



UNIVERSIDADE  
FEDERAL DO CEARÁ  
CAMPUS DE QUIXADÁ

## CURSO DE ENGENHARIA DE SOFTWARE

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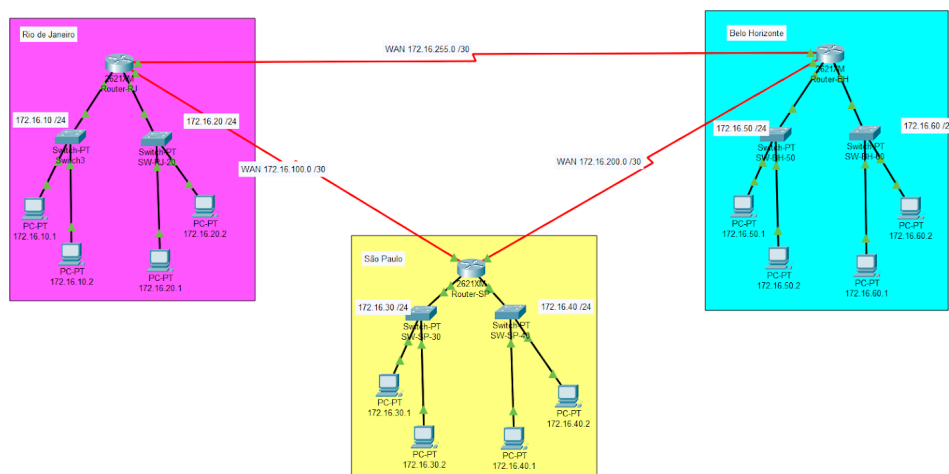
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# 1 Introdução

O presente relatório tem como objetivo descrever a experiência da equipe com a ferramenta Cisco Packet Tracer, assim como a implementação de 3 cenários diferentes com diferentes conexões, assim como todo o processo de testagem de cada uma das conexões com todos os dispositivos conectados em cada sub-rede em todos os cenários. Por meio de linhas de comandos, nós conseguimos testar a efetividade e a tenacidade em cada cenário, para cada sub-rede. O cenário a ser resolvido no presente trabalho, contava com três unidades de uma empresa, localizadas no Rio de Janeiro, em São Paulo e em Minas Gerais, e em cada unidade nas presentes cidades contava com duas sub-redes. Nosso objetivo era implementar diferentes conexões em cada unidade, e fazer com que todas as 3 unidades pudessem se comunicar entre si. Os seguintes cenários são:

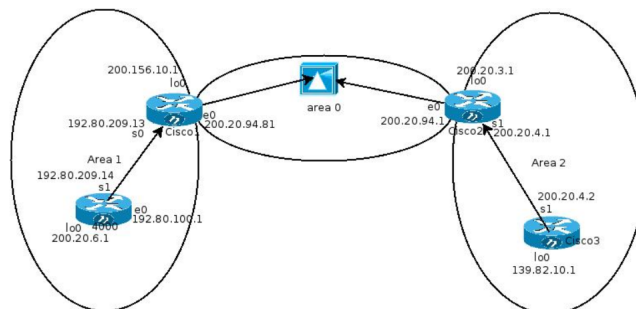
- Cenário 1: Roteamento estático.
- Cenário 2: Roteamento dinâmico com RIP.
- Cenário 3: Roteamento dinâmico com OSPF.



Os 3 cenários contam com 3 diferentes conexões, no cenário 1 temos um roteamento estático, no cenário 2 um roteamento dinâmico com RIP e no cenário 3 um roteamento dinâmico com OSPF.

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## 2 ROTEAMENTO ESTÁTICO



Um endereço de IP estático basicamente não muda. Quando um dispositivo é configurado com um certo endereço IP, este endereço não vai mudar até que o dispositivo seja reconfigurado ou se a estrutura da rede eventualmente mude. Agora que sabemos o que é um IP estático, podemos continuar com o Roteamento estático. O roteamento estático é uma forma de roteamento que ocorre quando o roteador usa uma entrada de roteamento manualmente configurada ao invés de uma configuração dinamicamente gerada. Em muitos casos, esses endereços estáticos são manualmente configurados pelo administrador da rede. Todavia, roteamento estático e dinâmico não são mutuamente exclusivos. Ambos estáticos e dinâmicos são geralmente usados para melhorar a eficiência dos roteamento.

## 3 ROTEAMENTO DINÂMICO COM RIP

Routing Information Protocol(RIP) é um protocolo de roteamento dinâmico na qual usa hop count como métrica de roteamento para achar o melhor caminho entre a fonte e o destino da rede.

### 3.1 HOUP COUNT

count is a rough measure of distance between two hosts.

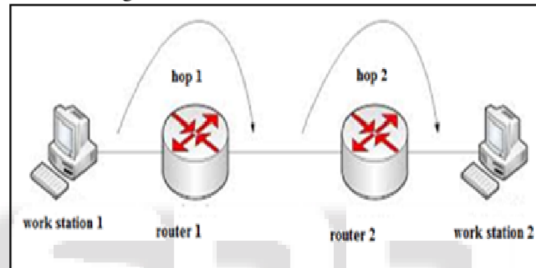


Fig. 1: Image of hop count

A. *RREQ Extension:*

Hop count é o número de roteadores entre a fonte e o destino na rede. O caminho com o menor número de hop count é considerado a melhor rota a ser feita para chegar na rede de destino.

### 3.2 FUNCIONALIDADES DO RIP

- Atualizações da rede são trocadas periodicamente entre os roteadores
- Atualizações (informações de roteamento) são sempre transmitidas
- As tabelas de roteamento são sempre enviadas a cada atualização
- Os roteadores sempre confiam nas informações de roteamento recebidas dos roteadores vizinhos. Isso também é conhecido como Routing on rumours (Tradução livre: Roteamento em rumores).

### 3.3 Versoes do Routing Information Protocol(RIP)

O RIP conta com 3 versões de de protocolo de roteamento, são elas a RIP Version1, RIP Version2 e RIPng.

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RIP v1	RIP v2	RIPng
Sends update as broadcast	Sends update as multicast	Sends update as multicast
Broadcast at 255.255.255.255	Multicast at 224.0.0.9	Multicast at FF02::9 (RIPng can only run on IPv6 networks)
Doesn't support authentication of update messages	Supports authentication of RIPv2 update messages	–
Classful routing protocol	Classless protocol, supports classful	Classless updates are sent

### 3.4 RIP v1

Também conhecido como Classful Routing Protocol porque neste protocolo não ocorre o envio de informações da máscara da sub-rede nas suas atualizações de roteamento.

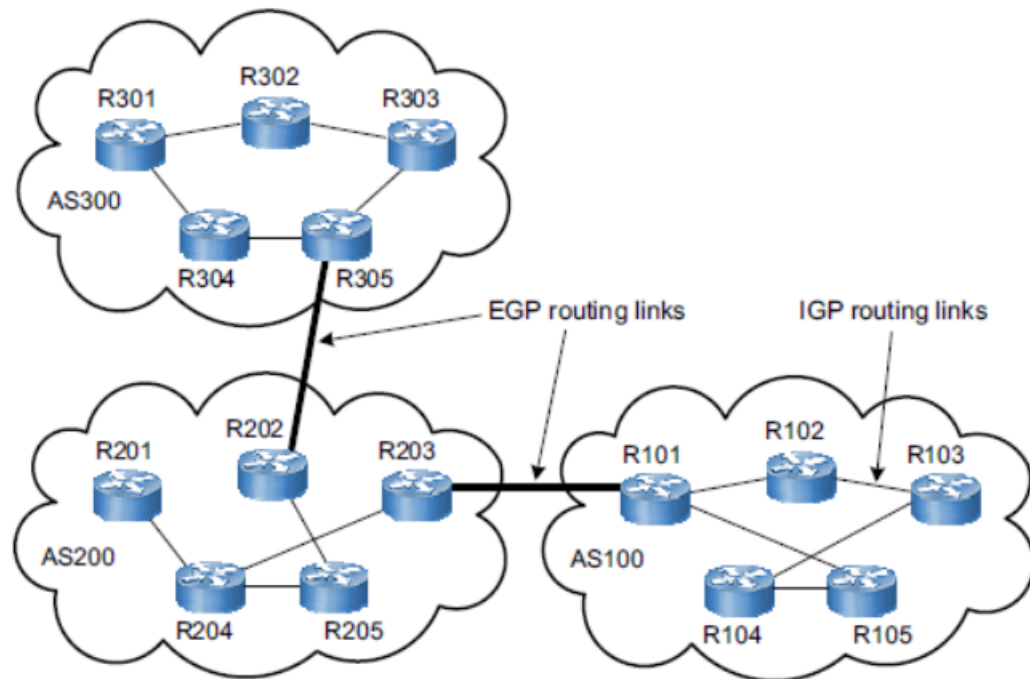
### 3.5 RIP v2

Também conhecido como Classless Routing Protocol porque envia informações da máscara de sub-rede nas suas atualizações de roteamento.

### 3.6 RIPng

O Routing Information Protocol next generation(RIPng) é um Interior gateway protocol(IGP) que usa um algoritmo de distância vetorial que determina a melhor rota para o destino.

## 4 OSPF

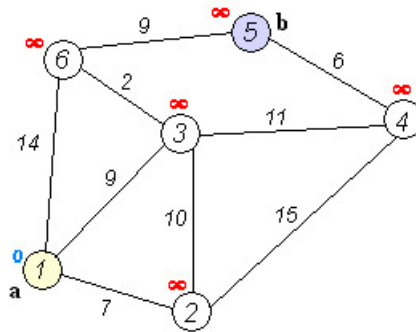


OSPF (Open Shortest Path First) é um protocolo de roteamento dinâmico que é usado em grandes redes. O protocolo mapeia toda a topologia da rede. Após o mapeamento de toda a rede, um algoritmo chamado de algoritmo de Dijkstra determina qual a melhor rota disponível. No mapeamento do OSPF pode detectar mudanças na topologia, tais como falhas em certas conexões entre outros problemas que podem acarretar a falha de conexão em certas rotas, e por isso que, com o uso do algoritmo ele evita tais rotas problemáticas. O algoritmo usado no OSPF, na qual determina a melhor rota, mostra-se superior em comparação ao RIP na questão de atualizar as rotas.



## 4.1 OSPF, E O ALGORITMO DE DIJKSTRA

O algoritmo de Dijkstra, usado no protocolo OSPF, foi criado pelo cientista da computação holandês Edsger Dijkstra em 1956, soluciona o problema do caminho mais curto em um grafo dirigido ou não dirigido com arestas de peso não negativo, em tempo computacional  $O(E + V \log(V))$ . Onde  $V$  é o número de vértices e  $E$  é o número de arestas.



[https://upload.wikimedia.org/wikipedia/commons/5/57/Dijkstra\\_animation.gif](https://upload.wikimedia.org/wikipedia/commons/5/57/Dijkstra_animation.gif)

## 5 PACKET TRACER

A ferramenta utilizada no presente trabalho foi o Packet Tracer, ferramenta multi-plataforma na qual simula visualmente as topologias de uma rede. O software permite aos usuários simularem configurações em cada componente em uma rede através de comandos simulando o Command Line Interface (CLI).

## 6 TESTES

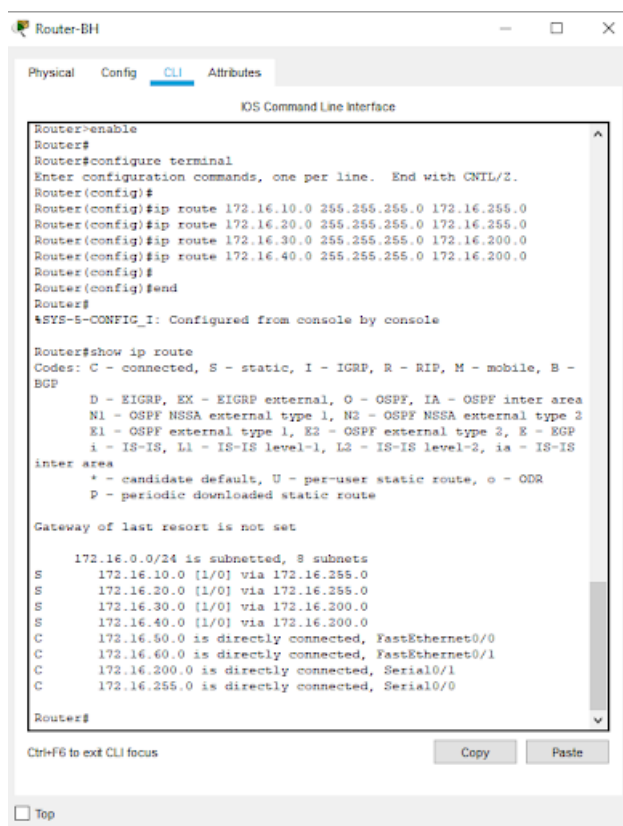
Todos os cenários apresentados foram devidamente testados, rota por rota, das diferentes conexões para provar a tenacidade da topologia então proposta para o presente trabalho.

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Com os comandos CLI, foi efetuada a validação da rede, comandos como show ip route foram utilizados para gerar as tabelas de rotas de todos os roteadores presentes na rede. Também foram utilizados comandos do command prompt, tais como tracert e ping para testar a conectividade entre todas as redes ou sub-redes conectadas.

## 6.1 TABELAS DE ROTAS ESTATICAS

### 6.2 Tabela de rota de Belo Horizonte



```
Router-BH
Physical Config CLI Attributes
IOS Command Line Interface

Router>enable
Router#
Router#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#
Router(config)#ip route 172.16.10.0 255.255.255.0 172.16.255.0
Router(config)#ip route 172.16.20.0 255.255.255.0 172.16.255.0
Router(config)#ip route 172.16.30.0 255.255.255.0 172.16.200.0
Router(config)#ip route 172.16.40.0 255.255.255.0 172.16.200.0
Router(config)#
Router(config)#end
Router#
*SYS-5-CONFIG_I: Configured from console by console

Router#show ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B -
BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS
inter area
       * - candidate default, U - per-user static route, o - ODR
       P - periodic downloaded static route

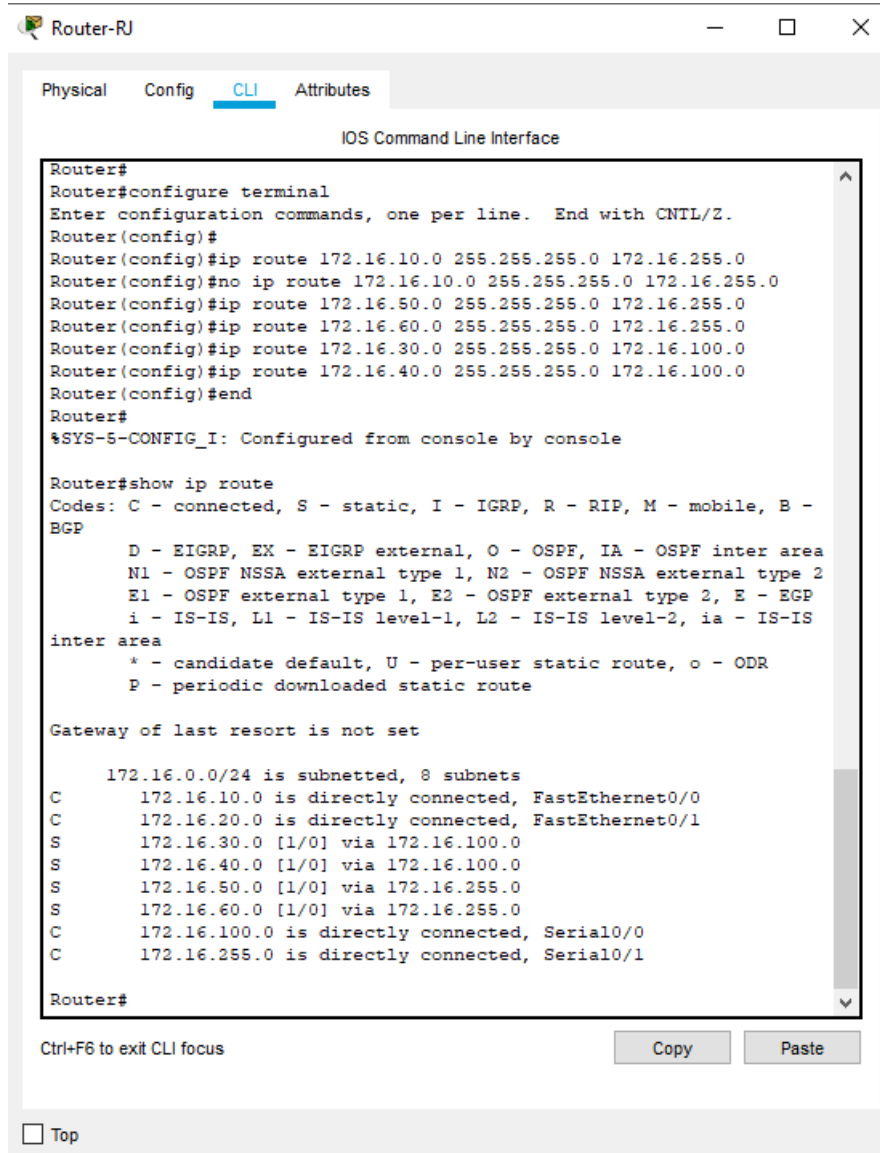
Gateway of last resort is not set

      172.16.0.0/24 is subnetted, 8 subnets
S       172.16.10.0 [1/0] via 172.16.255.0
S       172.16.20.0 [1/0] via 172.16.255.0
S       172.16.30.0 [1/0] via 172.16.200.0
S       172.16.40.0 [1/0] via 172.16.200.0
C       172.16.50.0 is directly connected, FastEthernet0/0
C       172.16.60.0 is directly connected, FastEthernet0/1
C       172.16.200.0 is directly connected, Serial0/1
C       172.16.255.0 is directly connected, Serial0/0

Router#
```

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## 6.3 Tabela de rota de Rio de Janeiro



```
Router-RJ
Physical Config CLI Attributes
IOS Command Line Interface

Router#
Router#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#
Router(config)#ip route 172.16.10.0 255.255.255.0 172.16.255.0
Router(config)#no ip route 172.16.10.0 255.255.255.0 172.16.255.0
Router(config)#ip route 172.16.50.0 255.255.255.0 172.16.255.0
Router(config)#ip route 172.16.60.0 255.255.255.0 172.16.255.0
Router(config)#ip route 172.16.30.0 255.255.255.0 172.16.100.0
Router(config)#ip route 172.16.40.0 255.255.255.0 172.16.100.0
Router(config)#end
Router#
%SYS-5-CONFIG_I: Configured from console by console

Router#show ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B -
BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS
inter area
       * - candidate default, U - per-user static route, o - ODR
       P - periodic downloaded static route

Gateway of last resort is not set

      172.16.0.0/24 is subnetted, 8 subnets
C       172.16.10.0 is directly connected, FastEthernet0/0
C       172.16.20.0 is directly connected, FastEthernet0/1
S       172.16.30.0 [1/0] via 172.16.100.0
S       172.16.40.0 [1/0] via 172.16.100.0
S       172.16.50.0 [1/0] via 172.16.255.0
S       172.16.60.0 [1/0] via 172.16.255.0
C       172.16.100.0 is directly connected, Serial0/0
C       172.16.255.0 is directly connected, Serial0/1

Router#
```

Ctrl+F6 to exit CLI focus

Copy Paste

☐ Top

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## 6.4 Tabela de rota de São Paulo



The screenshot shows a Cisco Router CLI window titled "Router-SP". The window has tabs for "Physical", "Config", "CLI", and "Attributes". The "CLI" tab is active, displaying the "IOS Command Line Interface". The user has entered the following commands:

```
Router>enable
Router#
Router#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#
Router(config)#ip route 172.16.10.0 255.255.255.0 172.16.100.0
Router(config)#ip route 172.16.20.0 255.255.255.0 172.16.100.0
Router(config)#ip route 172.16.50.0 255.255.255.0 172.16.200.0
Router(config)#ip route 172.16.60.0 255.255.255.0 172.16.200.0
Router(config)#end
Router#
```

The router has confirmed the configuration with the message: "%SYS-5-CONFIG\_I: Configured from console by console".

The user has then entered the command "show ip route", which displays the following output:

```
Router#show ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B -
BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS
inter area
       * - candidate default, U - per-user static route, o - ODR
       P - periodic downloaded static route

Gateway of last resort is not set

      172.16.0.0/24 is subnetted, 8 subnets
S       172.16.10.0 [1/0] via 172.16.100.0
S       172.16.20.0 [1/0] via 172.16.100.0
C       172.16.30.0 is directly connected, FastEthernet0/0
C       172.16.40.0 is directly connected, FastEthernet0/1
S       172.16.50.0 [1/0] via 172.16.200.0
S       172.16.60.0 [1/0] via 172.16.200.0
C       172.16.100.0 is directly connected, Serial0/0
C       172.16.200.0 is directly connected, Serial0/1

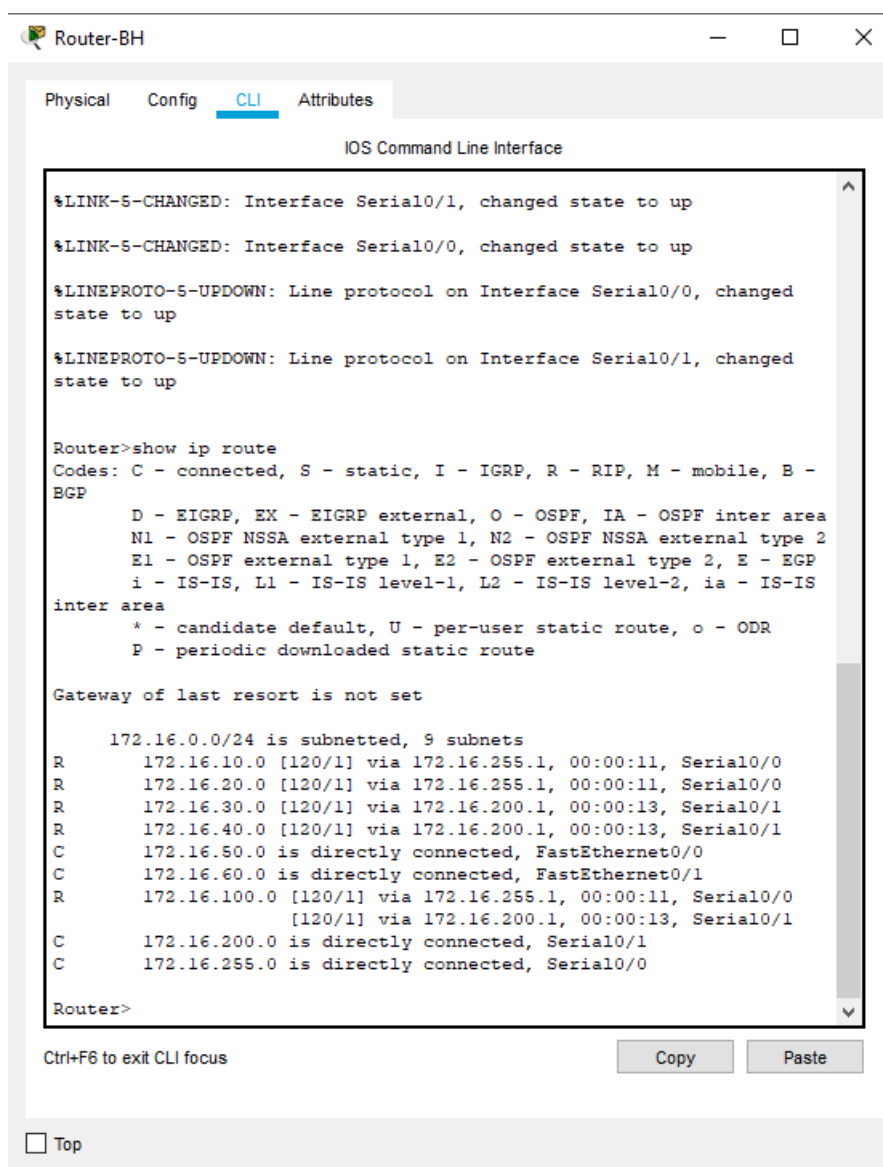
Router#
```

At the bottom of the window, there is a "Ctrl+F6 to exit CLI focus" message and "Copy" and "Paste" buttons. A "Top" button is also visible at the bottom left of the window.

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## 6.5 Tabela de Rotas Dinâmica RIP

## 6.6 Tabela de rota de Belo Horizonte



```
Router-BH

Physical Config CLI Attributes

IOS Command Line Interface

%LINK-5-CHANGED: Interface Serial0/1, changed state to up
%LINK-5-CHANGED: Interface Serial0/0, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0/0, changed
state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0/1, changed
state to up

Router>show ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B -
BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS
inter area
       * - candidate default, U - per-user static route, o - ODR
       P - periodic downloaded static route

Gateway of last resort is not set

    172.16.0.0/24 is subnetted, 9 subnets
R       172.16.10.0 [120/1] via 172.16.255.1, 00:00:11, Serial0/0
R       172.16.20.0 [120/1] via 172.16.255.1, 00:00:11, Serial0/0
R       172.16.30.0 [120/1] via 172.16.200.1, 00:00:13, Serial0/1
R       172.16.40.0 [120/1] via 172.16.200.1, 00:00:13, Serial0/1
C       172.16.50.0 is directly connected, FastEthernet0/0
C       172.16.60.0 is directly connected, FastEthernet0/1
R       172.16.100.0 [120/1] via 172.16.255.1, 00:00:11, Serial0/0
           [120/1] via 172.16.200.1, 00:00:13, Serial0/1
C       172.16.200.0 is directly connected, Serial0/1
C       172.16.255.0 is directly connected, Serial0/0

Router>
```

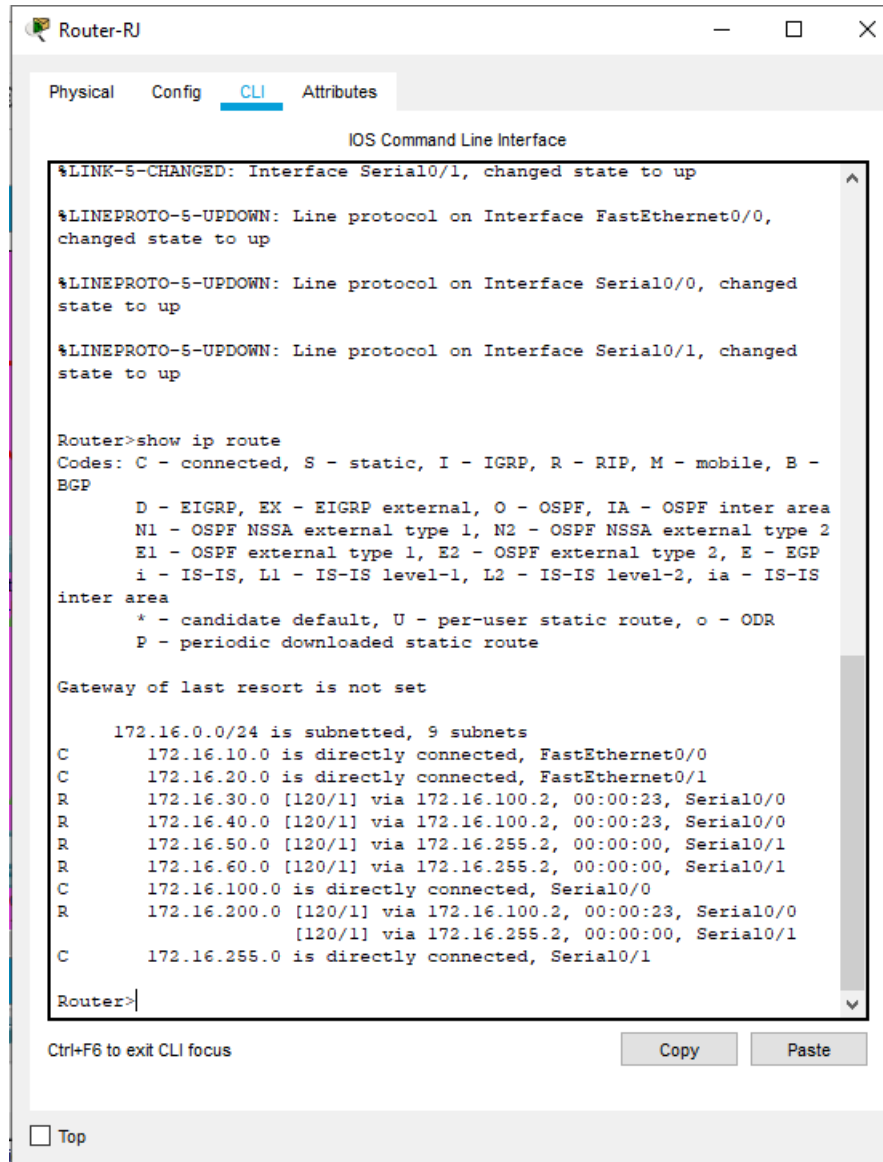
Ctrl+F6 to exit CLI focus

Copy Paste

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## 6.7 Tabela de rota de Rio de Janeiro



The screenshot shows a Cisco Router CLI window titled "Router-RJ". The window has tabs for "Physical", "Config", "CLI", and "Attributes". The "CLI" tab is active, showing the "IOS Command Line Interface". The output of the "show ip route" command is displayed, showing the routing table for the router. The output includes status messages for interface state changes, a legend for route codes, and a list of routes with their metrics and next hops.

```
%LINK-5-CHANGED: Interface Serial0/1, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0,
changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0/0, changed
state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0/1, changed
state to up

Router>show ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B -
BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS
inter area
       * - candidate default, U - per-user static route, o - ODR
       P - periodic downloaded static route

Gateway of last resort is not set

    172.16.0.0/24 is subnetted, 9 subnets
C       172.16.10.0 is directly connected, FastEthernet0/0
C       172.16.20.0 is directly connected, FastEthernet0/1
R       172.16.30.0 [120/1] via 172.16.100.2, 00:00:23, Serial0/0
R       172.16.40.0 [120/1] via 172.16.100.2, 00:00:23, Serial0/0
R       172.16.50.0 [120/1] via 172.16.255.2, 00:00:00, Serial0/1
R       172.16.60.0 [120/1] via 172.16.255.2, 00:00:00, Serial0/1
C       172.16.100.0 is directly connected, Serial0/0
R       172.16.200.0 [120/1] via 172.16.100.2, 00:00:23, Serial0/0
           [120/1] via 172.16.255.2, 00:00:00, Serial0/1
C       172.16.255.0 is directly connected, Serial0/1

Router>
```

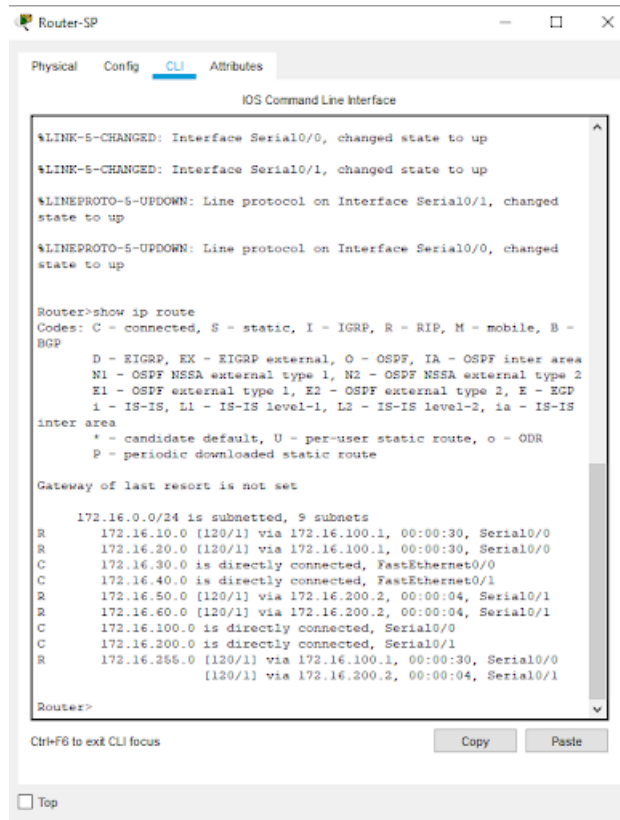
Ctrl+F6 to exit CLI focus

Copy Paste

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## 6.8 Tabela de rota de São Paulo



The screenshot shows a Cisco Router CLI window titled "Router-SP". The "CLI" tab is selected. The window displays the output of the "show ip route" command. The output includes status messages for interfaces Serial0/0 and Serial0/1, a legend for route codes, and a list of routes. The routes are as follows:

```
Router>show ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B -
      BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
      N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
      E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
      i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS
      inter area
      * - candidate default, U - per-user static route, o - ODR
      P - periodic downloaded static route

Gateway of last resort is not set

      172.16.0.0/24 is subnetted, 9 subnets
R       172.16.10.0 [120/1] via 172.16.100.1, 00:00:30, Serial0/0
R       172.16.20.0 [120/1] via 172.16.100.1, 00:00:30, Serial0/0
C       172.16.30.0 is directly connected, FastEthernet0/0
C       172.16.40.0 is directly connected, FastEthernet0/1
R       172.16.50.0 [120/1] via 172.16.200.2, 00:00:04, Serial0/1
R       172.16.60.0 [120/1] via 172.16.200.2, 00:00:04, Serial0/1
C       172.16.100.0 is directly connected, Serial0/0
C       172.16.200.0 is directly connected, Serial0/1
R       172.16.255.0 [120/1] via 172.16.100.1, 00:00:30, Serial0/0
           [120/1] via 172.16.200.2, 00:00:04, Serial0/1

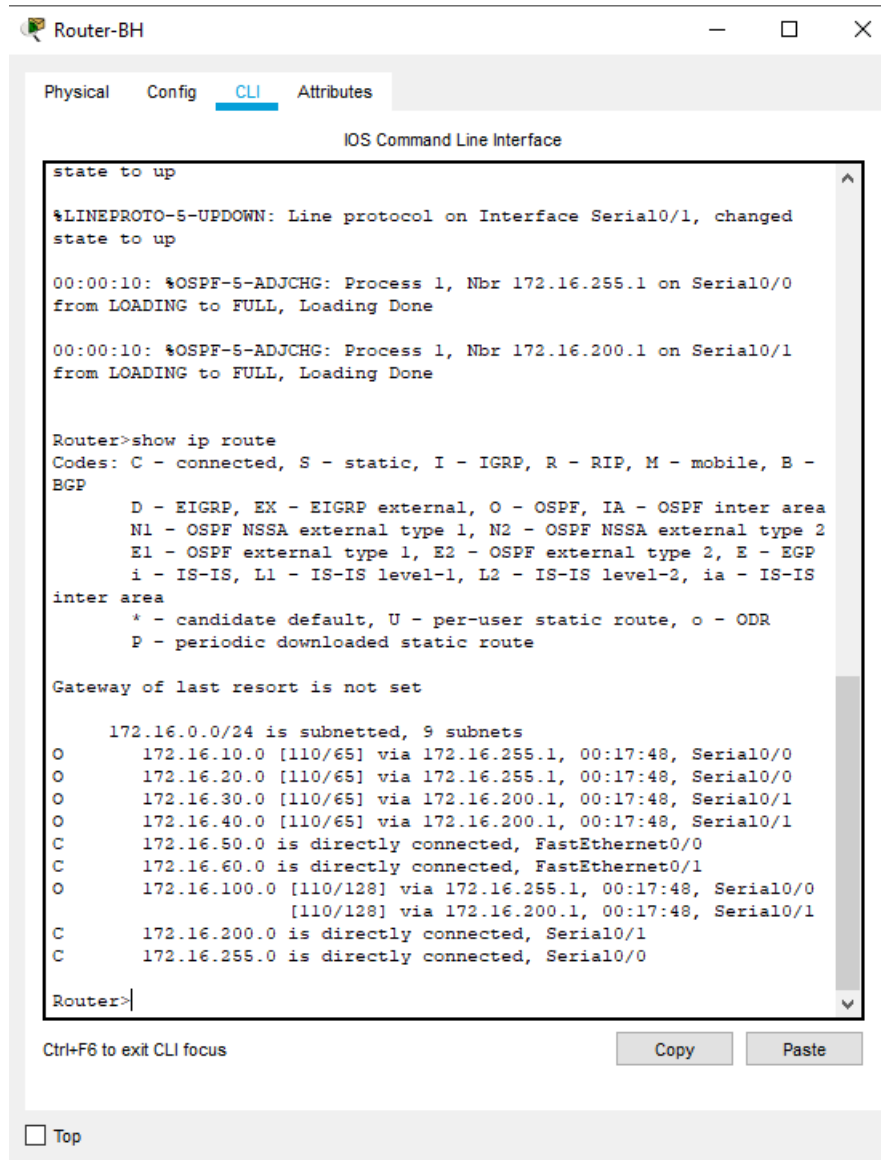
Router>
```

At the bottom of the window, there are buttons for "Copy" and "Paste", and a "Top" link.

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## 6.9 Tabela de Rotas Dinâmica OSPF

## 6.10 Tabela de rota de Belo Horizonte



The screenshot shows a Cisco Router CLI window titled "Router-BH". The "CLI" tab is selected. The window displays the following text:

```
state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0/1, changed
state to up
00:00:10: %OSPF-5-ADJCHG: Process 1, Nbr 172.16.255.1 on Serial0/0
from LOADING to FULL, Loading Done
00:00:10: %OSPF-5-ADJCHG: Process 1, Nbr 172.16.200.1 on Serial0/1
from LOADING to FULL, Loading Done

Router>show ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B -
BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS
inter area
       * - candidate default, U - per-user static route, o - ODR
       P - periodic downloaded static route

Gateway of last resort is not set

    172.16.0.0/24 is subnetted, 9 subnets
O       172.16.10.0 [110/65] via 172.16.255.1, 00:17:48, Serial0/0
O       172.16.20.0 [110/65] via 172.16.255.1, 00:17:48, Serial0/0
O       172.16.30.0 [110/65] via 172.16.200.1, 00:17:48, Serial0/1
O       172.16.40.0 [110/65] via 172.16.200.1, 00:17:48, Serial0/1
C       172.16.50.0 is directly connected, FastEthernet0/0
C       172.16.60.0 is directly connected, FastEthernet0/1
O       172.16.100.0 [110/128] via 172.16.255.1, 00:17:48, Serial0/0
        [110/128] via 172.16.200.1, 00:17:48, Serial0/1
C       172.16.200.0 is directly connected, Serial0/1
C       172.16.255.0 is directly connected, Serial0/0


Router>
```

Below the CLI window, there are buttons for "Copy" and "Paste", and a "Top" link.

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## 6.11 Tabela de rota de Rio de Janeiro



The screenshot shows a window titled "Router-RJ" with tabs for "Physical", "Config", "CLI", and "Attributes". The "CLI" tab is active, displaying the "IOS Command Line Interface". The output of the "show ip route" command is shown, including the following text:

```
state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0/1, changed
state to up
00:00:10: %OSPF-5-ADJCHG: Process 1, Nbr 172.16.255.2 on Serial0/1
from LOADING to FULL, Loading Done
00:00:10: %OSPF-5-ADJCHG: Process 1, Nbr 172.16.200.1 on Serial0/0
from LOADING to FULL, Loading Done

Router>show ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B -
BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS
inter area
       * - candidate default, U - per-user static route, o - ODR
       P - periodic downloaded static route

Gateway of last resort is not set

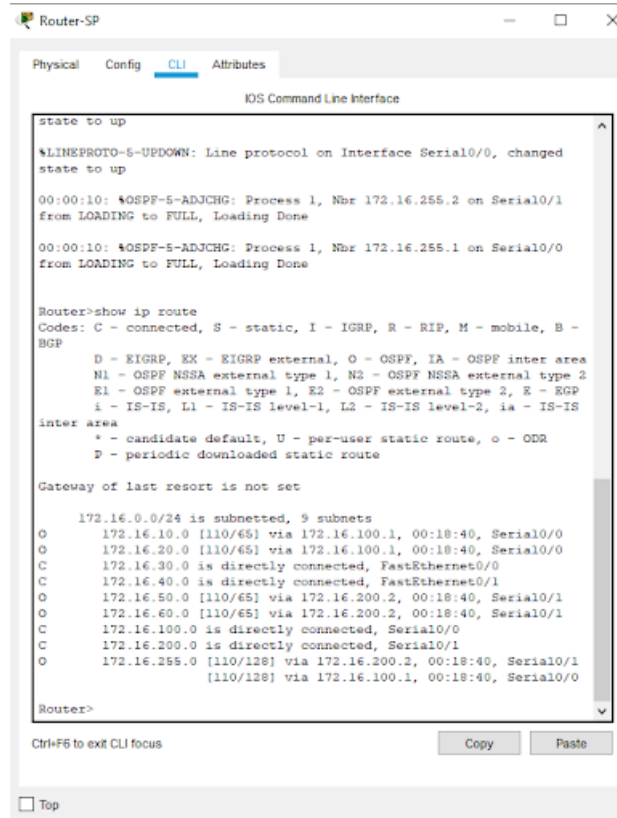
    172.16.0.0/24 is subnetted, 9 subnets
C       172.16.10.0 is directly connected, FastEthernet0/0
C       172.16.20.0 is directly connected, FastEthernet0/1
O       172.16.30.0 [110/65] via 172.16.100.2, 00:17:15, Serial0/0
O       172.16.40.0 [110/65] via 172.16.100.2, 00:17:15, Serial0/0
O       172.16.50.0 [110/65] via 172.16.255.2, 00:17:25, Serial0/1
O       172.16.60.0 [110/65] via 172.16.255.2, 00:17:25, Serial0/1
C       172.16.100.0 is directly connected, Serial0/0
O       172.16.200.0 [110/128] via 172.16.100.2, 00:17:15, Serial0/0
        [110/128] via 172.16.255.2, 00:17:15, Serial0/1
C       172.16.255.0 is directly connected, Serial0/1

Router>
```

At the bottom of the CLI window, there is a "Ctrl+F6 to exit CLI focus" message and "Copy" and "Paste" buttons. A "Top" button is also visible at the bottom left of the window.

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## 6.12 Tabela de rota de São Paulo



The screenshot shows a Cisco Router CLI window titled "Router-SP". The window has tabs for "Physical", "Config", "CLI", and "Attributes". The "CLI" tab is active, and the "IOS Command Line Interface" is displayed. The output of the "show ip route" command is shown, including the following text:

```
state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0/0, changed
state to up
00:00:10: %OSPF-5-ADJCHG: Process 1, Nbr 172.16.255.2 on Serial0/1
from LOADING to FULL, Loading Done
00:00:10: %OSPF-5-ADJCHG: Process 1, Nbr 172.16.255.1 on Serial0/0
from LOADING to FULL, Loading Done

Router>show ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B -
BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS
inter area
       * - candidate default, U - per-user static route, o - ODR
       P - periodic downloaded static route

Gateway of last resort is not set

172.16.0.0/24 is subnetted, 9 subnets
O       172.16.10.0 [110/65] via 172.16.100.1, 00:18:40, Serial0/0
O       172.16.20.0 [110/65] via 172.16.100.1, 00:18:40, Serial0/0
C       172.16.30.0 is directly connected, FastEthernet0/0
C       172.16.40.0 is directly connected, FastEthernet0/1
O       172.16.50.0 [110/65] via 172.16.200.2, 00:18:40, Serial0/1
O       172.16.60.0 [110/65] via 172.16.200.2, 00:18:40, Serial0/1
C       172.16.100.0 is directly connected, Serial0/0
C       172.16.200.0 is directly connected, Serial0/1
O       172.16.255.0 [110/128] via 172.16.200.2, 00:18:40, Serial0/1
               [110/128] via 172.16.100.1, 00:18:40, Serial0/0

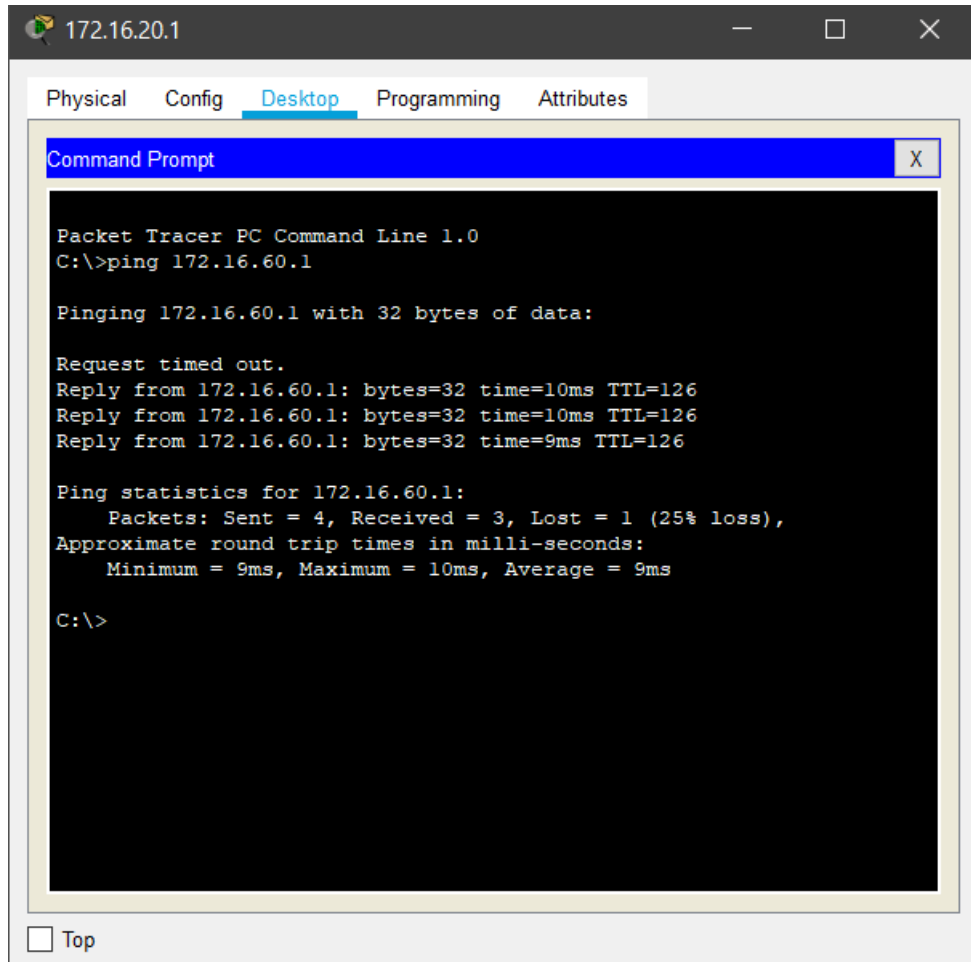
Router>
```

At the bottom of the window, there is a "Ctrl+F6 to exit CLI focus" label and "Copy" and "Paste" buttons. A "Top" button is also visible at the bottom left.

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## 7 Pings e Tracert

### 7.1 Ping Rio de Janeiro para Belo Horizonte



The screenshot shows a Packet Tracer PC Command Line window for a device named 172.16.20.1. The window has tabs for Physical, Config, Desktop, Programming, and Attributes. The Desktop tab is active, displaying a Command Prompt window. The Command Prompt shows the execution of the command 'ping 172.16.60.1'. The output indicates that the first ping request timed out, while the subsequent three replies were successful with times of 10ms, 10ms, and 9ms respectively. The ping statistics show 4 packets sent, 3 received, and 1 lost (25% loss), with an average round trip time of 9ms.

```
Packet Tracer PC Command Line 1.0
C:\>ping 172.16.60.1

Pinging 172.16.60.1 with 32 bytes of data:

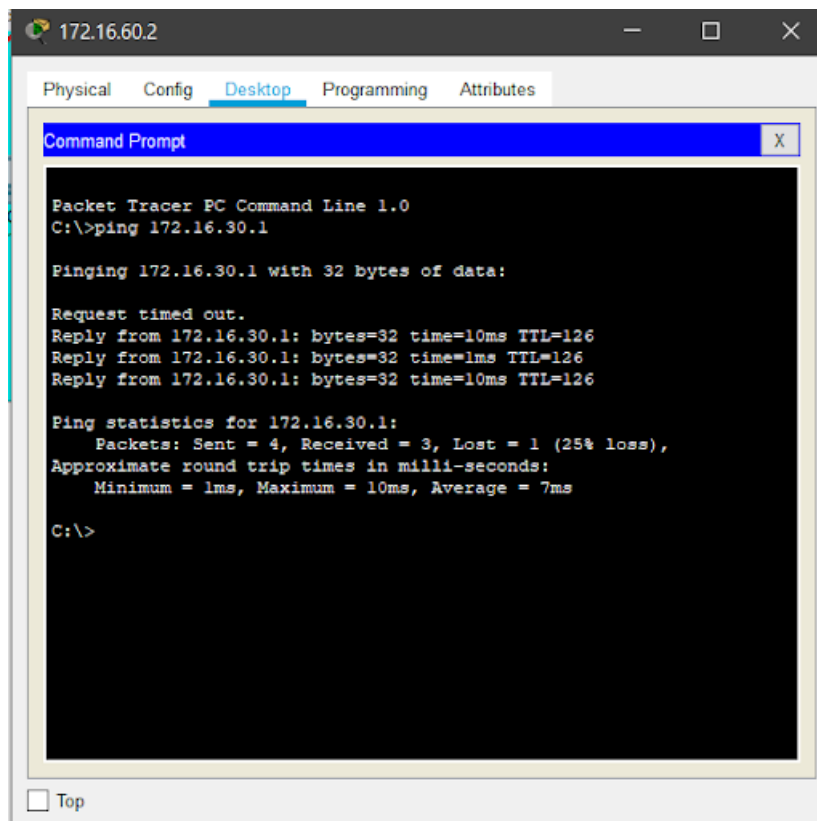
Request timed out.
Reply from 172.16.60.1: bytes=32 time=10ms TTL=126
Reply from 172.16.60.1: bytes=32 time=10ms TTL=126
Reply from 172.16.60.1: bytes=32 time=9ms TTL=126

Ping statistics for 172.16.60.1:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 9ms, Maximum = 10ms, Average = 9ms

C:\>
```

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## 7.2 Ping Belo Horizonte para São Paulo



The screenshot shows a Packet Tracer PC Command Line window for a device with IP 172.16.60.2. The window has tabs for Physical, Config, Desktop, Programming, and Attributes. The Desktop tab is active, displaying a Command Prompt window. The Command Prompt shows the execution of the command 'ping 172.16.30.1'. The output indicates that the first ping request timed out, while the subsequent three requests were successful. The ping statistics show 4 packets sent, 3 received, and 1 lost (25% loss). The approximate round trip times are: Minimum = 1ms, Maximum = 10ms, Average = 7ms.

```
Packet Tracer PC Command Line 1.0
C:\>ping 172.16.30.1

Pinging 172.16.30.1 with 32 bytes of data:

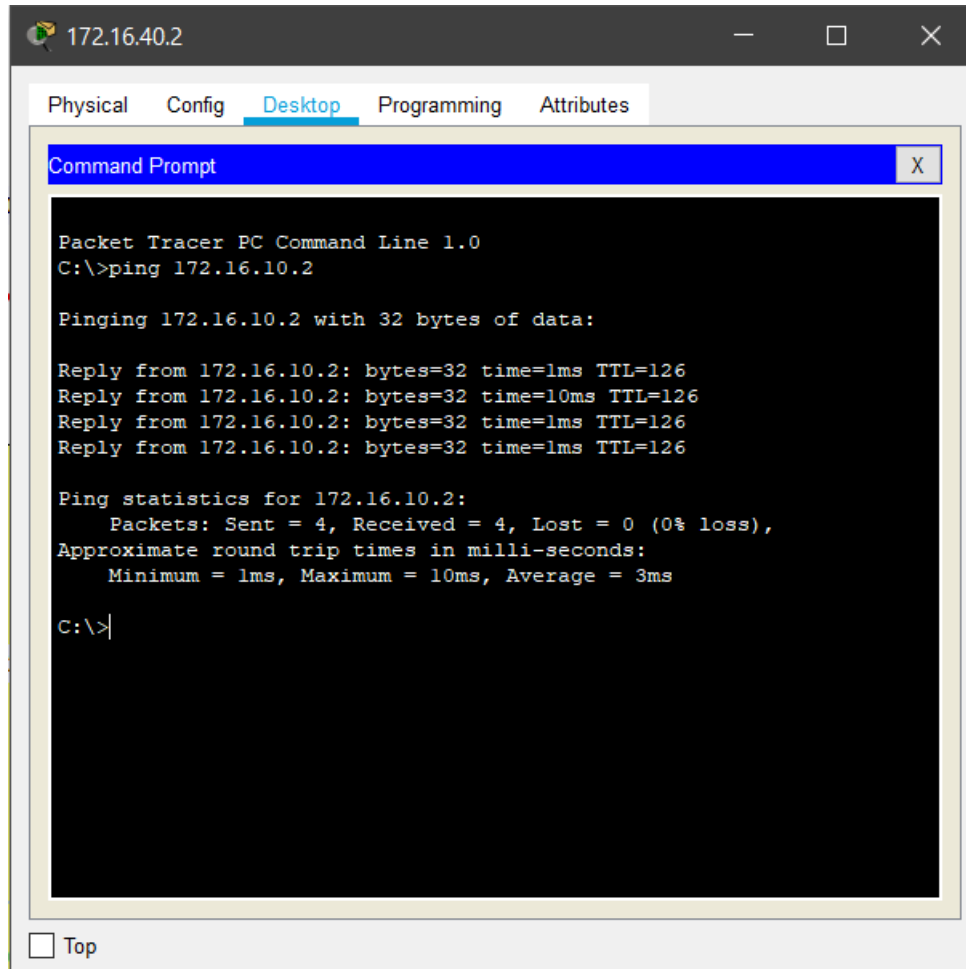
Request timed out.
Reply from 172.16.30.1: bytes=32 time=10ms TTL=126
Reply from 172.16.30.1: bytes=32 time=1ms TTL=126
Reply from 172.16.30.1: bytes=32 time=10ms TTL=126

Ping statistics for 172.16.30.1:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 1ms, Maximum = 10ms, Average = 7ms

C:\>
```

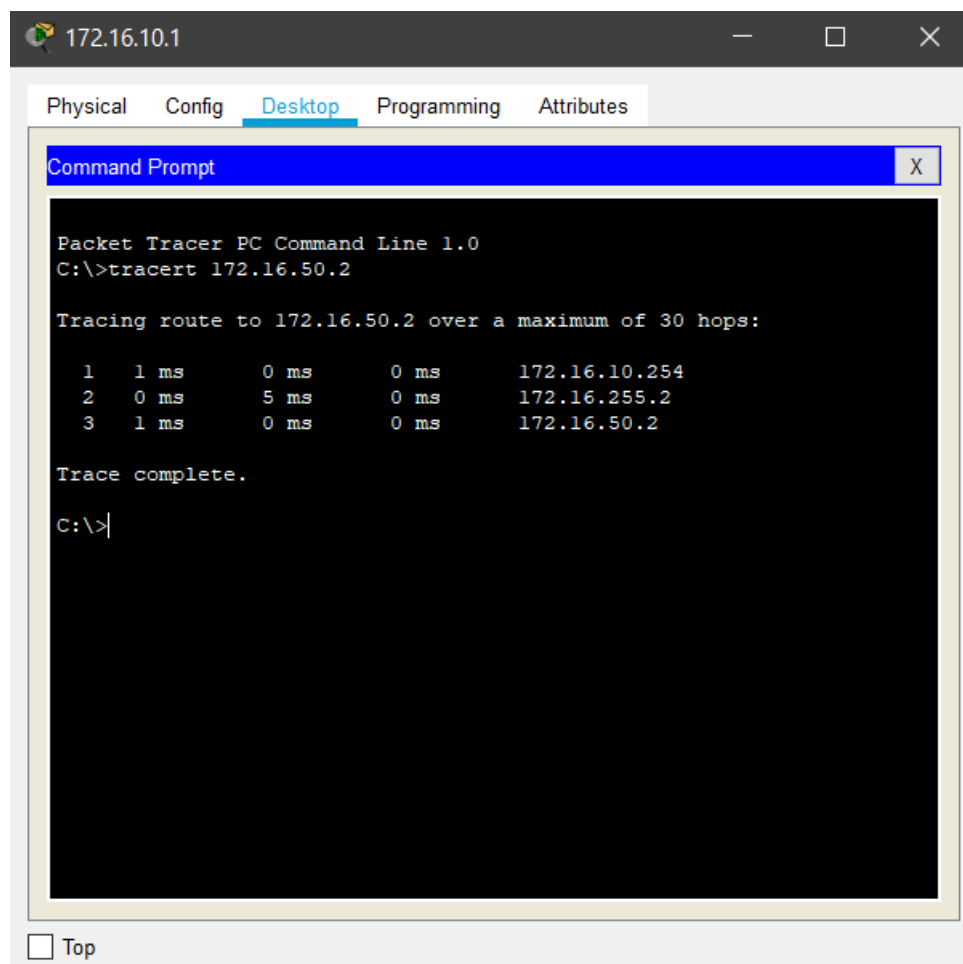
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### 7.3 Ping São Paulo para Rio de Janeiro



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## 7.4 Tracert Rio de Janeiro para Belo Horizonte



The screenshot shows a Packet Tracer PC Command Line window for a device with IP 172.16.10.1. The 'Desktop' tab is selected. The command prompt displays the output of the 'tracert 172.16.50.2' command. The output shows a successful trace over 3 hops, with the final destination being 172.16.50.2. The trace is complete, and the command prompt is ready for the next input.

```
Packet Tracer PC Command Line 1.0
C:\>tracert 172.16.50.2

Tracing route to 172.16.50.2 over a maximum of 30 hops:

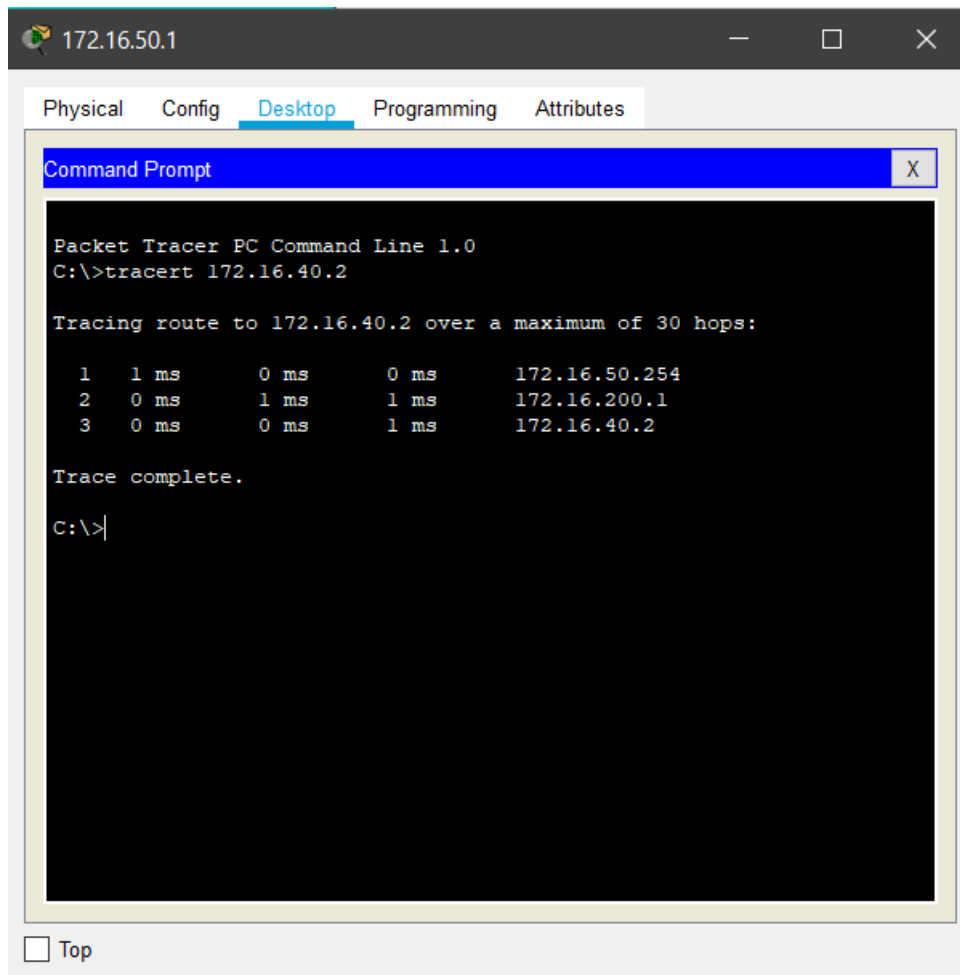
  1  1 ms      0 ms      0 ms      172.16.10.254
  2  0 ms      5 ms      0 ms      172.16.255.2
  3  1 ms      0 ms      0 ms      172.16.50.2

Trace complete.

C:\>
```

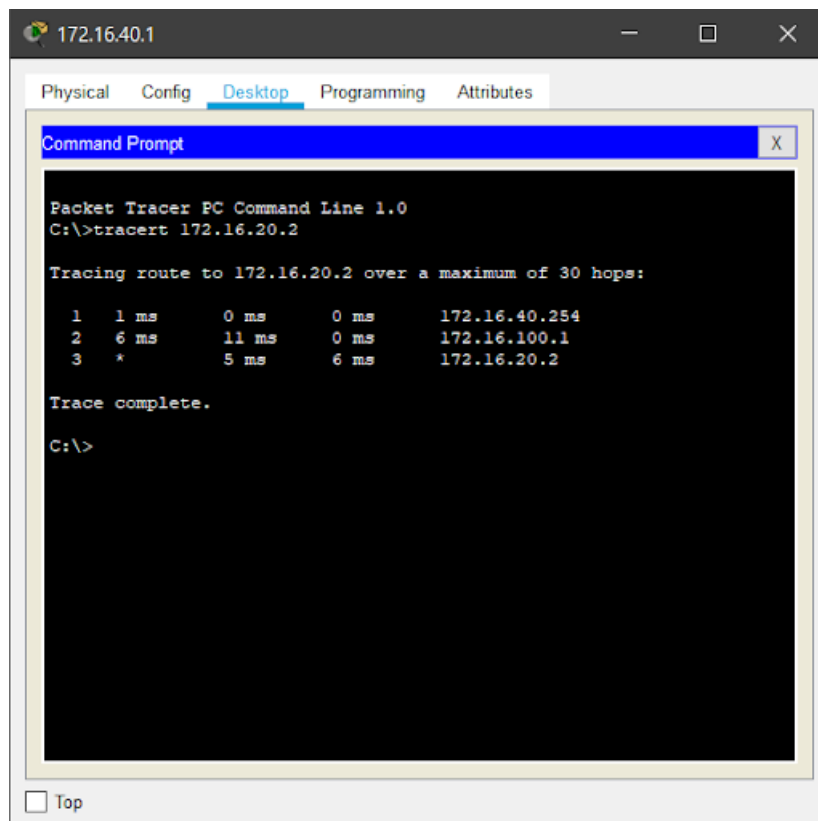
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## 7.5 Tracert Belo Horizonte para São Paulo



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## 7.6 Tracert São Paulo para Rio de Janeiro



The screenshot shows a Packet Tracer PC Command Line window for a device with IP 172.16.40.1. The 'Desktop' tab is active, displaying a Command Prompt. The user has entered the command 'tracert 172.16.20.2'. The output shows a successful trace over 3 hops. The first hop is the source IP, the second is 172.16.100.1, and the third is the destination IP 172.16.20.2. The trace is complete.

```
Packet Tracer PC Command Line 1.0
C:\>tracert 172.16.20.2

Tracing route to 172.16.20.2 over a maximum of 30 hops:

  1  1 ms      0 ms      0 ms      172.16.40.254
  2  6 ms      11 ms     0 ms      172.16.100.1
  3  *          5 ms      6 ms      172.16.20.2

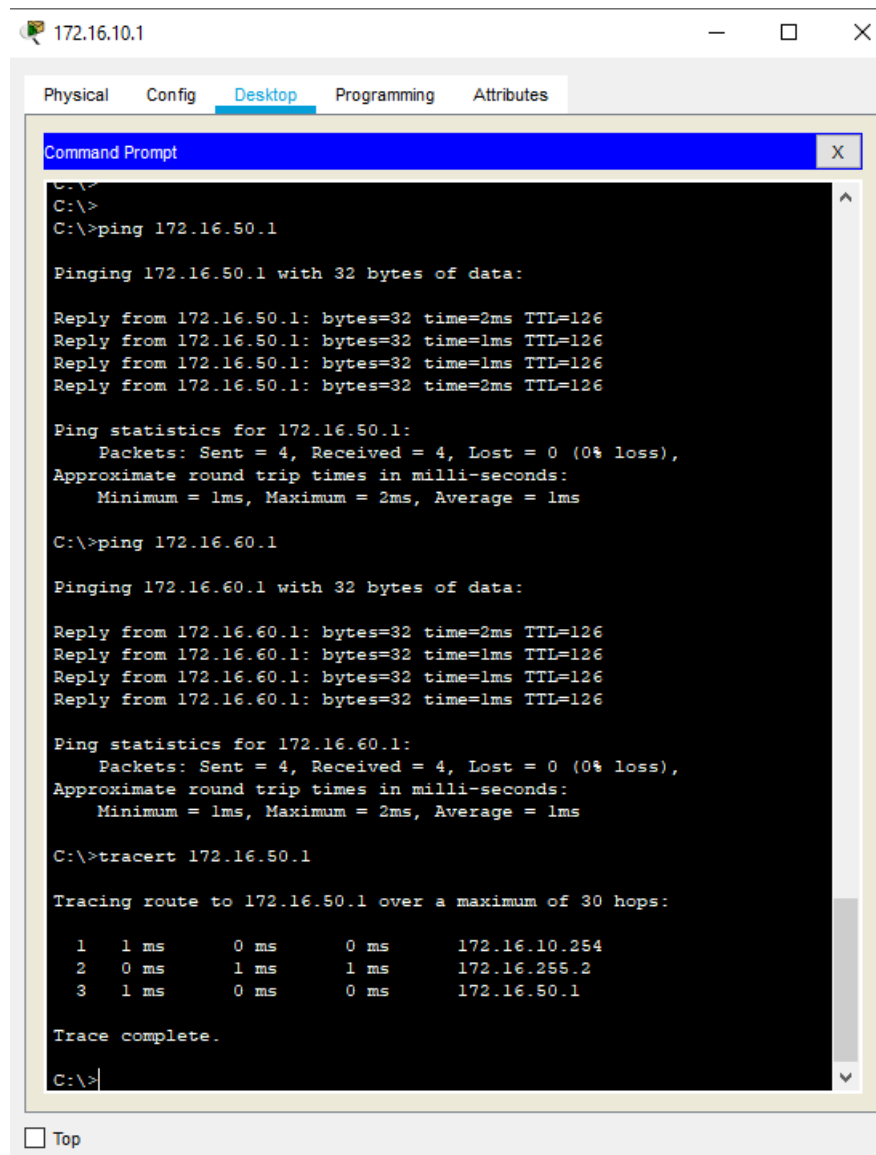
Trace complete.

C:\>
```

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## 8 Simulação de Queda entre Rio de Janeiro e São Paulo



172.16.10.1

Physical Config Desktop Programming Attributes

Command Prompt

```
C:\>
C:\>
C:\>ping 172.16.50.1

Pinging 172.16.50.1 with 32 bytes of data:

Reply from 172.16.50.1: bytes=32 time=2ms TTL=126
Reply from 172.16.50.1: bytes=32 time=1ms TTL=126
Reply from 172.16.50.1: bytes=32 time=1ms TTL=126
Reply from 172.16.50.1: bytes=32 time=2ms TTL=126

Ping statistics for 172.16.50.1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 1ms, Maximum = 2ms, Average = 1ms

C:\>ping 172.16.60.1

Pinging 172.16.60.1 with 32 bytes of data:

Reply from 172.16.60.1: bytes=32 time=2ms TTL=126
Reply from 172.16.60.1: bytes=32 time=1ms TTL=126
Reply from 172.16.60.1: bytes=32 time=1ms TTL=126
Reply from 172.16.60.1: bytes=32 time=1ms TTL=126

Ping statistics for 172.16.60.1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 1ms, Maximum = 2ms, Average = 1ms

C:\>tracert 172.16.50.1

Tracing route to 172.16.50.1 over a maximum of 30 hops:

  1  1 ms    0 ms    0 ms    172.16.10.254
  2  0 ms    1 ms    1 ms    172.16.255.2
  3  1 ms    0 ms    0 ms    172.16.50.1

Trace complete.

C:\>
```

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172.16.10.1

Physical Config Desktop Programming Attributes

Command Prompt

```
Ping statistics for 172.16.50.1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 1ms, Maximum = 2ms, Average = 1ms

C:\>ping 172.16.60.1

Pinging 172.16.60.1 with 32 bytes of data:

Reply from 172.16.60.1: bytes=32 time=2ms TTL=126
Reply from 172.16.60.1: bytes=32 time=1ms TTL=126
Reply from 172.16.60.1: bytes=32 time=1ms TTL=126
Reply from 172.16.60.1: bytes=32 time=1ms TTL=126

Ping statistics for 172.16.60.1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 1ms, Maximum = 2ms, Average = 1ms

C:\>tracert 172.16.50.1

Tracing route to 172.16.50.1 over a maximum of 30 hops:

  1  1 ms    0 ms    0 ms    172.16.10.254
  2  0 ms    1 ms    1 ms    172.16.255.2
  3  1 ms    0 ms    0 ms    172.16.50.1

Trace complete.

C:\>tracert 172.16.60.1

Tracing route to 172.16.60.1 over a maximum of 30 hops:

  1  0 ms    0 ms    0 ms    172.16.10.254
  2  1 ms    1 ms    0 ms    172.16.255.2
  3  1 ms    0 ms    0 ms    172.16.60.1

Trace complete.

C:\>
```

☐ Top

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```
172.16.10.1
Physical Config Desktop Programming Attributes

Command Prompt

Pinging 172.16.30.1 with 32 bytes of data:

Reply from 172.16.30.1: bytes=32 time=2ms TTL=125
Reply from 172.16.30.1: bytes=32 time=4ms TTL=125
Reply from 172.16.30.1: bytes=32 time=4ms TTL=125
Reply from 172.16.30.1: bytes=32 time=5ms TTL=125

Ping statistics for 172.16.30.1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 2ms, Maximum = 5ms, Average = 3ms

C:\>ping 172.16.40.1

Pinging 172.16.40.1 with 32 bytes of data:

Reply from 172.16.40.1: bytes=32 time=3ms TTL=125
Reply from 172.16.40.1: bytes=32 time=2ms TTL=125
Reply from 172.16.40.1: bytes=32 time=2ms TTL=125
Reply from 172.16.40.1: bytes=32 time=2ms TTL=125

Ping statistics for 172.16.40.1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 2ms, Maximum = 3ms, Average = 2ms

C:\>ping 172.16.50.1

Pinging 172.16.50.1 with 32 bytes of data:

Reply from 172.16.50.1: bytes=32 time=2ms TTL=126
Reply from 172.16.50.1: bytes=32 time=11ms TTL=126
Reply from 172.16.50.1: bytes=32 time=4ms TTL=126
Reply from 172.16.50.1: bytes=32 time=2ms TTL=126

Ping statistics for 172.16.50.1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 2ms, Maximum = 11ms, Average = 4ms

☐ Top
```

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```
172.16.10.1
Physical Config Desktop Programming Attributes
Command Prompt
Pinging 172.16.40.1 with 32 bytes of data:
Reply from 172.16.40.1: bytes=32 time=3ms TTL=125
Reply from 172.16.40.1: bytes=32 time=2ms TTL=125
Reply from 172.16.40.1: bytes=32 time=2ms TTL=125
Reply from 172.16.40.1: bytes=32 time=2ms TTL=125

Ping statistics for 172.16.40.1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 2ms, Maximum = 3ms, Average = 2ms

C:\>ping 172.16.50.1

Pinging 172.16.50.1 with 32 bytes of data:
Reply from 172.16.50.1: bytes=32 time=2ms TTL=126
Reply from 172.16.50.1: bytes=32 time=11ms TTL=126
Reply from 172.16.50.1: bytes=32 time=4ms TTL=126
Reply from 172.16.50.1: bytes=32 time=2ms TTL=126

Ping statistics for 172.16.50.1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 2ms, Maximum = 11ms, Average = 4ms

C:\>ping 172.16.60.1

Pinging 172.16.60.1 with 32 bytes of data:
Reply from 172.16.60.1: bytes=32 time=1ms TTL=126
Reply from 172.16.60.1: bytes=32 time=5ms TTL=126
Reply from 172.16.60.1: bytes=32 time=1ms TTL=126
Reply from 172.16.60.1: bytes=32 time=1ms TTL=126

Ping statistics for 172.16.60.1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 1ms, Maximum = 5ms, Average = 2ms

C:\>
```

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## 9 Conclusao

Concluimos que, com diferentes tipos de conexões podemos ter diferentes taxas de performance . Tendo em mente que cada tipo de conexão tem seus prós e contras e que cada uma delas é indicada para diferentes ocasiões. Por exemplo, conexões estáticas são consideradas fáceis para implementar em redes menores. Todavia, a configuração se tornaria complexa drasticamente à medida em que a rede se tornaria maior. Já as conexões dinâmicas, são ótimas pelo fato de que podem adaptar suas rotas automaticamente se possível. Mas podem ser mais complexas para implementar inicialmente. Portanto, o presente trabalho mostra a extrema importância do estudo de uma rede para saber qual tipo de protocolo de roteamento seria o ideal para certas redes. E a simulação de uma rede para saber como seria seu comportamento com N dispositivos conectados, ou simulações de possíveis quedas. Estudar todos esses fatores antes de uma eventual implementação de uma rede é essencial para evitar problemas de custos de manutenção e implementação, problemas de conectividade, entre outros fatores negativos que podem acarretar a uma má performance da rede se não houvesse todo um estudo antes.

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