

Protocolos de Acesso ao Meio

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Tipos de Protocolos

- ⇒ Protocolos de Acesso Baseados em Contenção
- ⇒ Protocolos de Acesso Ordenado sem Contenção

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Protocolos de Acesso baseados em Contenção

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Protocolos de Acesso Baseados em Contenção

- ⇒ Retardo de transferência não limitado
- ⇒ Ausência de equidade
- ⇒ Instabilidade em sobrecarga

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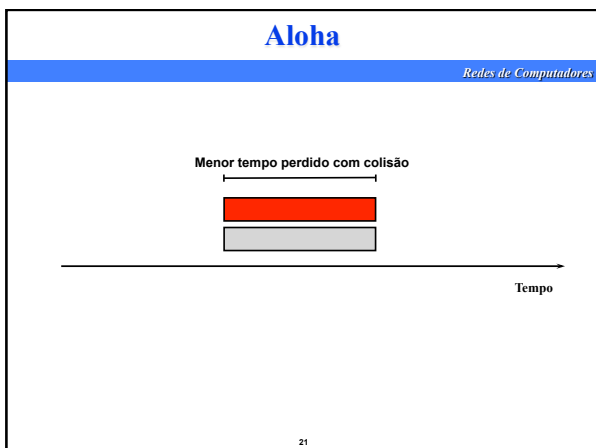
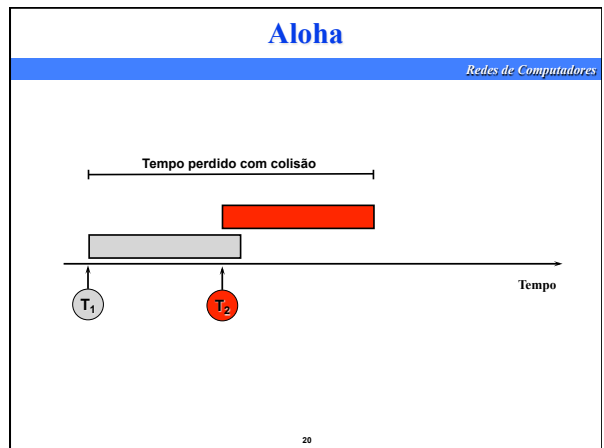
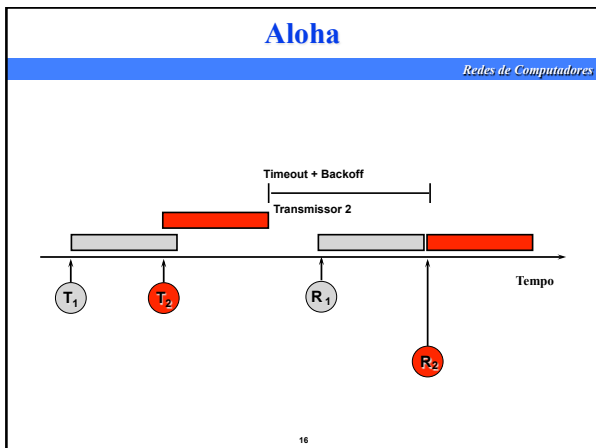
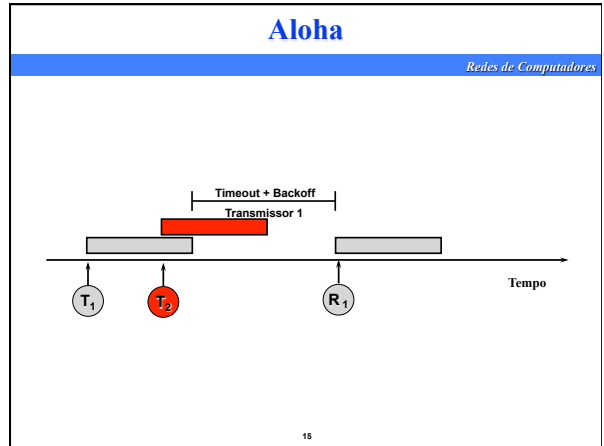
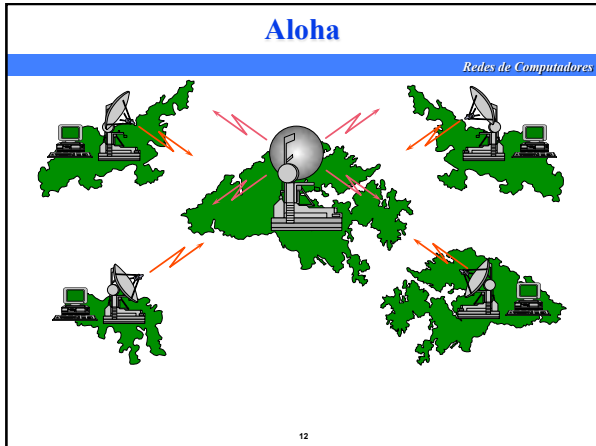
Protocolos de Acesso Baseados em Contenção

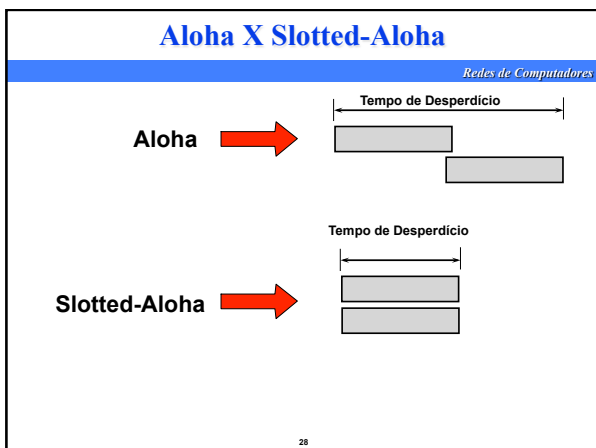
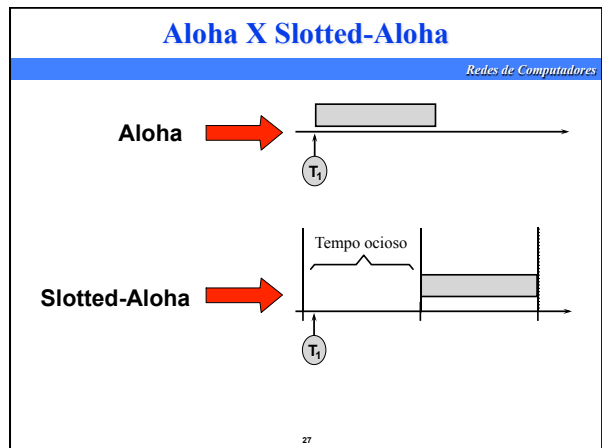
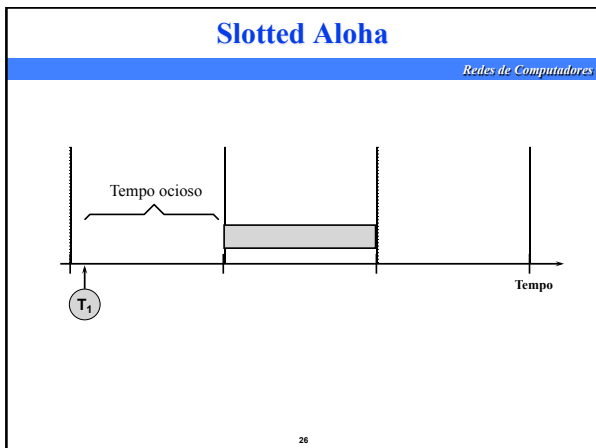
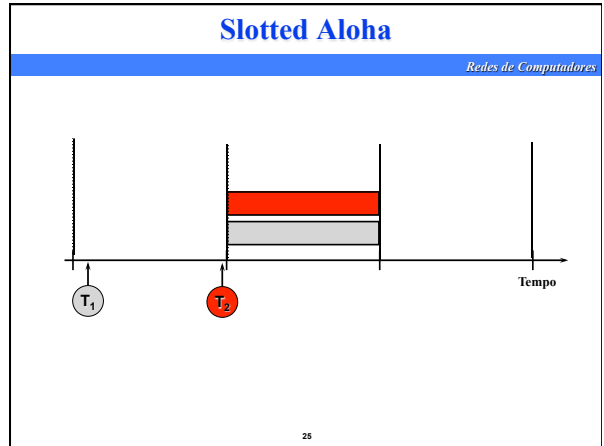
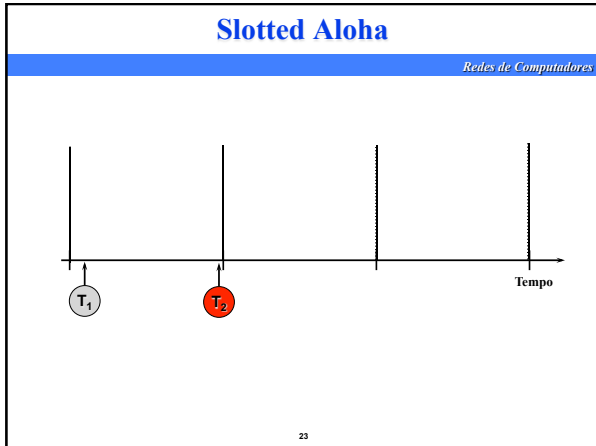
- ⇒ Aloha
- ⇒ Slotted-Aloha
- ⇒ CSMA
- ⇒ CSMA-CD
- ⇒ CSMA-CA

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Aloha

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- ### Aloha
- Redes de Computadores
- ⇒ Eficiência
 - Aloha 18%
 - Slotted Aloha 37%
 - ⇒ Não tem equidade
 - ⇒ Não tem prioridade
 - ⇒ Retardo de transferência aleatório
 - ⇒ Instabilidade em sobrecarga
- 29

Redes de Computadores

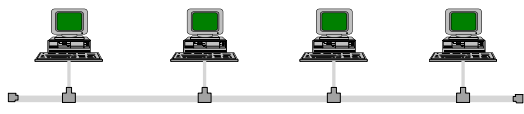
CSMA

Carrier Sense Multiple Access

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CSMA (Carrier Sense Multiple Access)


Redes de Computadores



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CSMA

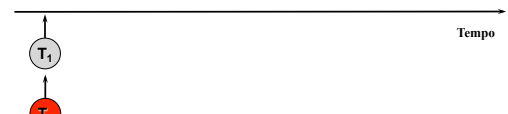
Redes de Computadores



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CSMA

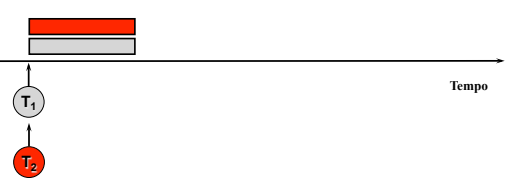
Redes de Computadores



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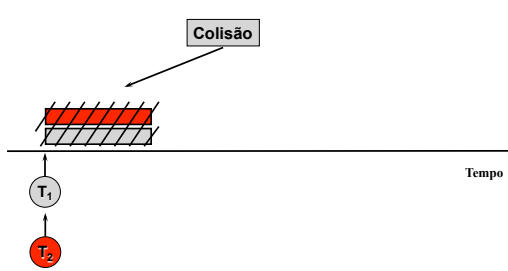
Redes de Computadores



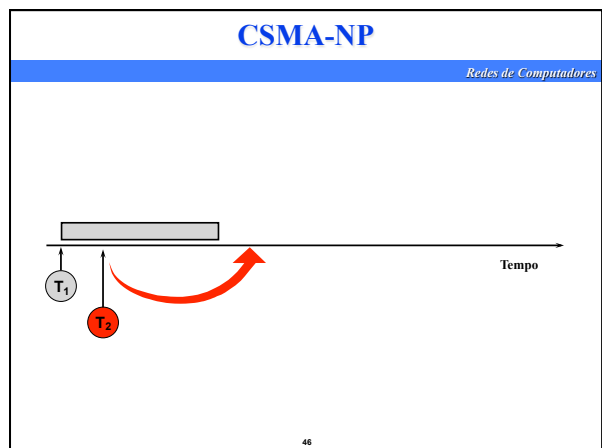
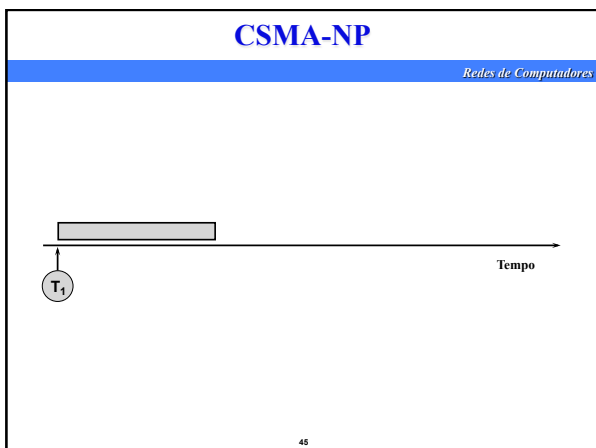
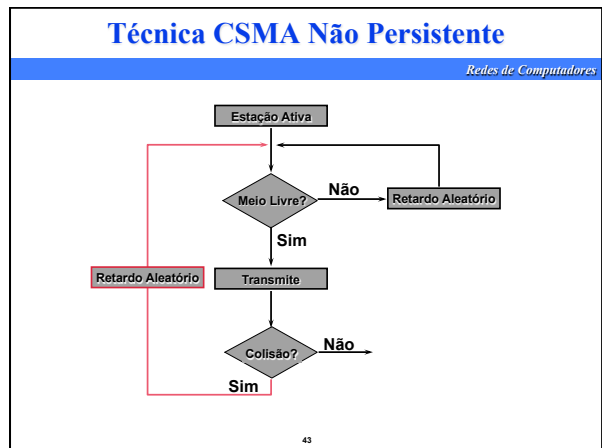
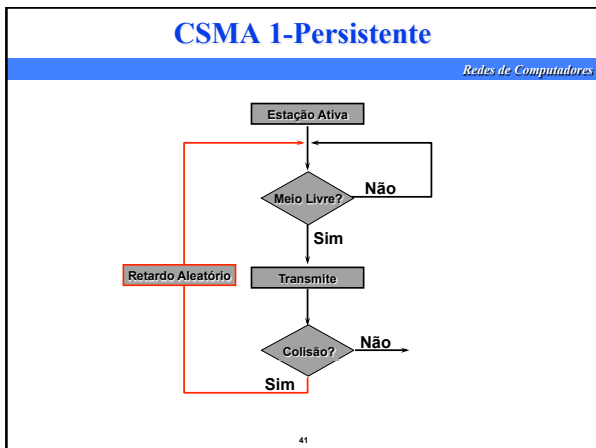
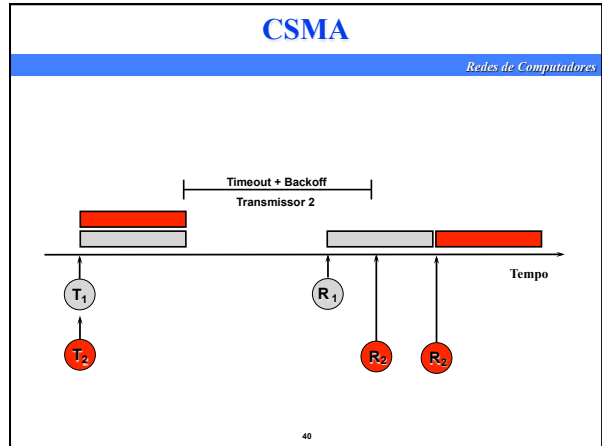
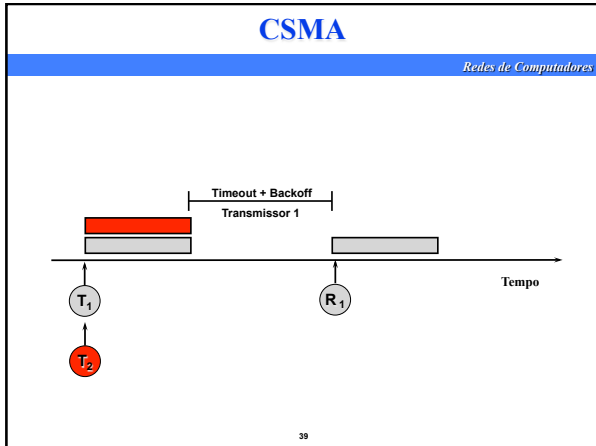
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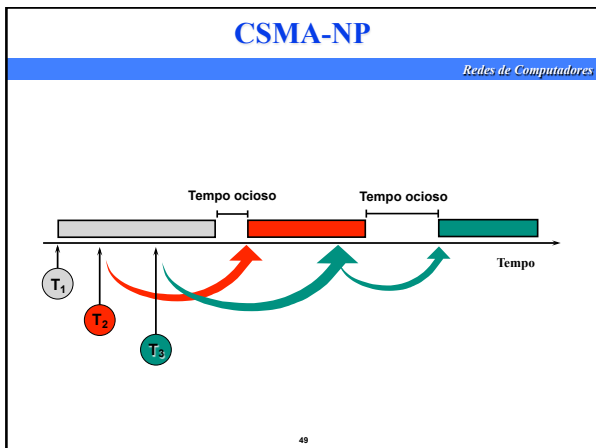
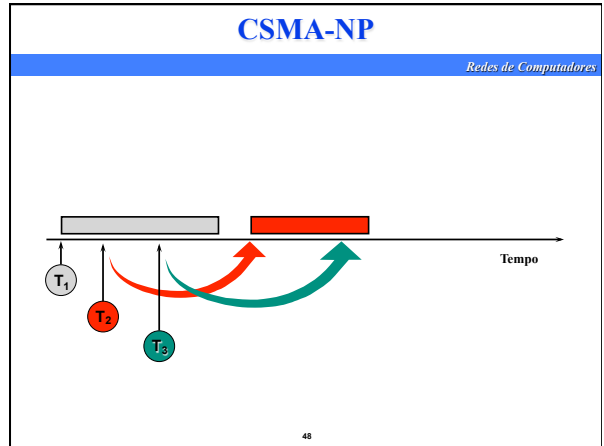
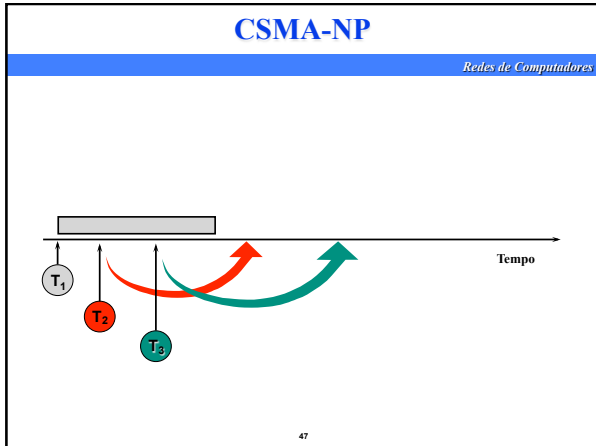
CSMA

Redes de Computadores



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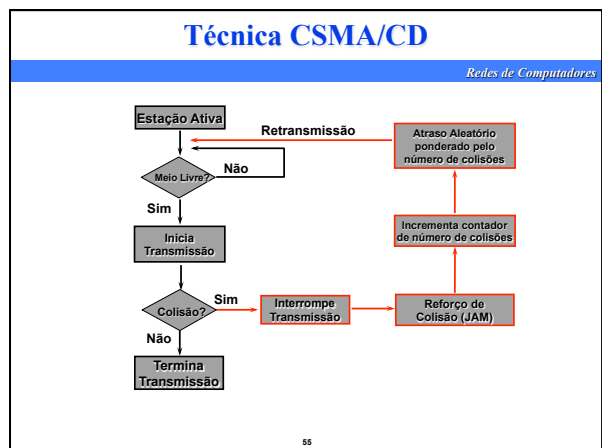
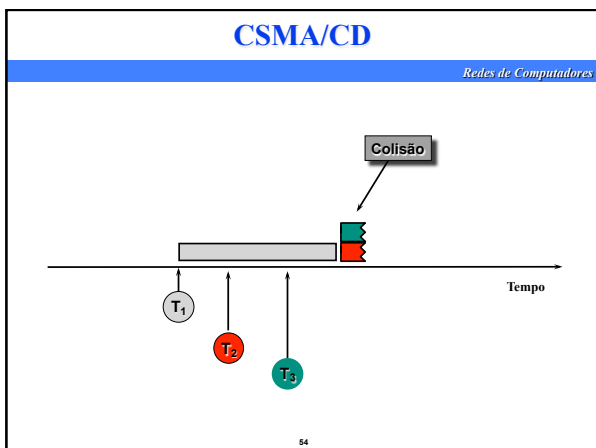


CSMA/CD

**Carrier Sense Multiple Access
with Collision Detection**

Redes de Computadores

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CSMA/CD - Retransmissão

Redes de Computadores

⇨ Espera Aleatória Exponencial Truncada

- se houve colisão, espera tempo aleatório entre 0 e limite
- o limite é dobrado a cada colisão sucessiva até o número máximo de colisões. Se não conseguir transmitir aborta.
- retardo de transmissão pequeno no começo e grande depois, impedindo sobrecarga
- padrão IEEE 802.3: limite dobra até 10 tentativas, depois permanece inalterado até no máximo 16 tentativas

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CSMA/CD

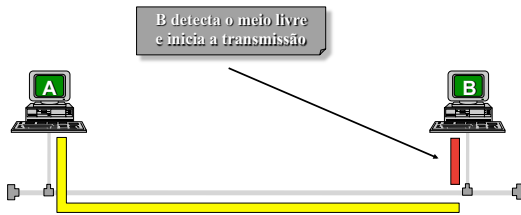
Redes de Computadores



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CSMA/CD

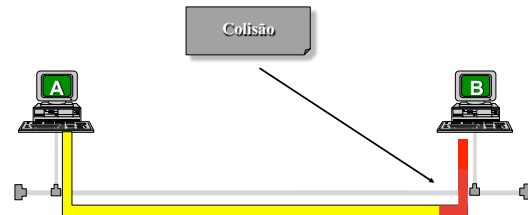
Redes de Computadores



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CSMA/CD

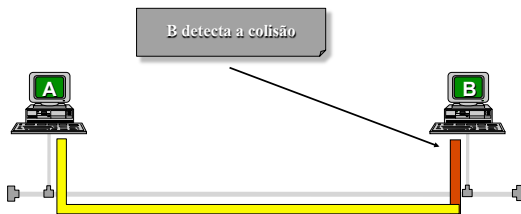
Redes de Computadores



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CSMA/CD

Redes de Computadores



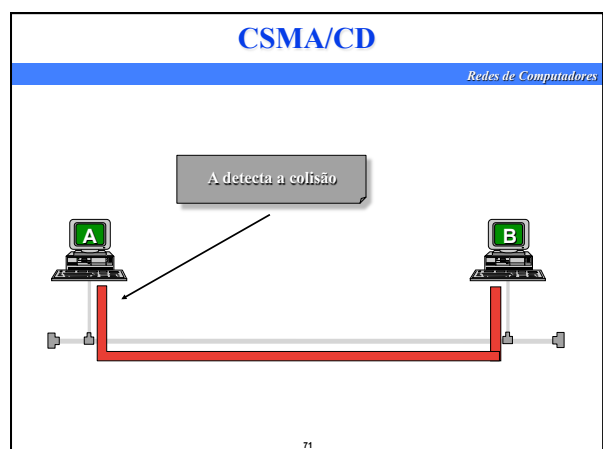
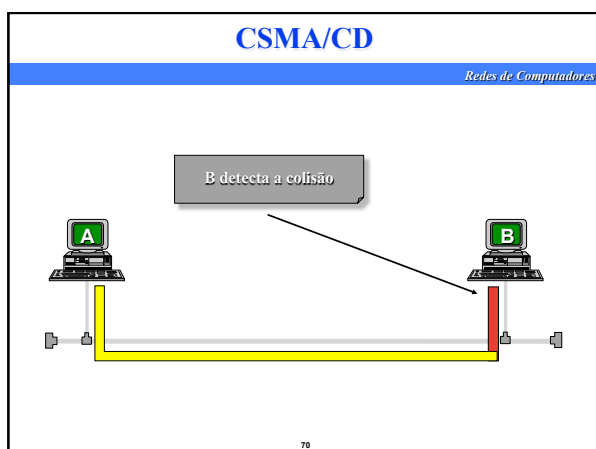
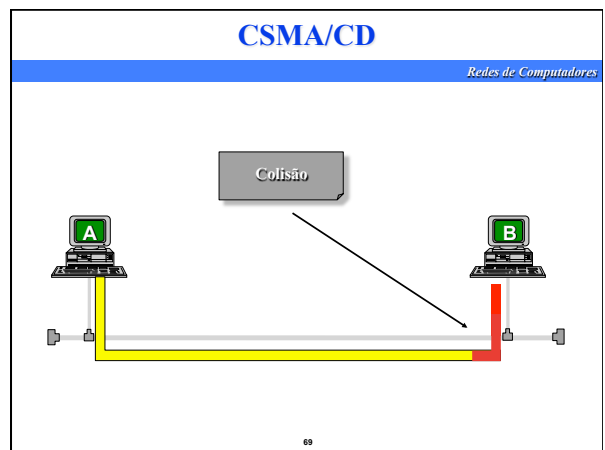
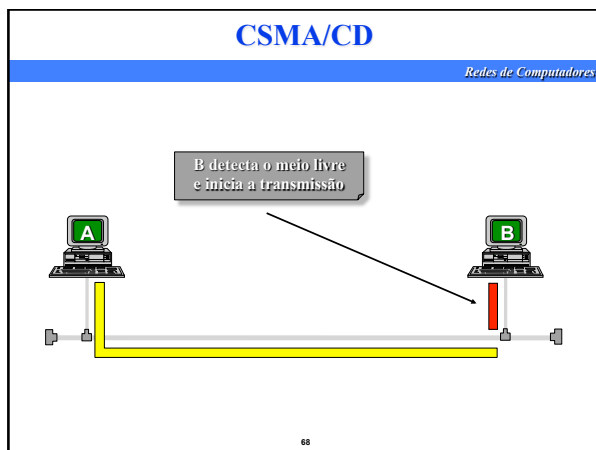
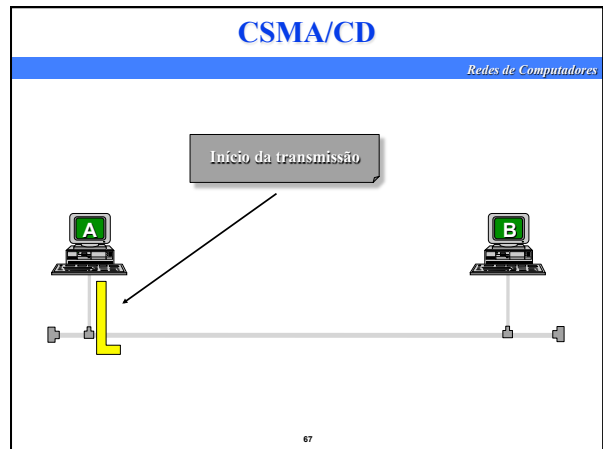
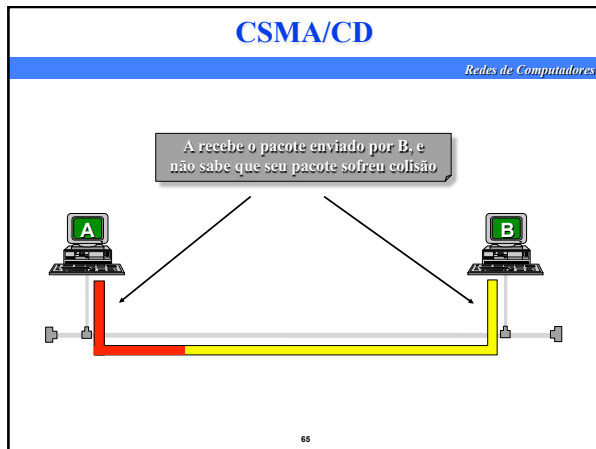
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CSMA/CD

Redes de Computadores



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CSMA/CD

Redes de Computadores

⇒ $M \geq 2 C T_p$ - Banda Básica

- M é o tamanho do pacote em bits
- C é a taxa de transmissão da rede em bps
- T_p é o tempo de propagação do sinal no meio (considerando retardo de repetidores)

⇒ $M \geq 4 C T_p$ - Banda Larga

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CSMA/CD

Redes de Computadores

- ⇒ Eficiência: 98%
- ⇒ Instável em alto tráfego
- ⇒ Retardo aleatório não limitado
- ⇒ Injusto
- ⇒ Distância máxima entre dois nós é limitada pelo protocolo de acesso

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CSMA/CA

Carrier Sense Multiple Access
with Collision Avoidance

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CSMA/CA

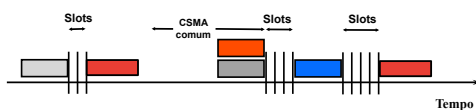
Redes de Computadores

- ⇒ Escuta o meio verificando se está livre, se estiver, transmite, senão aguarda o fim da transmissão
- ⇒ Cada estação que deseja transmitir escolhe aleatoriamente um slot para iniciar sua transmissão
- ⇒ Depois de cada transmissão, estações começam a contagem de intervalos de tempo (slots)
- ⇒ Quem escolher o menor slot, transmite primeiro e ganha o meio
- ⇒ Se mais de uma estação sortear o mesmo slot => colisão
- ⇒ Se nenhuma estação transmitir, a rede entra no modo CSMA comum, podendo ocorrer colisões
- ⇒ Detecta colisão pela ausência do ACK (reconhecimento)

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CSMA/CA

Redes de Computadores



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Protocolos de Acesso Ordenado

Redes de Computadores

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Protocolos de Acesso Ordenado

Redes de Computadores

- ⇒ Retardo de transferência limitado
- ⇒ Justo (“fair”)
- ⇒ Estável em sobrecarga

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Protocolos de Acesso Ordenado

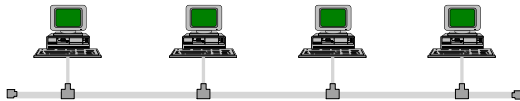
Redes de Computadores

- ⇒ Polling
- ⇒ Token Passing - Passagem de Permissão

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Polling

Redes de Computadores



- ⇒ Topologia lógica: barra
- ⇒ Estação central: controladora
- ⇒ Estações só transmitem quando interrogadas pela controladora da rede
- ⇒ Se não tiver quadro a transmitir, envia um quadro de status avisando a controladora

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Polling

Redes de Computadores

- ⇒ Justo
- ⇒ Prioridade
- ⇒ Retardo de transferência limitado
- ⇒ Estável em sobrecarga
- ⇒ Interface simples de pequeno custo
- ⇒ Problema de confiabilidade devido a estrutura centralizada
- ⇒ Interessante quando características das estações são bem conhecidas, podendo ser usadas para determinar a disciplina de passagem de controle

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Passagem de Permissão - Token Passing

Redes de Computadores

- ⇒ O token (permissão) é passado sequencialmente de uma estação para outra
- ⇒ Só quem tem o token pode transmitir
- ⇒ Topologia: anel (Token Ring) ou barra (Token Bus)
 - *na topologia em barra, a ordem lógica não é necessariamente a ordem física*
 - *na topologia em anel as ordens lógica e física coincidem.*

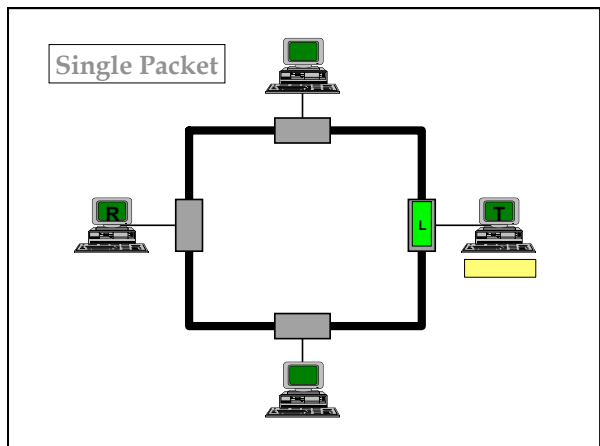
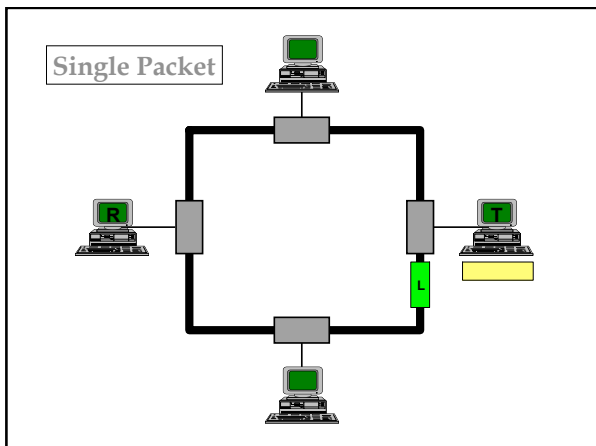
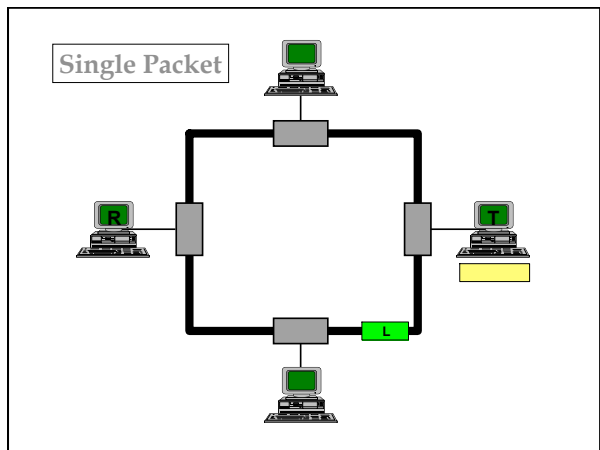
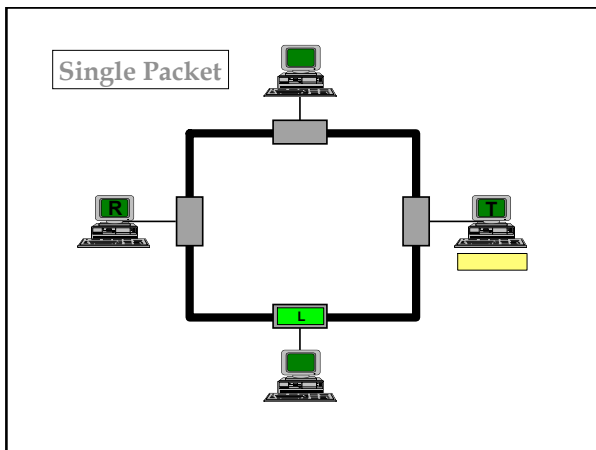
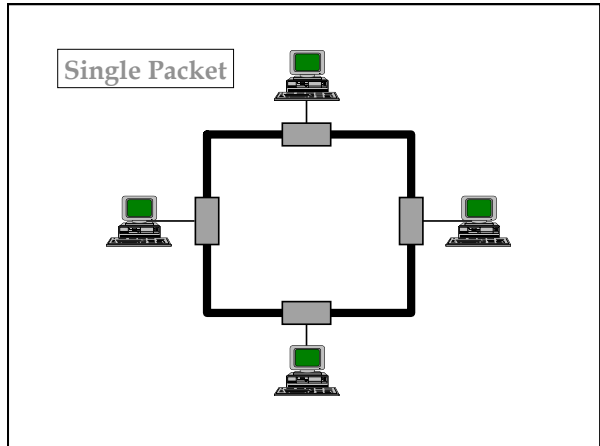
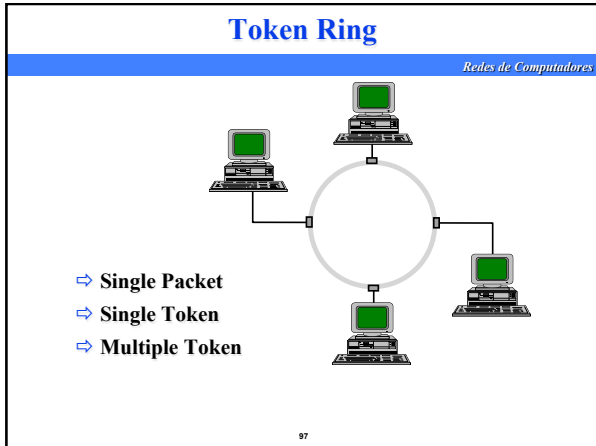
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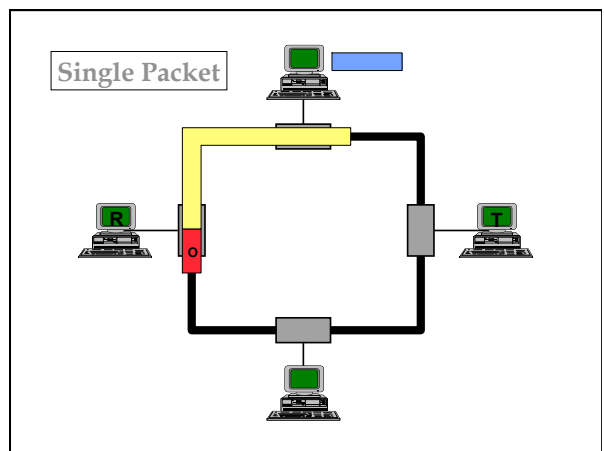
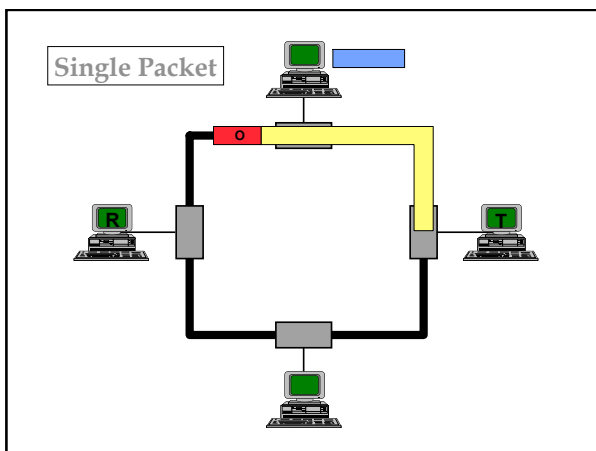
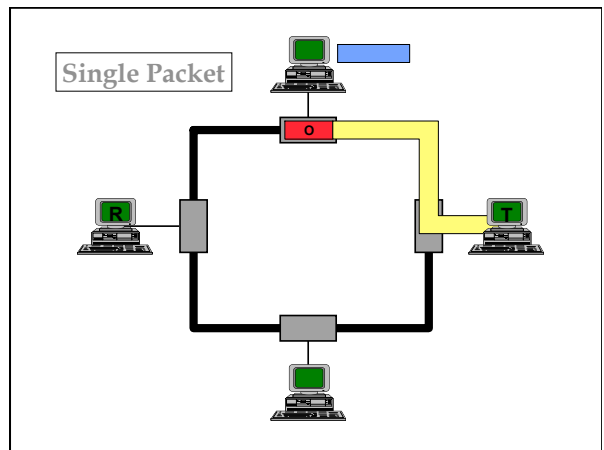
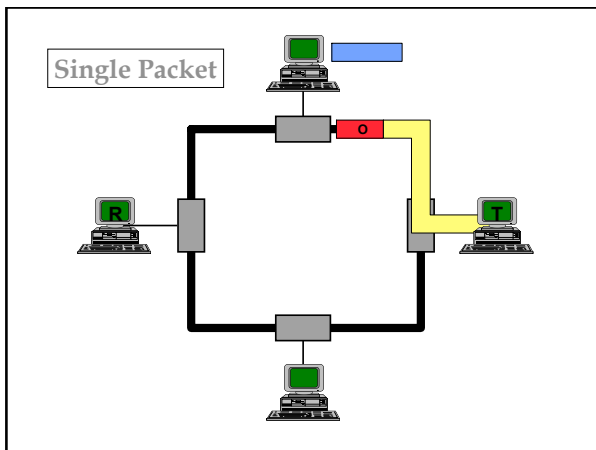
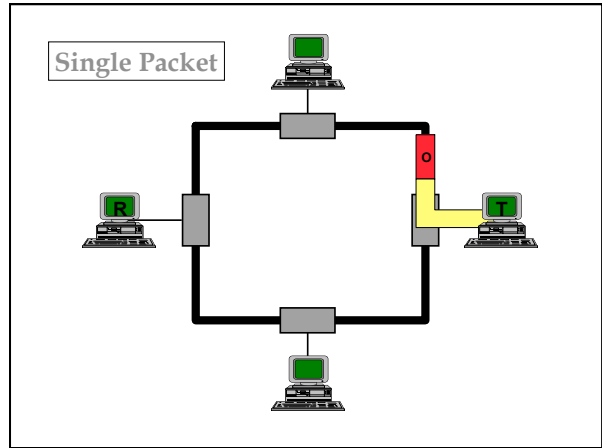
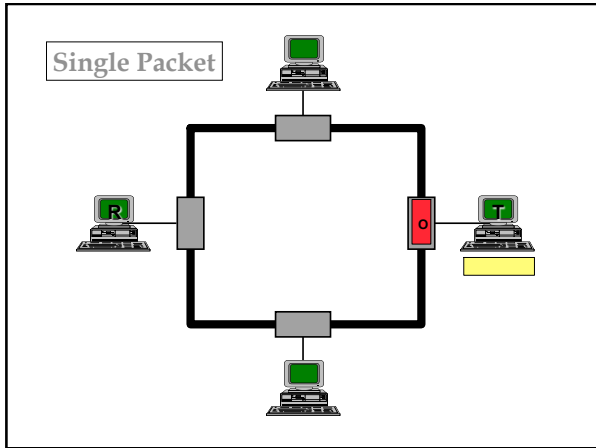
Token Ring

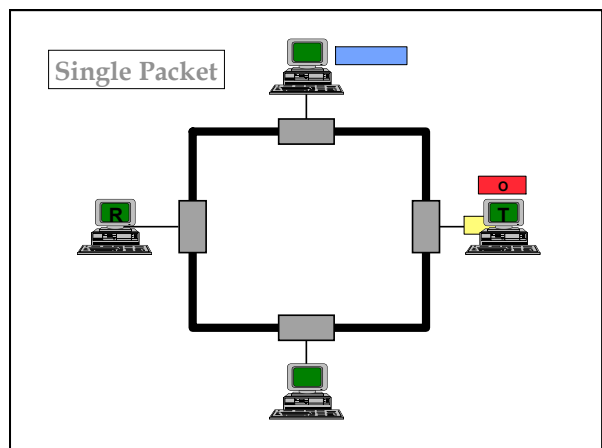
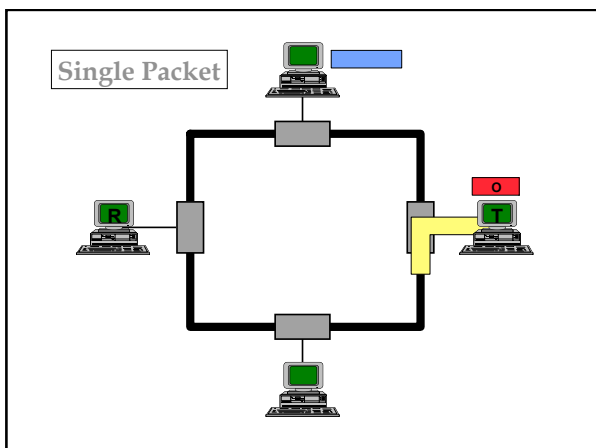
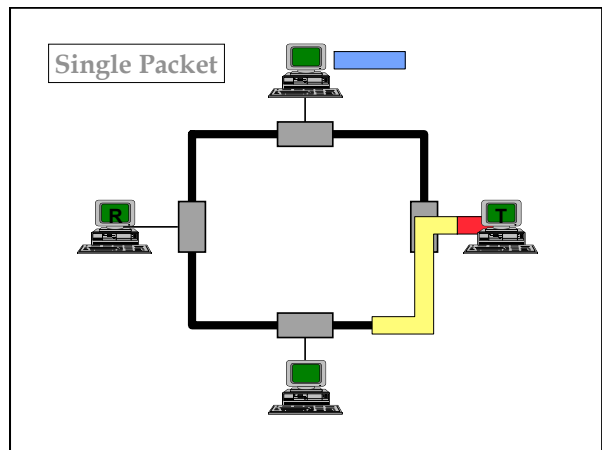
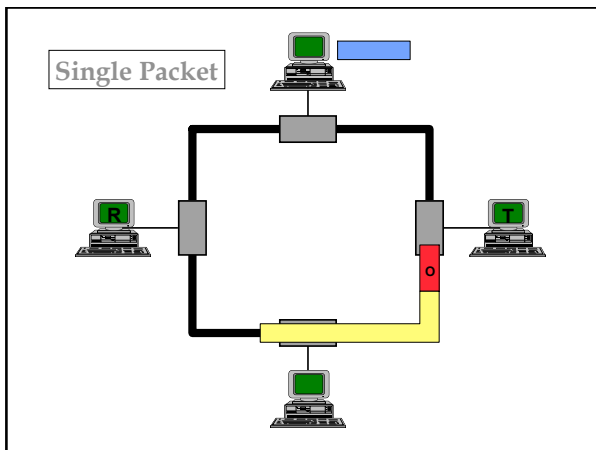
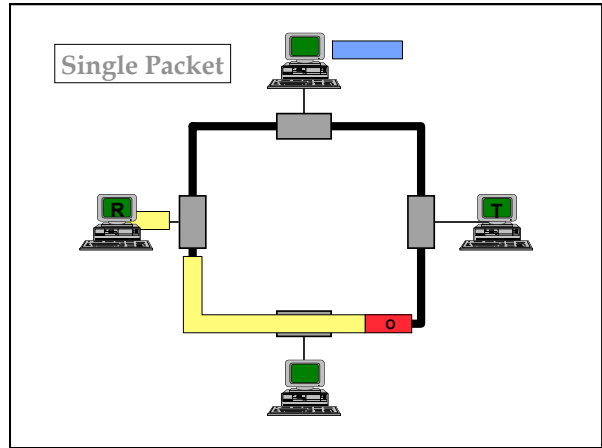
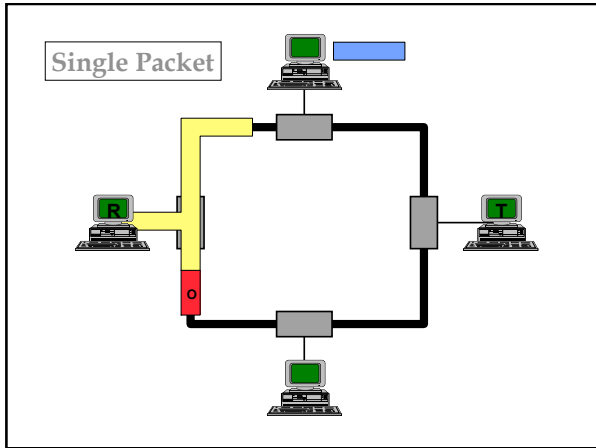
Redes de Computadores

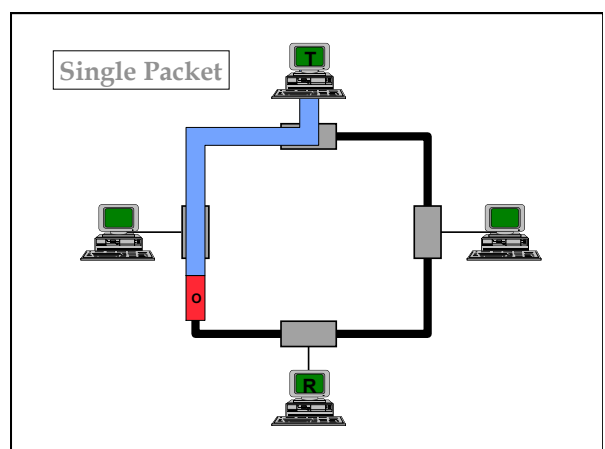
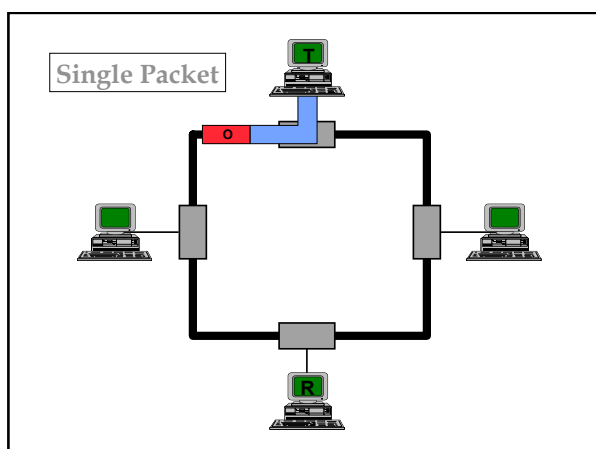
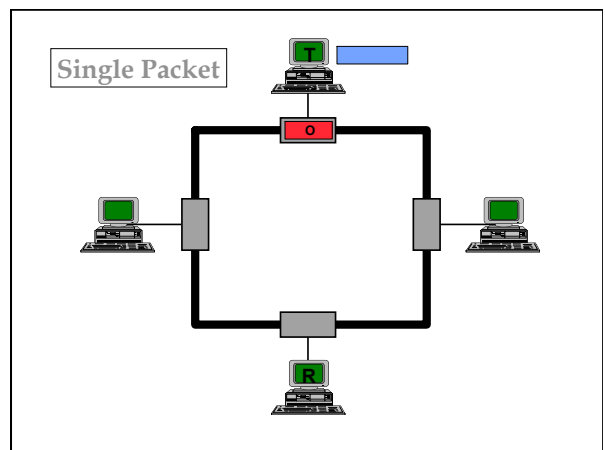
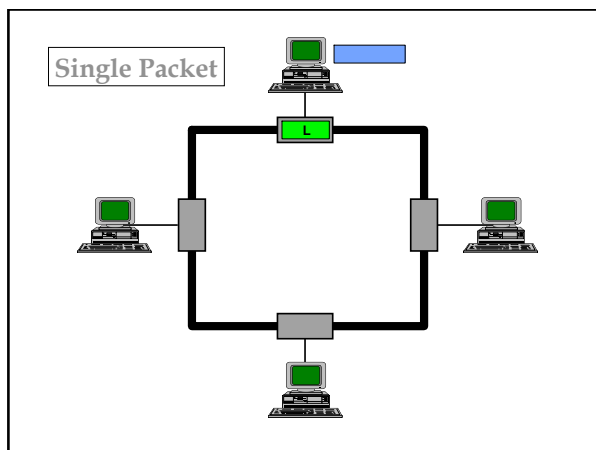
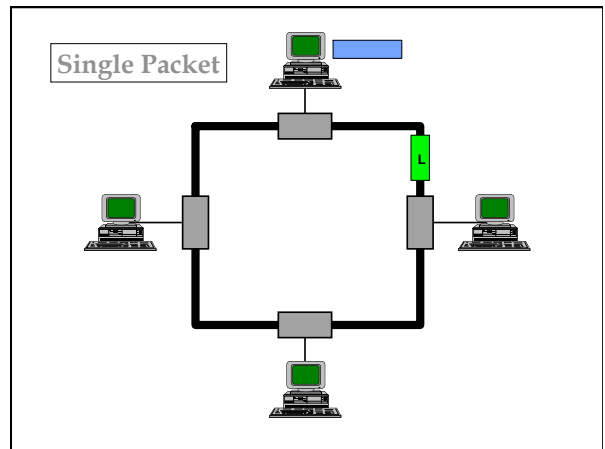
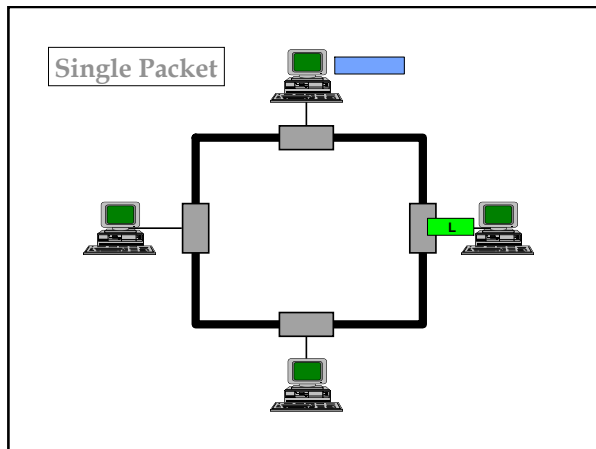
- ⇒ Técnica mais antiga para o anel, proposta em 1969 por Farmer e Newhall
- ⇒ Permissão circula no anel
- ⇒ Ao querer transmitir, a estação espera pela permissão livre, altera para ocupada e transmite seus dados em seguida
- ⇒ A transmissora é responsável pela retirada da mensagem do anel e pela inserção da nova permissão livre
- ⇒ O momento de inserção de uma nova permissão livre no anel varia conforme o tipo de operação

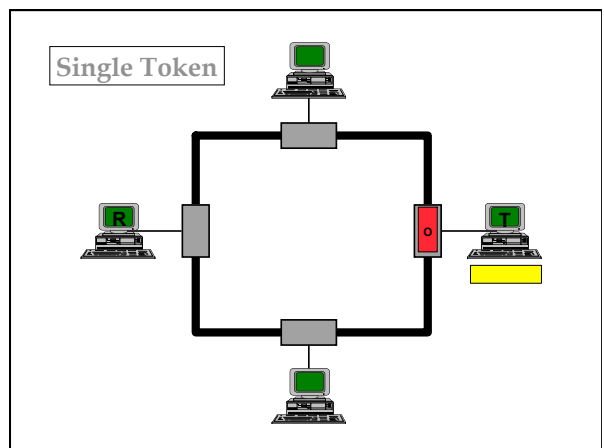
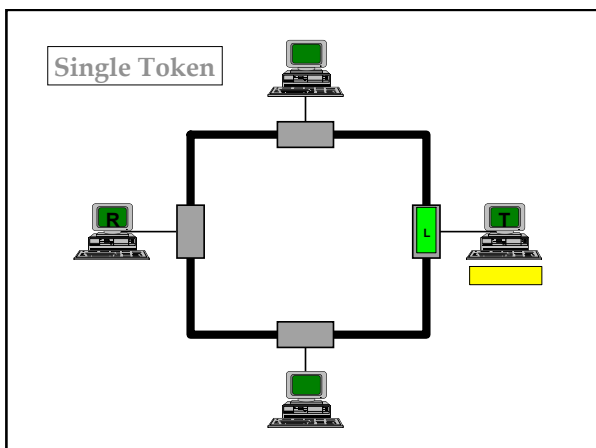
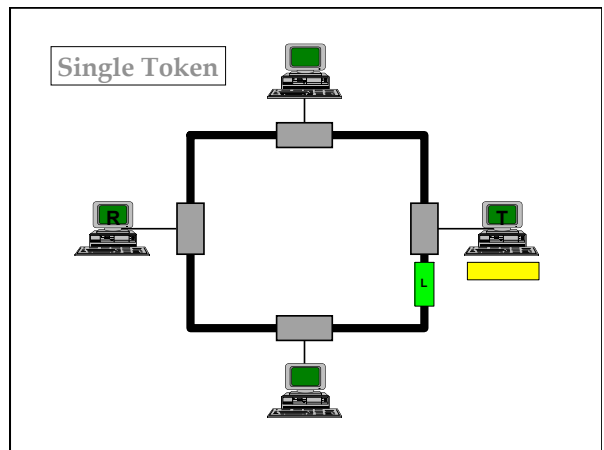
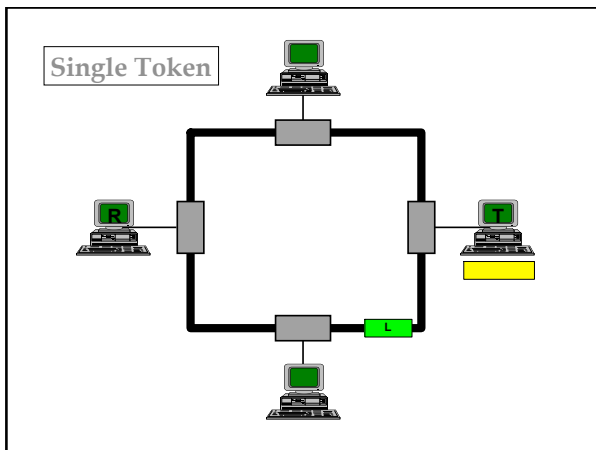
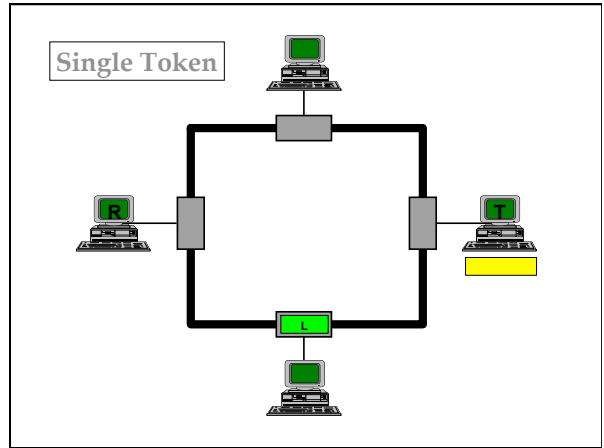
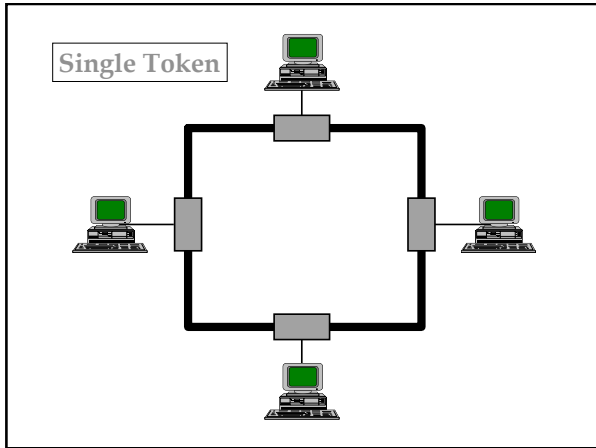
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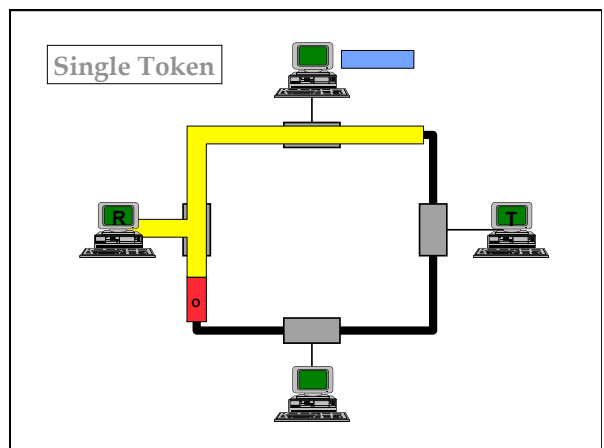
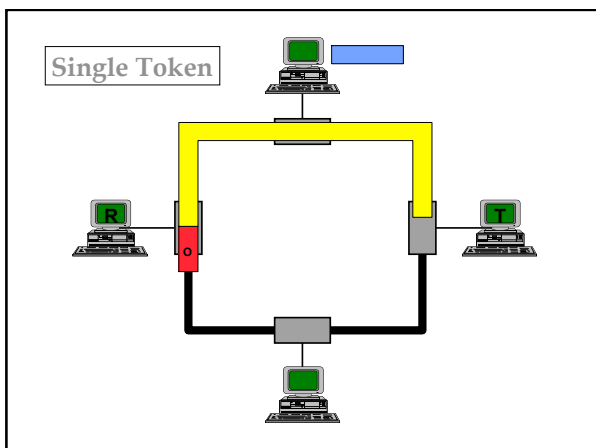
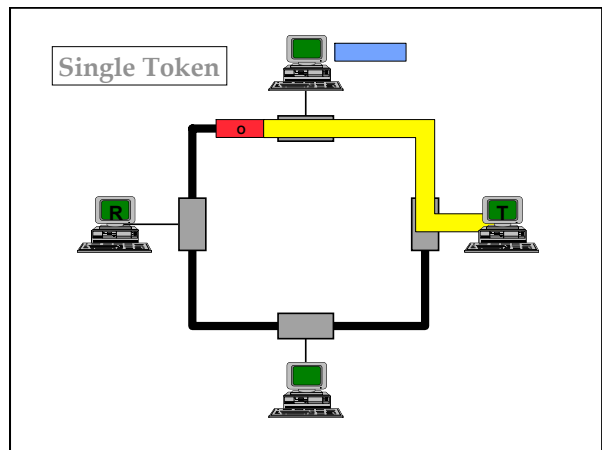
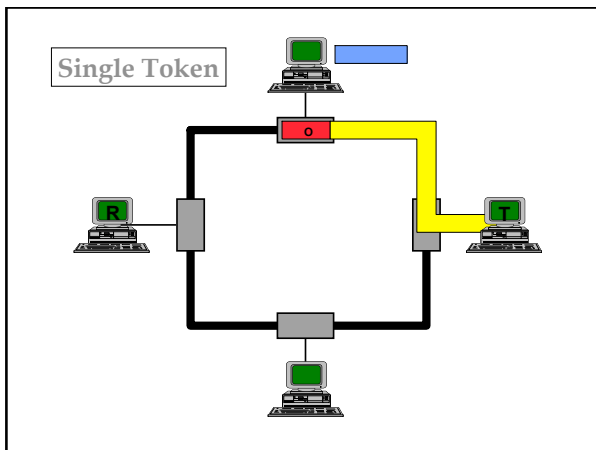
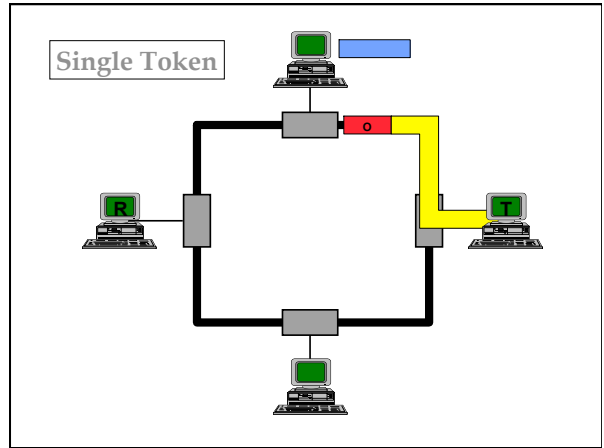
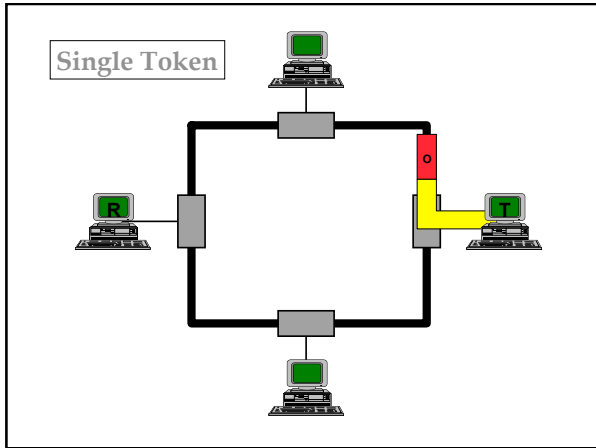


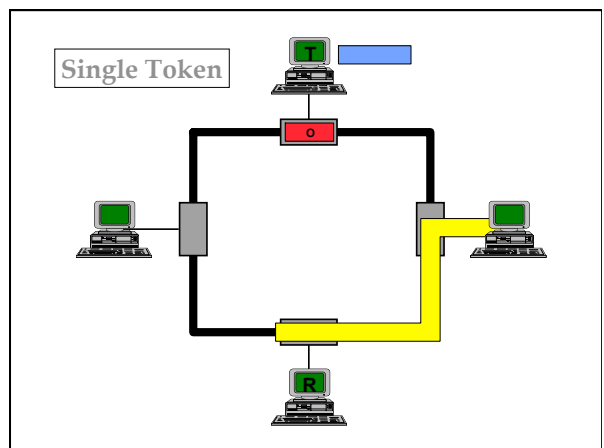
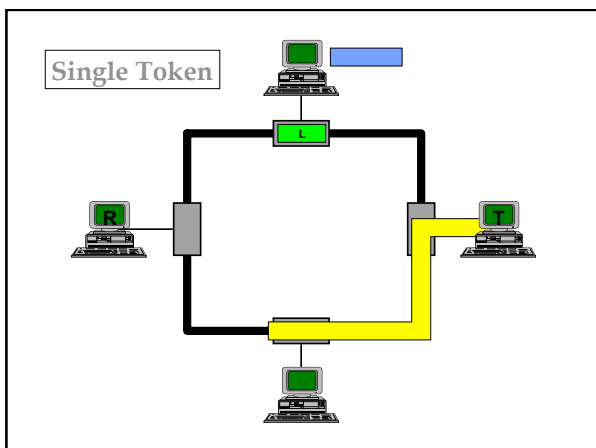
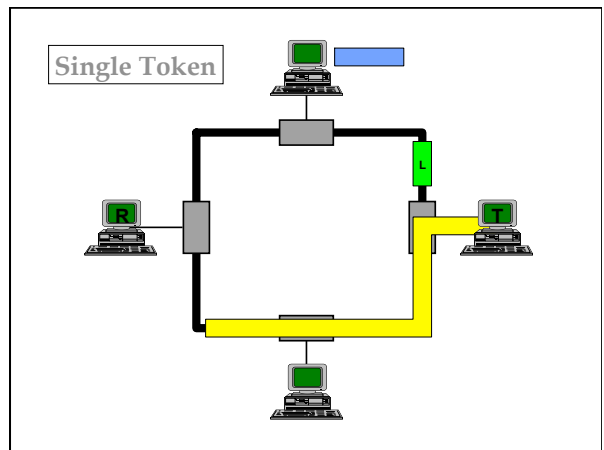
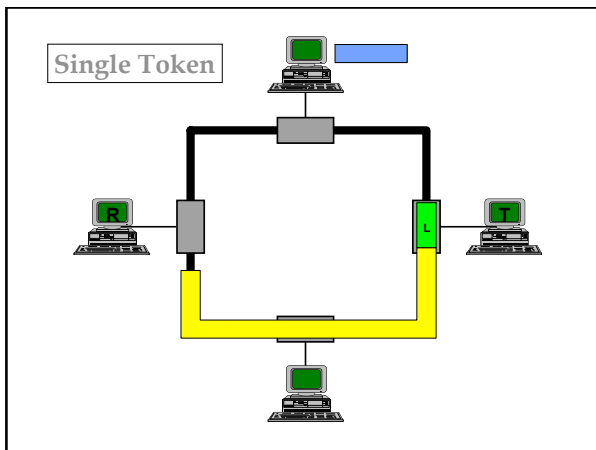
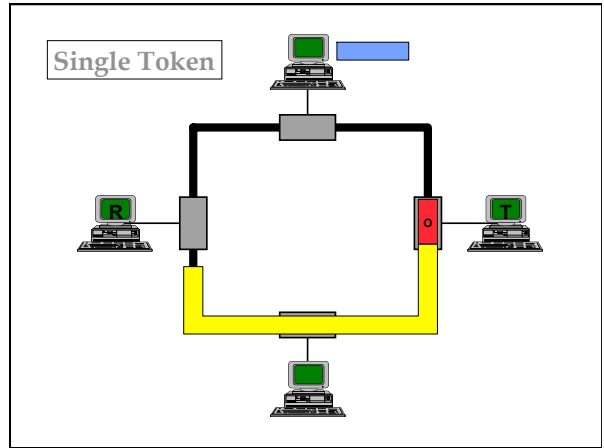
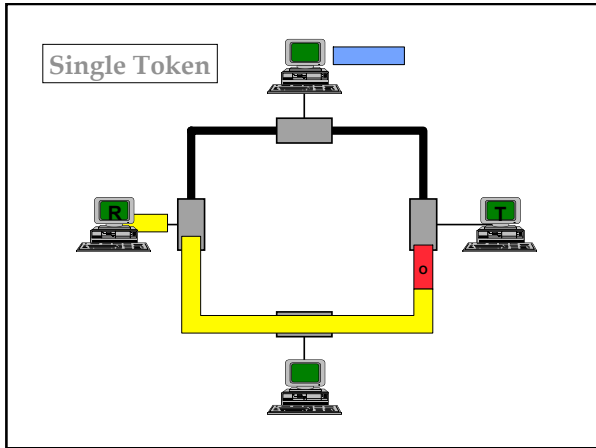


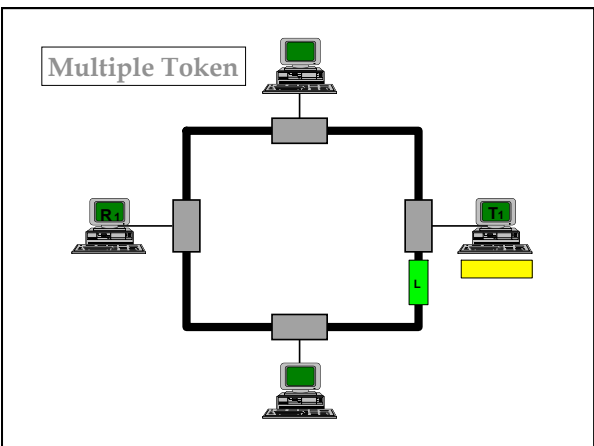
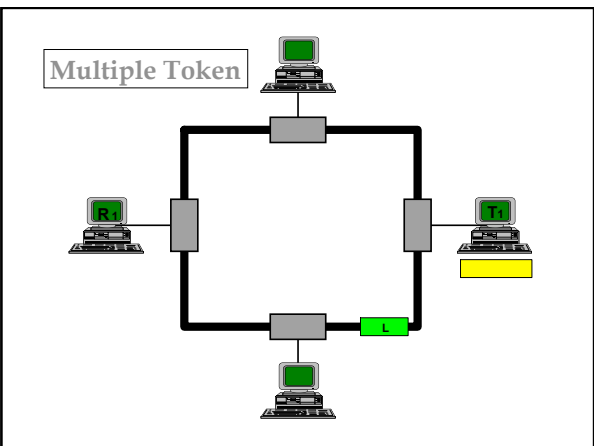
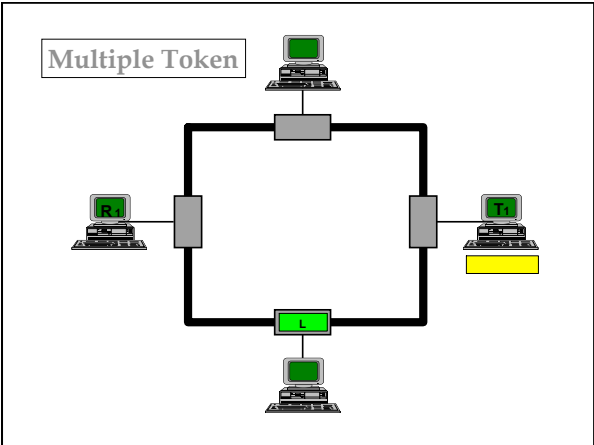
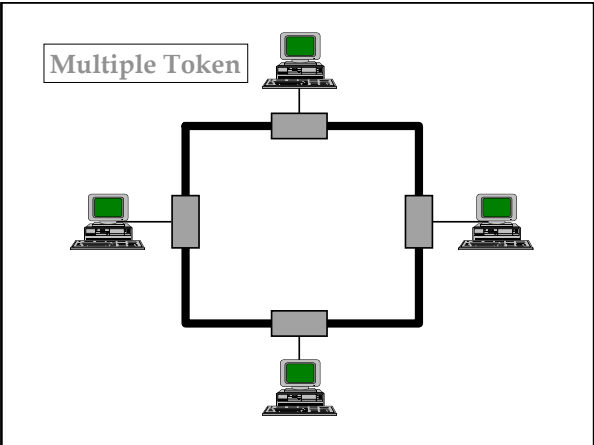
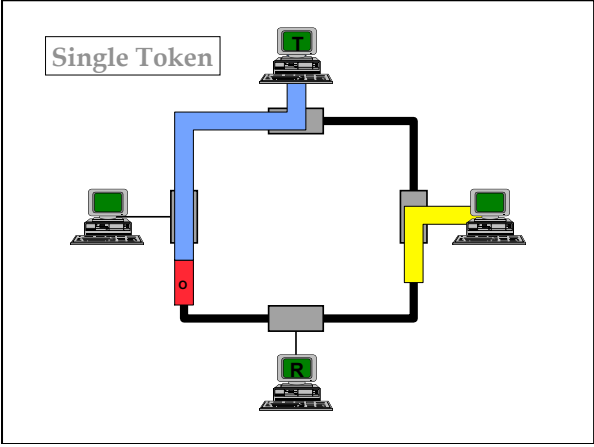
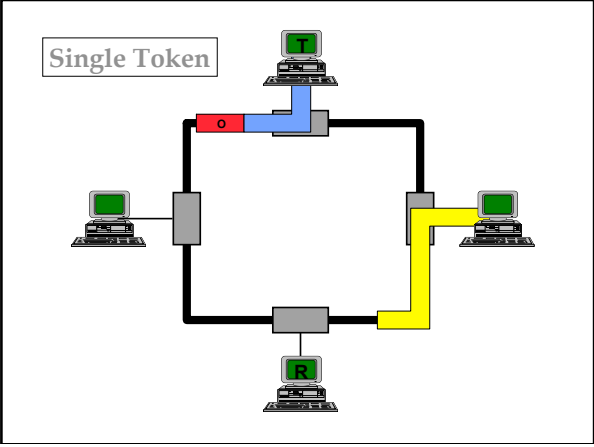


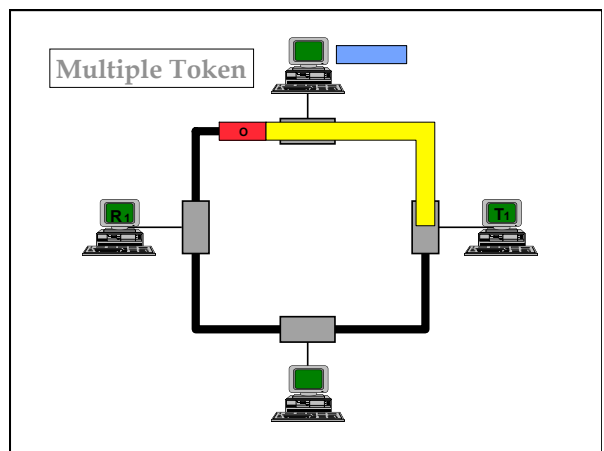
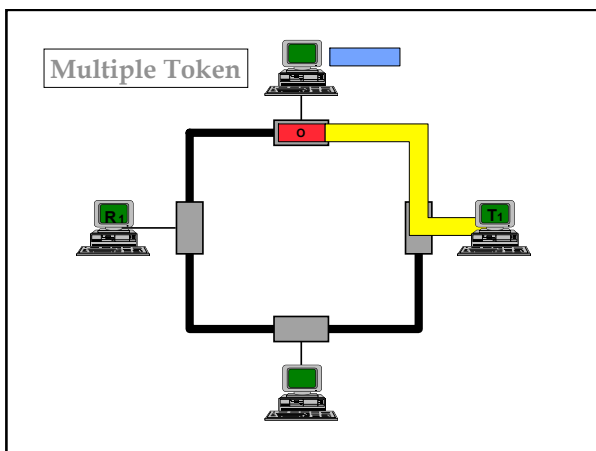
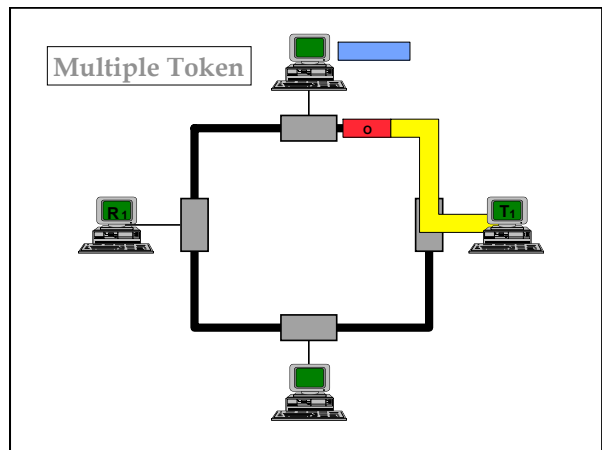
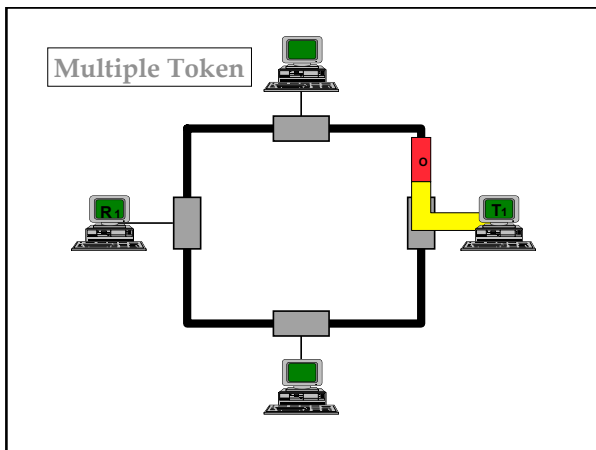
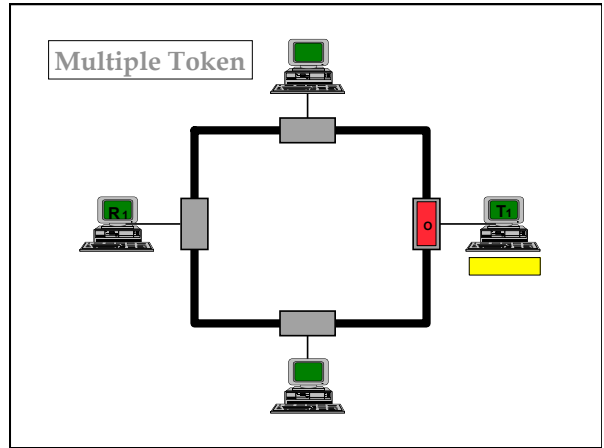
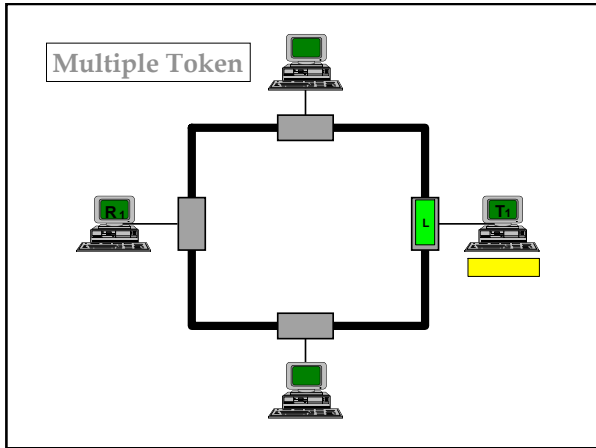


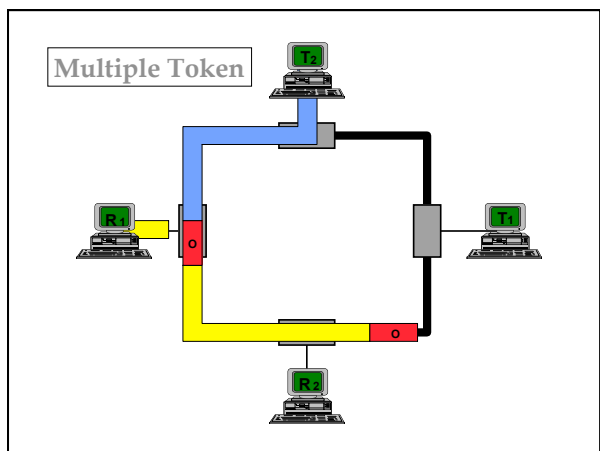
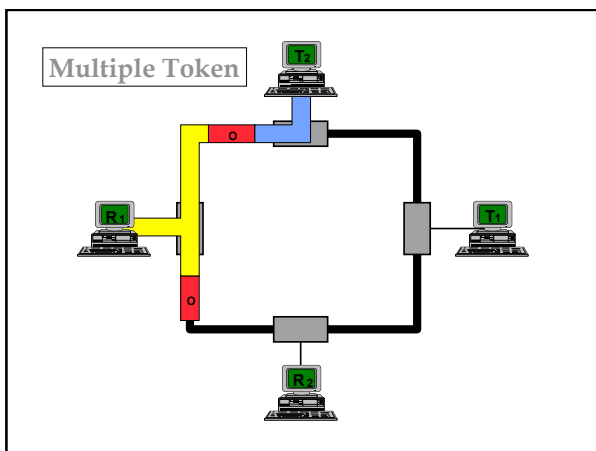
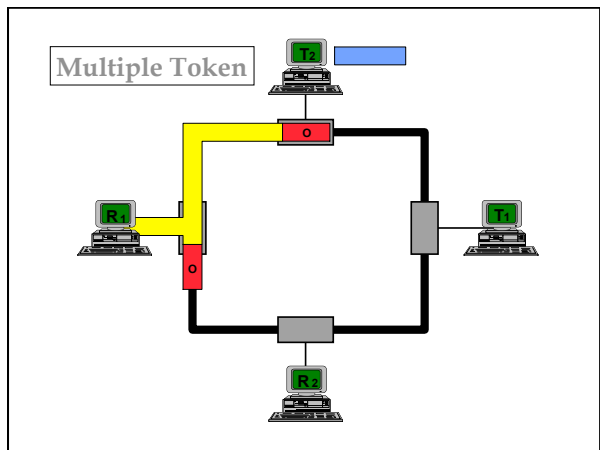
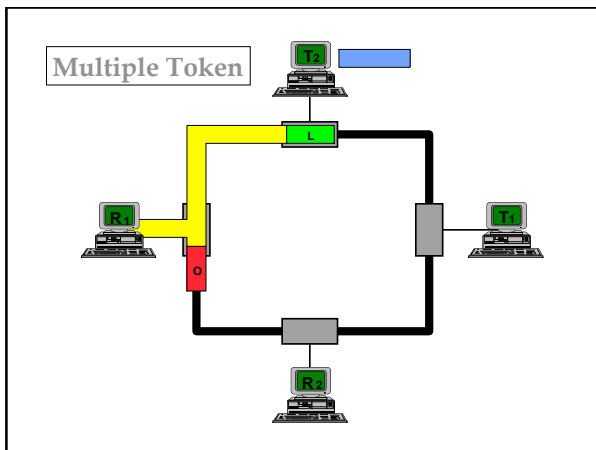
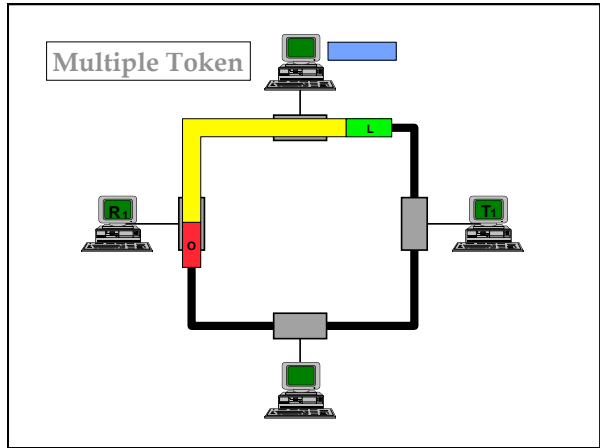
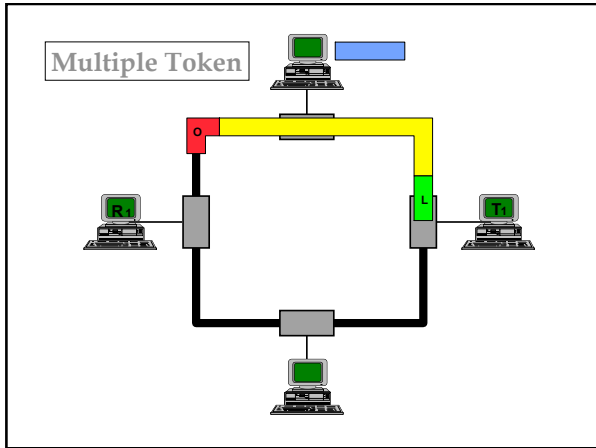


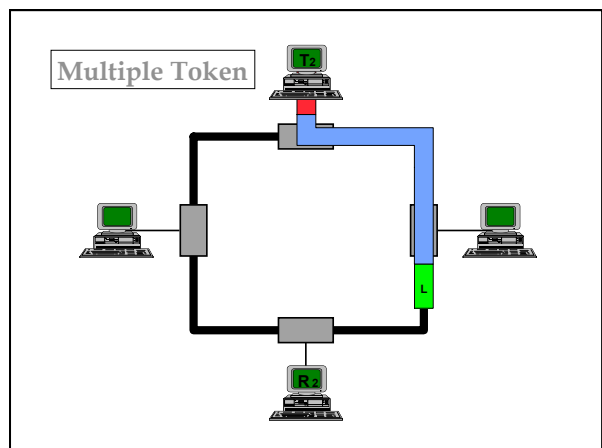
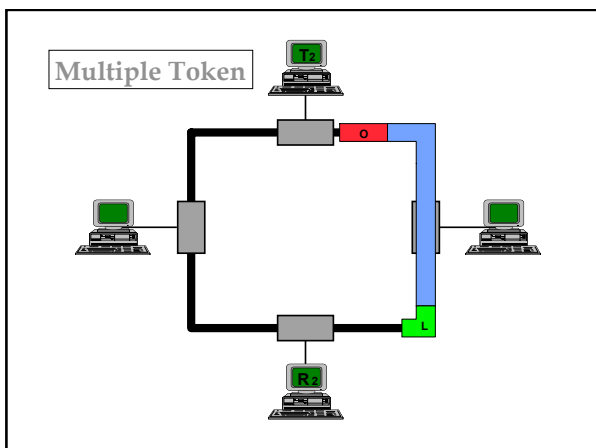
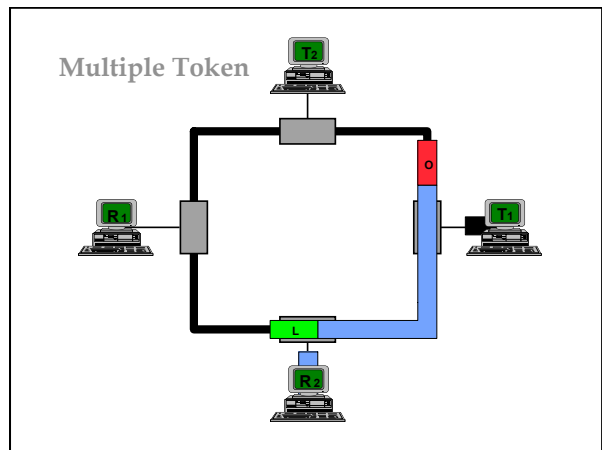
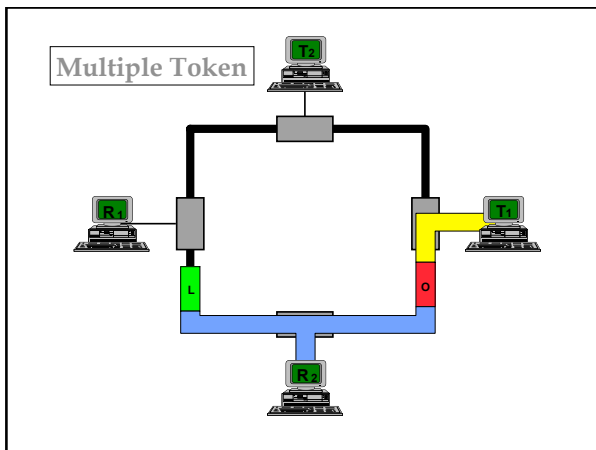
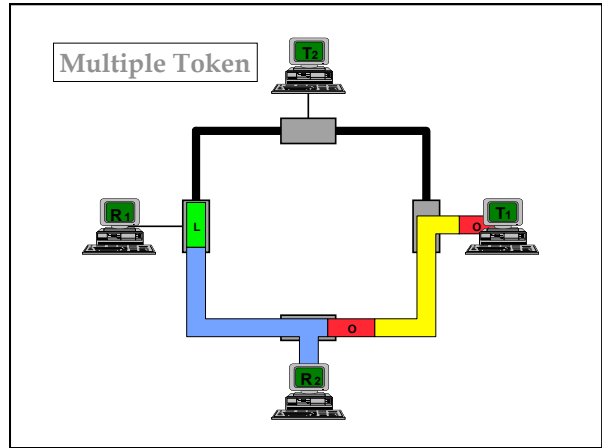
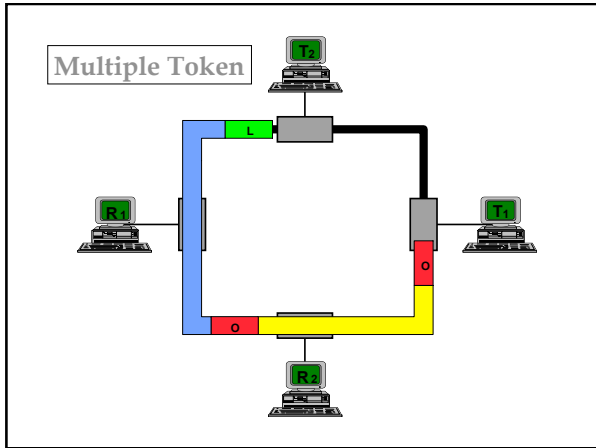


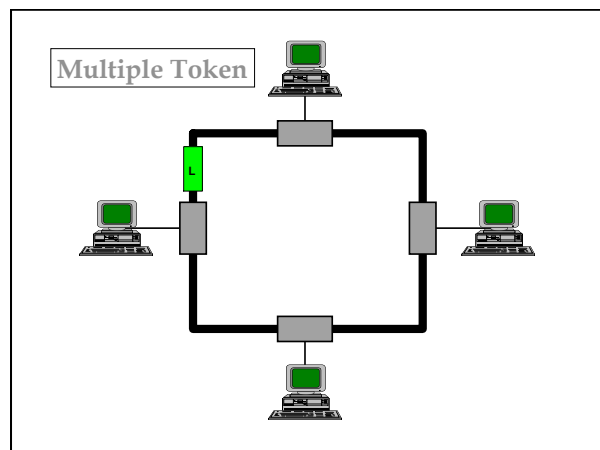
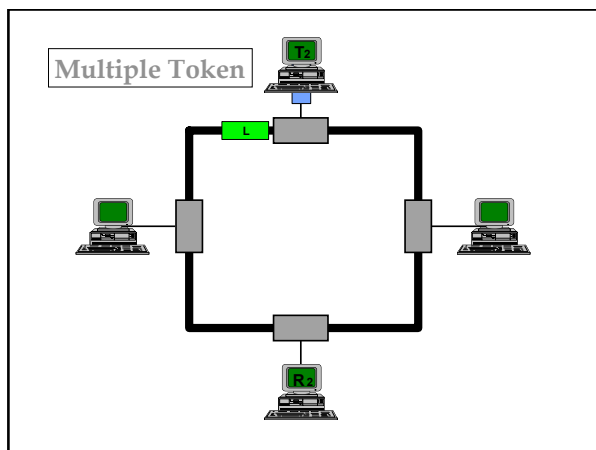
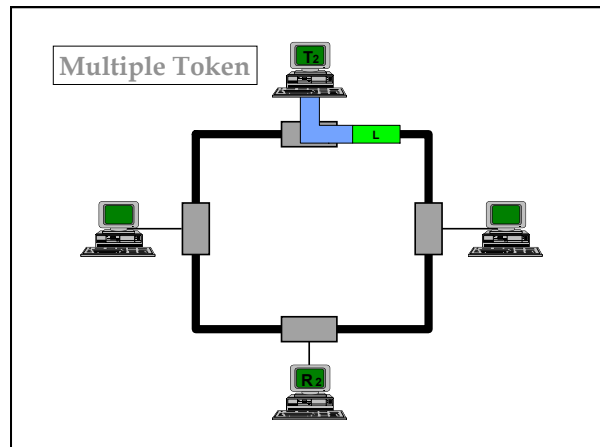
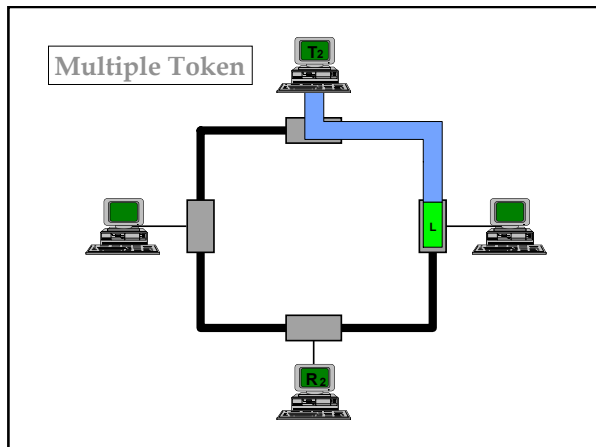












Token Ring

Redes de Computadores

- ⇨ Eficiência
- ⇨ Equidade
- ⇨ Prioridade
- ⇨ Retardo de transferência
- ⇨ Estabilidade em sobrecarga

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Latência do Anel

Redes de Computadores

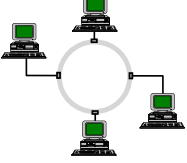
- ⇨ Latência = soma do retardo dos repetidores e do tempo de propagação no anel
- ⇨ Podem existir tantos bits circulando quanto sua latência permitir
- ⇨ A latência pode ser aumentada introduzindo um buffer de retardo em qualquer estação

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Comparação entre os Tipos de Operação do Token Ring

Redes de Computadores

- ⇒ Se a latência for desprezível, os três tipos de operação têm o mesmo desempenho



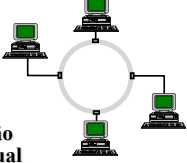
- ⇒ O instante de tempo em que a estação termina de transmitir é igual ao instante em que chega o último bit transmitido de volta a origem

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Comparação entre os Tipos de Operação do Token Ring

Redes de Computadores

- ⇒ $L =$ latência; $t =$ tempo de transmissão de 1 quadro
- ⇒ Se $L \leq t$, single token e multiple token são mais eficientes que single packet



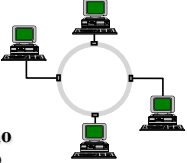
- ⇒ O instante de tempo em que a estação termina de transmitir é maior ou igual ao instante em que chega o primeiro bit transmitido de volta a origem

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Comparação entre os Tipos de Operação do Token Ring

Redes de Computadores

- ⇒ $L =$ latência; $t =$ tempo de transmissão de 1 quadro
- ⇒ Se $L > t$, multiple token é mais eficiente que single token que é mais eficiente que single packet



- ⇒ O instante de tempo em que a estação termina de transmitir é menor que o instante em que chega o primeiro bit transmitido de volta a origem

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