

Network Readiness

Objectives

01 Learn about investments made to optimize network connectivity for Microsoft Teams

02 Have a better understanding of how media travels across networks

03 Understand how to optimize and test your network to best take advantage of Microsoft 365

Call quality overview



User scenario: Good vs. bad experience

Good experience

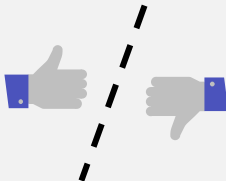
She is able to call other people and join meetings.

She has an uninterrupted, natural conversation.

She can see the other person well and can be seen.

She can follow a presentation that is shared in the meeting.

She can focus on the conversation.



Bad experience

Sometimes she cannot call others or has challenges joining meetings.

Others are difficult to hear due to echo and noise. People start talking at the same time.

The video seems to be asynchronous and blurry.

The presentation seems to lag behind and she cannot follow the presenter.

She gets distracted by the technology.



User scenario: quality influencers (for each user)

Focus for this session

Sending process

Room acoustics
echo, noise, ...

Quality of capturing device
certified, HD-audio, latency...

Client device
raw performance, hardware acceleration, resources available

Convert to bitstream: encode
Codec, HD, SD, resiliency, ...

Network
Upstream bandwidth, wireless vs wired, latency, jitter, packet loss, ...



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Receiving process

Room acoustics
echo, noise, ...

Quality of playback device
certified, HD-audio, latency...

Client device
raw performance, hardware acceleration, resources available

Convert bitstream to audio: decode
HD, SD, resiliency, ...

Network
Upstream bandwidth, wireless vs wired, latency, jitter, packet loss, ...



Intelligence in Teams

Packet loss resiliency

Self-tuning and recovery mechanisms (LTR, IDR, FEC, RTX)

Crisp sharing

Dynamic use of bandwidth depending on content/context

Improved low bandwidth

Adapt video frame rate for usability, not less than .5fps

New Satin codec for wideband audio on low bandwidth

Teams will provide the best experience possible

But it won't solve design or capacity issues. Planning required



Microsoft 365 network overview



Microsoft Global Network and Next Gen Infrastructure

Global footprint

- Microsoft's global network is one of the top two networks in the world
- Hundreds of thousands of route miles of privately-owned dark fiber
- Peered with over 2700 ISPs globally in 190 locations and 38 countries
- Available for 90+% of the internet connected population with metrics comparable to the Tier 1 ISPs/Telcos
- Media processors & relays deployed to 50+ Microsoft data centers and edge sites with more being deployed

Optimized for media

- Fiber connections designed to reduce latency between regions
- Edge sites placed close to the users to reduce number of hops and latency
- Keep improving ISP peering performance based on call quality telemetry
- Audio traffic prioritized throughout the Microsoft Global Network
- Meetings hosted close to the participants
- Consolidated IP ranges and ports for calling and media

Microsoft's fiber optic network could stretch to the moon and back, three times over!



Challenges with the traditional model for Microsoft 365 traffic



Higher latency to Microsoft network

Longer corporate network path (WAN)
Not connecting to closest
Azure Front Door



Teams media traffic should use UDP for optimal media quality

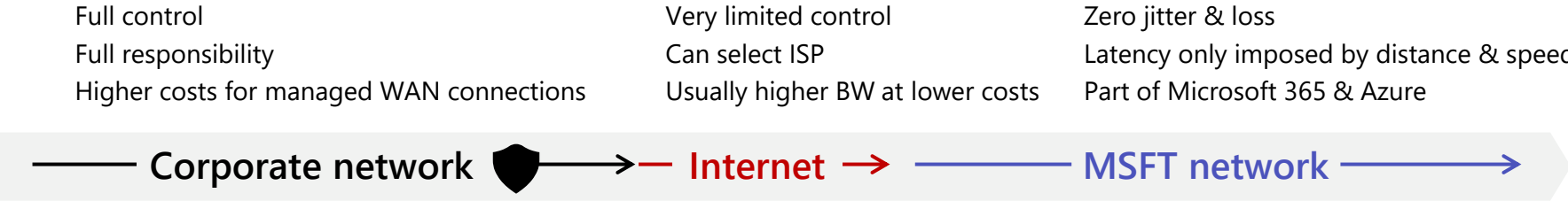
Traditional proxies often are not
designed to handle UDP traffic,
forcing TCP to be used
VPN connections may force traffic via
TCP tunnel



Load on central infrastructure

Clients maintain persistent connections for all users
Calls/meetings add additional load, sometimes all
at once (e.g. an 'All Hands' call)
Media packets are high volume, small packet

How we connect to Microsoft 365 over the Internet



How to optimize your network

Full control
Full responsibility
Higher costs for managed WAN connections

Very limited control
Can select ISP
Usually higher BW at lower costs

Zero jitter & loss
Latency only imposed by distance & Speed of light
Part of Microsoft 365 & Azure

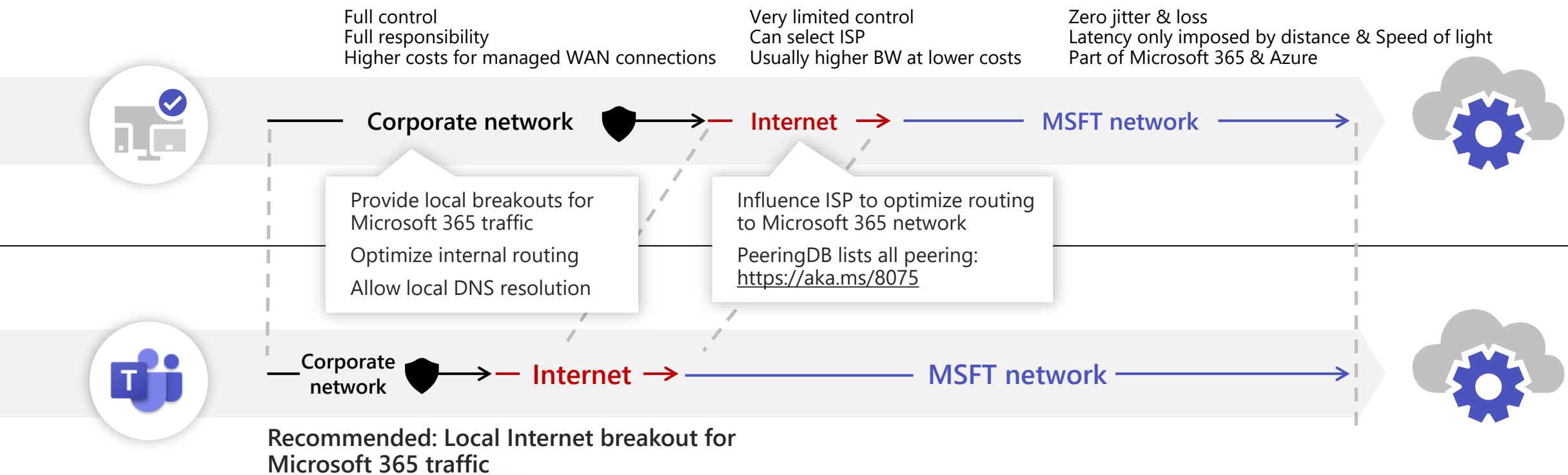


Traditional, centralized Internet breakout

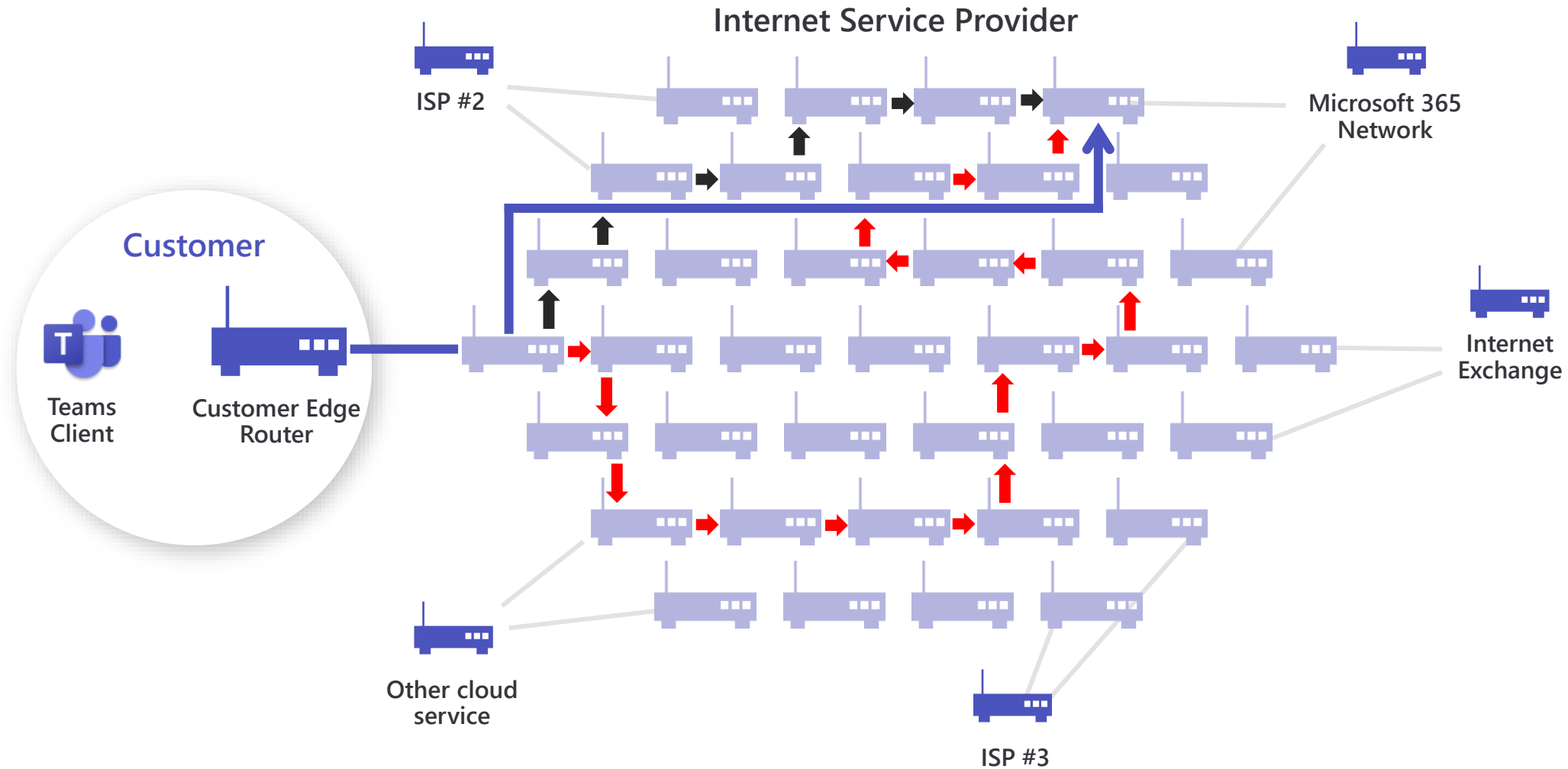


Recommended: Local Internet breakout for Microsoft 365 traffic

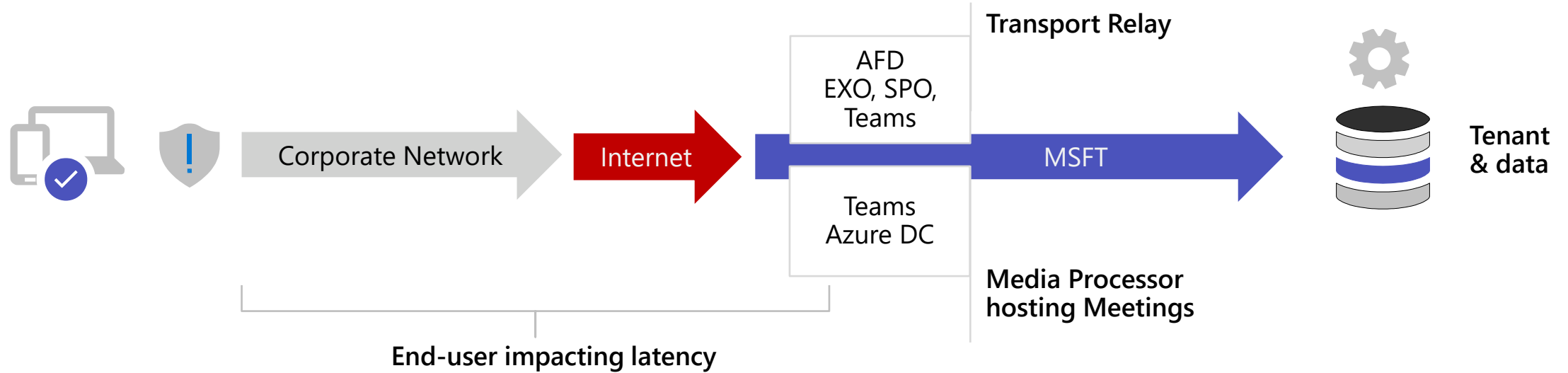
Optimize connectivity to Microsoft 365 network



About peering

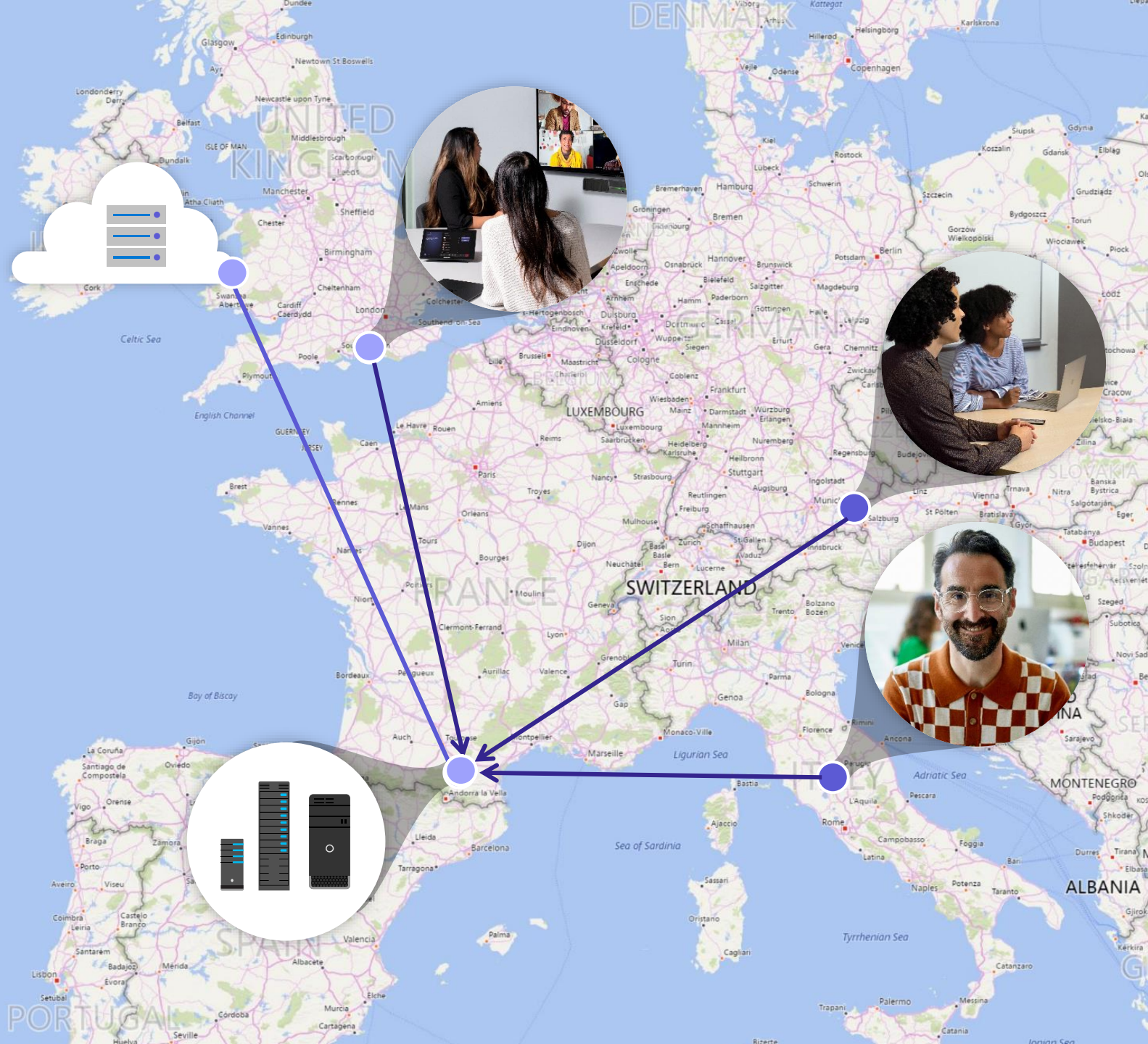


Low latency is the currency in a SaaS world



AFD = Azure Front Door

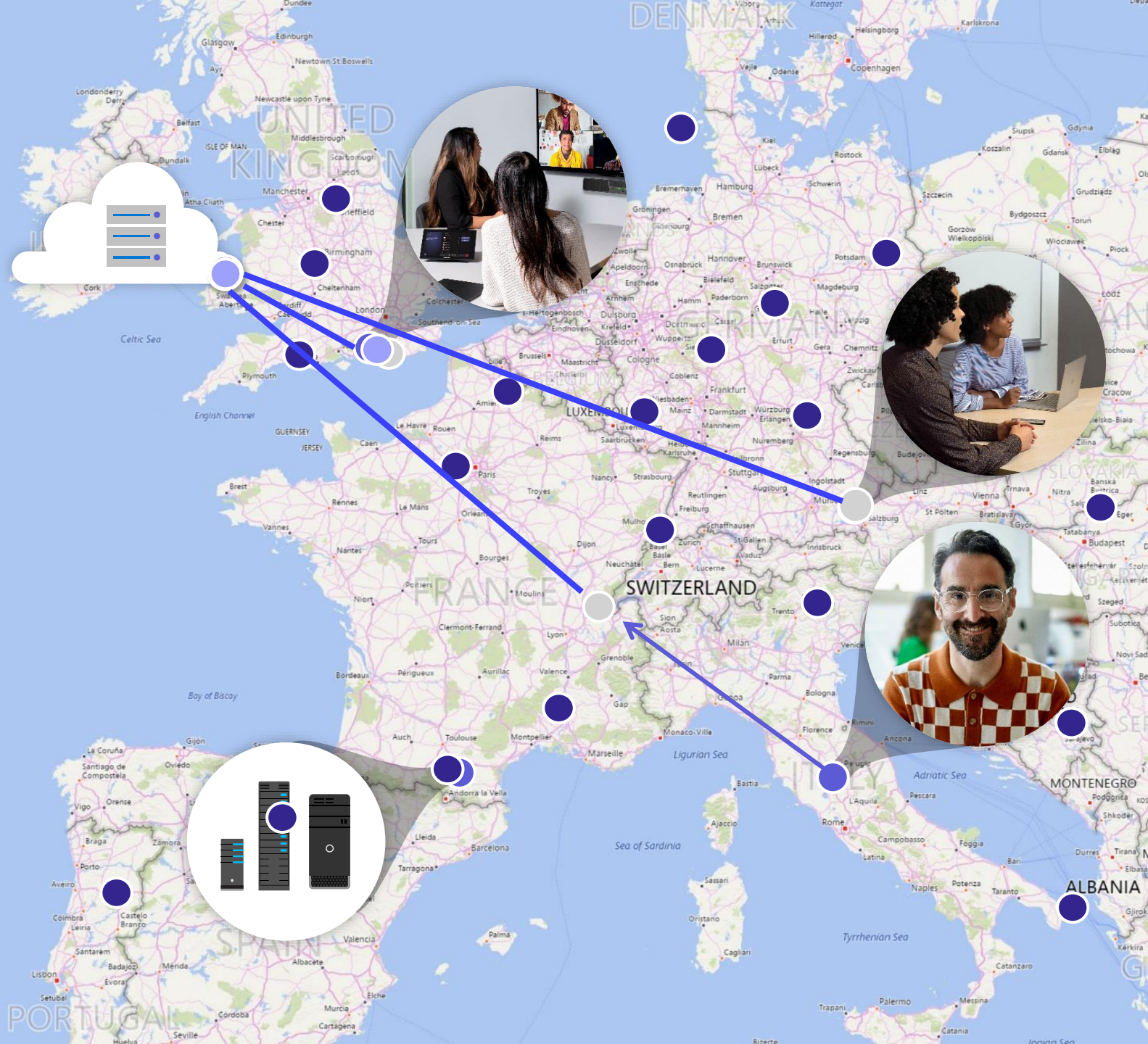
Services close to the user to minimize latency between user and the service



Centralized Internet

From your office to Microsoft 365

- Corporate network
- Internet access
- Office location
- Data



Local breakout

Ideal connection to Microsoft 365

- Corporate network
- Internet access
- Microsoft network
- Office location
- Microsoft peering location
- Utilized peering location
- Data

Meeting locations



Meeting locations

Teams provides local meetings

To minimize latency and provide better user experience

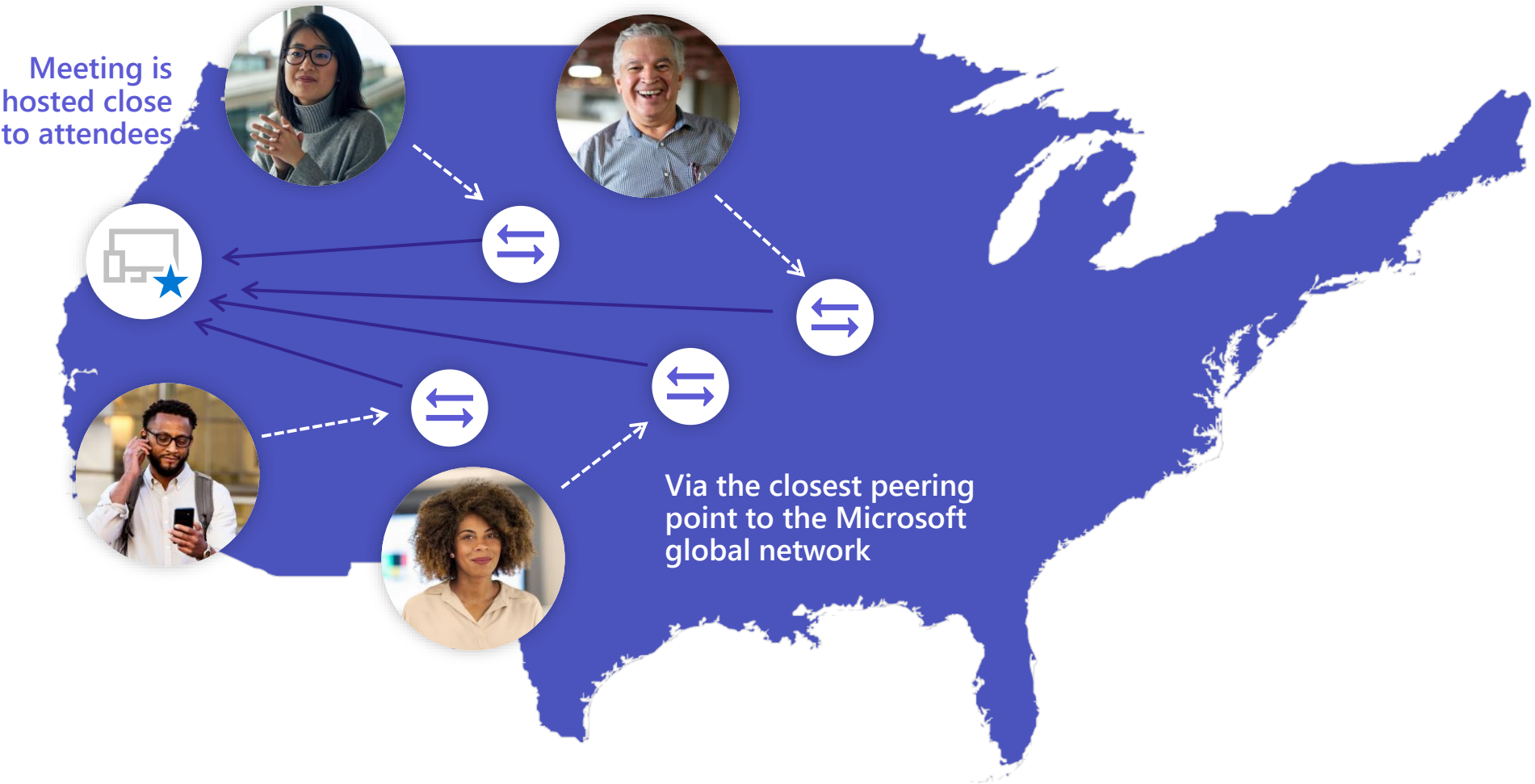
Meeting located in user region

Based on the first user who joins the meeting

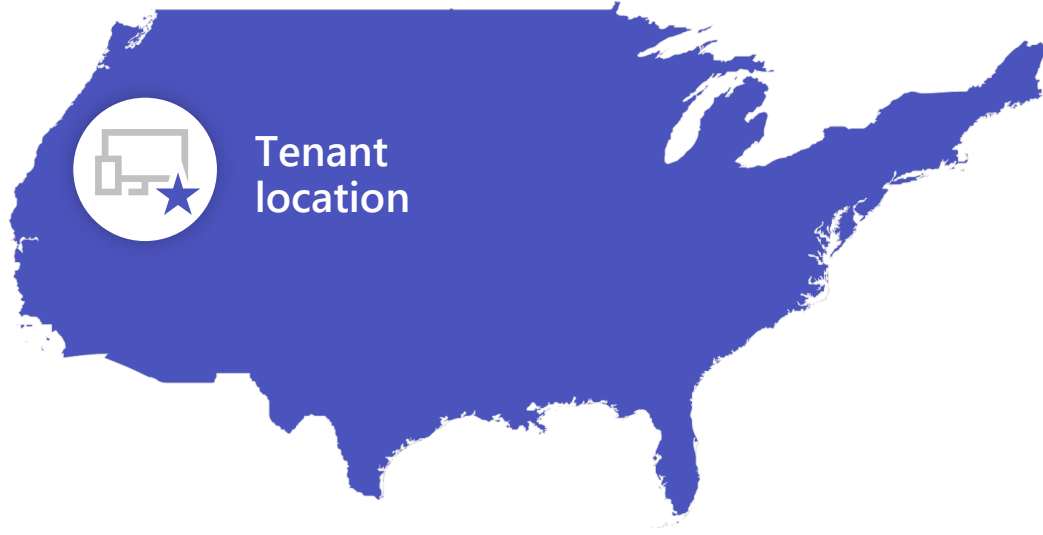
Minimum number of hops to datacenter



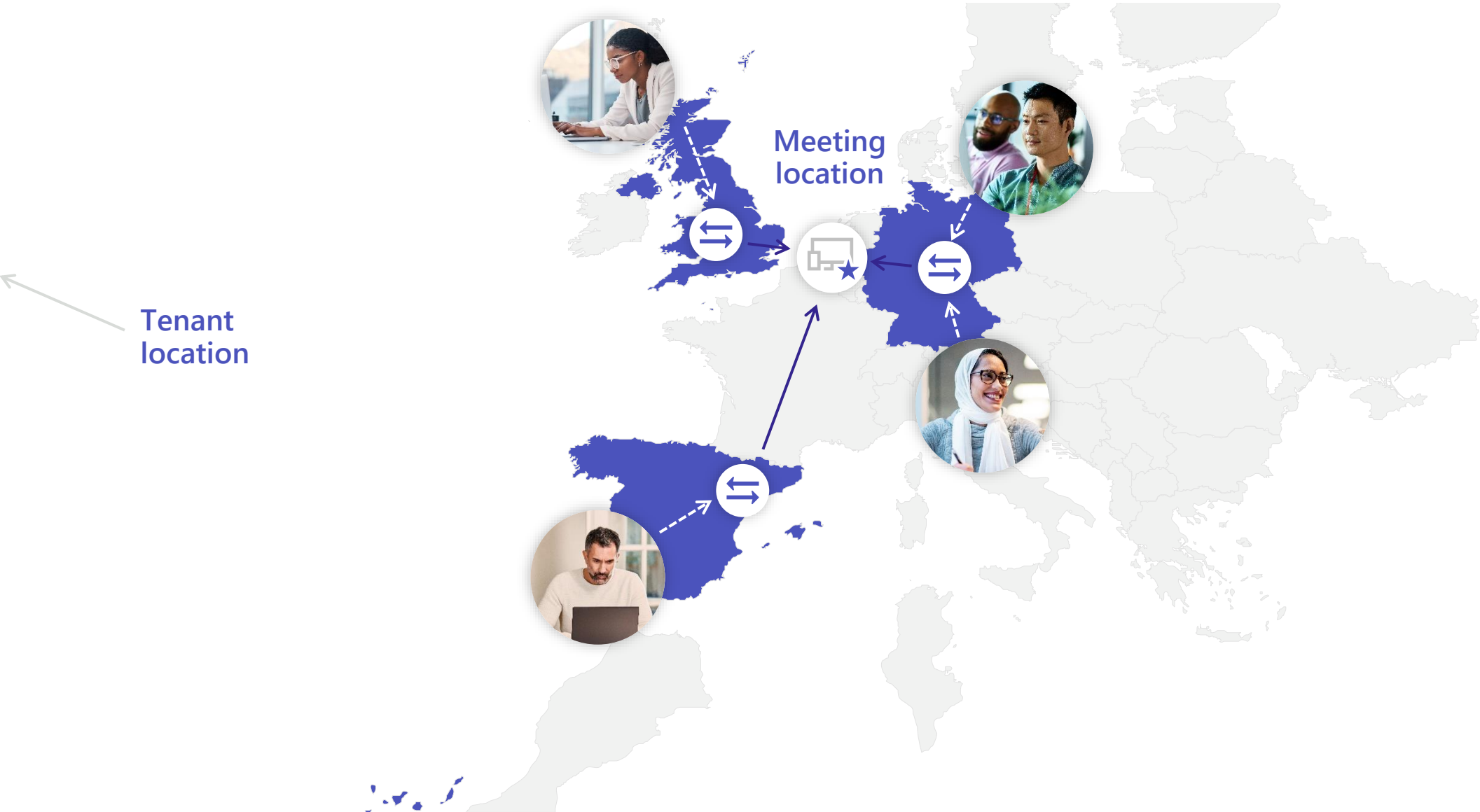
Example 1: US tenant with US users



Example 2: US tenant with European users



Example 2: US tenant with European users



Transport relays & media processors



Types of calls

Direct calls

Ad-hoc call with 2 users

Media flows as directly as possible between end points

Meetings

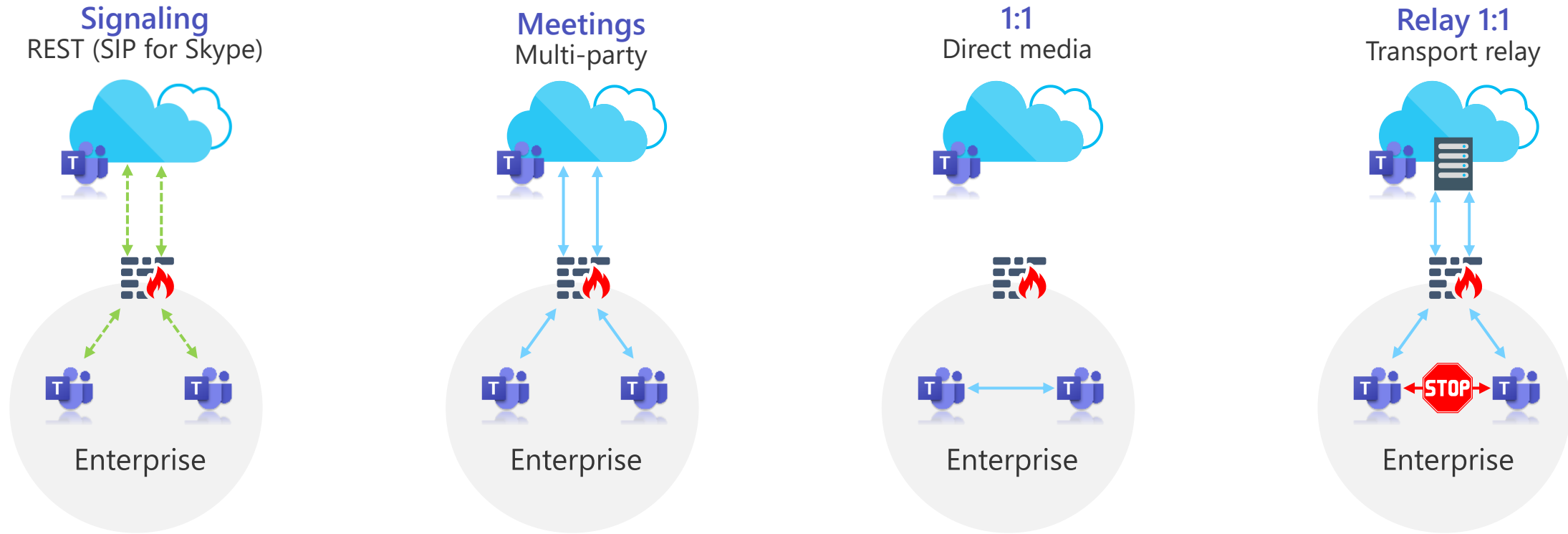
Ad-hoc (*Meet Now*) call with 3 or more users

Scheduled calls

Media flows as directly as possible between end points and conferencing service



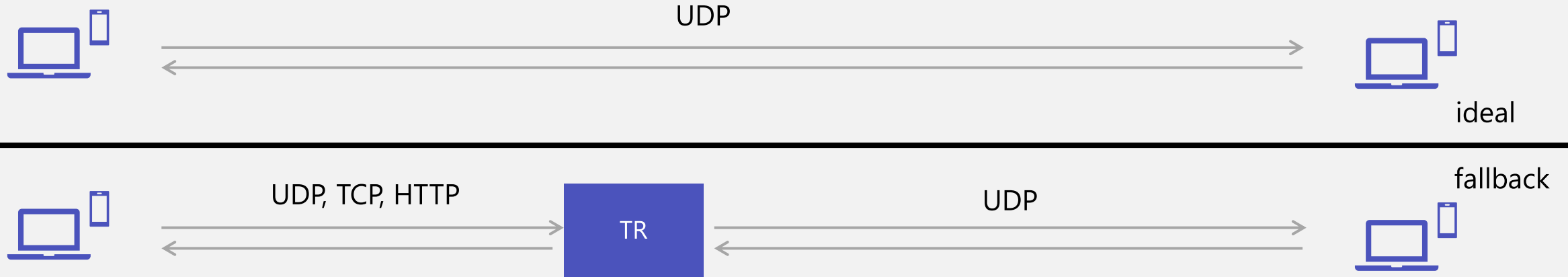
Types of calls: Media flow



Legend:

- REST/Signaling (SIP is used for Skype for Business)
- Media

Transport Relay principles



UDP is king when it comes to latency, direct connection is preferred

Transport Relay (TR) is used as fallback to establish connection to second endpoint

Client to TR can be UDP, TCP, or native HTTP for proxy support

TR will only offer UDP candidates even when you establish session over TCP or HTTP

Transport Relay

Azure Traffic Manager

Traffic Manager works at the **DNS** level

Client looks up DNS record worldaz.tr.teams.microsoft.com

Routed to **best** Transport relay based on DNS IP

Sovereign tenants use local infrastructure

Transport Relay

Cloud born service

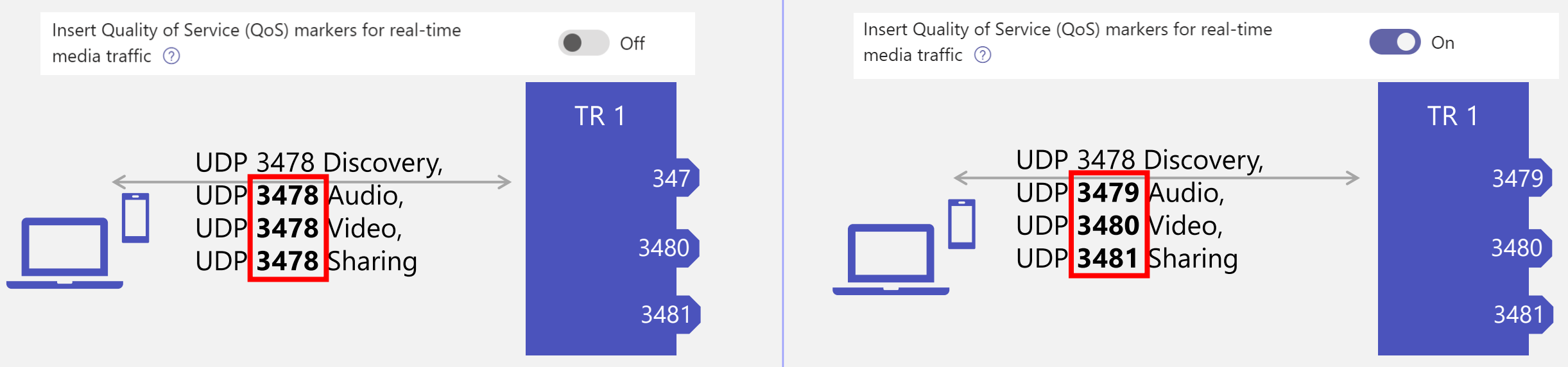
Dynamic discovery
via Azure Traffic Manager

Different UDP ports
per workload

Customers can
only benefit
from this if local
DNS is used



UDP ports 3478 - 3481

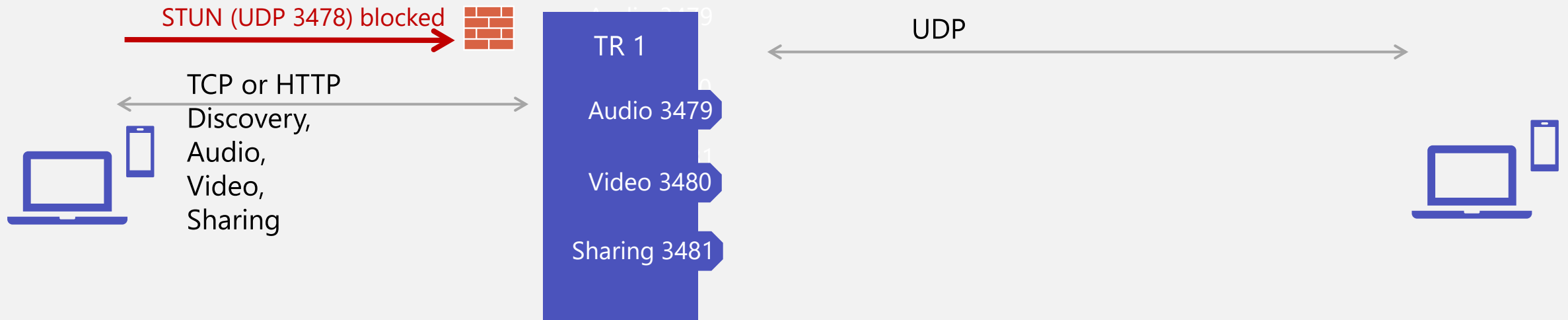


UDP 3478 is always used for initial communication with TR

TR always allocates workload specific UDP ports

Client-to-TR uses service-specific workloads only if QoS is enabled

TCP blocked on one side

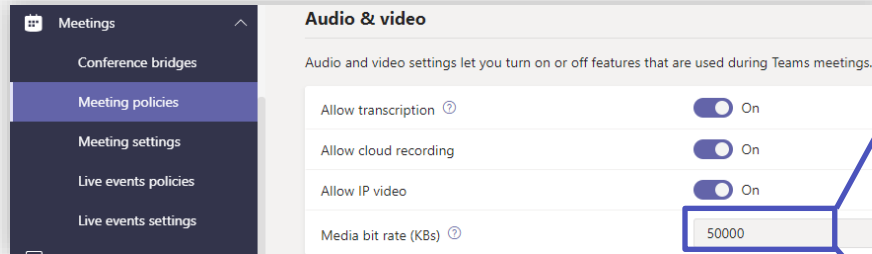


User cannot reach his TR via UDP

Fallback to TCP or HTTP

Allocated candidates remain UDP, call leg to TR remains UDP

BW controls - why & when to use



Controls average, cumulative BW consumption
(Audio, Video, Sharing)

Bandwidth(up/down)	Scenarios
30 kbps	Peer-to-peer audio calling
130 kbps	Peer-to-peer audio calling and screen sharing
500 kbps	Peer-to-peer quality video calling 360p at 30fps
1.2 Mbps	Peer-to-peer HD quality video calling with resolution of HD 720p at 30fps
1.5 Mbps	Peer-to-peer HD quality video calling with resolution of HD 1080p at 30fps
500kbps/1Mbps	Group Video calling
1Mbps/2Mbps	HD Group video calling (540p videos on 1080p screen)

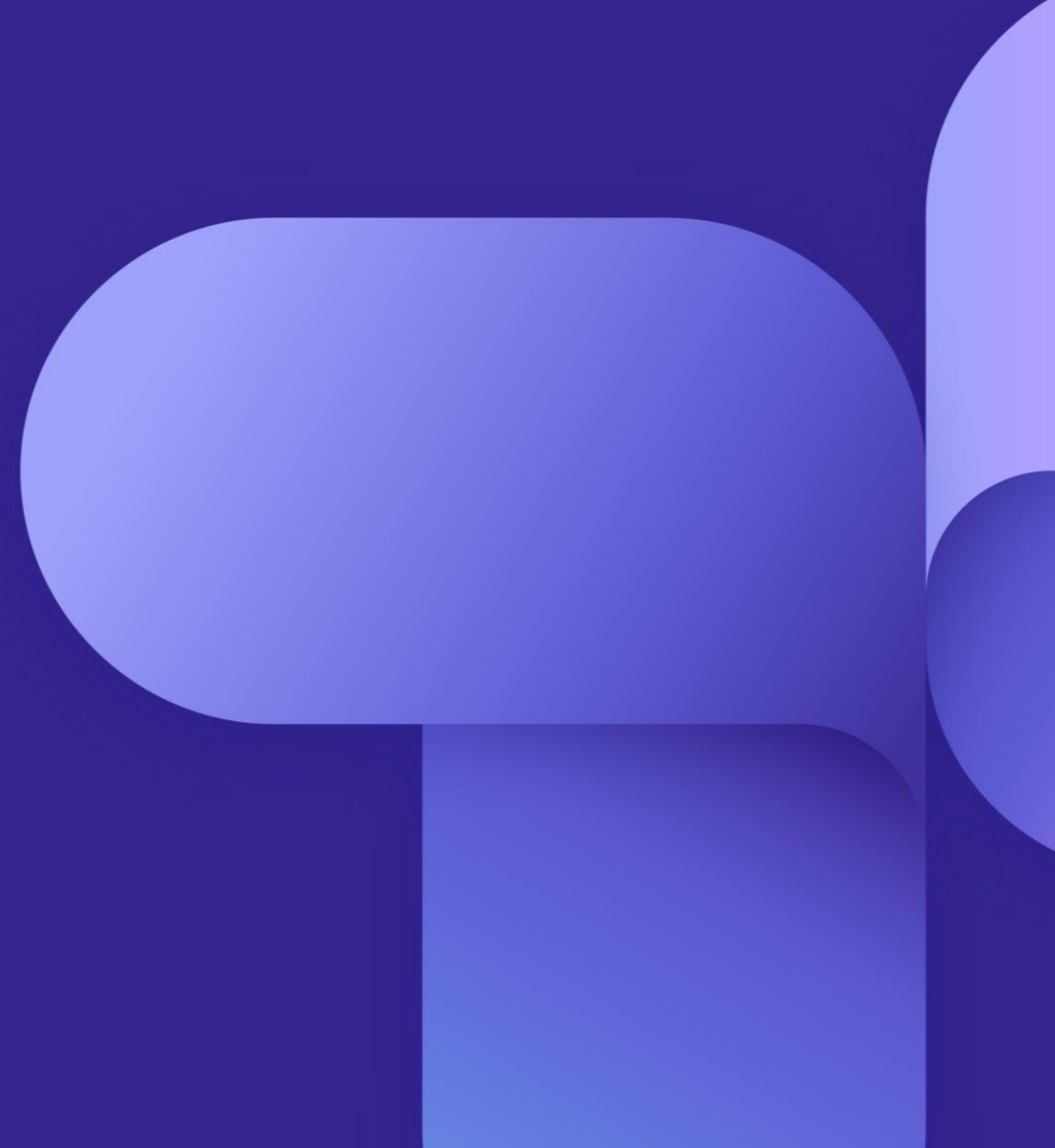
Media Stack optimizes for end-user experience under given conditions, no direct control over codecs etc.

Limit is on average consumption, not peak.

Sharing may have peaks above this rate limit.

→ <https://docs.microsoft.com/en-us/microsoftteams/prepare-network>

Proxy servers and firewalls



Proxy servers



Proxy servers should *always* be bypassed with Teams Rooms devices



If you must define a proxy, do this via the Admin account



Microsoft Teams Rooms is designed to inherit proxy settings from the Windows OS.



Never do deep packet inspection or break/inspect on real time media.

Ports and URL's

[Microsoft Teams](#)

[Windows Update](#)

Windows Store:

https://*.ws.microsoft.com

http://*.ws.microsoft.com

Intune:

[Manage.Microsoft.com](https://manage.microsoft.com)

[Graph.Windows.net](https://graph.windows.net)

Time Server:

[Pool.ntp.org](https://pool.ntp.org)



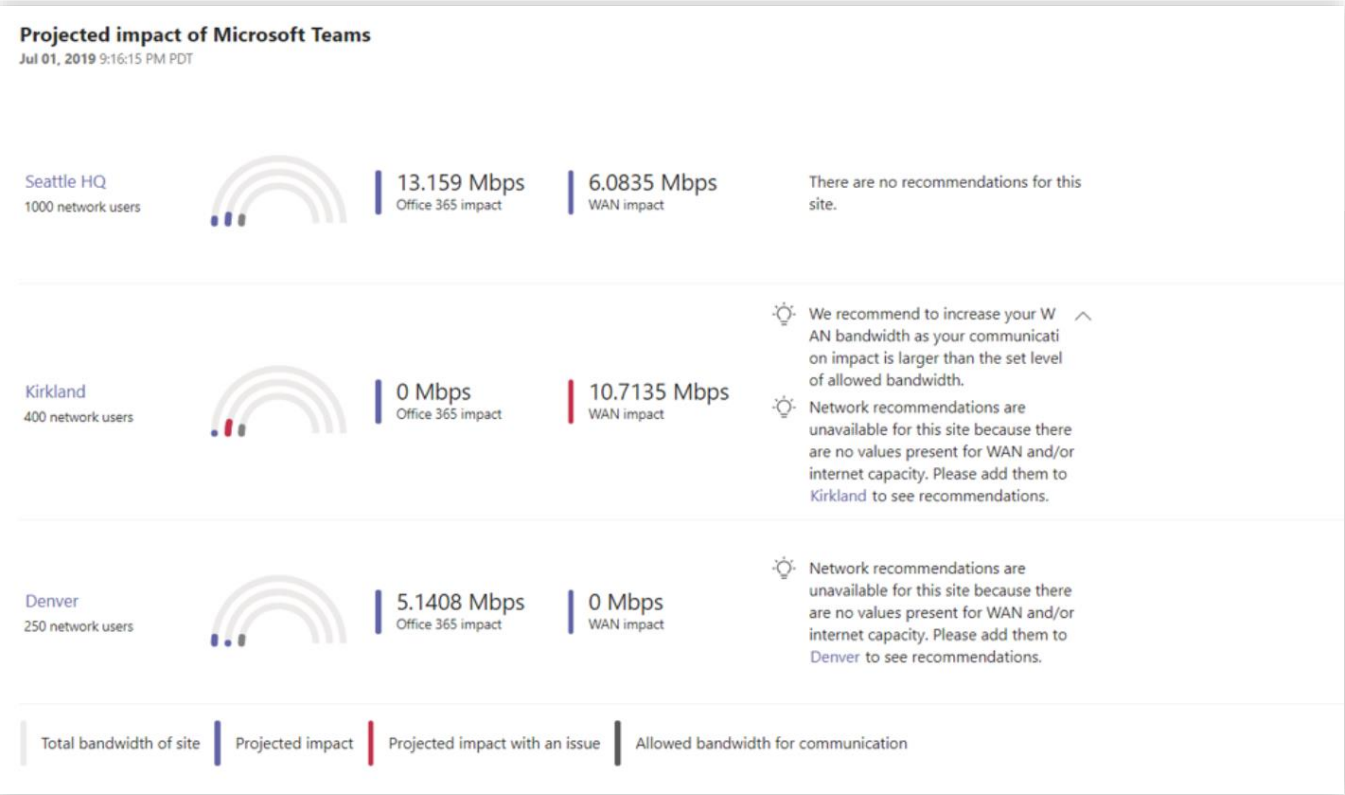
Tools



Network Planner in Teams Admin Center

Microsoft Teams users across your organization

When your network details and Teams usage is provided, the Network Planner calculates your network requirements for deploying Teams and cloud voice across your organization’s physical locations.

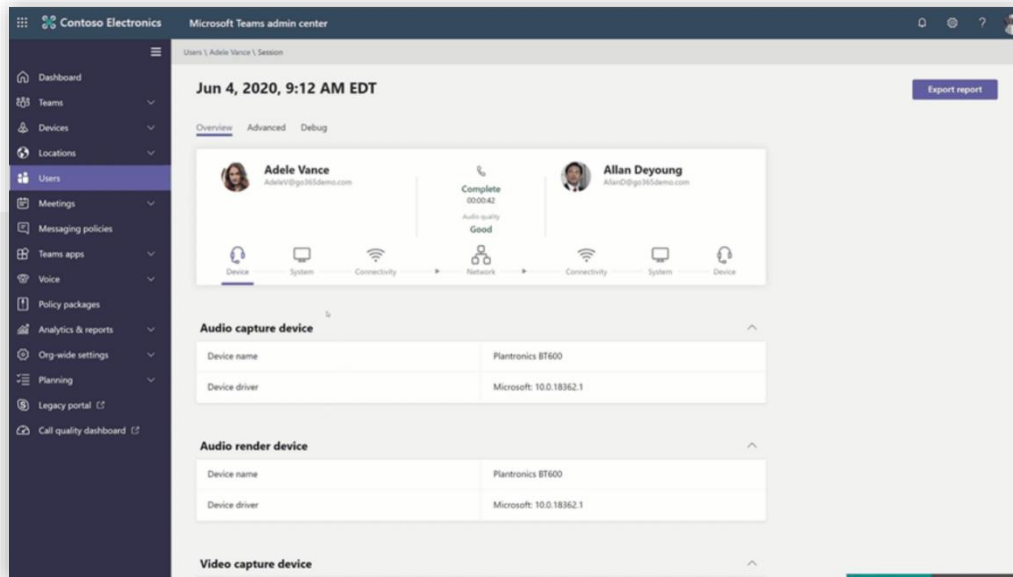


Call analytics and Call Quality Dashboard

Call analytics

Allows to get all details for individual call

Used reactively when users report bad experience

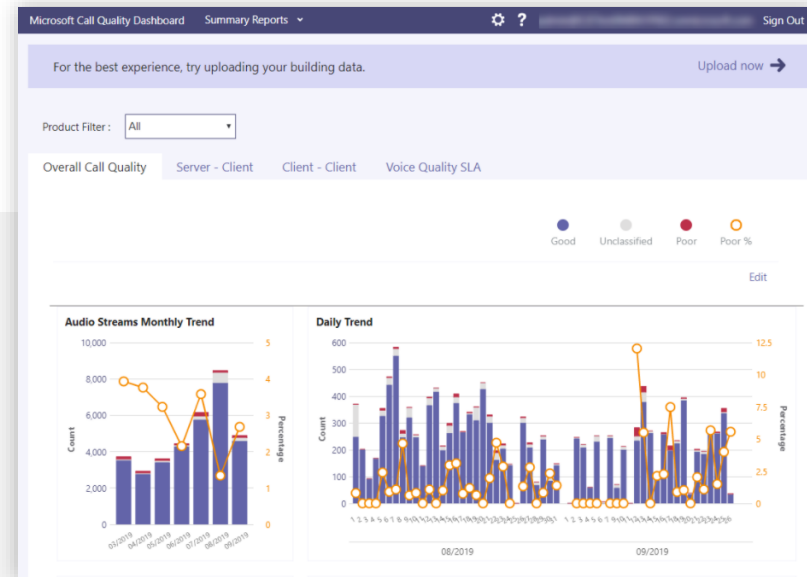


Call Quality Dashboard

Provides aggregated view of all calls

Can be filtered by location, subnet etc.

Used proactively to discover trends and hotspots



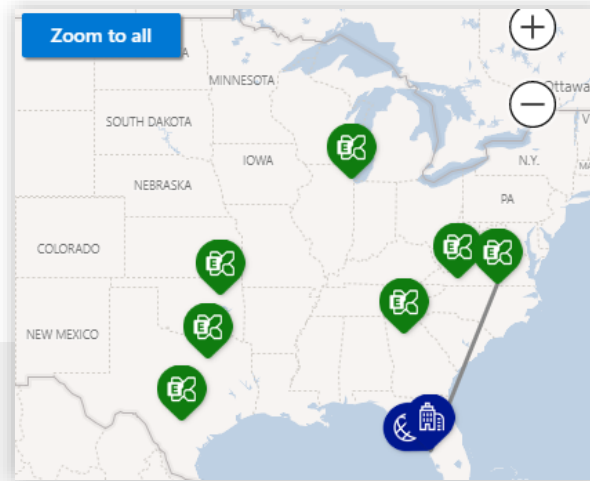
connectivity.office.com

This tool uses your location and shows where the optimal front door locations are

When you select **Run test**, we'll begin with your web browser connectivity and then test your device connections. [Learn what happens at each step](#)

- ☒ Automatically detect location
Bing Maps provides street address suggestions and geo-coding for your location.
- ☐ Add your location
Enter your location if you don't want us to detect it automatically.

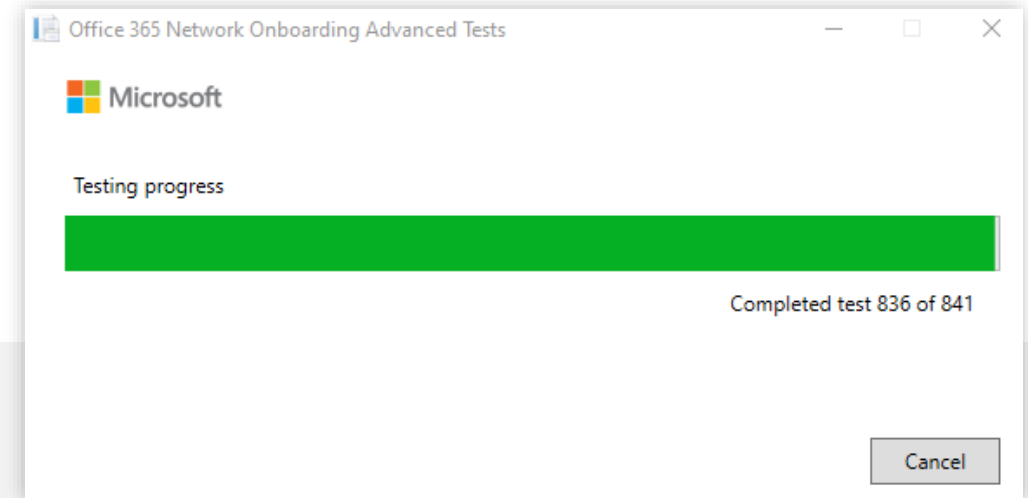
Run test



connectivity.office.com

Advanced network tests can also be run to get additional information

Microsoft Teams	
Test	Result
✓ Media connectivity (audio, video, and application sharing)	No errors
✓ Packet loss	0.00% (target < 1% during 15 s)
✓ Latency	30 ms (target < 100 ms)
✓ Jitter	28 ms (target < 30 ms)



connectivity.office.com

Poor results example

Microsoft Teams		
Test		Result
✔	Media connectivity (audio, video, and application sharing)	No errors
✔	Packet loss	0.83% (target < 1% during 15 s)
⚠	Latency	159 ms (target < 100 ms)
⚠	Jitter	90 ms (target < 30 ms)

Test	Result
Your location	St Petersburg, FL, United States found by the web browser
Network egress location (the location where your network connects to your ISP)	Cassel, Hesse, Germany
⚠ Your distance from the network egress location	4,837 miles (7,784 kilometers)
⚠ Customers in your metropolitan area with better performance	62% of people in your area have a better network connection.

Performance requirements

Metric	Client to Microsoft edge	Customer edge to Microsoft edge
Latency (one way)	<50ms	<30ms
Latency (RTT or Round-trip Time)	<100ms	<60ms
Burst packet loss	<10% during any 200ms interval	<1% during any 200ms interval
Packet loss	<1% during any 15s interval	<0.1% during any 15s interval
Packet inter-arrival jitter	<30ms during any 15s interval	<15ms during any 15s interval
Packet reorder	<0.05% out-of-order packets	<0.01% out-of-order packets

Network performance in the Microsoft 365 Admin Center

Metrics collected by OneDrive, Teams, and Exchange

Compare results against other organizations in a region

Quickly see performance results



01

You should have a better understanding of the investments Microsoft has made with Microsoft Teams

02

We went into detail how Microsoft designed cloud-based connectivity, especially for Microsoft Teams

03

Explain why bypassing proxy and firewalls can provide an optimal experience for Microsoft Teams. Showed tools to test and monitor network performance

Summary

Thank you.

