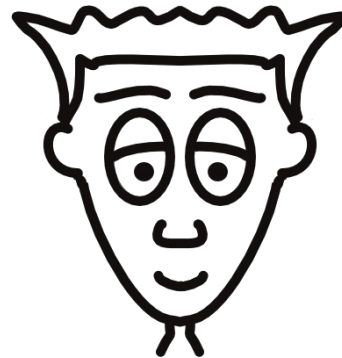


Camada de Enlace

Entendi...

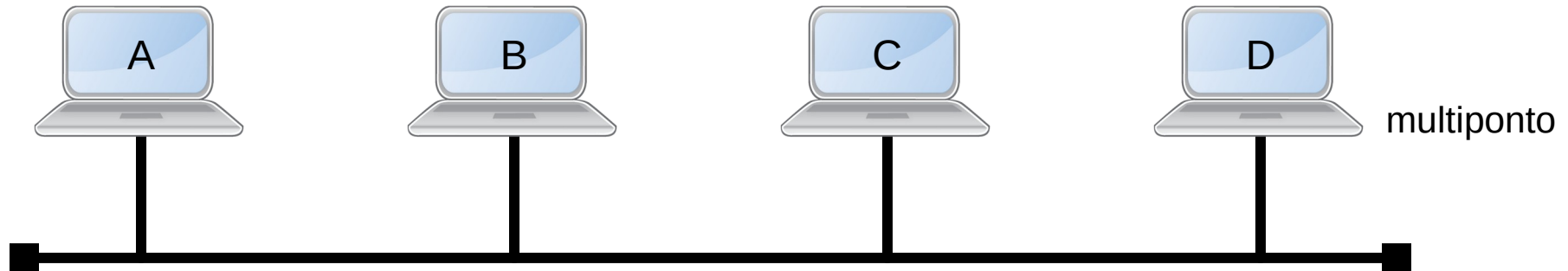
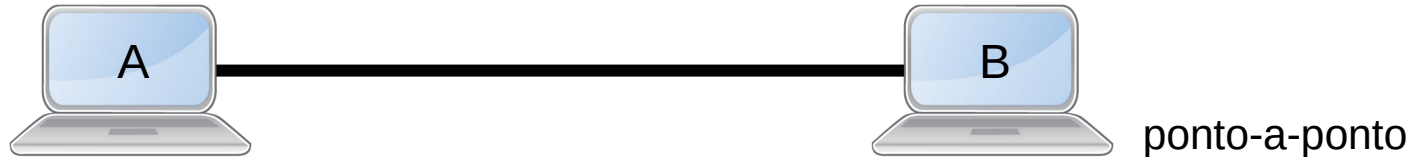
A Camada de Transporte garante “**conexão fim-a-fim**”, independente do enlace de rede!

Além disso, usando orientado à conexão no enlace, é provável que eu cause **overhead** desnecessariamente...



Camada de Enlace

Tipos de enlace de rede: ponto-a-ponto e multiponto:



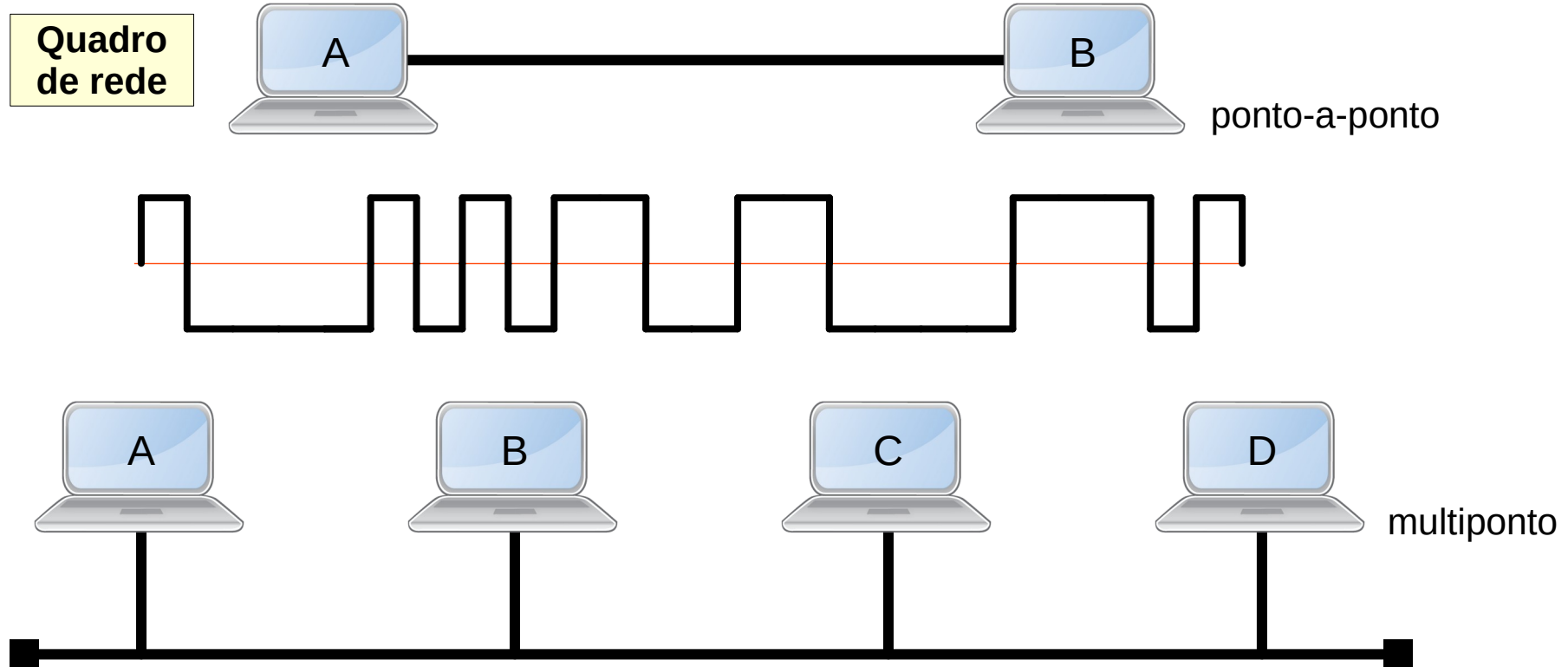
Camada de Enlace

Mas o que isso interfere no enlace?



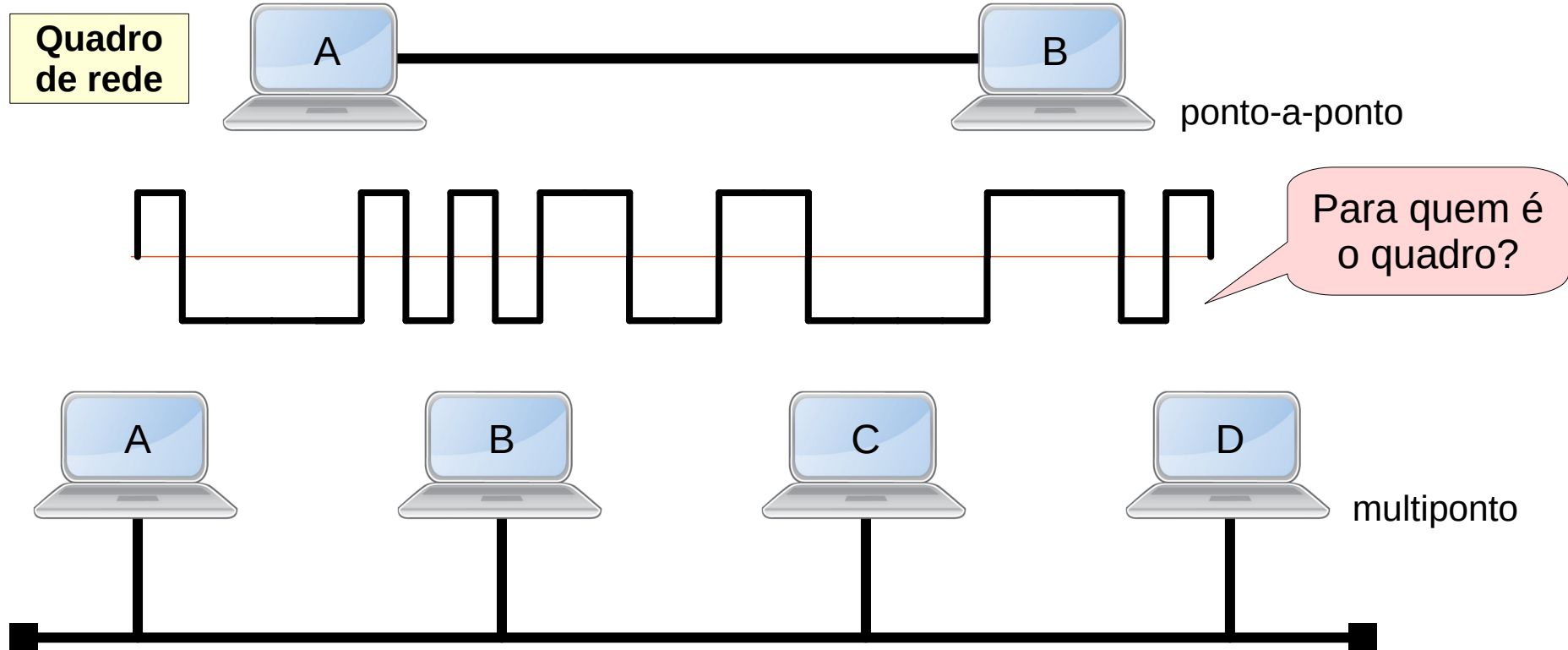
Camada de Enlace

Tipos de enlace de rede: ponto-a-ponto e multiponto:

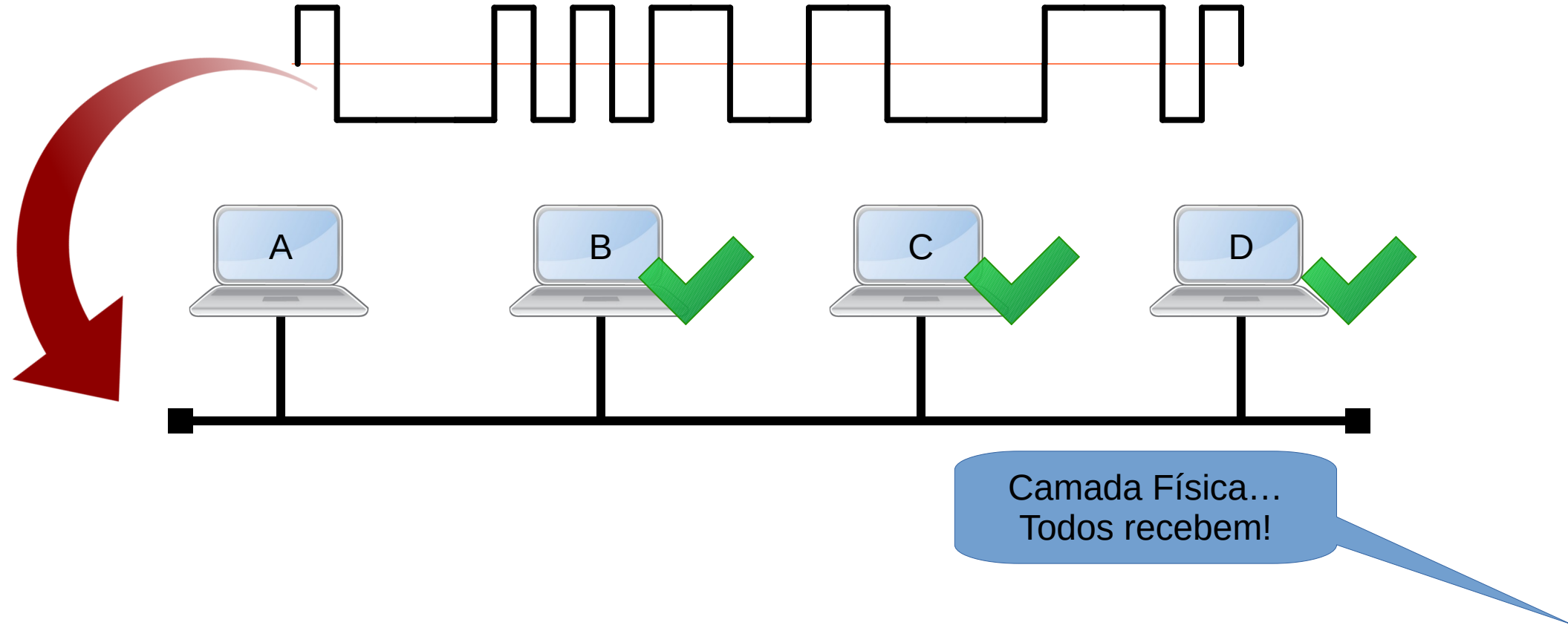


Camada de Enlace

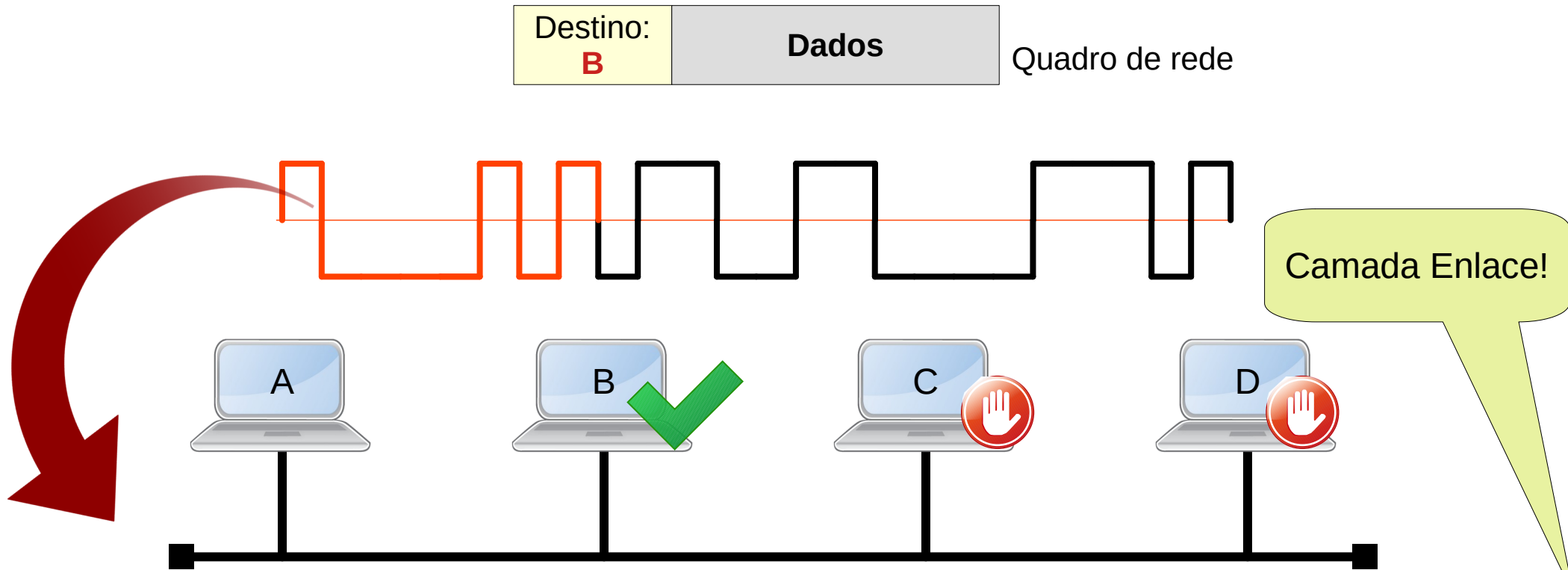
Tipos de enlace de rede: ponto-a-ponto e multiponto:



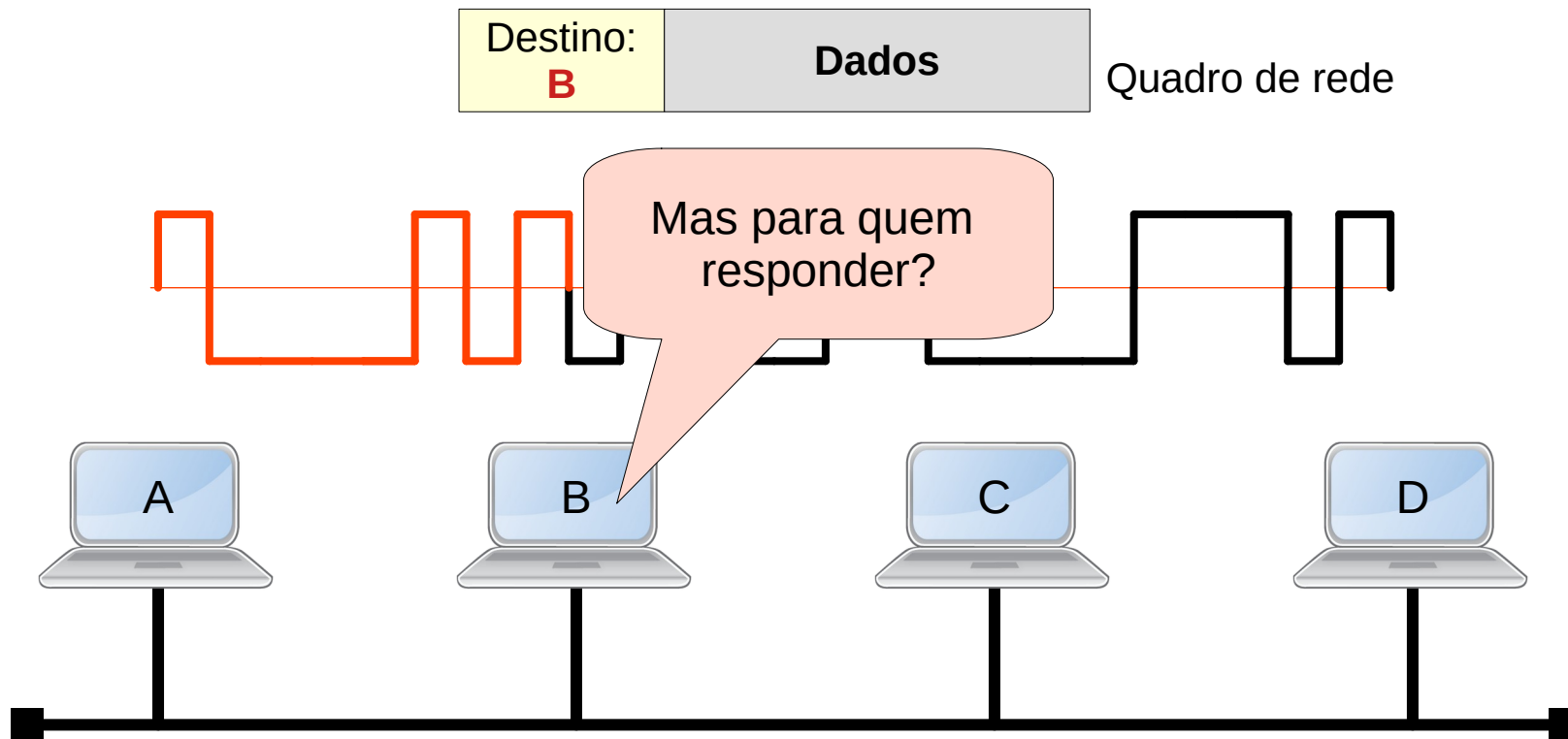
Camada de Enlace



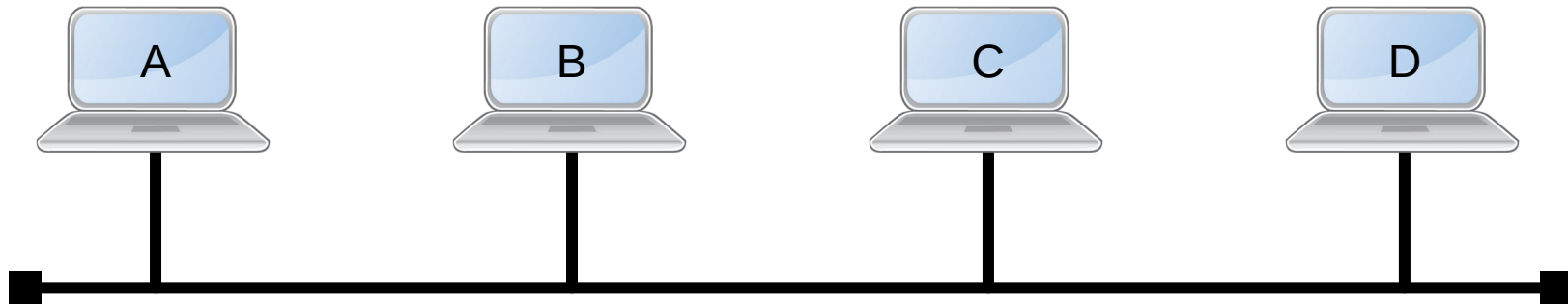
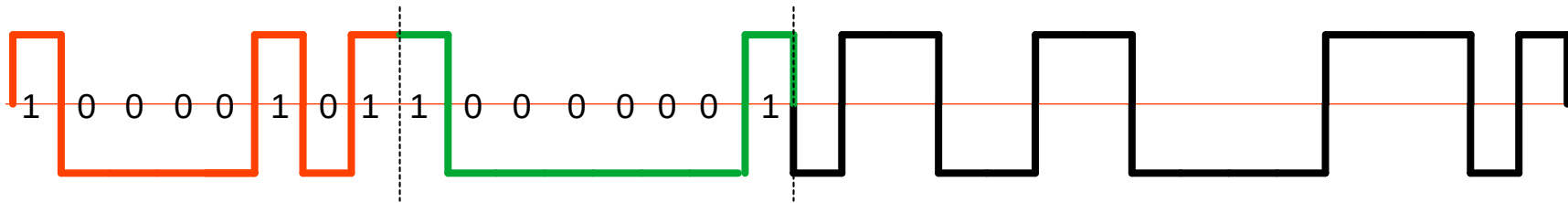
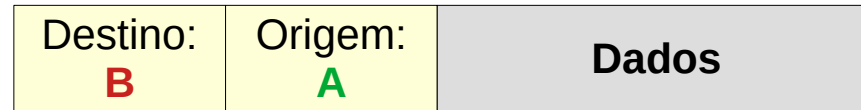
Camada de Enlace



Camada de Enlace



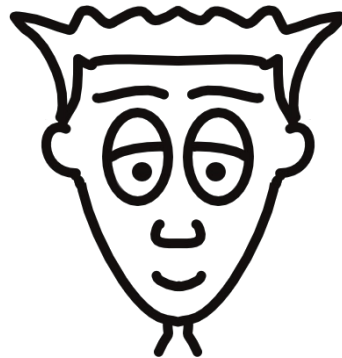
Camada de Enlace



Camada de Enlace

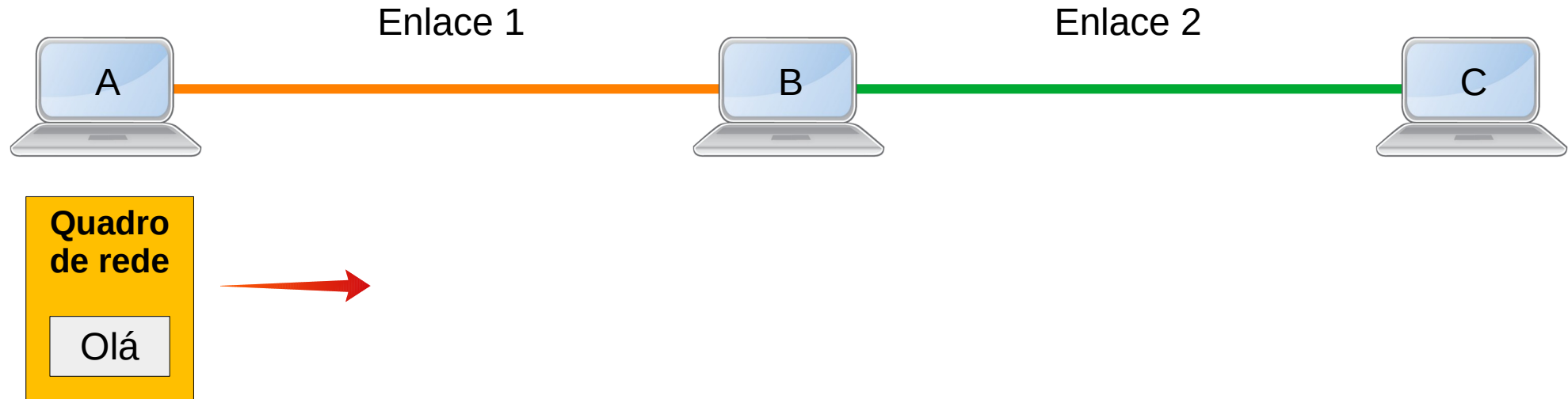
Hum... enlaces ponto-a-ponto possuem características diferentes do multiponto!

Mas tem como conectar mais que duas máquinas em uma rede ponto-a-ponto?



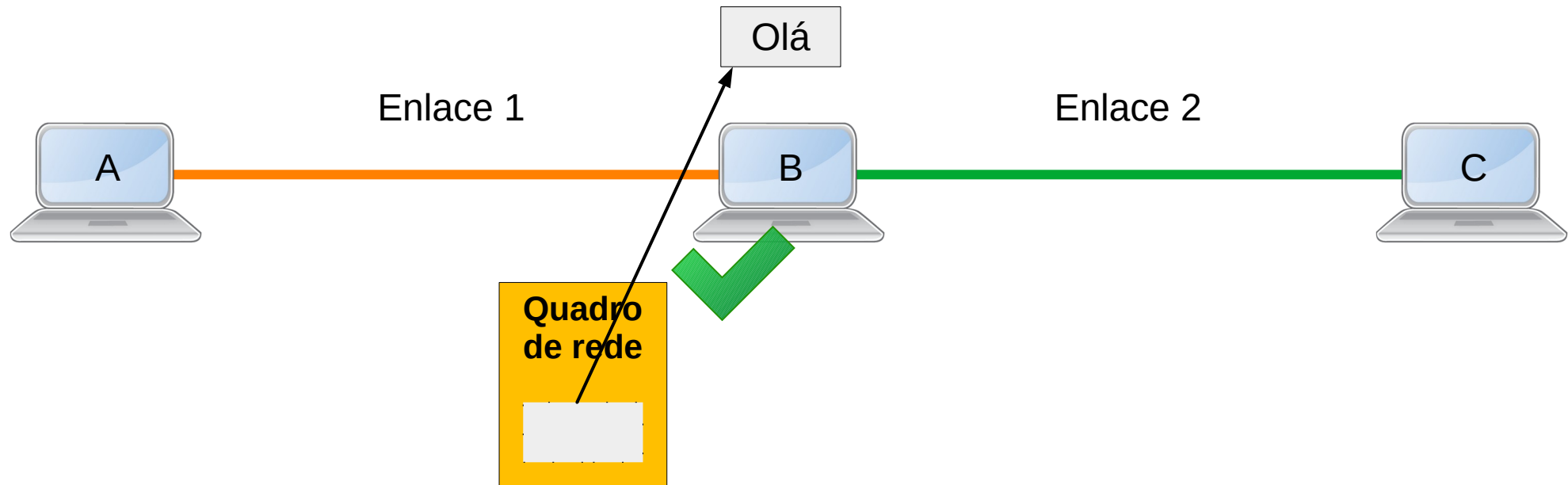
Camada de Enlace

Tipos de enlace de rede: ponto-a-ponto e multiponto:



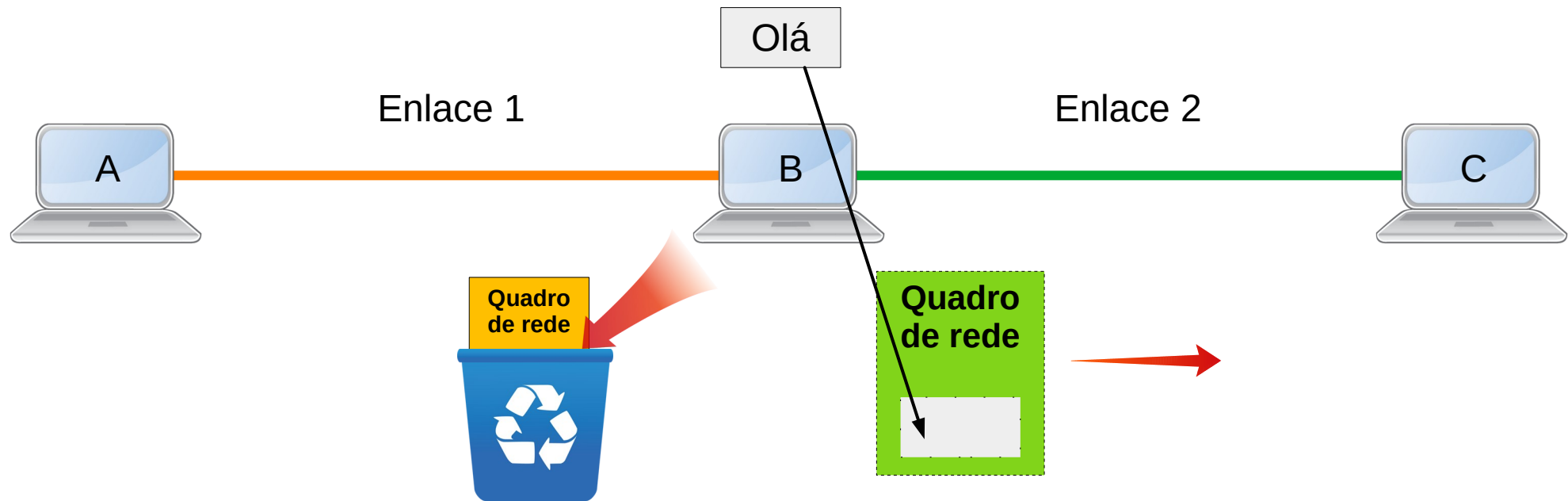
Camada de Enlace

Tipos de enlace de rede: ponto-a-ponto e multiponto:



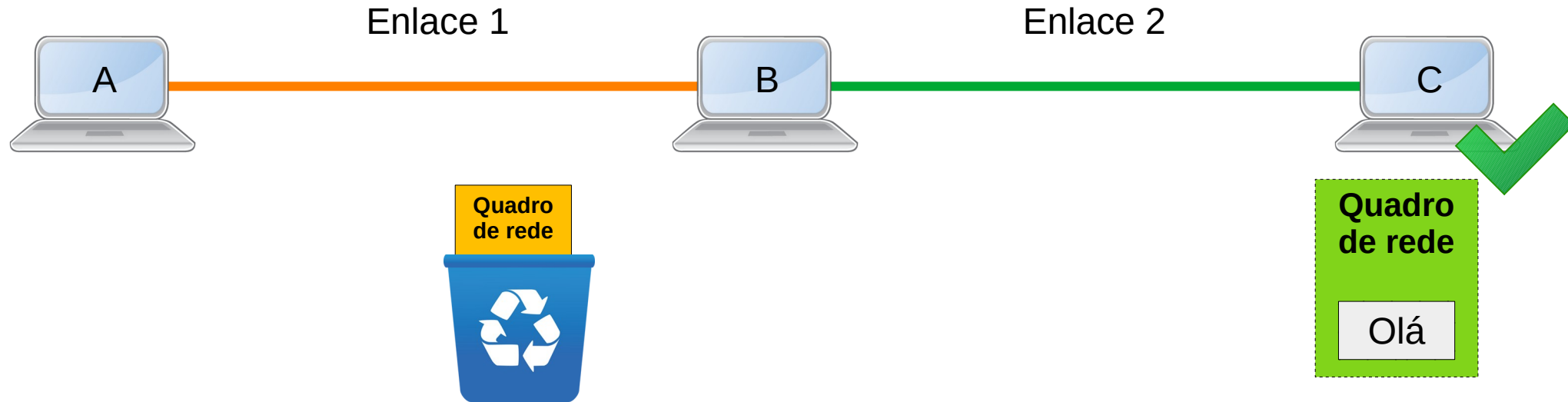
Camada de Enlace

Tipos de enlace de rede: ponto-a-ponto e multiponto:



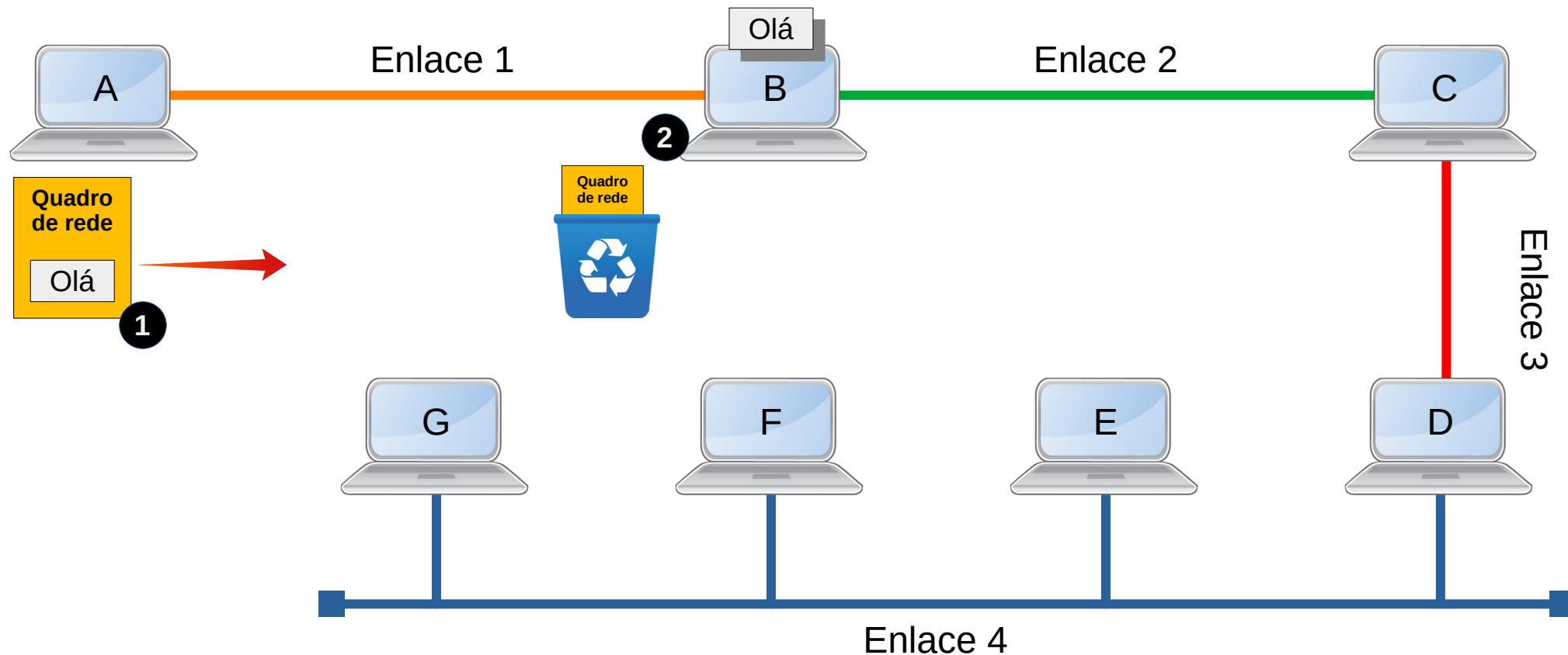
Camada de Enlace

Tipos de enlace de rede: ponto-a-ponto e multiponto:



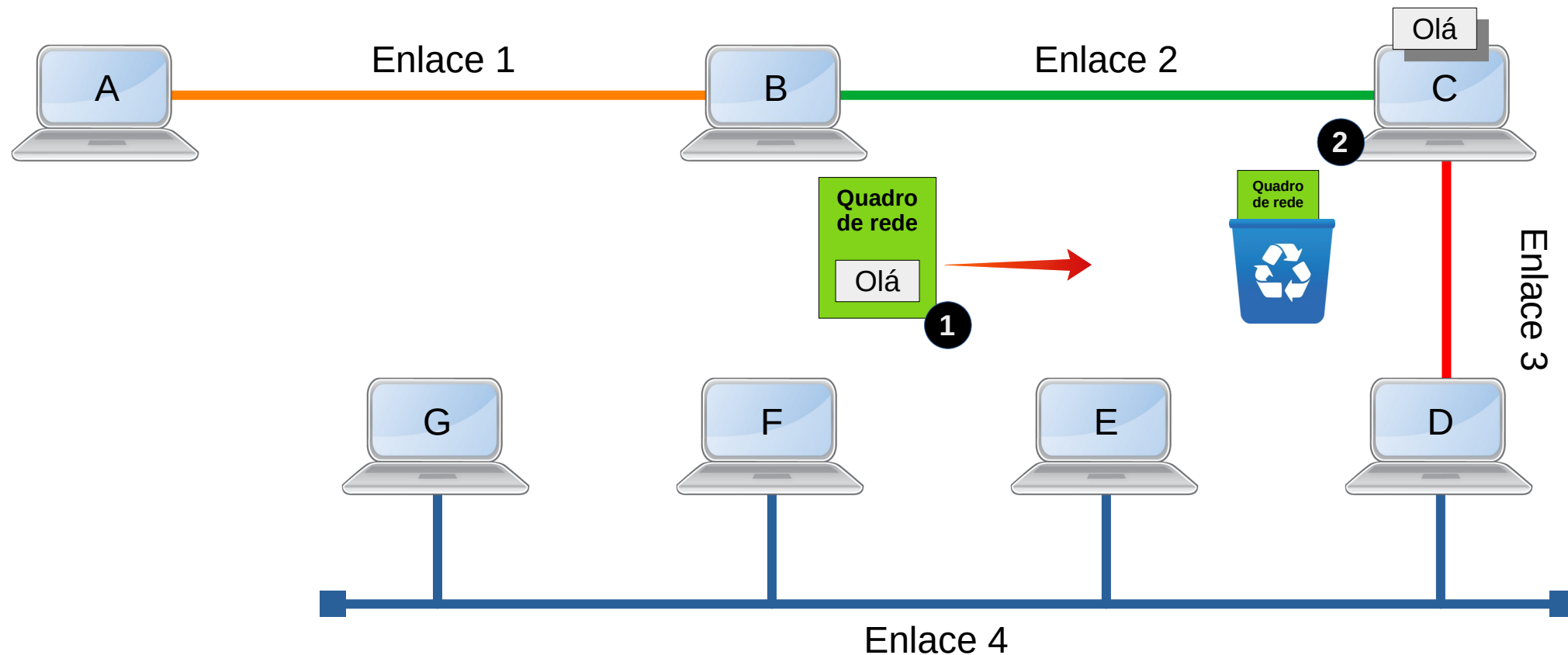
Camada de Enlace

Tipos de enlace de rede: ponto-a-ponto e multiponto:



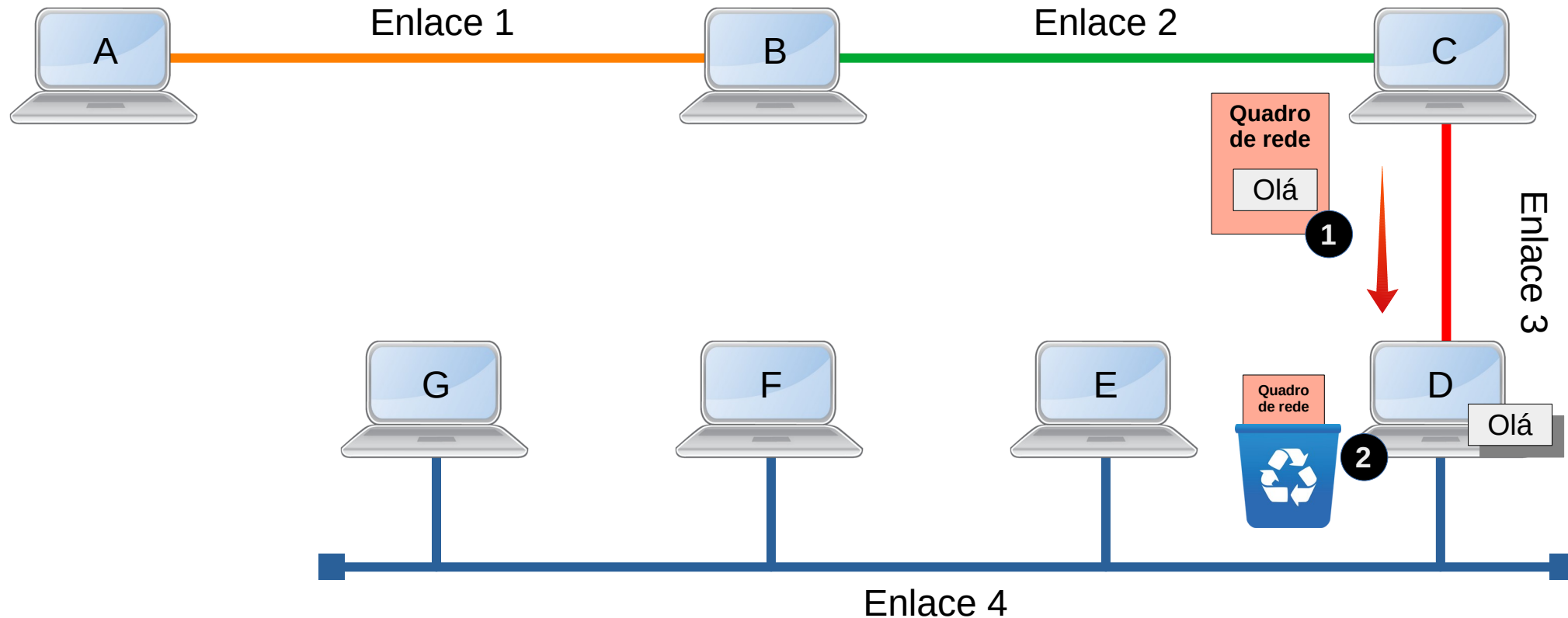
Camada de Enlace

Tipos de enlace de rede: ponto-a-ponto e multiponto:



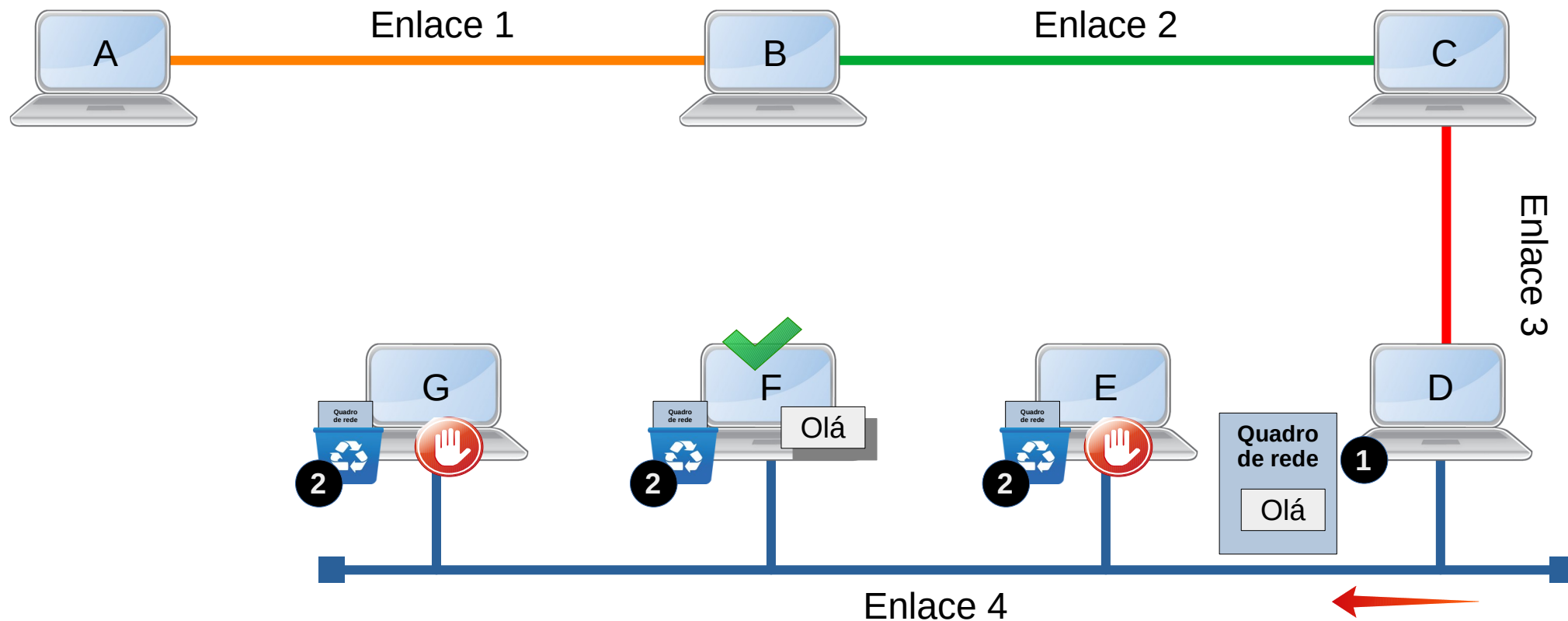
Camada de Enlace

Tipos de enlace de rede: ponto-a-ponto e multiponto:



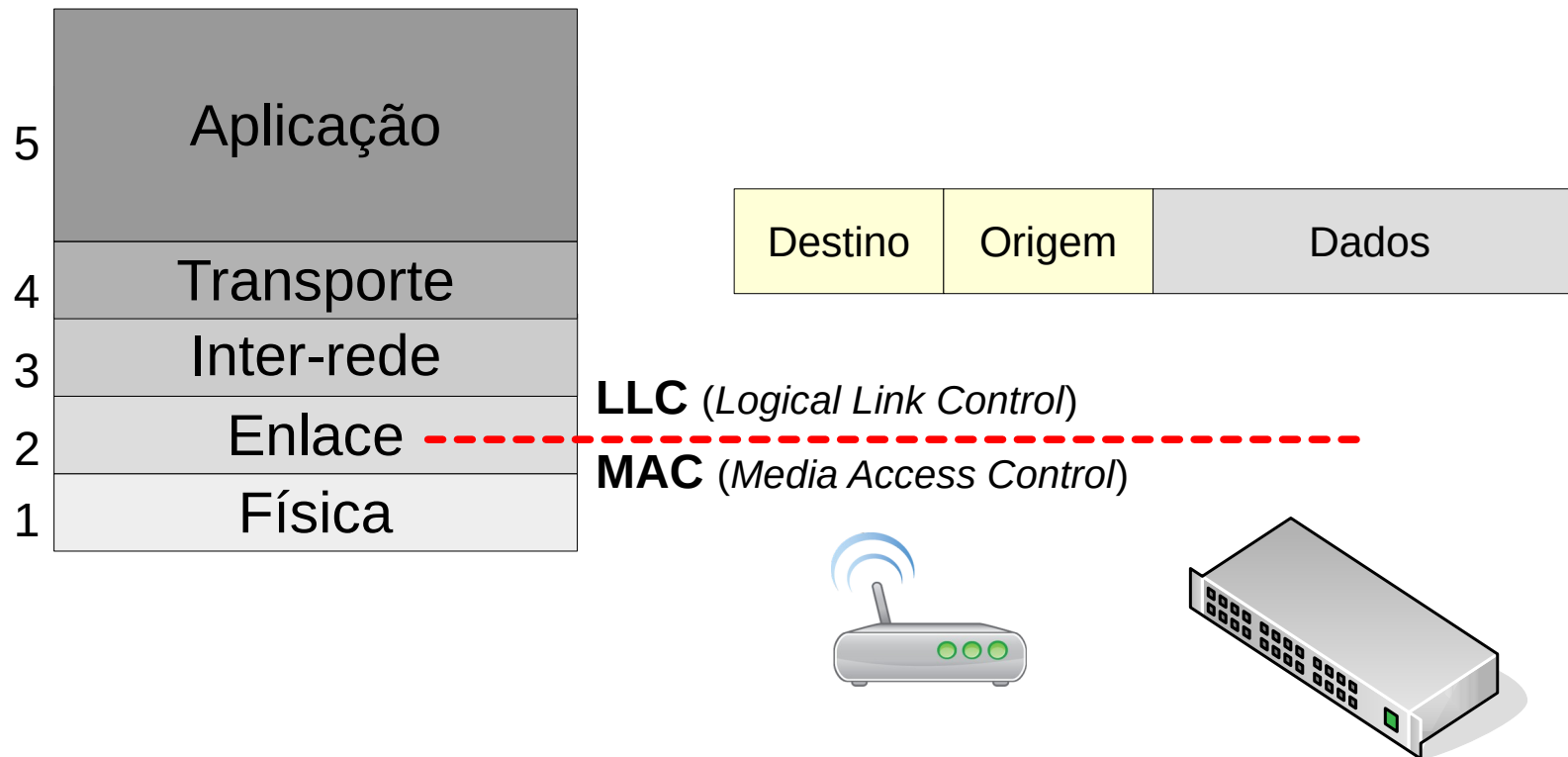
Camada de Enlace

Tipos de enlace de rede: ponto-a-ponto e multiponto:



Camada de Enlace

Como há vários tipos de enlaces e muitas tecnologias/problemas diferentes para tratar, a camada de enlace é dividida em duas subcamadas:

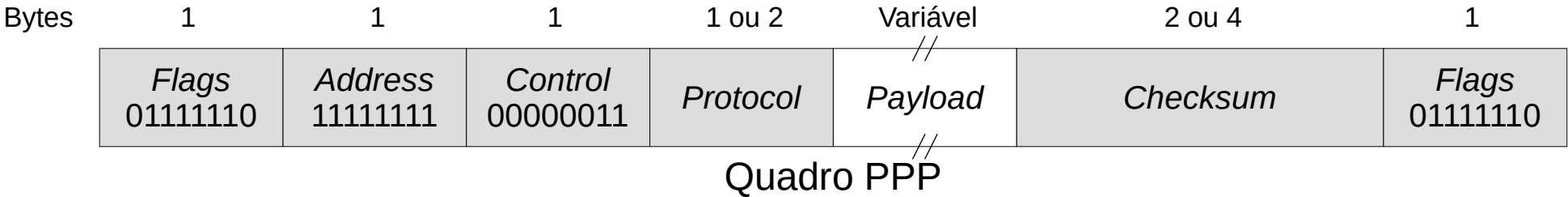


Camada de Enlace

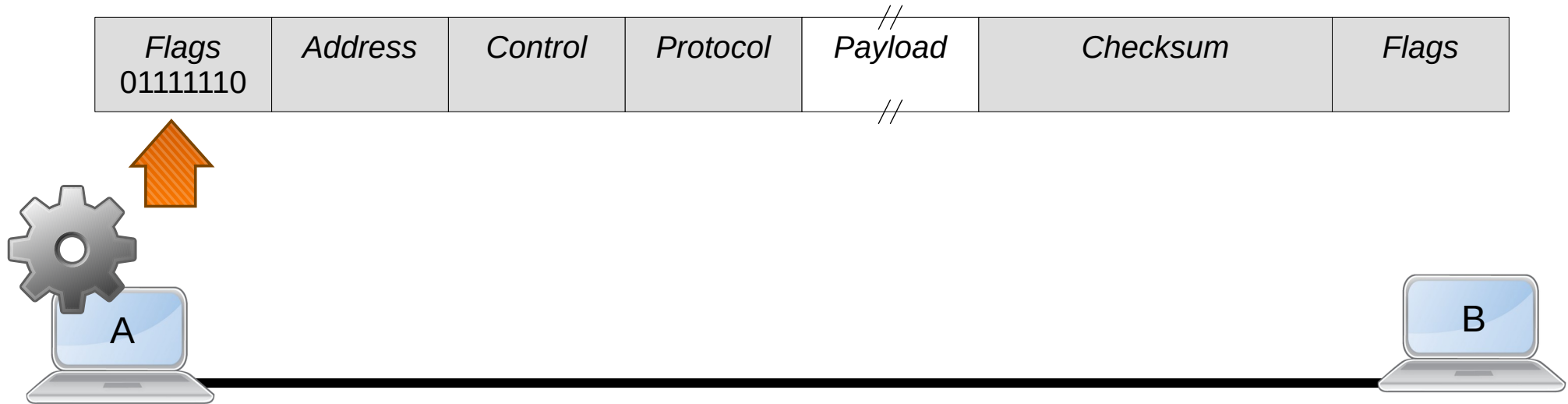
Protocolos Ponto-a-ponto

Protocolos indicados para enlaces de longa distância (MANs e WANs). Há vários protocolos desses:

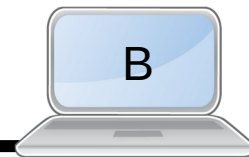
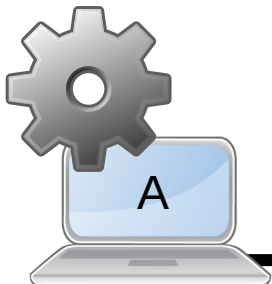
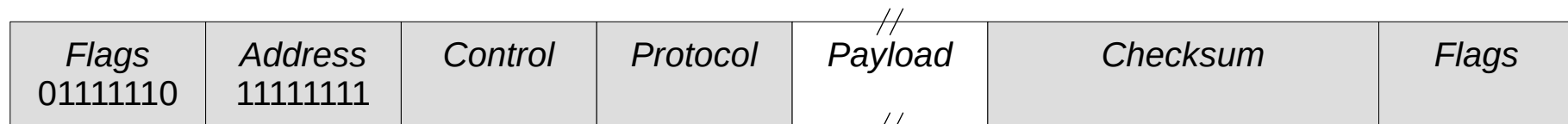
- SDLC (*Synchronous Data Link Control*);
 - ADCCP (*Advanced Data Communication Control Procedure*) - ANSI;
 - HDLC (*High-level Data Link Control*) - ISO;
 - LAP (*Link Access Procedure*);
 - PPP (*Point-to-Point Protocol*).



Camada de Enlace

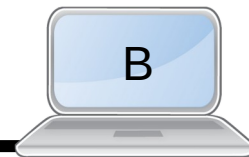
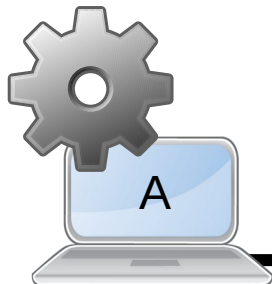


Camada de Enlace



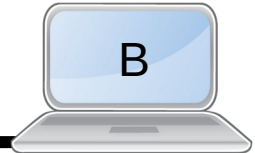
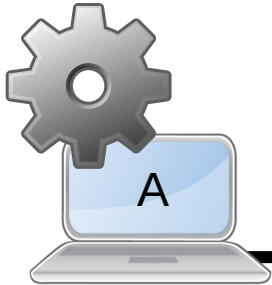
Camada de Enlace

<i>Flags</i> 01111110	<i>Address</i> 11111111	<i>Control</i> 00000011	<i>Protocol</i>	// <i>Payload</i> //	<i>Checksum</i>	<i>Flags</i>
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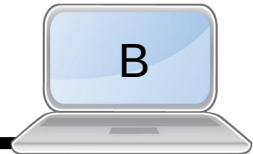
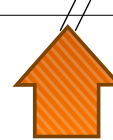
Camada de Enlace

<i>Flags</i> 01111110	<i>Address</i> 11111111	<i>Control</i> 00000011	<i>Protocol</i> 00000100	// <i>Payload</i> //	<i>Checksum</i>	<i>Flags</i>
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Camada de Enlace

<i>Flags</i> 01111110	<i>Address</i> 11111111	<i>Control</i> 00000011	<i>Protocol</i> 00000100	// <i>Payload</i> 01000111	<i>Checksum</i>	<i>Flags</i>
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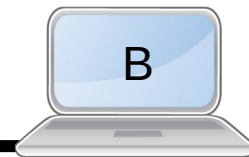
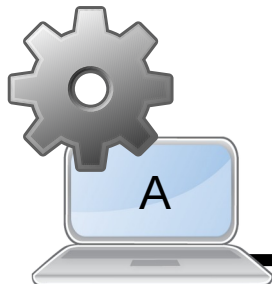


Camada de Enlace

<i>Flags</i> 01111110	<i>Address</i> 11111111	<i>Control</i> 00000011	<i>Protocol</i> 00000100	<i>Payload</i> 01000111	<i>Checksum</i> 10110110	<i>Flags</i>
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Address + *Control* + *Protocol* + *Payload* =

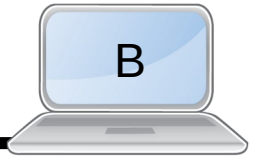
Resultado
do checksum



Camada de Enlace

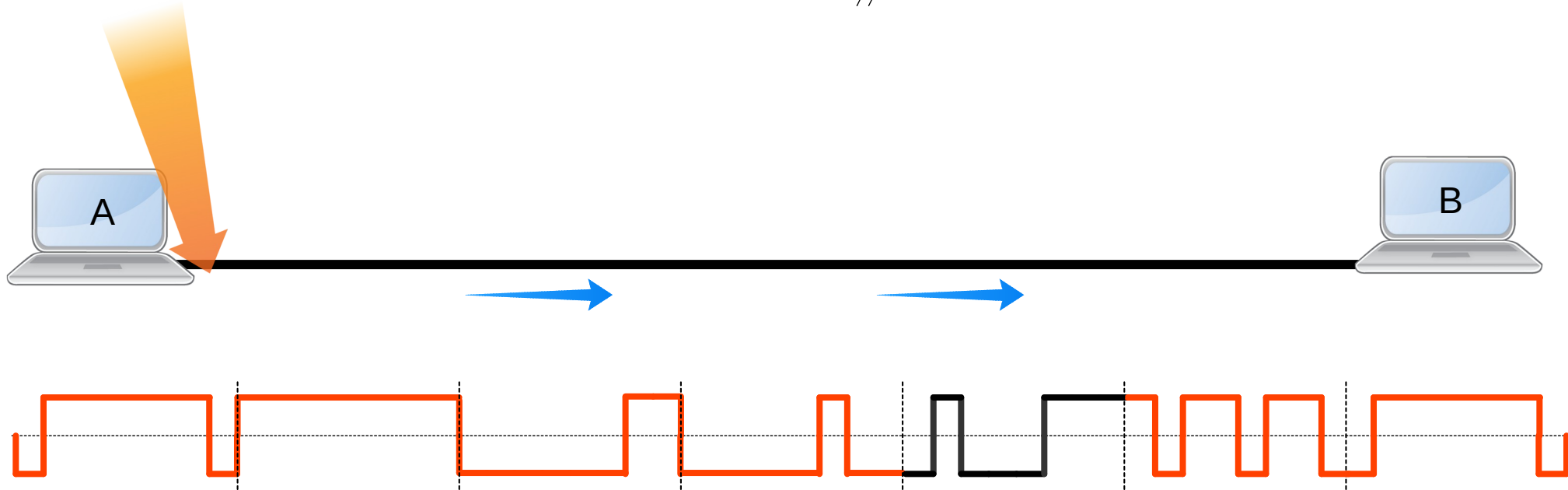
<i>Flags</i> 01111110	<i>Address</i> 11111111	<i>Control</i> 00000011	<i>Protocol</i> 00000100	<i>Payload</i> 01000111	<i>Checksum</i> 10110110	<i>Flags</i> 01111110
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//
//



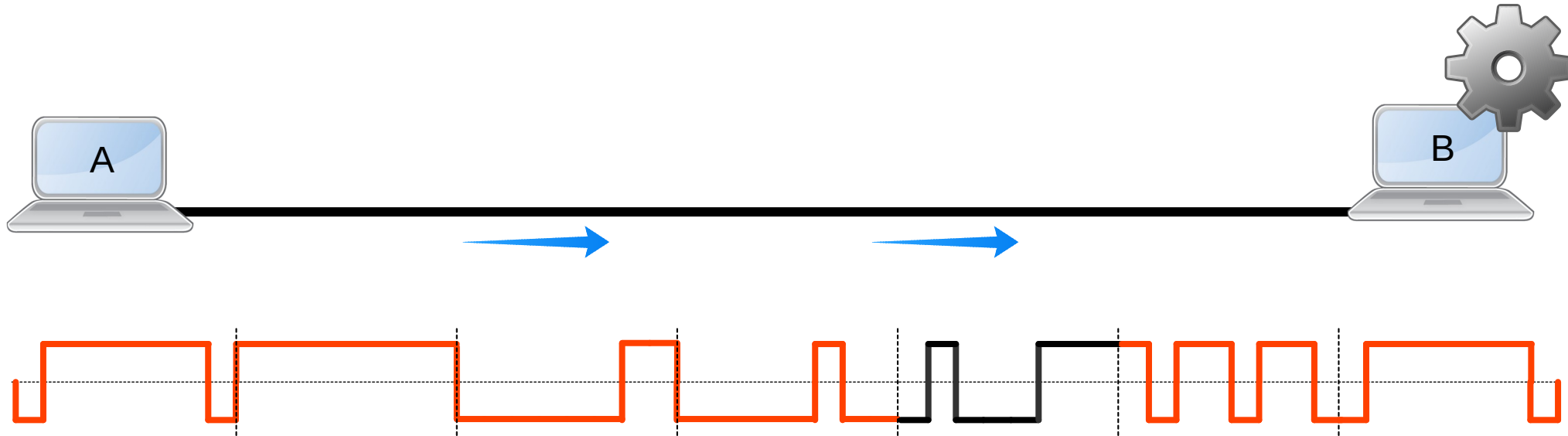
Camada de Enlace

<i>Flags</i> 01111110	<i>Address</i> 11111111	<i>Control</i> 00000011	<i>Protocol</i> 00000100	// <i>Payload</i> 01000111 //	<i>Checksum</i> 10110110	<i>Flags</i> 01111110
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Camada de Enlace

<i>Flags</i> 01111110	<i>Address</i> 11111111	<i>Control</i> 00000011	<i>Protocol</i> 00000100	// <i>Payload</i> 01000111 //	<i>Checksum</i> 10110110	<i>Flags</i> 01111110
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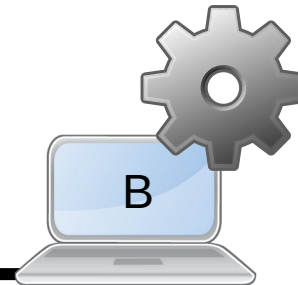


Camada de Enlace

<i>Flags</i> 01111110	<i>Address</i> 11111111	<i>Control</i> 00000011	<i>Protocol</i> 00000100	// <i>Payload</i> 01000111	<i>Checksum</i> 10110110	<i>Flags</i> 01111110
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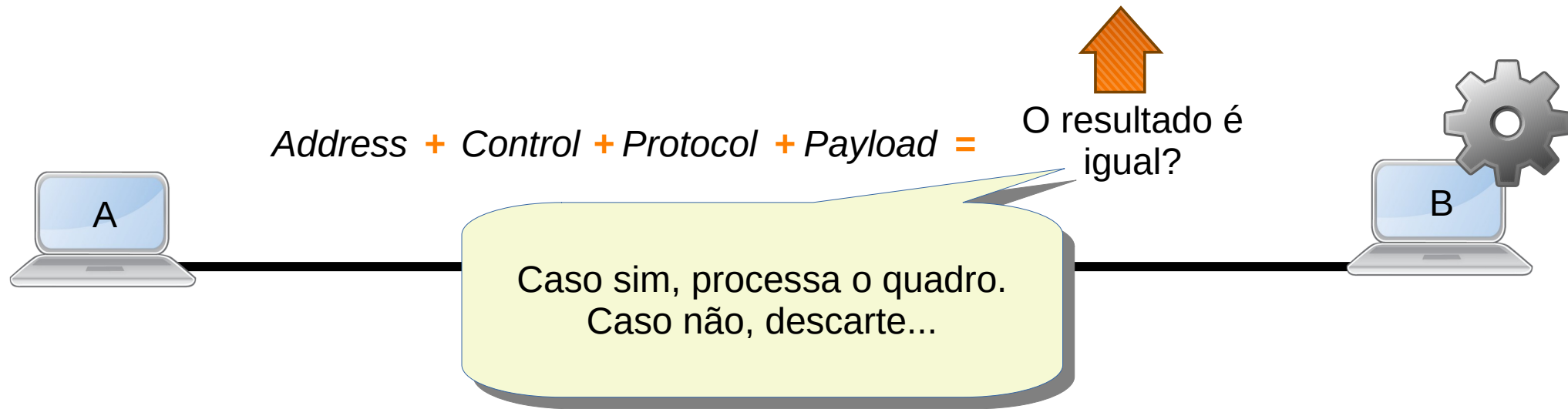
Address + *Control* + *Protocol* + *Payload* =

O resultado é igual?

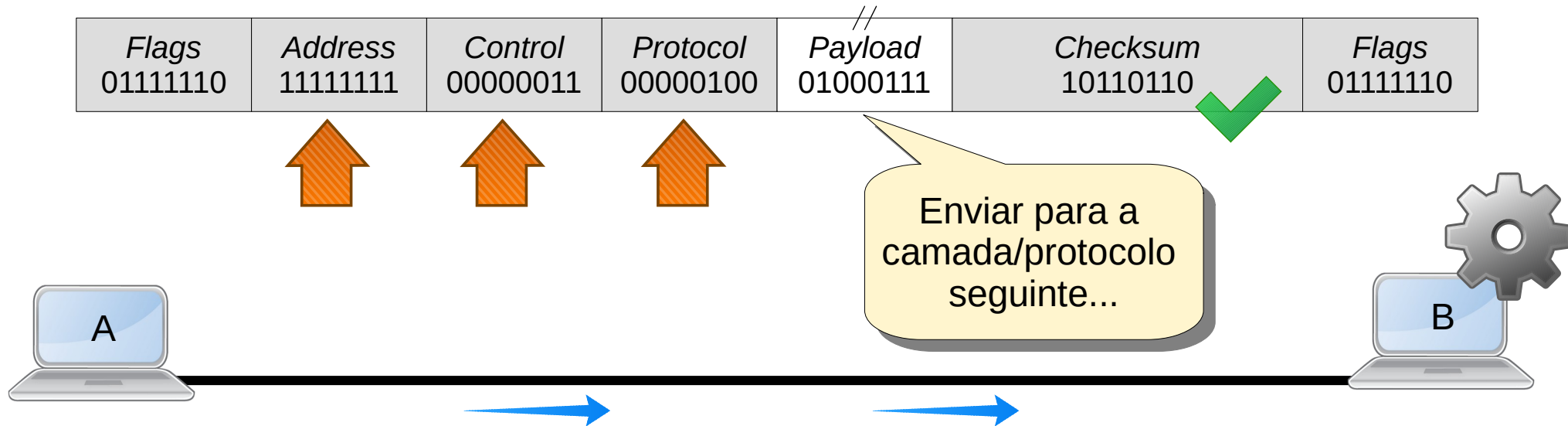


Camada de Enlace

<i>Flags</i> 01111110	<i>Address</i> 11111111	<i>Control</i> 00000011	<i>Protocol</i> 00000100	// <i>Payload</i> 01000111	<i>Checksum</i> 10110110	<i>Flags</i> 01111110
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Camada de Enlace



Camada de Enlace

Conclusão:

A Camada de Enlace trata dos erros da Camada Física e começa a dar “inteligência” para a rede.



Próximas aulas de enlace: Ethernet, WiFi, Switching e VLAN.

Obrigado!!!

Prof. Dr. Luiz Arthur Feitosa dos Santos



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

Links e referencias na descrição do vídeo