



UNIVERSIDADE
LUSÓFONA

Relatório Técnico

Projeto de Redes de Computadores

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1. Introdução

Este relatório descreve a implementação de uma rede empresarial para a empresa **Omicron Lda.** utilizando o simulador Cisco Packet Tracer. O projeto envolveu a criação de uma infraestrutura de rede completa que conecta a sede em Coimbra com quatro filiais (Porto, Tavira, Viseu e Ericeira), implementando VLANs departamentais, serviços centralizados e conectividade WiFi.

A rede foi projetada para suportar diferentes departamentos (Servidores, RH, Financeiro, Logístico, Administração e TI) distribuídos pelas várias localizações, garantindo comunicação eficiente e acesso centralizado aos recursos da empresa

2. Topologia da Rede

2.1. Arquitetura geral

A rede implementada segue uma topologia **estrela hierárquica** com Coimbra como centro de todas as comunicações. Todas as filiais conectam-se diretamente à sede através de ligações WAN de 1 Gbps.

Localizações:

- **Coimbra** (Sede): Centro da rede com serviços centralizados.
- **Porto**: Filial com departamentos Financeiro, Logístico e Administração.
- **Tavira**: Filial com departamentos Logístico e Administração.
- **Viseu**: Filial com departamentos Financeiro e Logístico.
- **Ericeira**: Filial com departamentos RH, Financeiro e TI.

2.2. Equipamentos Utilizados

Routers:

- 7x Cisco PT-Router (Coimbra, Porto, Tavira, Viseu, Ericeira, ISP, INTERNET).

Switches:

- 1x Cisco Catalyst 3650-24 (Switch Core em Coimbra).
- 7x Cisco 2960-24 (Switches de acesso).

Servidores:

- Servidor DHCP (10.19.7.2).
- Servidor Web (10.19.7.3).
- Servidor DNS(10.19.7.4).

Dispositivos Finais:

- 66 PCs distribuídos pelos departamentos.
- 1 Access Point WiFi (AP-PT-N).
- 1 Smartphone para teste WiFi.

3. Endereçamento e VLANs

3.1. Esquema de Endereçamento

Rede Principal: 10.0.0.0/8 (Classe A)

Interligações WAN: 172.16.19.0/24

Ligação ISP: 89.19.0.0/30

3.2. VLANs Implementadas

VLAN	Nome	Departamento	Localizações
119	Servidores	Servidores	Coimbra
219	RH	Recursos Humanos	Coimbra, Ericeira
319	Financeiro	Financeiro	Coimbra, Porto, Viseu, Ericeira
419	Logístico	Logístico	Porto, Tavira, Viseu
519	Administração	Administração	Coimbra, Porto, Tavira
619	TI	Tecnologias Informação	Coimbra, Ericeira

Seguindo o formato N19/19N para o grupo 19:

3.3. Sub-redes por Localização

Coimbra:

- 10.19.7.0/28 - Servidores (VLAN 119)
- 10.19.8.0/28 - RH (VLAN 219)
- 10.19.1.0/26 - Financeiro (VLAN 319)
- 10.19.5.0/27 - Administração (VLAN 519)
- 10.19.6.0/27 - TI (VLAN 619)

Porto:

- 10.19.9.0/28 - Financeiro (VLAN 319)

- 10.19.2.0/25 - Logístico (VLAN 419)
- 10.19.10.0/28 - Administração (VLAN 519)

Tavira:

- 10.19.3.0/24 - Logístico (VLAN 419)
- 10.19.11.0/28 - Administração (VLAN 519)

Viseu:

- 10.19.12.0/28 - Financeiro (VLAN 319)
- 10.19.4.0/25 - Logístico (VLAN 419)

Ericeira:

- 10.19.13.0/28 - RH (VLAN 219)
- 10.19.14.0/28 - Financeiro (VLAN 319)
- 10.19.15.0/28 - TI (VLAN 619)

4. Serviços Implementados

4.1. DHCP Centralizado

Implementámos um servidor DHCP centralizado em Coimbra (10.19.7.2) que atende todas as localizações através de **DHCP Relay** configurado nos routers das filiais. Esta abordagem centraliza a gestão de endereços IP e garante consistência na configuração.

4.2. DNS

O servidor DNS (10.19.7.2) resolve o nome [intranet.omicron.local](#) para o servidor web (10.19.7.3), permitindo acesso por nome em toda a rede. No entanto, embora tenha sido solicitado que fosse configurado um servidor DNS separado, acabou-se por utilizar o mesmo servidor do DHCP para essa função, o que, na verdade a utilização de um servidor DNS, é uma prática recomendada para uma implementação empresarial completa.

4.3. Servidor Web

O servidor web (10.19.7.3) hospeda a página da empresa com informações do projeto do Grupo 19.

4.4. WiFi

Implementámos uma rede WiFi em Coimbra usando um AP-PT-N conectado à VLAN 619 (TI).

5. Configurações Principais

5.1. Switch Core (Coimbra)

O Cisco 3650 atua como switch core com funcionalidades Layer 3, fazendo roteamento entre VLANs através de SVIs (Switch Virtual Interfaces). Esta configuração otimiza o desempenho local e reduz a carga no router principal.

5.2. Roteamento

Roteamento Estático: Configurado em todos os routers para garantir conectividade entre localizações.

NAT: Implementado no router ISP para permitir acesso à Internet de todas as localizações.

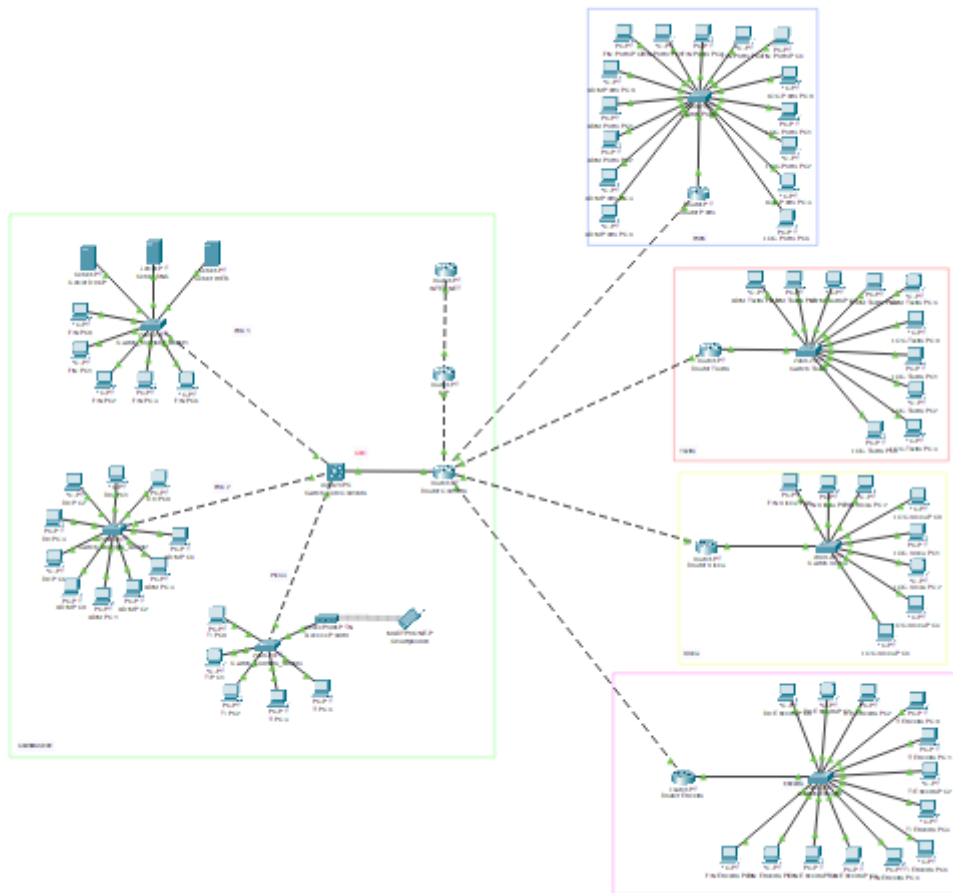
5.3. Interligações WAN

Todas as filiais conectam-se a Coimbra usando a rede 172.16.19.0/24 com sub-redes /30:

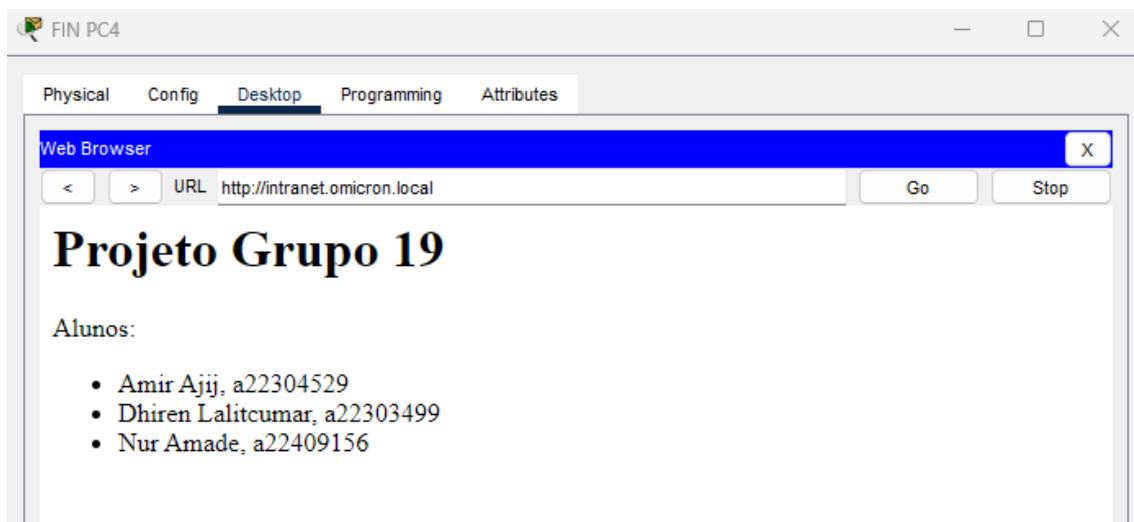
- Coimbra ↔ Porto: 172.16.19.0/30
- Coimbra ↔ Tavira: 172.16.19.4/30
- Coimbra ↔ Viseu: 172.16.19.8/30
- Coimbra ↔ Ericeira: 172.16.19.12/30

6. Screenshots da Implementação

6.1. Topologia Completa



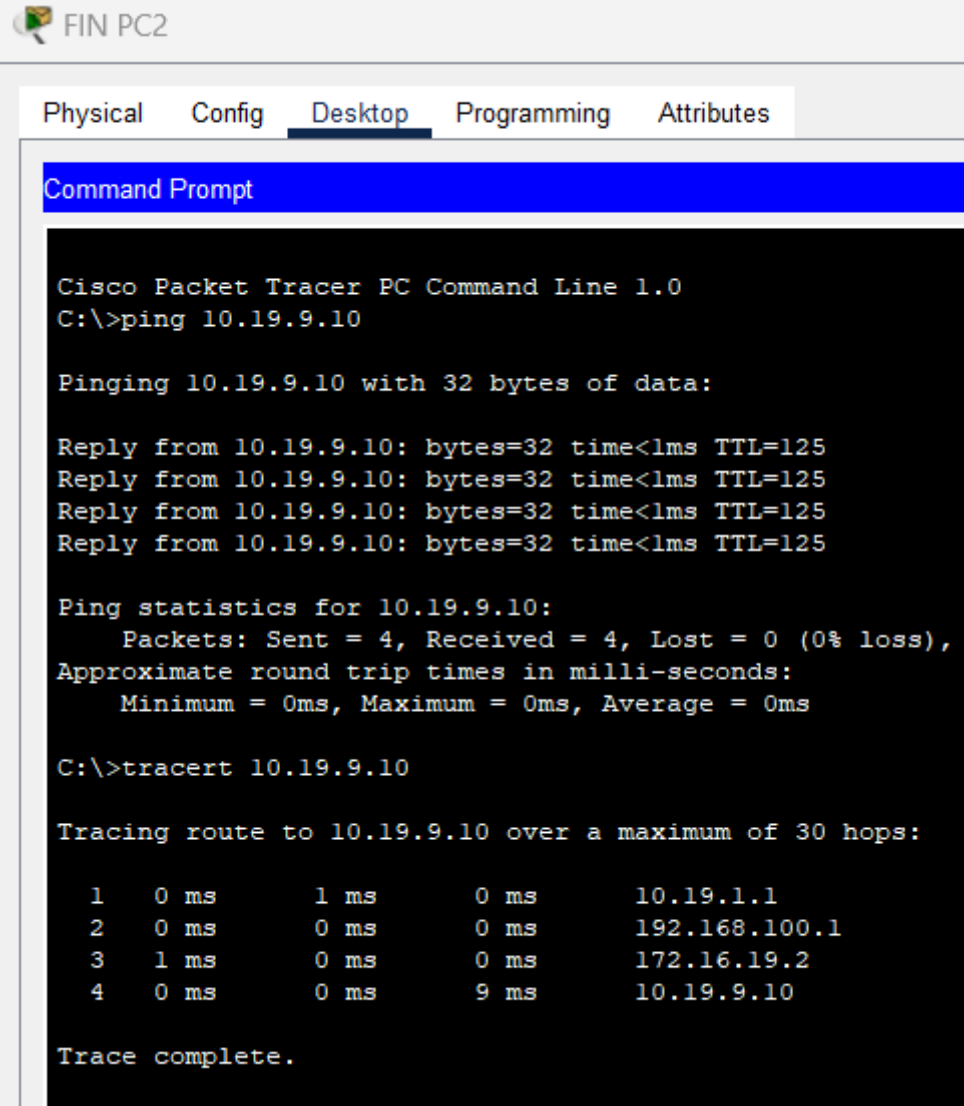
6.2 Servidor Web



7. Testes de Conectividade

7.1 Conectividade Intra-departamental (Mesmo Departamento e Diferentes Localizações)

Teste: PC Financeiro Coimbra → PC Financeiro Porto



The screenshot shows the Cisco Packet Tracer interface for a PC named 'FIN PC2'. The 'Desktop' tab is selected, displaying a Command Prompt window. The user has executed a series of commands to test connectivity to the IP address 10.19.9.10. The output shows successful ping results with 0% loss and a successful traceroute showing four hops.

```
FIN PC2
Physical Config Desktop Programming Attributes
Command Prompt

Cisco Packet Tracer PC Command Line 1.0
C:\>ping 10.19.9.10

Pinging 10.19.9.10 with 32 bytes of data:

Reply from 10.19.9.10: bytes=32 time<1ms TTL=125
Reply from 10.19.9.10: bytes=32 time<1ms TTL=125
Reply from 10.19.9.10: bytes=32 time<1ms TTL=125
Reply from 10.19.9.10: bytes=32 time<1ms TTL=125

Ping statistics for 10.19.9.10:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>tracert 10.19.9.10

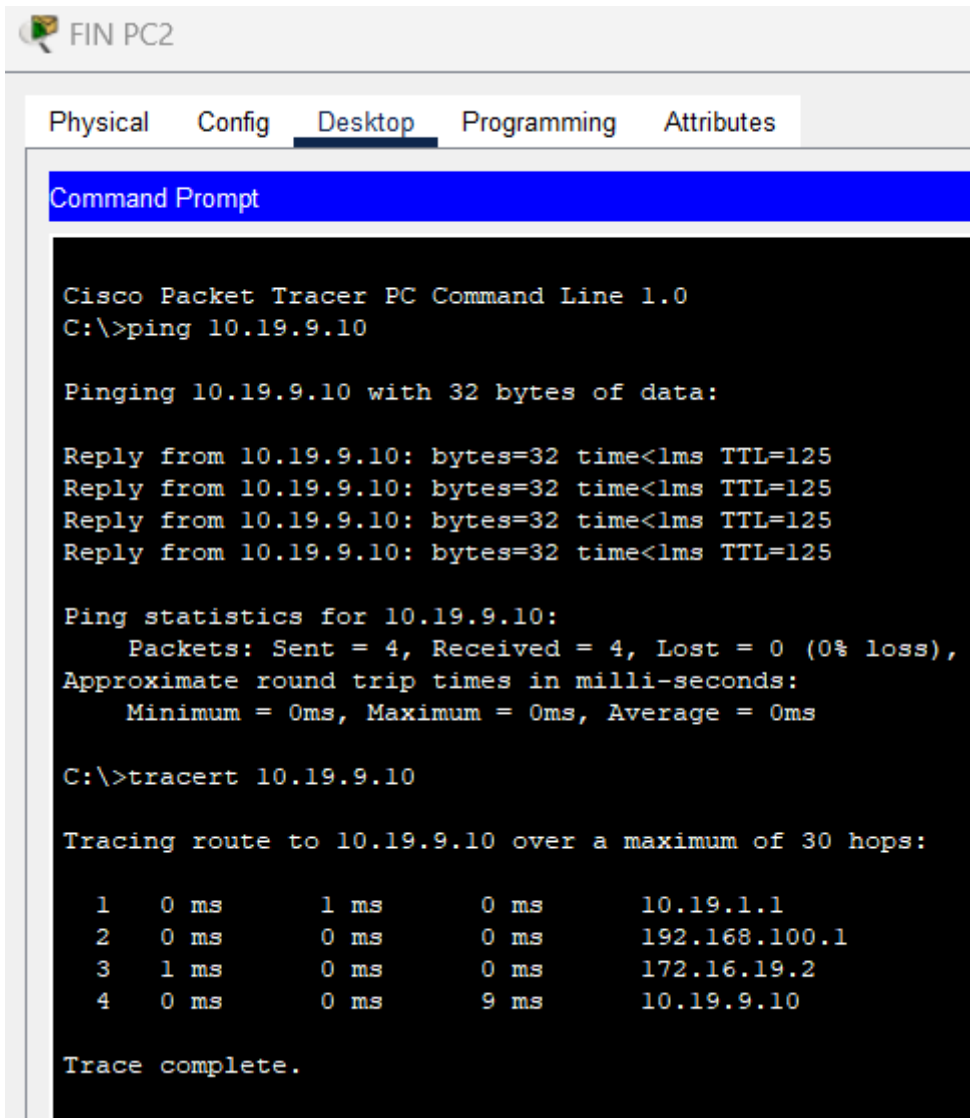
Tracing route to 10.19.9.10 over a maximum of 30 hops:

  0  0 ms    0 ms    0 ms    10.19.1.1
  1  0 ms    0 ms    0 ms    192.168.100.1
  2  1 ms    0 ms    0 ms    172.16.19.2
  3  0 ms    0 ms    9 ms    10.19.9.10

Trace complete.
```

7.2 Conectividade Intra-departamental (Mesmo Departamento e Diferentes Localizações)

Teste: PC Financeiro Coimbra → PC Financeiro Porto



The screenshot shows the Cisco Packet Tracer PC Command Line interface for a device named 'FIN PC2'. The 'Desktop' tab is selected. The command prompt shows the execution of a ping command to 10.19.9.10, which is successful. It also shows the execution of a tracert command to 10.19.9.10, which displays a four-hop path with the final destination being 10.19.9.10.

```
FIN PC2
Physical  Config  Desktop  Programming  Attributes
Command Prompt

Cisco Packet Tracer PC Command Line 1.0
C:\>ping 10.19.9.10

Pinging 10.19.9.10 with 32 bytes of data:

Reply from 10.19.9.10: bytes=32 time<1ms TTL=125
Reply from 10.19.9.10: bytes=32 time<1ms TTL=125
Reply from 10.19.9.10: bytes=32 time<1ms TTL=125
Reply from 10.19.9.10: bytes=32 time<1ms TTL=125

Ping statistics for 10.19.9.10:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>tracert 10.19.9.10

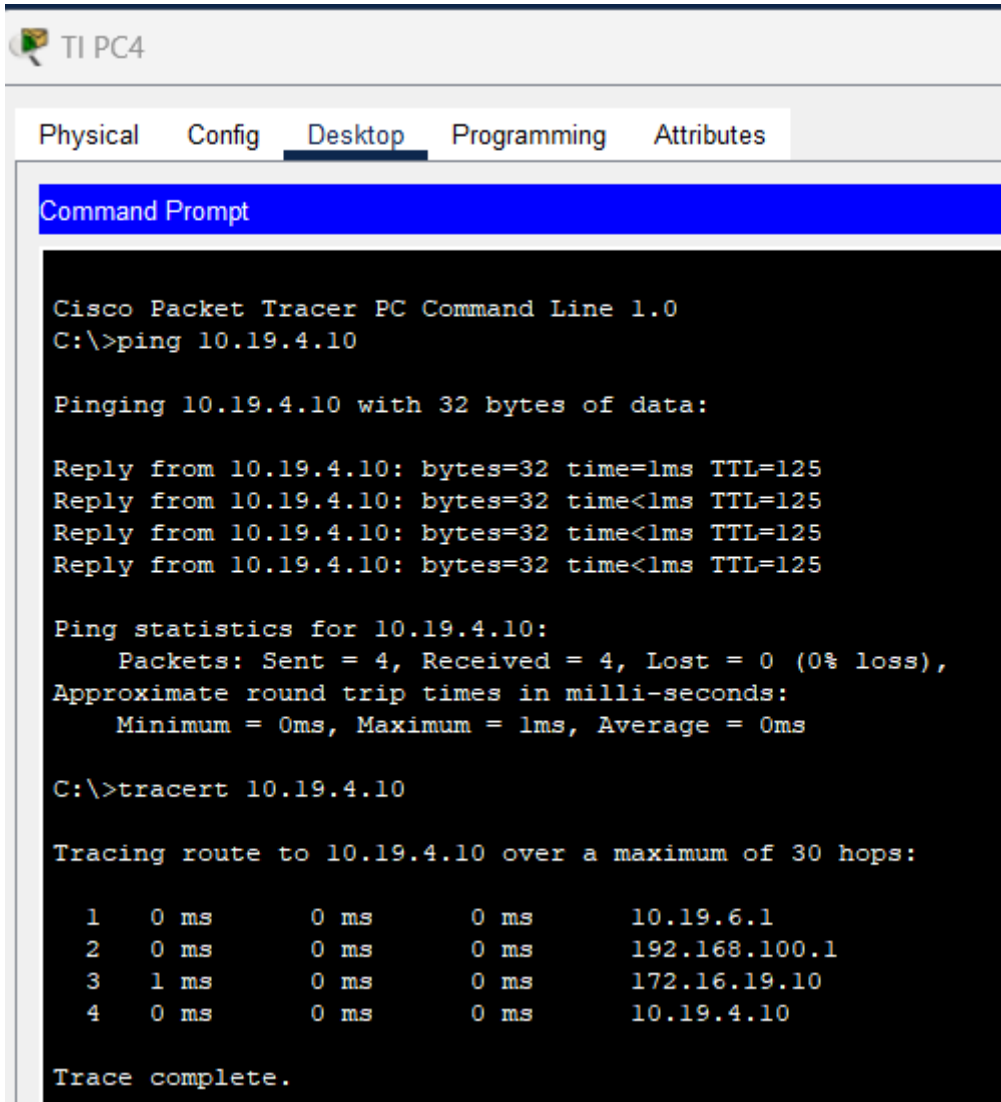
Tracing route to 10.19.9.10 over a maximum of 30 hops:

  0  0 ms    1 ms     0 ms     10.19.1.1
  1  0 ms    0 ms     0 ms     192.168.100.1
  2  1 ms    0 ms     0 ms     172.16.19.2
  3  0 ms    0 ms     9 ms     10.19.9.10

Trace complete.
```

7.3 Conectividade Inter-departamental (Diferentes Departamentos e Diferente localização)

Teste: PC TI Coimbra → PC LOG Viseu



The screenshot shows the Cisco Packet Tracer PC Command Line interface for a device named 'TI PC4'. The 'Desktop' tab is selected. The command prompt shows the execution of a ping command to 10.19.4.10, which is successful. It also shows the execution of a traceroute command to 10.19.4.10, which shows a path of 4 hops.

```
Cisco Packet Tracer PC Command Line 1.0
C:\>ping 10.19.4.10

Pinging 10.19.4.10 with 32 bytes of data:

Reply from 10.19.4.10: bytes=32 time=1ms TTL=125
Reply from 10.19.4.10: bytes=32 time<1ms TTL=125
Reply from 10.19.4.10: bytes=32 time<1ms TTL=125
Reply from 10.19.4.10: bytes=32 time<1ms TTL=125

Ping statistics for 10.19.4.10:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 1ms, Average = 0ms

C:\>tracert 10.19.4.10

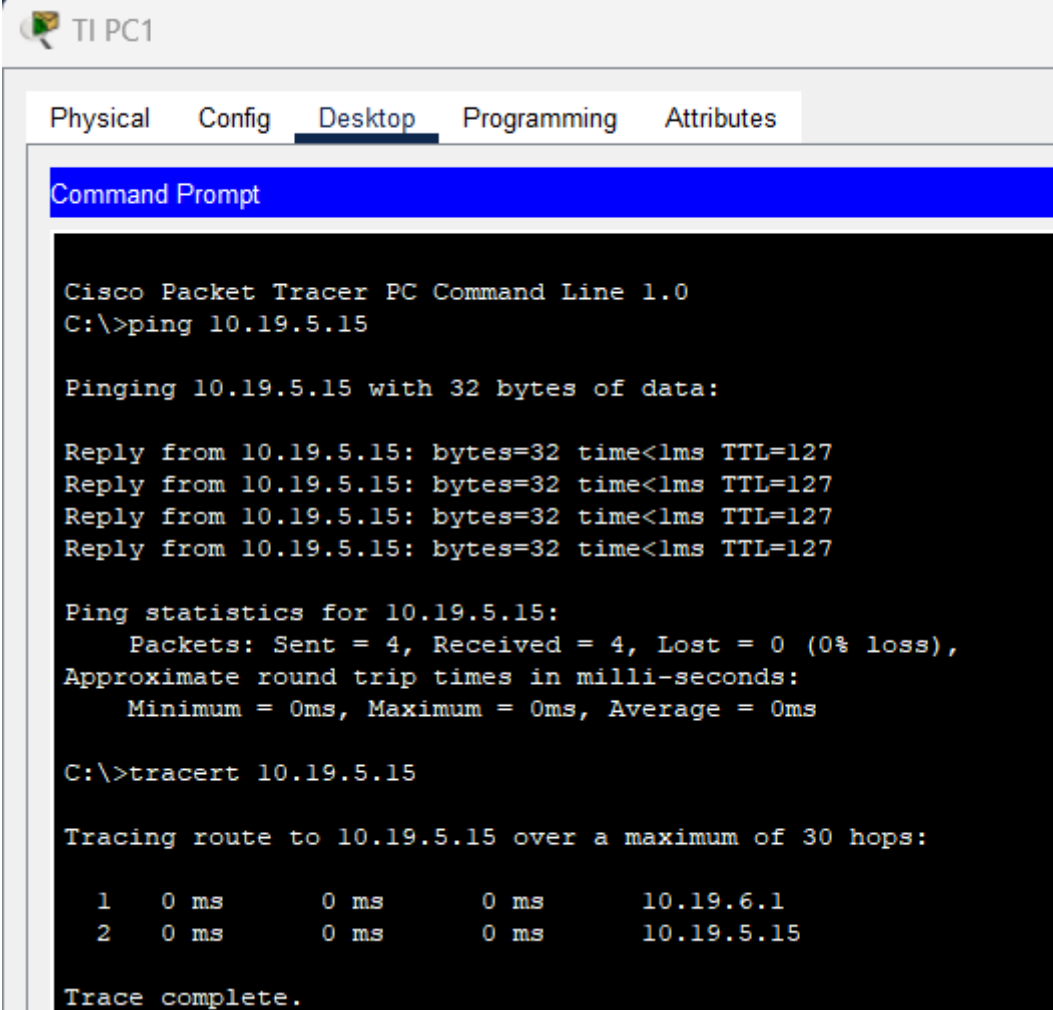
Tracing route to 10.19.4.10 over a maximum of 30 hops:

  1  0 ms      0 ms      0 ms      10.19.6.1
  2  0 ms      0 ms      0 ms      192.168.100.1
  3  1 ms      0 ms      0 ms      172.16.19.10
  4  0 ms      0 ms      0 ms      10.19.4.10

Trace complete.
```

7.4 Conectividade Inter-departamental (Diferentes Departamentos e Diferente localização)

Teste: PC TI Coimbra → PC ADM Coimbra



The screenshot shows a Cisco Packet Tracer PC Command Prompt window for a device named 'TI PC1'. The window has tabs for 'Physical', 'Config', 'Desktop' (selected), 'Programming', and 'Attributes'. The Command Prompt displays the following text:

```
Cisco Packet Tracer PC Command Line 1.0
C:\>ping 10.19.5.15

Pinging 10.19.5.15 with 32 bytes of data:

Reply from 10.19.5.15: bytes=32 time<1ms TTL=127
Reply from 10.19.5.15: bytes=32 time<1ms TTL=127
Reply from 10.19.5.15: bytes=32 time<1ms TTL=127
Reply from 10.19.5.15: bytes=32 time<1ms TTL=127

Ping statistics for 10.19.5.15:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>tracert 10.19.5.15

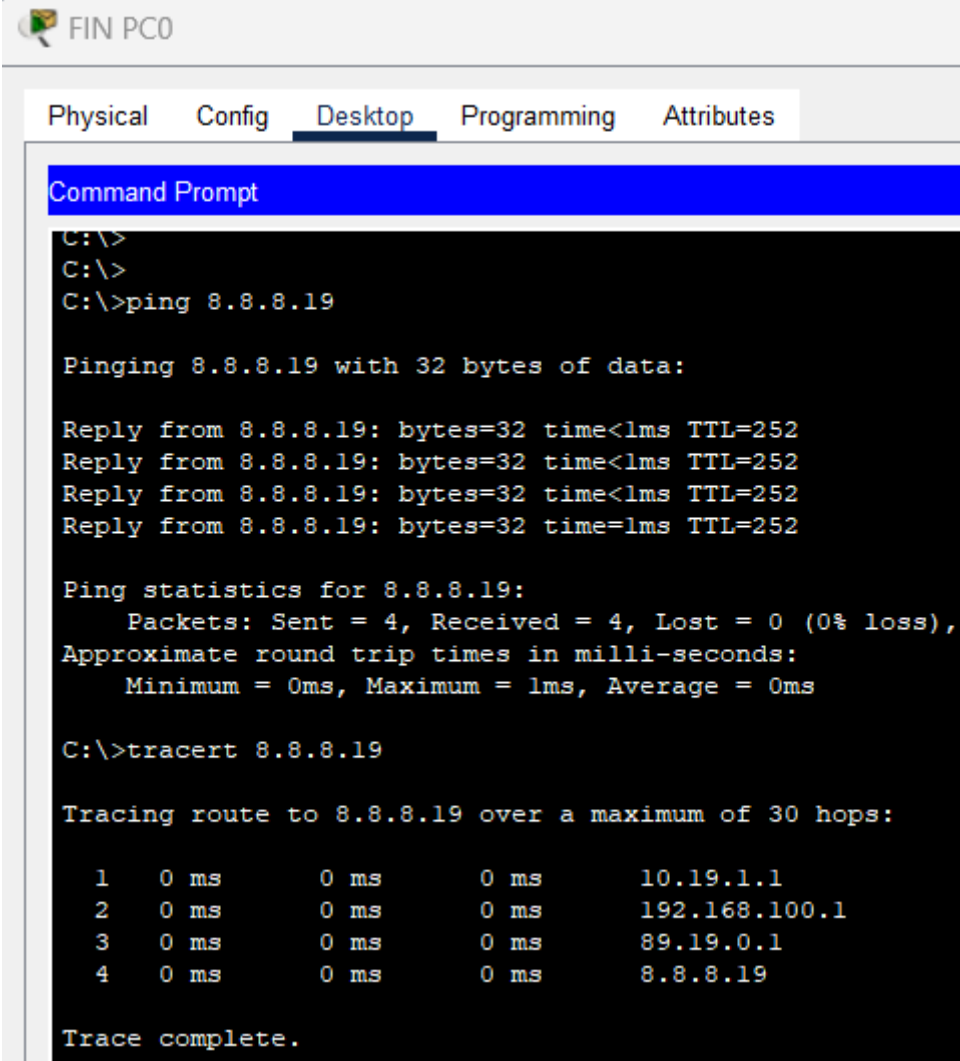
Tracing route to 10.19.5.15 over a maximum of 30 hops:

  1  0 ms      0 ms      0 ms      10.19.6.1
  2  0 ms      0 ms      0 ms      10.19.5.15

Trace complete.
```

7.5 Ping e Traceroute para Internet

Teste 1: PC FIN Coimbra → Router INTERNET (8.8.8.19)



```
FIN PC0
Physical  Config  Desktop  Programming  Attributes

Command Prompt

C:\>
C:\>
C:\>ping 8.8.8.19

Pinging 8.8.8.19 with 32 bytes of data:

Reply from 8.8.8.19: bytes=32 time<1ms TTL=252
Reply from 8.8.8.19: bytes=32 time<1ms TTL=252
Reply from 8.8.8.19: bytes=32 time<1ms TTL=252
Reply from 8.8.8.19: bytes=32 time=1ms TTL=252

Ping statistics for 8.8.8.19:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 1ms, Average = 0ms

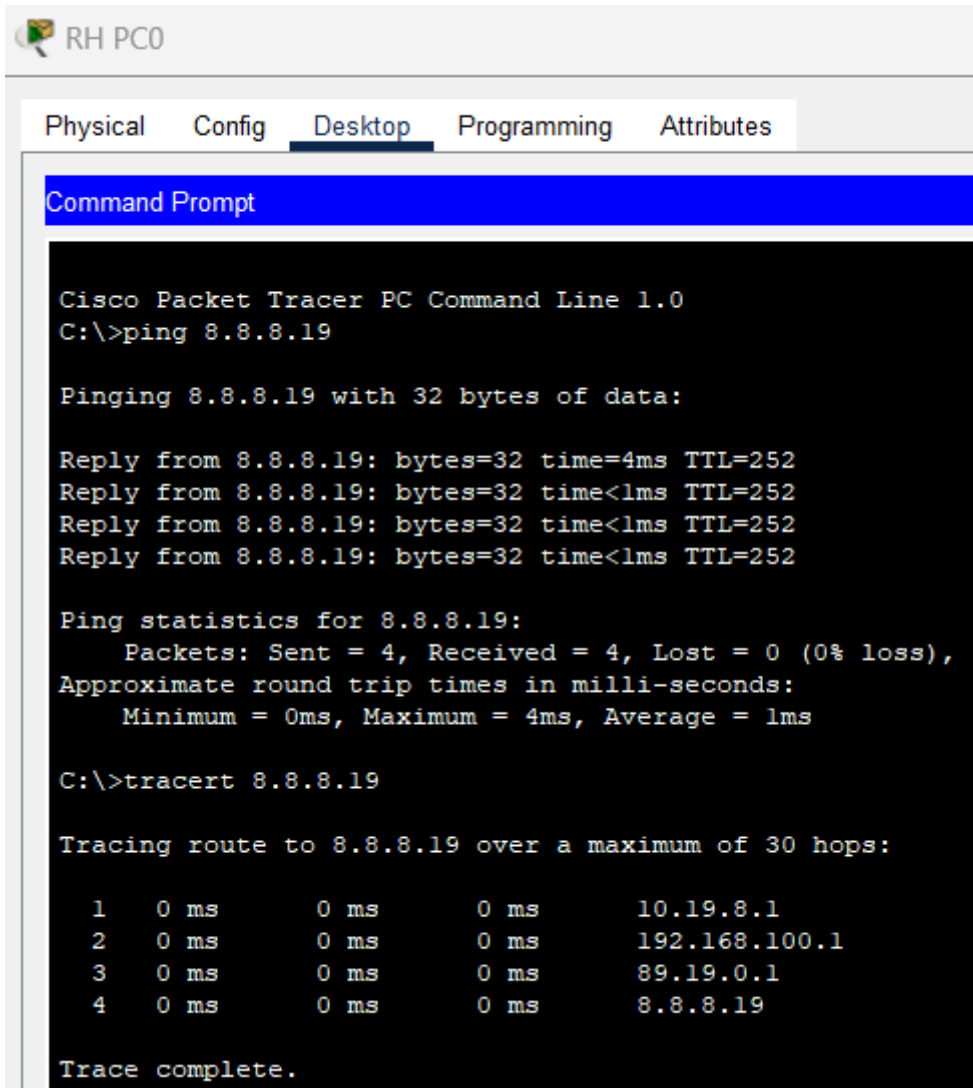
C:\>tracert 8.8.8.19

Tracing route to 8.8.8.19 over a maximum of 30 hops:

  0  0 ms    0 ms    0 ms    10.19.1.1
  1  0 ms    0 ms    0 ms    192.168.100.1
  2  0 ms    0 ms    0 ms    89.19.0.1
  3  0 ms    0 ms    0 ms    8.8.8.19

Trace complete.
```


Teste 2: PC RH Coimbra → R outer INTERNET (8.8.8.19)



RH PC0

Physical Config **Desktop** Programming Attributes

Command Prompt

```
Cisco Packet Tracer PC Command Line 1.0
C:\>ping 8.8.8.19

Pinging 8.8.8.19 with 32 bytes of data:

Reply from 8.8.8.19: bytes=32 time=4ms TTL=252
Reply from 8.8.8.19: bytes=32 time<1ms TTL=252
Reply from 8.8.8.19: bytes=32 time<1ms TTL=252
Reply from 8.8.8.19: bytes=32 time<1ms TTL=252

Ping statistics for 8.8.8.19:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 4ms, Average = 1ms

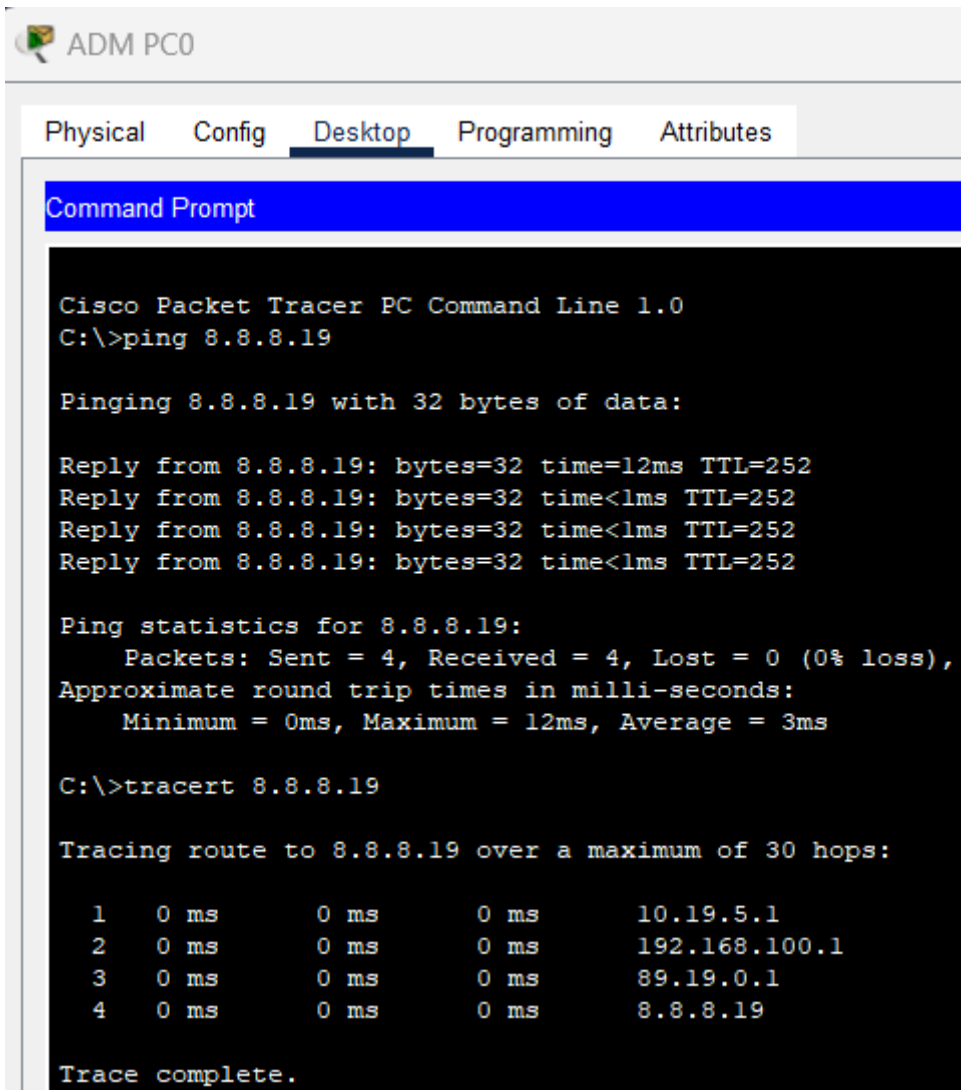
C:\>tracert 8.8.8.19

Tracing route to 8.8.8.19 over a maximum of 30 hops:

  0  0 ms    0 ms    0 ms    10.19.8.1
  1  0 ms    0 ms    0 ms   192.168.100.1
  2  0 ms    0 ms    0 ms    89.19.0.1
  3  0 ms    0 ms    0 ms    8.8.8.19

Trace complete.
```

Teste 3: PC ADM Coimbra → Router INTERNET (8.8.8.19)



ADM PC0

Physical Config **Desktop** Programming Attributes

Command Prompt

```
Cisco Packet Tracer PC Command Line 1.0
C:\>ping 8.8.8.19

Pinging 8.8.8.19 with 32 bytes of data:

Reply from 8.8.8.19: bytes=32 time=12ms TTL=252
Reply from 8.8.8.19: bytes=32 time<1ms TTL=252
Reply from 8.8.8.19: bytes=32 time<1ms TTL=252
Reply from 8.8.8.19: bytes=32 time<1ms TTL=252

Ping statistics for 8.8.8.19:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 12ms, Average = 3ms

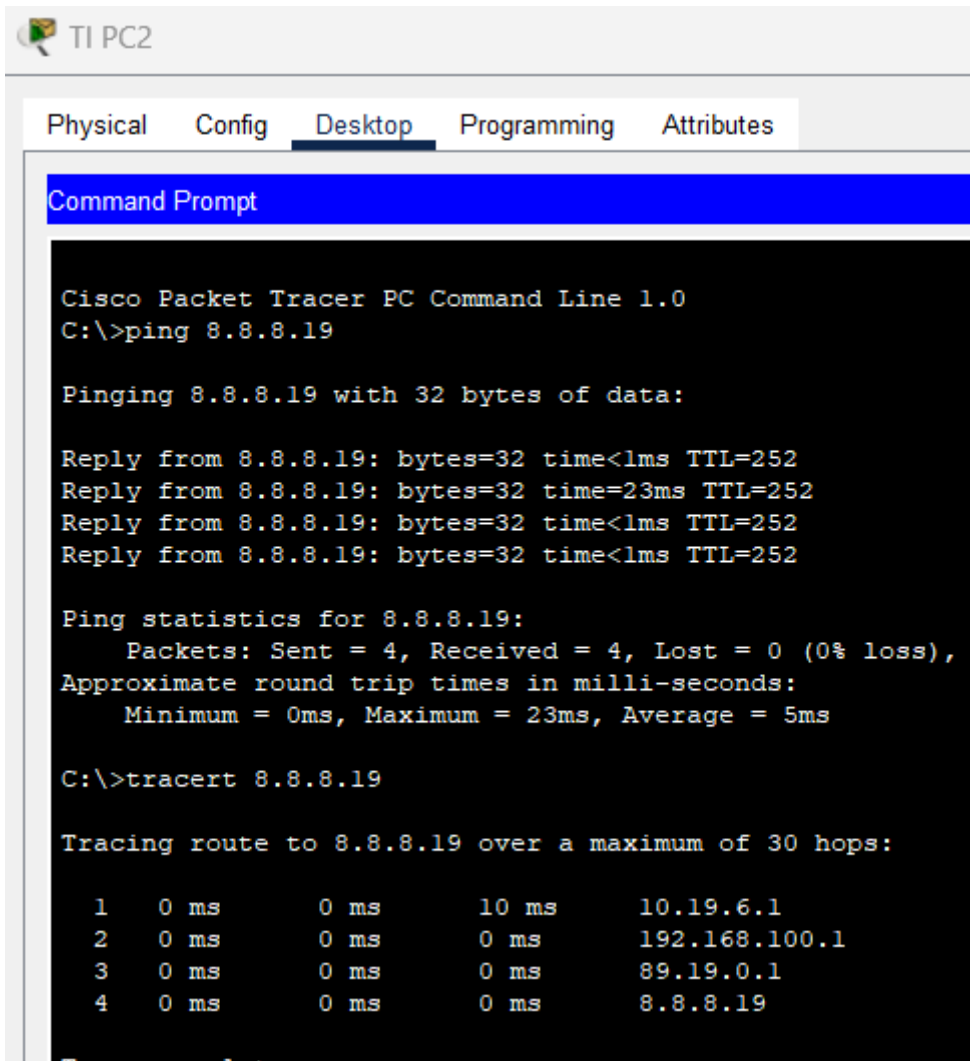
C:\>tracert 8.8.8.19

Tracing route to 8.8.8.19 over a maximum of 30 hops:

  1  0 ms    0 ms    0 ms    10.19.5.1
  2  0 ms    0 ms    0 ms    192.168.100.1
  3  0 ms    0 ms    0 ms    89.19.0.1
  4  0 ms    0 ms    0 ms    8.8.8.19

Trace complete.
```

Teste 4: PC TI Coimbra → Route r INTERNET (8.8.8.19)



The screenshot shows the 'Desktop' tab of a PC named 'TI PC2' in Cisco Packet Tracer. The Command Prompt window displays the following output:

```
Cisco Packet Tracer PC Command Line 1.0
C:\>ping 8.8.8.19

Pinging 8.8.8.19 with 32 bytes of data:

Reply from 8.8.8.19: bytes=32 time<1ms TTL=252
Reply from 8.8.8.19: bytes=32 time=23ms TTL=252
Reply from 8.8.8.19: bytes=32 time<1ms TTL=252
Reply from 8.8.8.19: bytes=32 time<1ms TTL=252

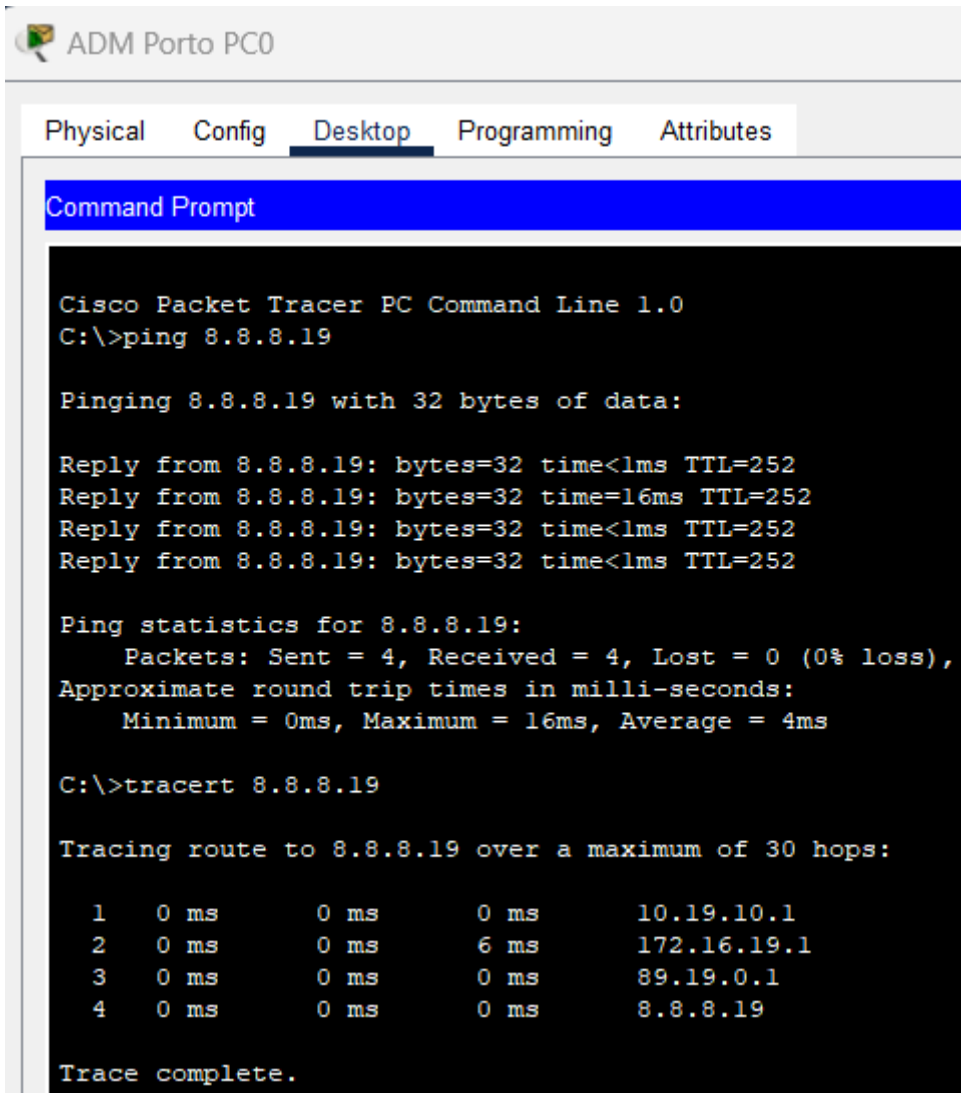
Ping statistics for 8.8.8.19:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 23ms, Average = 5ms

C:\>tracert 8.8.8.19

Tracing route to 8.8.8.19 over a maximum of 30 hops:

  1  0 ms      0 ms      10 ms     10.19.6.1
  2  0 ms      0 ms      0 ms      192.168.100.1
  3  0 ms      0 ms      0 ms      89.19.0.1
  4  0 ms      0 ms      0 ms      8.8.8.19
```

Teste 5: PC ADM Porto → Router INTERNET (8.8.8.19)



ADM Porto PC0

Physical Config **Desktop** Programming Attributes

Command Prompt

```
Cisco Packet Tracer PC Command Line 1.0
C:\>ping 8.8.8.19

Pinging 8.8.8.19 with 32 bytes of data:

Reply from 8.8.8.19: bytes=32 time<1ms TTL=252
Reply from 8.8.8.19: bytes=32 time=16ms TTL=252
Reply from 8.8.8.19: bytes=32 time<1ms TTL=252
Reply from 8.8.8.19: bytes=32 time<1ms TTL=252

Ping statistics for 8.8.8.19:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 16ms, Average = 4ms

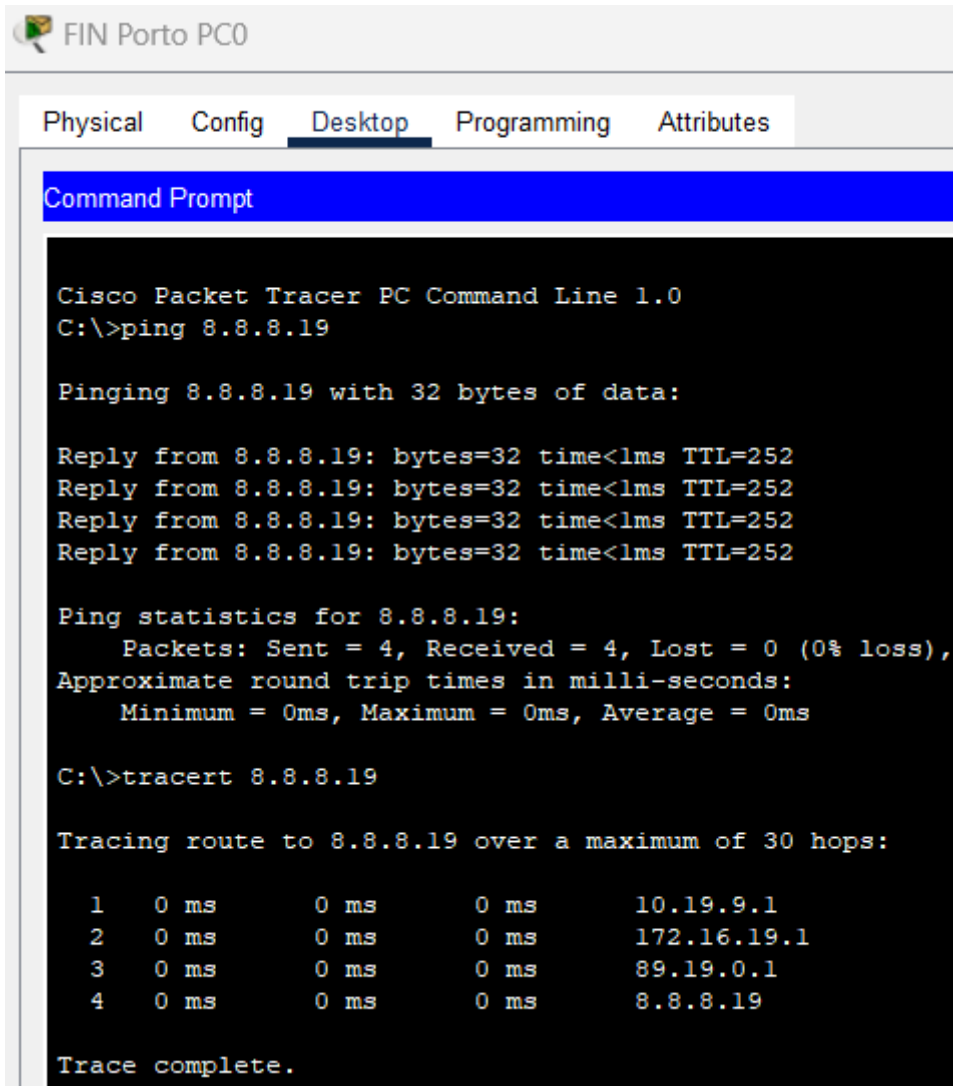
C:\>tracert 8.8.8.19

Tracing route to 8.8.8.19 over a maximum of 30 hops:

  0  0 ms    0 ms    0 ms    10.19.10.1
  1  0 ms    0 ms    6 ms    172.16.19.1
  2  0 ms    0 ms    0 ms    89.19.0.1
  3  0 ms    0 ms    0 ms    8.8.8.19

Trace complete.
```

Teste 6: PC FIN Porto → Router INTERNET (8.8.8.19)



FIN Porto PC0

Physical Config Desktop Programming Attributes

Command Prompt

```
Cisco Packet Tracer PC Command Line 1.0
C:\>ping 8.8.8.19

Pinging 8.8.8.19 with 32 bytes of data:

Reply from 8.8.8.19: bytes=32 time<1ms TTL=252
Reply from 8.8.8.19: bytes=32 time<1ms TTL=252
Reply from 8.8.8.19: bytes=32 time<1ms TTL=252
Reply from 8.8.8.19: bytes=32 time<1ms TTL=252

Ping statistics for 8.8.8.19:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 0ms, Average = 0ms

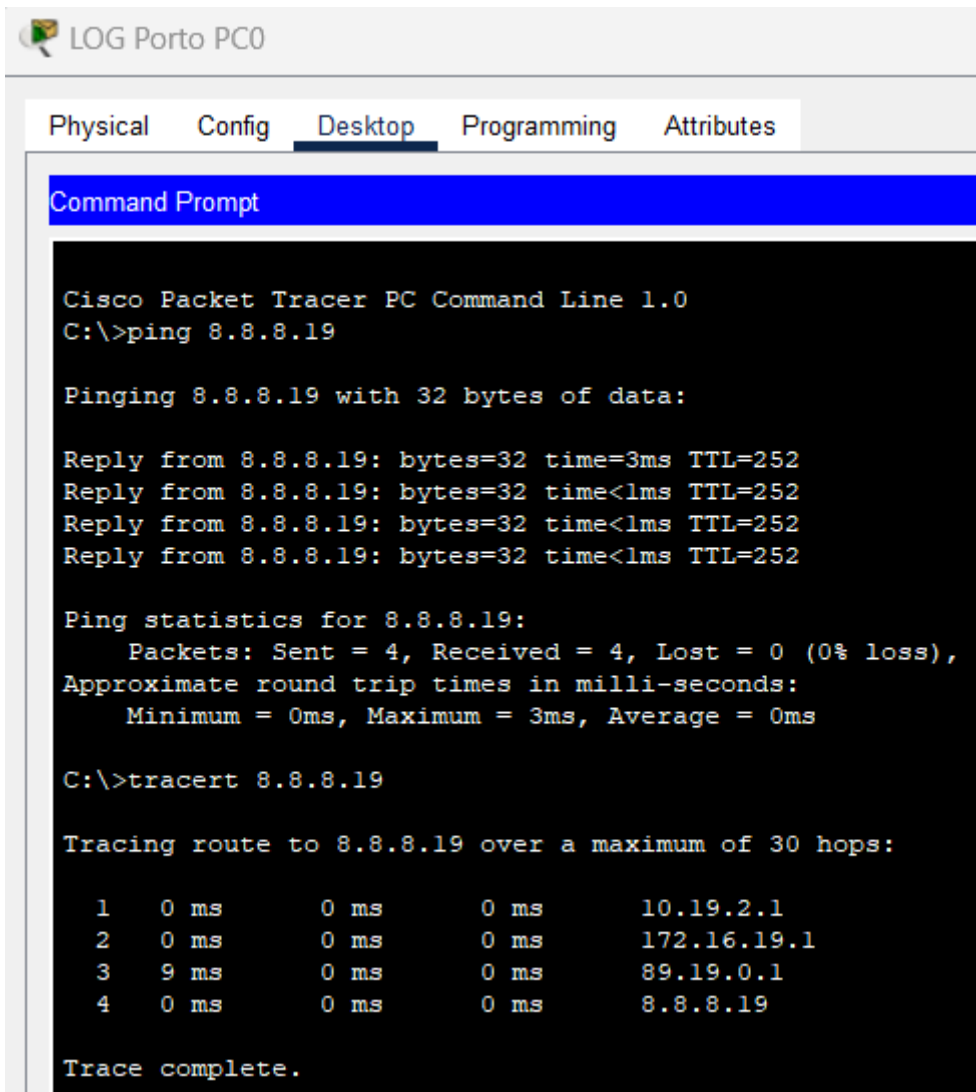
C:\>tracert 8.8.8.19

Tracing route to 8.8.8.19 over a maximum of 30 hops:

  1  0 ms    0 ms    0 ms    10.19.9.1
  2  0 ms    0 ms    0 ms    172.16.19.1
  3  0 ms    0 ms    0 ms    89.19.0.1
  4  0 ms    0 ms    0 ms    8.8.8.19

Trace complete.
```

Teste 7: PC LOG Porto → Router INTERNET (8.8.8.19)



The screenshot shows the 'LOG Porto PC0' window with 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 'ping 8.8.8.19' and 'tracert 8.8.8.19' commands, with their respective outputs.

```
Cisco Packet Tracer PC Command Line 1.0
C:\>ping 8.8.8.19

Pinging 8.8.8.19 with 32 bytes of data:

Reply from 8.8.8.19: bytes=32 time=3ms TTL=252
Reply from 8.8.8.19: bytes=32 time<1ms TTL=252
Reply from 8.8.8.19: bytes=32 time<1ms TTL=252
Reply from 8.8.8.19: bytes=32 time<1ms TTL=252

Ping statistics for 8.8.8.19:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 3ms, Average = 0ms

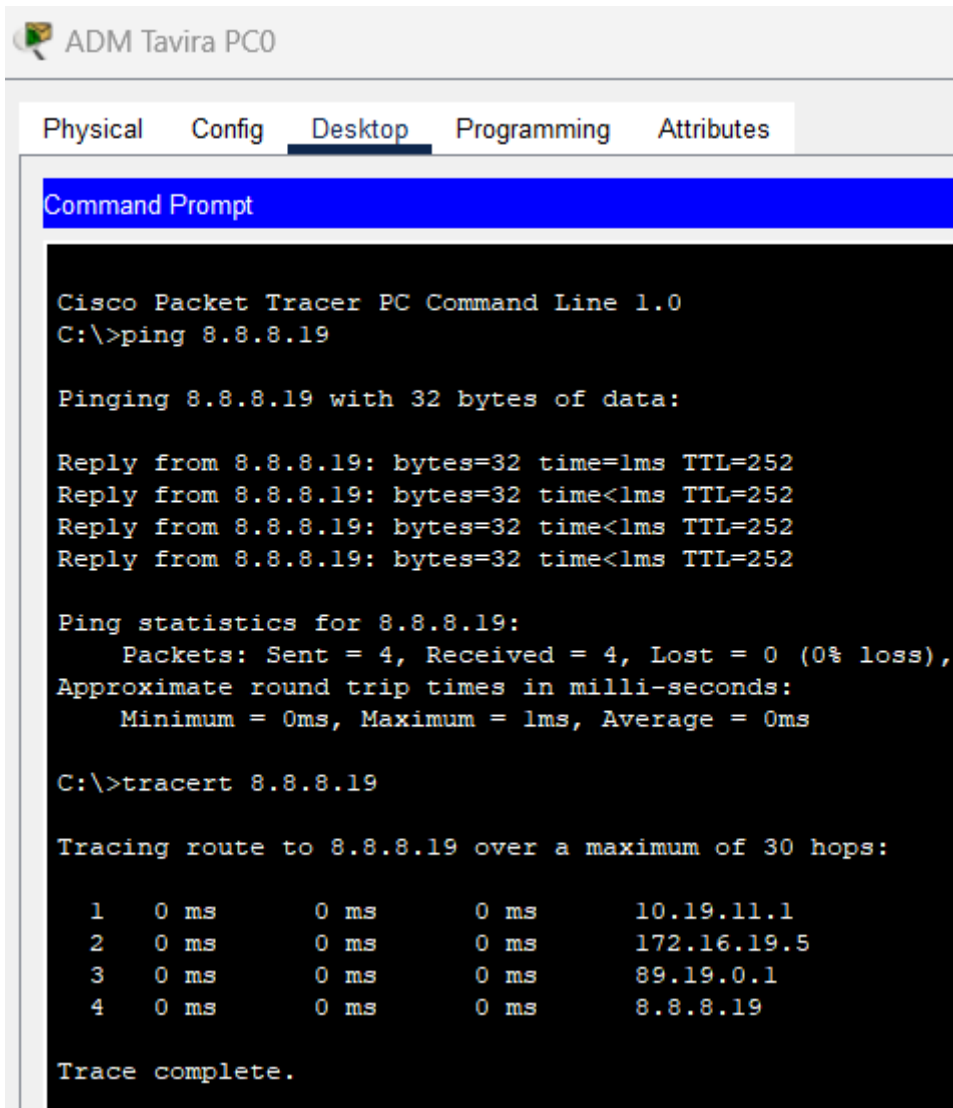
C:\>tracert 8.8.8.19

Tracing route to 8.8.8.19 over a maximum of 30 hops:

  0  0 ms    0 ms    0 ms    10.19.2.1
  1  0 ms    0 ms    0 ms    172.16.19.1
  2  9 ms    0 ms    0 ms    89.19.0.1
  3  0 ms    0 ms    0 ms    8.8.8.19

Trace complete.
```

Teste 8: PC ADM Tavira → Router INTERNET (8.8.8.19)



ADM Tavira PC0

Physical Config **Desktop** Programming Attributes

Command Prompt

```
Cisco Packet Tracer PC Command Line 1.0
C:\>ping 8.8.8.19

Pinging 8.8.8.19 with 32 bytes of data:

Reply from 8.8.8.19: bytes=32 time=1ms TTL=252
Reply from 8.8.8.19: bytes=32 time<1ms TTL=252
Reply from 8.8.8.19: bytes=32 time<1ms TTL=252
Reply from 8.8.8.19: bytes=32 time<1ms TTL=252

Ping statistics for 8.8.8.19:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 1ms, Average = 0ms

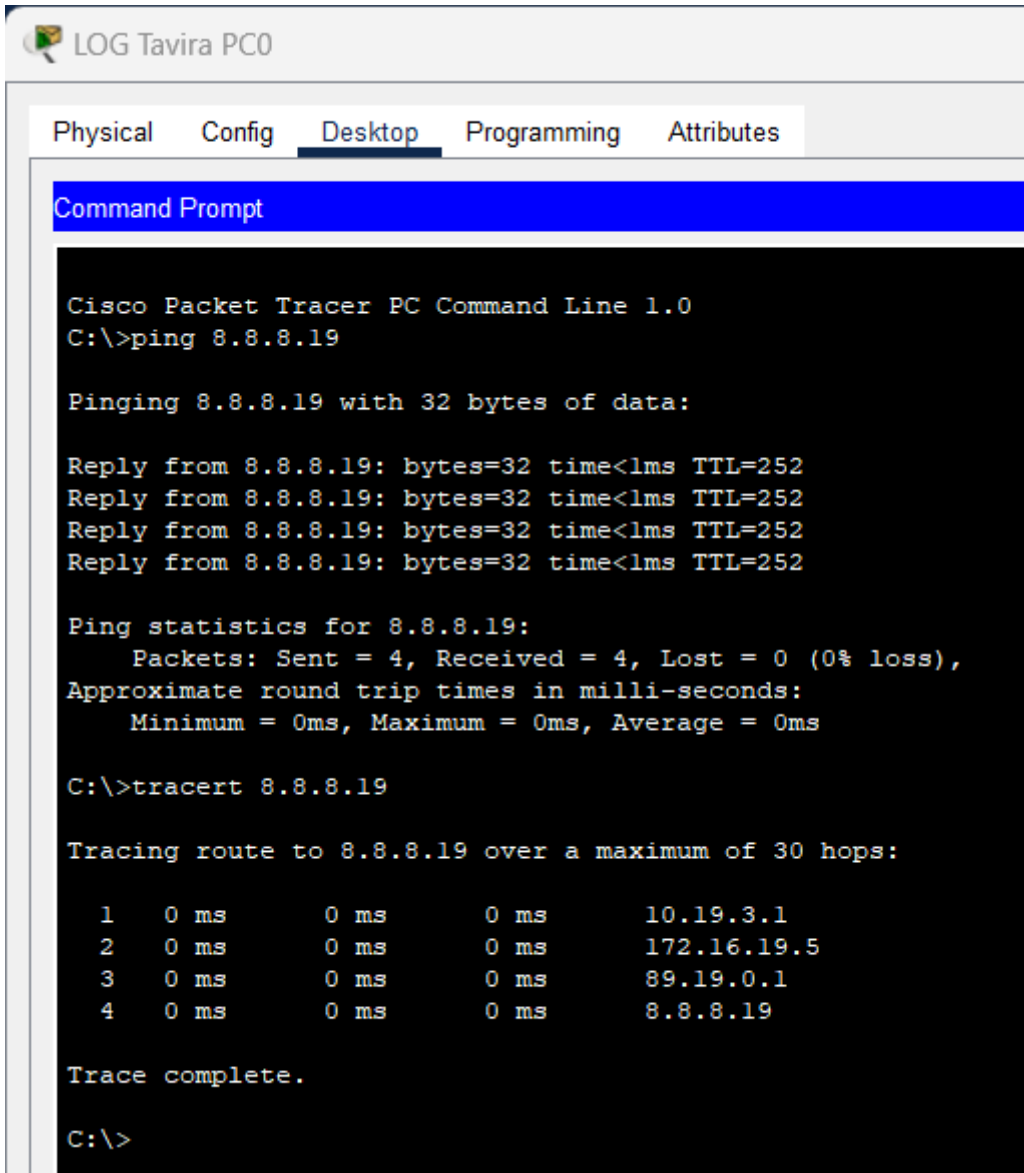
C:\>tracert 8.8.8.19

Tracing route to 8.8.8.19 over a maximum of 30 hops:

  1  0 ms      0 ms      0 ms      10.19.11.1
  2  0 ms      0 ms      0 ms      172.16.19.5
  3  0 ms      0 ms      0 ms      89.19.0.1
  4  0 ms      0 ms      0 ms      8.8.8.19

Trace complete.
```

Teste 9: PC LOG Tavira → Router INTERNET (8.8.8.19)



The screenshot shows the 'LOG Tavira PC0' application window. It has a tabbed interface with 'Physical', 'Config', 'Desktop', 'Programming', and 'Attributes'. The 'Desktop' tab is active, displaying a 'Command Prompt' window. The Command Prompt shows the output of a ping and a traceroute command from a Cisco Packet Tracer PC Command Line 1.0.

```
Cisco Packet Tracer PC Command Line 1.0
C:\>ping 8.8.8.19

Pinging 8.8.8.19 with 32 bytes of data:

Reply from 8.8.8.19: bytes=32 time<1ms TTL=252
Reply from 8.8.8.19: bytes=32 time<1ms TTL=252
Reply from 8.8.8.19: bytes=32 time<1ms TTL=252
Reply from 8.8.8.19: bytes=32 time<1ms TTL=252

Ping statistics for 8.8.8.19:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>tracert 8.8.8.19

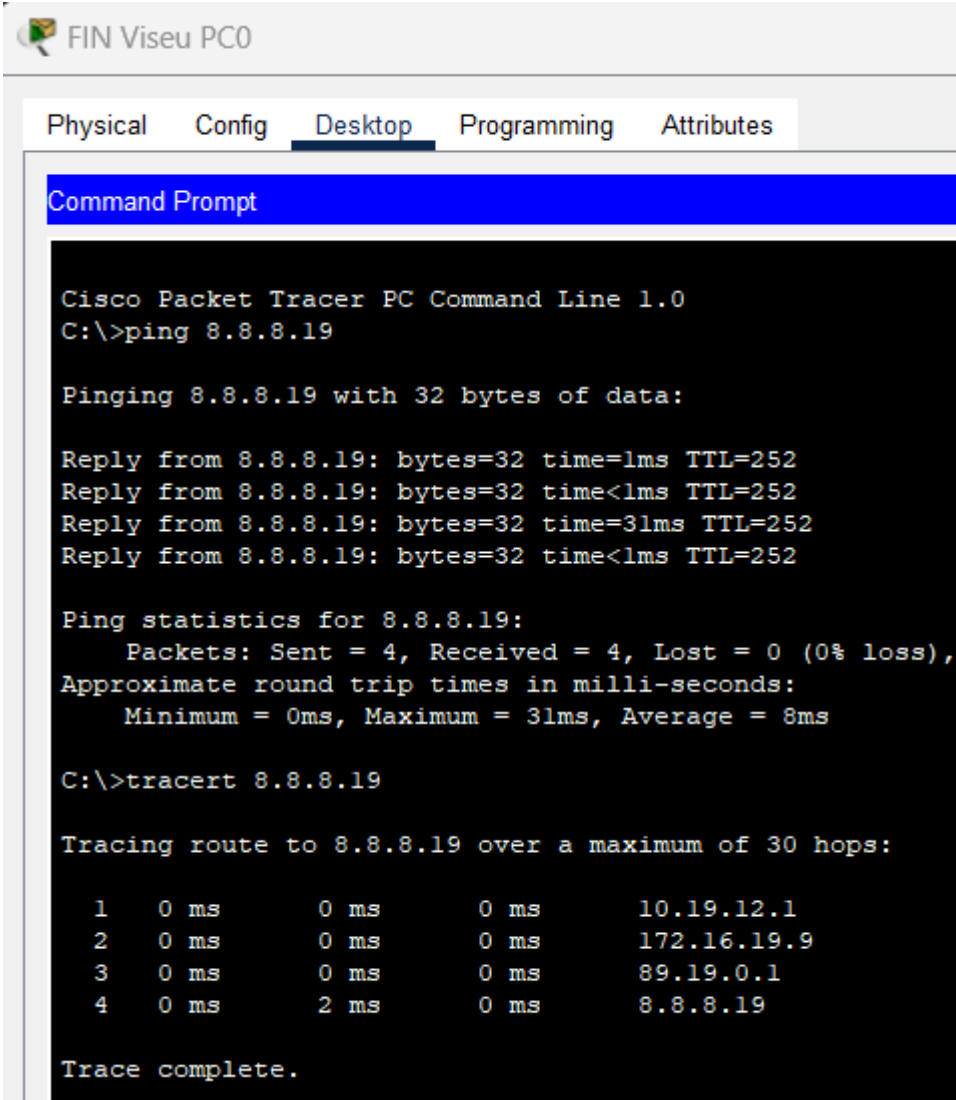
Tracing route to 8.8.8.19 over a maximum of 30 hops:

  1  0 ms    0 ms    0 ms    10.19.3.1
  2  0 ms    0 ms    0 ms    172.16.19.5
  3  0 ms    0 ms    0 ms    89.19.0.1
  4  0 ms    0 ms    0 ms    8.8.8.19

Trace complete.

C:\>
```


Teste 11: PC FIN Viseu → Router INTERNET (8.8.8.19)



FIN Viseu PC0

Physical Config **Desktop** Programming Attributes

Command Prompt

```
Cisco Packet Tracer PC Command Line 1.0
C:\>ping 8.8.8.19

Pinging 8.8.8.19 with 32 bytes of data:

Reply from 8.8.8.19: bytes=32 time=1ms TTL=252
Reply from 8.8.8.19: bytes=32 time<1ms TTL=252
Reply from 8.8.8.19: bytes=32 time=31ms TTL=252
Reply from 8.8.8.19: bytes=32 time<1ms TTL=252

Ping statistics for 8.8.8.19:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 31ms, Average = 8ms

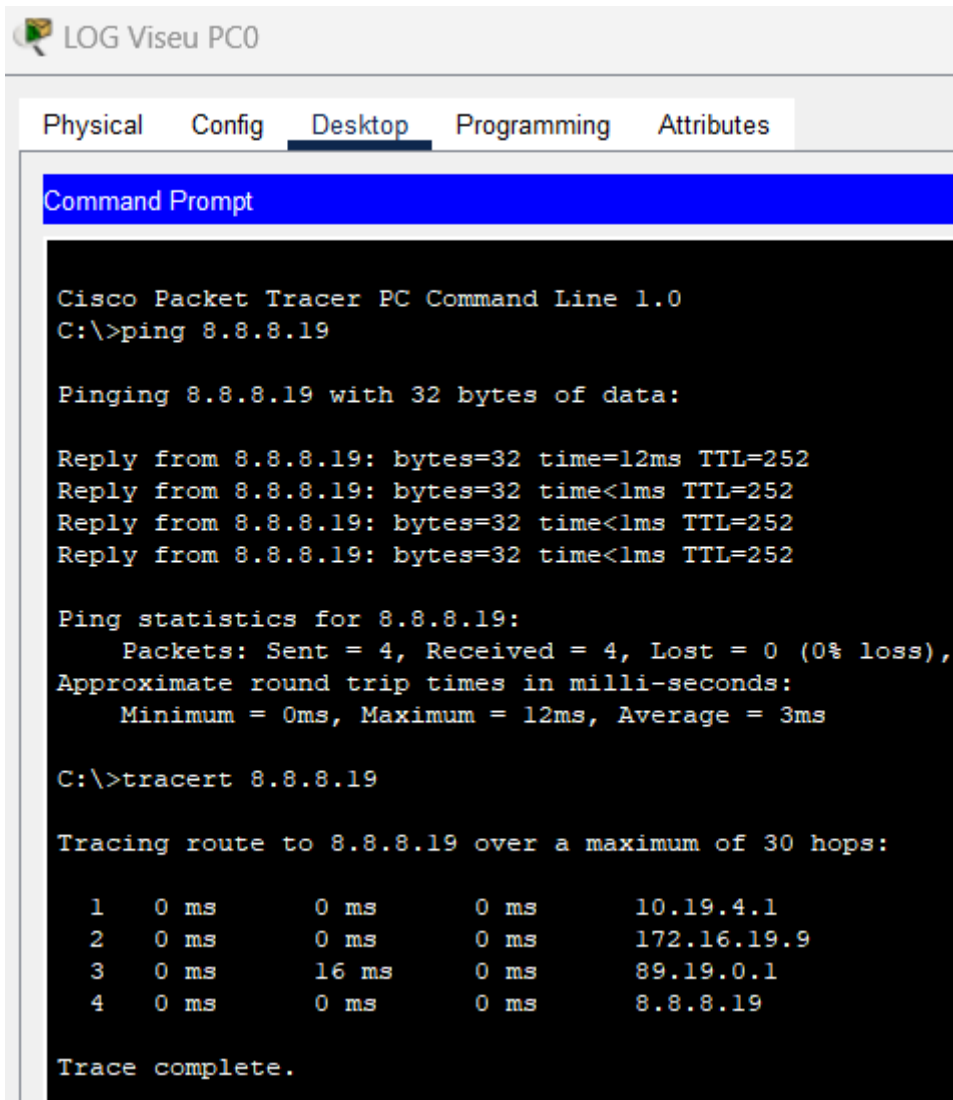
C:\>tracert 8.8.8.19

Tracing route to 8.8.8.19 over a maximum of 30 hops:

  0  0 ms    0 ms    0 ms    10.19.12.1
  1  0 ms    0 ms    0 ms    172.16.19.9
  2  0 ms    0 ms    0 ms    89.19.0.1
  3  0 ms    2 ms    0 ms    8.8.8.19

Trace complete.
```

Teste 12: PC LOG Viseu → Router INTERNET (8.8.8.19)



The screenshot shows the 'LOG Viseu PC0' window with 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 'ping 8.8.8.19' and 'tracert 8.8.8.19' commands, with their respective outputs.

```
Cisco Packet Tracer PC Command Line 1.0
C:\>ping 8.8.8.19

Pinging 8.8.8.19 with 32 bytes of data:

Reply from 8.8.8.19: bytes=32 time=12ms TTL=252
Reply from 8.8.8.19: bytes=32 time<1ms TTL=252
Reply from 8.8.8.19: bytes=32 time<1ms TTL=252
Reply from 8.8.8.19: bytes=32 time<1ms TTL=252

Ping statistics for 8.8.8.19:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 12ms, Average = 3ms

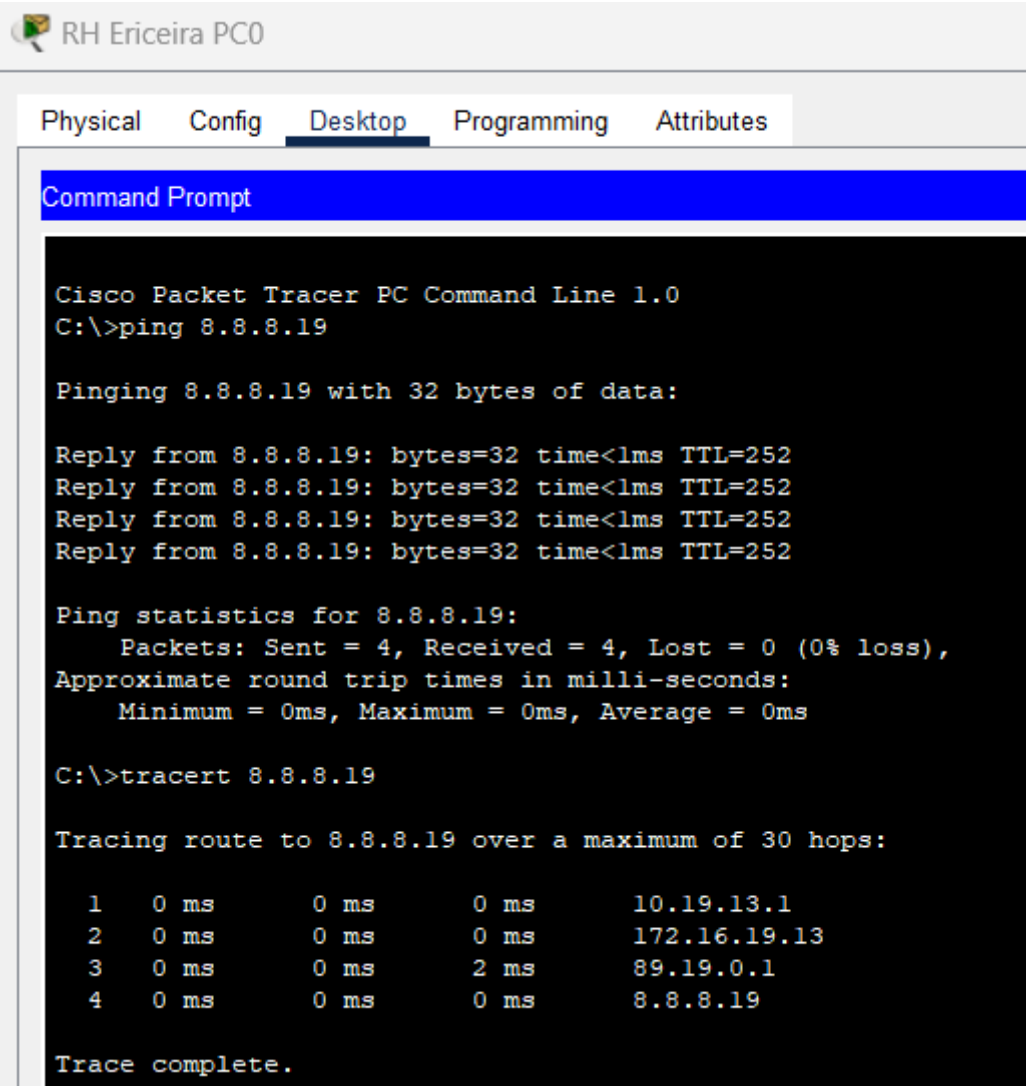
C:\>tracert 8.8.8.19

Tracing route to 8.8.8.19 over a maximum of 30 hops:

  1  0 ms      0 ms      0 ms      10.19.4.1
  2  0 ms      0 ms      0 ms      172.16.19.9
  3  0 ms      16 ms     0 ms      89.19.0.1
  4  0 ms      0 ms      0 ms      8.8.8.19

Trace complete.
```

Teste 13: PC RH Ericeira → Router INTERNET (8.8.8.19)



RH Ericeira PC0

Physical Config **Desktop** Programming Attributes

Command Prompt

```
Cisco Packet Tracer PC Command Line 1.0
C:\>ping 8.8.8.19

Pinging 8.8.8.19 with 32 bytes of data:

Reply from 8.8.8.19: bytes=32 time<1ms TTL=252
Reply from 8.8.8.19: bytes=32 time<1ms TTL=252
Reply from 8.8.8.19: bytes=32 time<1ms TTL=252
Reply from 8.8.8.19: bytes=32 time<1ms TTL=252

Ping statistics for 8.8.8.19:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 0ms, Average = 0ms

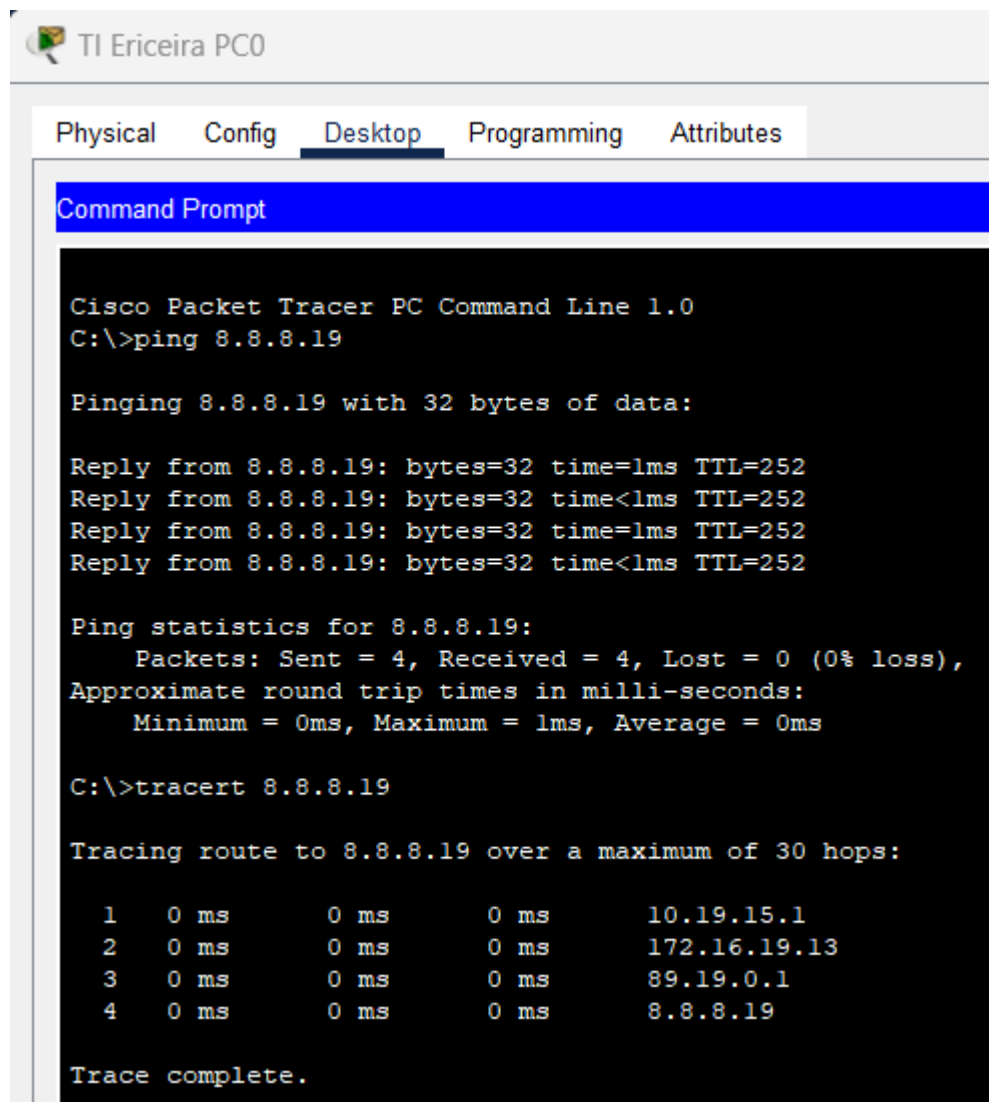
C:\>tracert 8.8.8.19

Tracing route to 8.8.8.19 over a maximum of 30 hops:

  0  0 ms    0 ms    0 ms    10.19.13.1
  1  0 ms    0 ms    0 ms    172.16.19.13
  2  0 ms    0 ms    2 ms    89.19.0.1
  3  0 ms    0 ms    0 ms    8.8.8.19

Trace complete.
```

Teste 14: PC TI Ericeira → Router INTERNET (8.8.8.19)



TI Ericeira PC0

Physical Config **Desktop** Programming Attributes

Command Prompt

```
Cisco Packet Tracer PC Command Line 1.0
C:\>ping 8.8.8.19

Pinging 8.8.8.19 with 32 bytes of data:

Reply from 8.8.8.19: bytes=32 time=1ms TTL=252
Reply from 8.8.8.19: bytes=32 time<1ms TTL=252
Reply from 8.8.8.19: bytes=32 time=1ms TTL=252
Reply from 8.8.8.19: bytes=32 time<1ms TTL=252

Ping statistics for 8.8.8.19:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 1ms, Average = 0ms

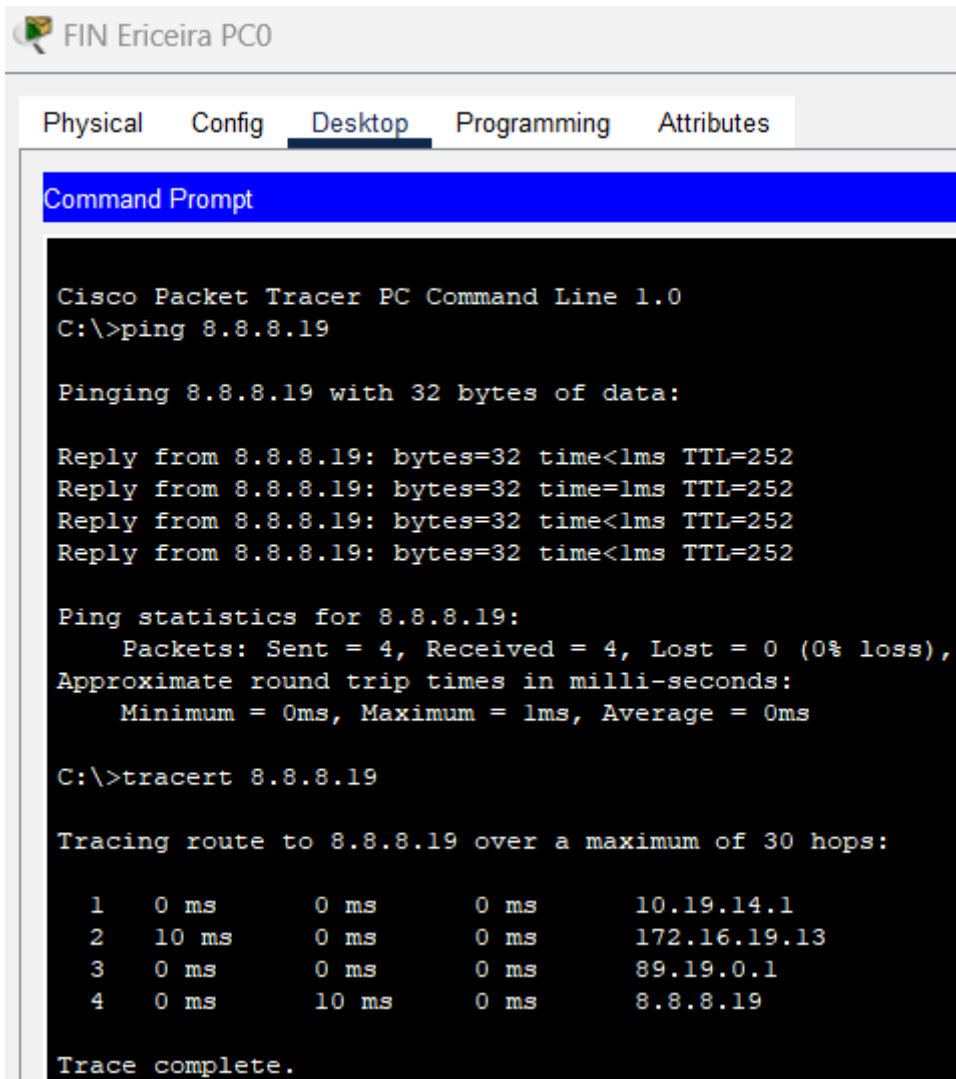
C:\>tracert 8.8.8.19

Tracing route to 8.8.8.19 over a maximum of 30 hops:

  0  0 ms    0 ms    0 ms    10.19.15.1
  1  0 ms    0 ms    0 ms    172.16.19.13
  2  0 ms    0 ms    0 ms    89.19.0.1
  3  0 ms    0 ms    0 ms    8.8.8.19

Trace complete.
```

Teste 15: PC FIN Ericeira → Router INTERNET (8.8.8.19)



FIN Ericeira PC0

Physical Config **Desktop** Programming Attributes

Command Prompt

```
Cisco Packet Tracer PC Command Line 1.0
C:\>ping 8.8.8.19

Pinging 8.8.8.19 with 32 bytes of data:

Reply from 8.8.8.19: bytes=32 time<1ms TTL=252
Reply from 8.8.8.19: bytes=32 time=1ms TTL=252
Reply from 8.8.8.19: bytes=32 time<1ms TTL=252
Reply from 8.8.8.19: bytes=32 time<1ms TTL=252

Ping statistics for 8.8.8.19:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 1ms, Average = 0ms

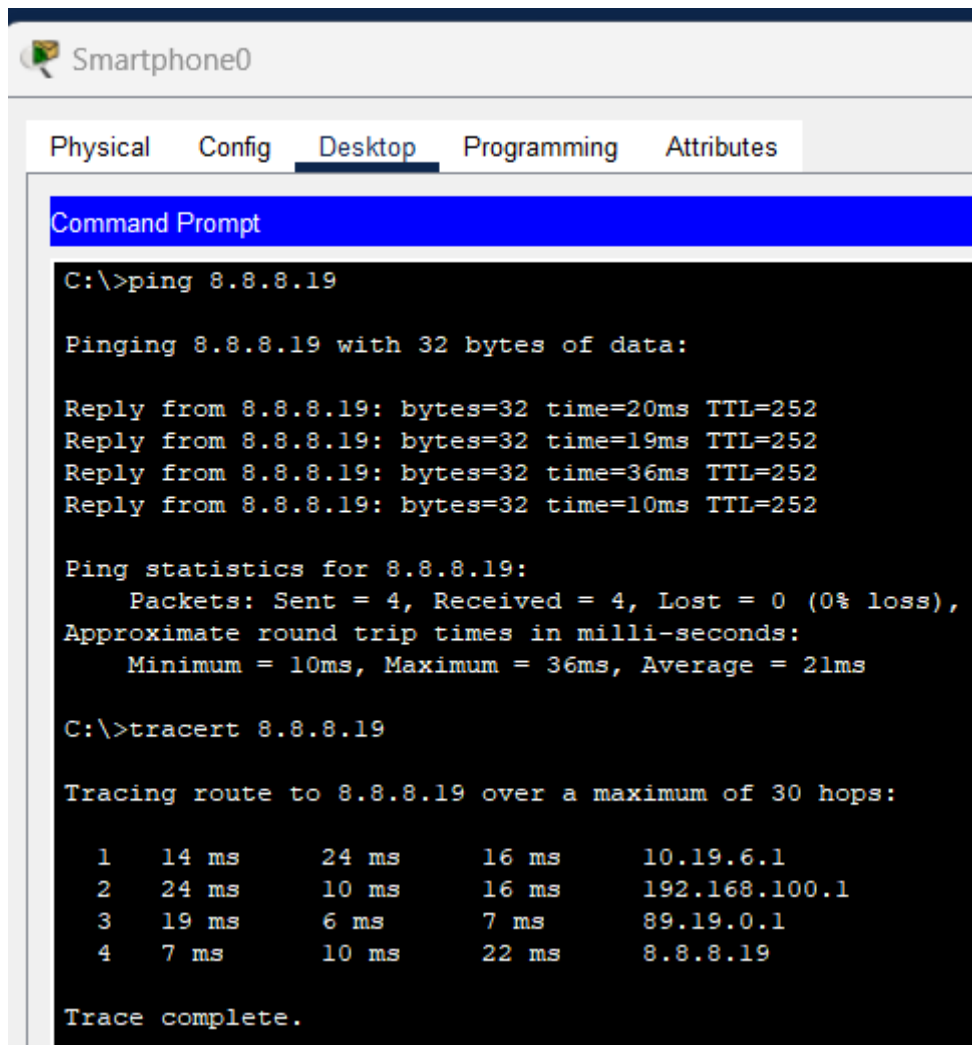
C:\>tracert 8.8.8.19

Tracing route to 8.8.8.19 over a maximum of 30 hops:

  1  0 ms      0 ms      0 ms      10.19.14.1
  2  10 ms     0 ms      0 ms      172.16.19.13
  3  0 ms      0 ms      0 ms      89.19.0.1
  4  0 ms      10 ms     0 ms      8.8.8.19

Trace complete.
```

Teste 16: Smartphone WIFI → Router INTERNET (8.8.8.19)



```
Smartphone0
Physical  Config  Desktop  Programming  Attributes
Command Prompt
C:\>ping 8.8.8.19

Pinging 8.8.8.19 with 32 bytes of data:

Reply from 8.8.8.19: bytes=32 time=20ms TTL=252
Reply from 8.8.8.19: bytes=32 time=19ms TTL=252
Reply from 8.8.8.19: bytes=32 time=36ms TTL=252
Reply from 8.8.8.19: bytes=32 time=10ms TTL=252

Ping statistics for 8.8.8.19:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 10ms, Maximum = 36ms, Average = 21ms

C:\>tracert 8.8.8.19

Tracing route to 8.8.8.19 over a maximum of 30 hops:

  0  14 ms    24 ms    16 ms    10.19.6.1
  1  24 ms    10 ms    16 ms    192.168.100.1
  2  19 ms     6 ms     7 ms     89.19.0.1
  3   7 ms    10 ms    22 ms    8.8.8.19

Trace complete.
```

Análise do Resultado dos Testes

Os testes de **ping** e **traceroute** demonstraram que a configuração da rede foi realizada com sucesso. Como evidenciado nas imagens, o **ping** obteve resposta de todos os destinos e o **traceroute** indicou o percurso correto dos pacotes, confirmando que a comunicação entre os dispositivos está funcional.

8. Desafios e Soluções

8.1 DHCP Centralizado

Desafio: Configurar DHCP centralizado para todas as filiais.

Solução: Implementação de DHCP Relay nos routers das filiais, direcionando pedidos para o servidor central em Coimbra.

8.2 Roteamento Inter-VLANs

Desafio: Permitir comunicação entre diferentes departamentos.

Solução: Configuração de SVIs no switch core 3650 para roteamento local eficiente.

8.3 Conectividade Internet

Desafio: Garantir acesso à Internet de todas as localizações.

Solução: Implementação de NAT no router ISP e configuração de rotas estáticas adequadas.

9. Conclusões

O projeto foi implementado com sucesso, cumprindo todos os requisitos especificados:

Conectividade completa entre todas as localizações

VLANs departamentais funcionais com IDs no formato correto (N19/19N)

Serviços centralizados (DHCP, DNS, Web) operacionais

Acesso à Internet de todas as localizações

Rede WiFi funcional com conectividade completa

Endereçamento hierárquico bem estruturado

A rede implementada demonstra uma arquitetura empresarial realista, com separação departamental, serviços centralizados e conectividade robusta. A utilização do switch core 3650 em Coimbra otimiza o desempenho local, enquanto o DHCP centralizado facilita a gestão da rede.

O projeto proporcionou uma compreensão prática de conceitos fundamentais de redes, incluindo VLANs, roteamento, NAT, DHCP e implementação de serviços de rede em ambiente empresarial.

10. Participações no Trabalho

Amir Ajj – a22304529 – 50%

Dhiren Lalitcumar – 22303499– 25%

Nur Amade – 22409156 – 25%