

SharePoint Saturday Cologne 2021

Virtual

29th May 2021



#SPSCGN



29. May 2021

1

Kenote: Ohne Netzwerk ist alles nichts

Frank Carius

#SPSCGN



29. May 2021



Keynote

09:00

10:00

11:00

12:00

13:00

14:00

15:00

16:00

SharePoint

Development

Compliance

Modern Work

Lounge Talks

A long-exposure photograph of a city street at night. The image shows light trails from cars and buses moving through a multi-lane road. In the background, several tall skyscrapers are illuminated with blue and white lights. The overall scene is vibrant and modern.

Messaging Collaboration Services

A person is sitting at a wooden desk, working on a silver laptop. The person's hands are on the keyboard, and they are wearing a light-colored sweater and a watch. A black mug with a tea bag is on the desk next to the laptop. The background is a brick wall. The text 'Homeoffice', 'Schulen', and 'Remote Consulting' is overlaid on the image in white, bold font.

Homeoffice

Schulen

Remote Consulting

A close-up photograph of a network server rack. The background is dark, with numerous glowing yellow and orange lights from the server components. In the foreground, a dense bundle of yellow Ethernet cables is visible, some plugged into ports. The text is overlaid on the image in white, bold font.

Protokolle

Routing, Proxy, VPN

Namensauflösung

Microsoft Global Network



Window size, Loss, Jitter

NAT, Portlimit, Proxy

GeoDNS, Anycast-IP

Monitoring, SNMP

Stellen Sie sich vor....

- Sie stehen an der Werksausfahrt und ...
 - ... zählen die LKWs
 - ... wiegen die LKWs
 - .. Hilft ihnen das weiter?

Das ist SNMP-Monitoring !

Interessiert es sie...

- ... wie voll die Autobahn ist ?
- ... welche anderen Fahrzeuge neben ihnen fahren?

Nein, kein Provider liefert diese Daten

Was ich wissen muss: Schnell genug?

Wie messe ich „Pünktlichkeit“ ?



Office 365 Guiding Principles

Trenne Office 365 Verkehr von normalen Internet. Office 365 ist ihr Tenant mit ihren Daten und authentifiziertem Zugriff

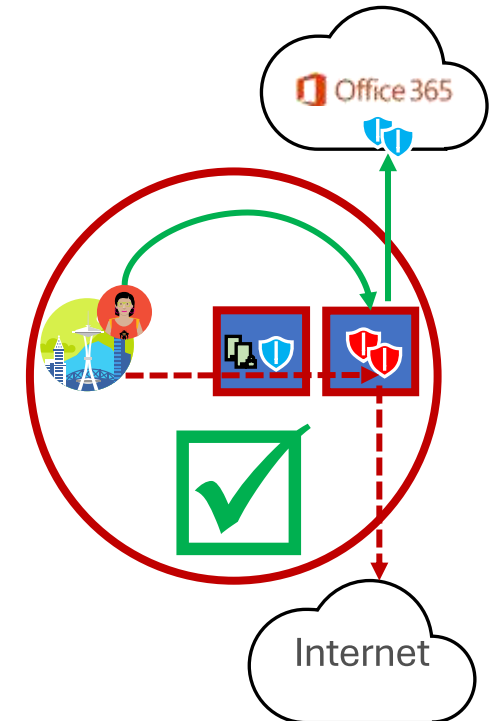
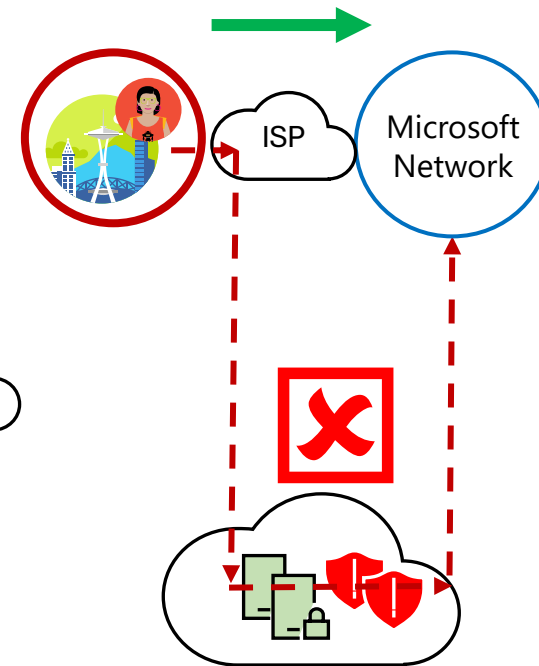
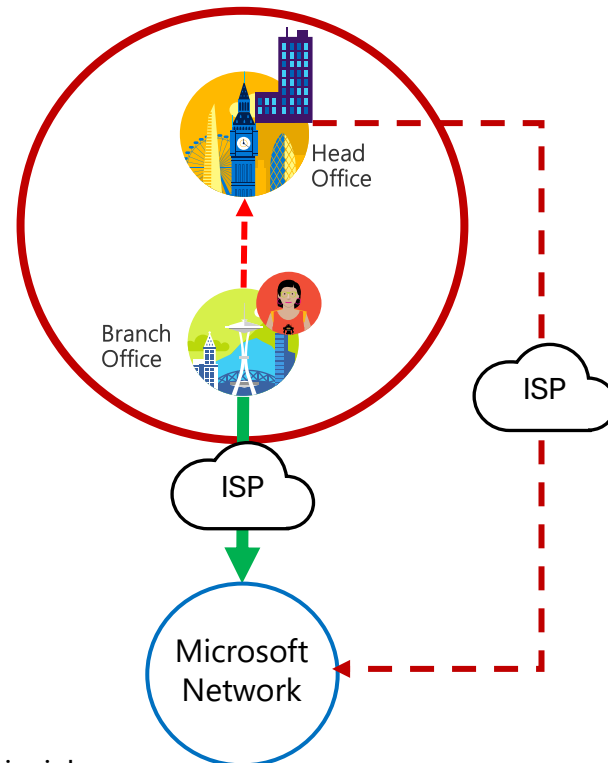
Leiten Sie Office 365 Daten über den kürzesten Weg aus ihrem Netzwerk ins Internet. Achten Sie auf die DNS-Auflösung.

Vermeide Umwege, Schleifen über Cloud Proxy-Server etc.

Umgehe „Inspection“-Prozesse, die keinen Sicherheitsgewinn bringen aber Latenzzeit addieren



aka.ms/o365ip



Network Ready für VoIP ?

- Vorgabe von Microsoft
- Aber womit messen ?

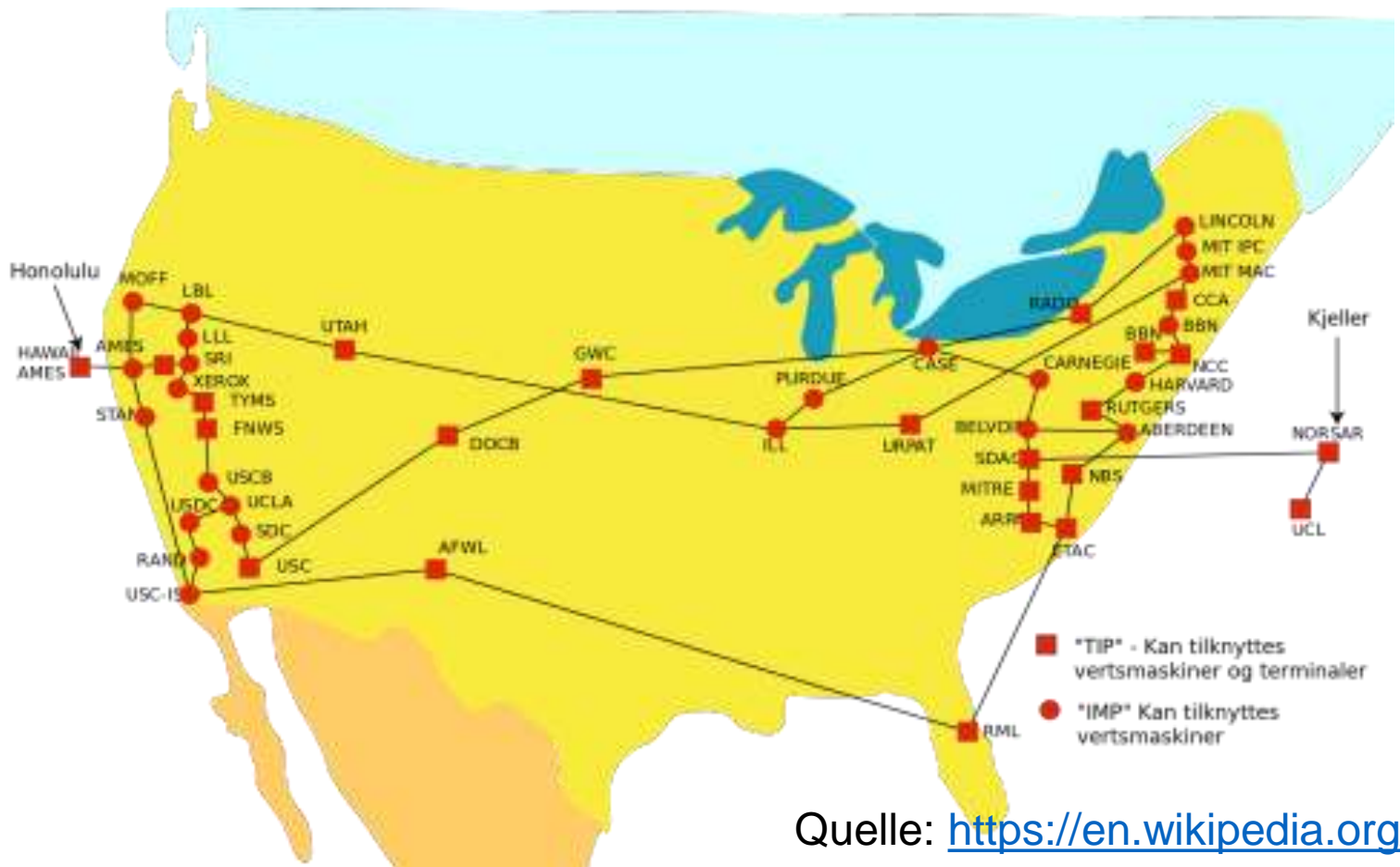
Metric	Edge	Client
Latency (one way)	< 30ms	< 50ms
Latency (RTT)	< 60ms	< 100ms
Burst packet loss	<1% during any 200 ms interval	<10% during any 200ms interval
Packet loss	<0.1% during any 15s interval	<1% during any 15s interval
Packet inter-arrival Jitter	<15ms during any 15s interval	<30ms during any 15s interval
Packet reorder	<0.01% out-of-order packets	<0.05% out-of-order packets

Grundlagen der Verbindung

- Lokaler Breakout
- DNS Auflösung
- Proxy Bypass / NAT
- Deep Inspection/Trusted Zone



Arpanet

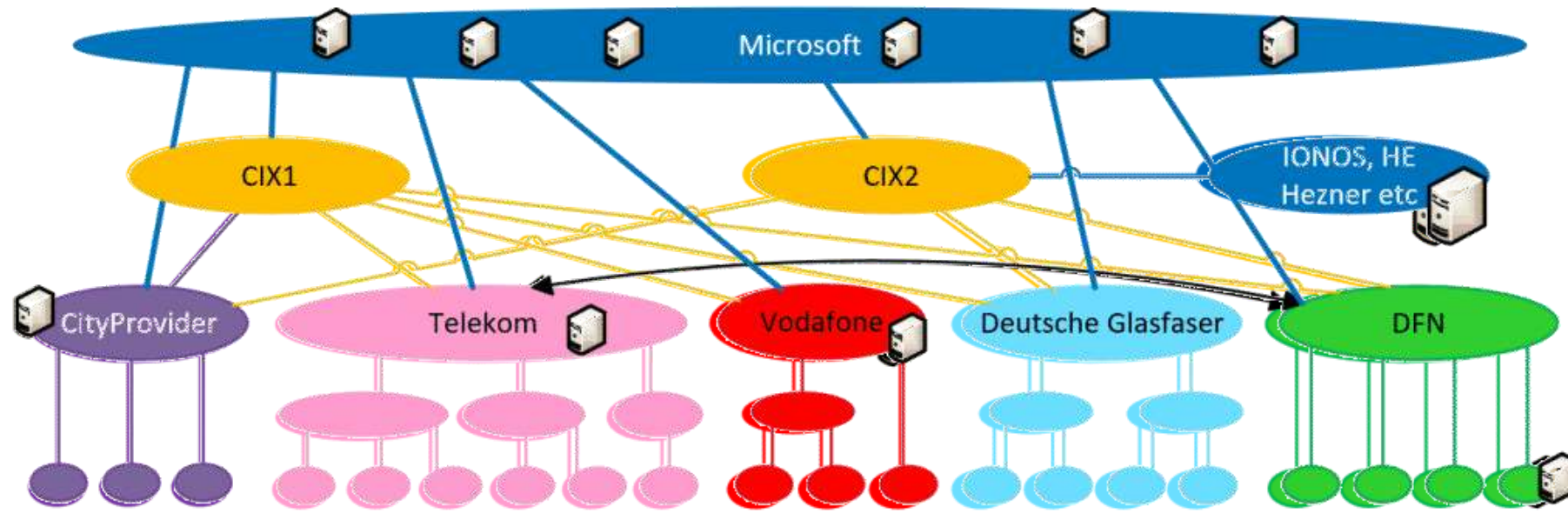


Quelle: <https://en.wikipedia.org/wiki/ARPANET>

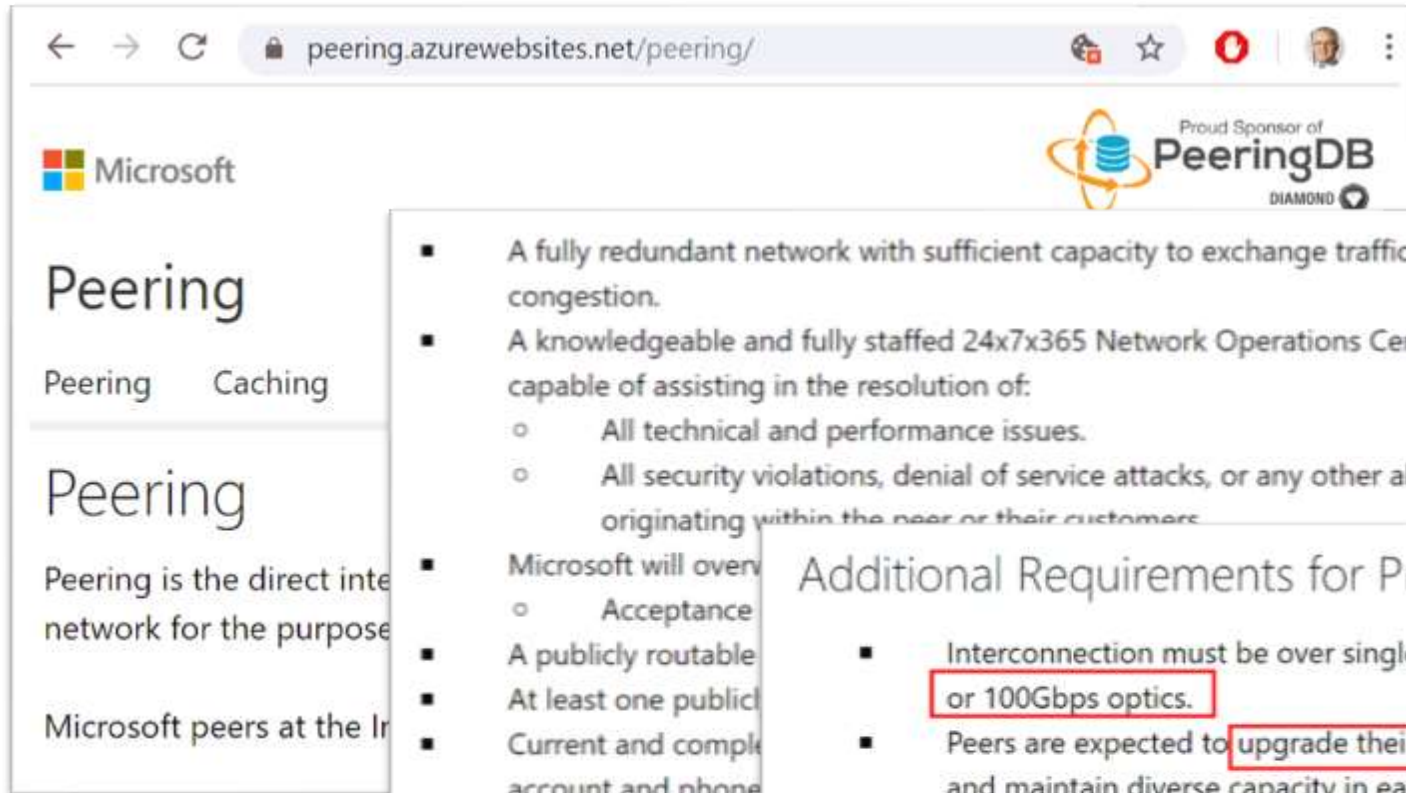
Internet Betreiber

- Zugangsprovider
- Hosting Provider
- Peerings (peeringdb.com)

Amazon, Netflix, Apple, Google,
Facebook, CDN



Microsoft Peering



The screenshot shows a web browser window with the URL `peering.azurewebsites.net/peering/`. The page features the Microsoft logo and a banner for "Proud Sponsor of PeeringDB DIAMOND". The main heading is "Peering", with a sub-heading "Peering Caching". Below this, there is a definition of peering: "Peering is the direct interconnection of two networks for the purpose of exchanging traffic between them. Microsoft peers at the Internet Service Provider (ISP) level." The page also includes a list of requirements for peering, which are detailed in the adjacent callout boxes.

- A fully redundant network with sufficient capacity to exchange traffic without congestion.
- A knowledgeable and fully staffed 24x7x365 Network Operations Center (NOC), capable of assisting in the resolution of:
 - All technical and performance issues.
 - All security violations, denial of service attacks, or any other abuse originating within the peer or their customers.

- Microsoft will only establish private interconnection points with ISP or Network Service providers.
 - Acceptance
- A publicly routable IP address space.
- At least one public IP address.
- Current and complete contact information, including account and phone numbers.
- Neither party shall be held liable for any damage or loss of data.

Additional Requirements for Private Interconnections

- Interconnection must be over single-mode fiber using the appropriate 10Gbps or 100Gbps optics.
- Peers are expected to upgrade their ports when peak utilization exceeds 50% and maintain diverse capacity in each metro, either within a single location or across several locations in a metro.
- Microsoft will only establish private interconnection points with ISP or Network Service providers.

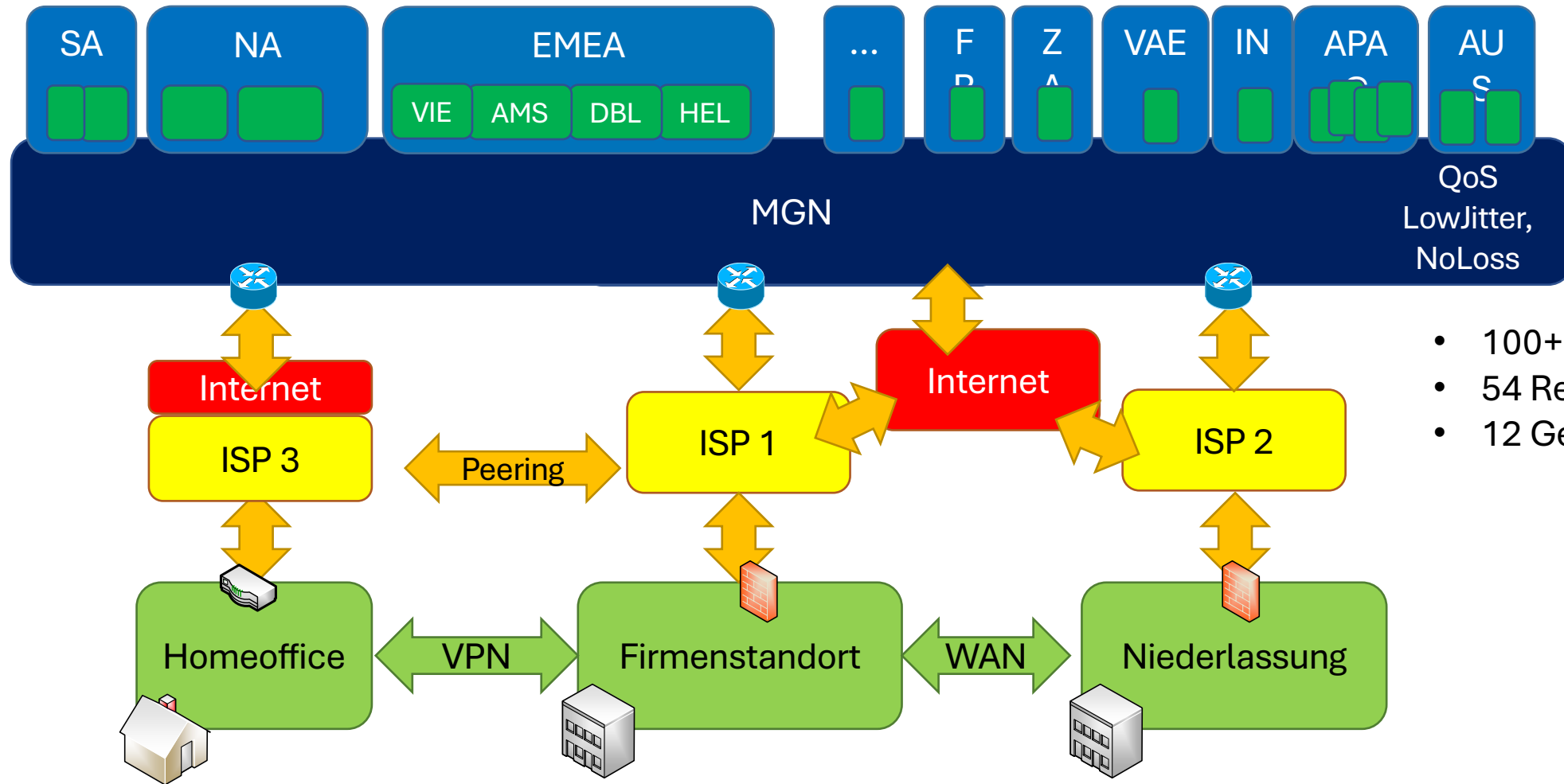


Microsoft Global Network

- Weltweit
- Verteilt



Der Weg vom Client zum Service



- 100+ Azure RZs
- 54 Regionen
- 12 Geos

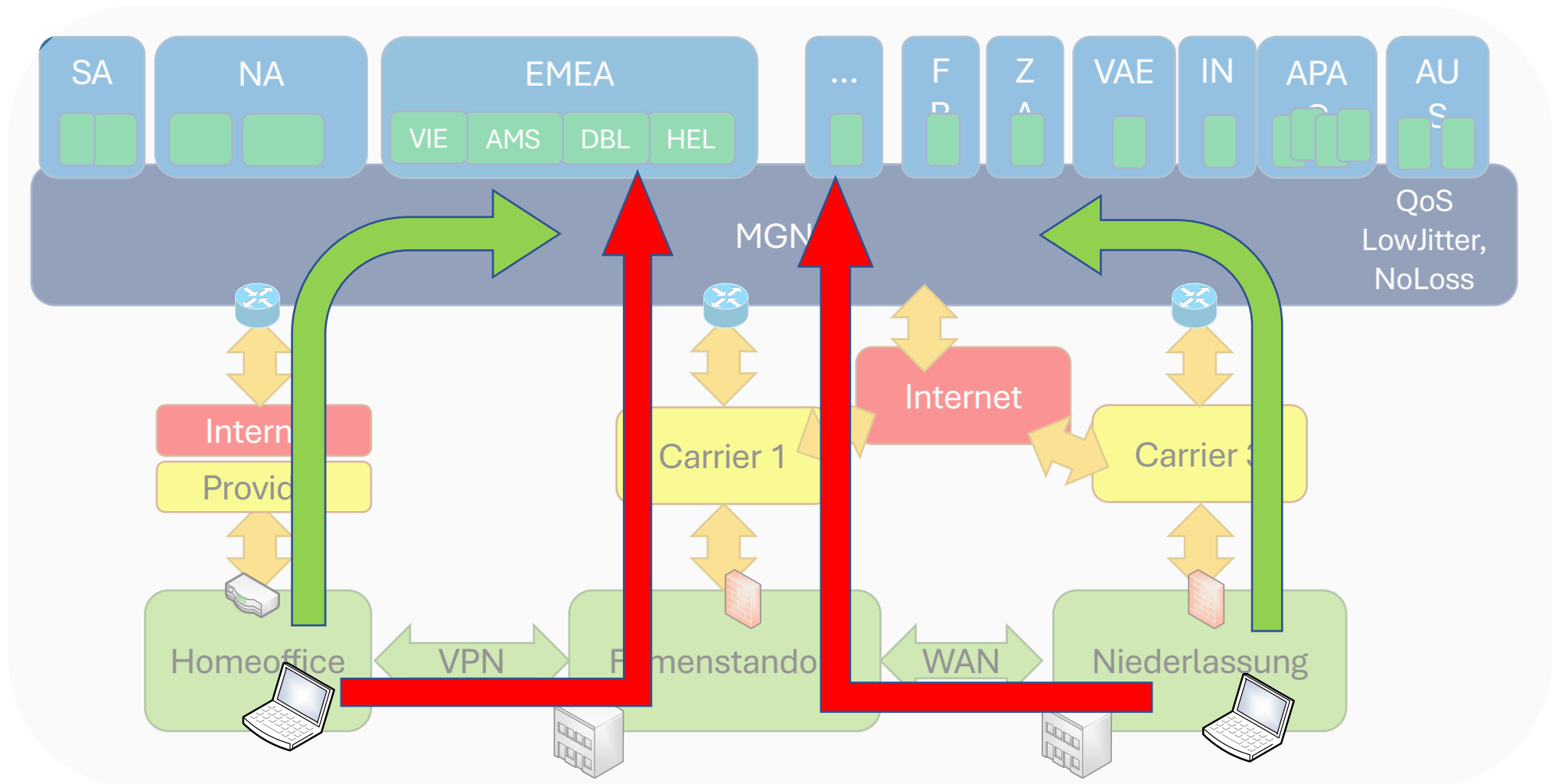
<https://products.office.com/de-de/where-is-your-data-located>

<https://docs.microsoft.com/en-us/Office365/Enterprise/moving-data-to-new-datacenter-geos>

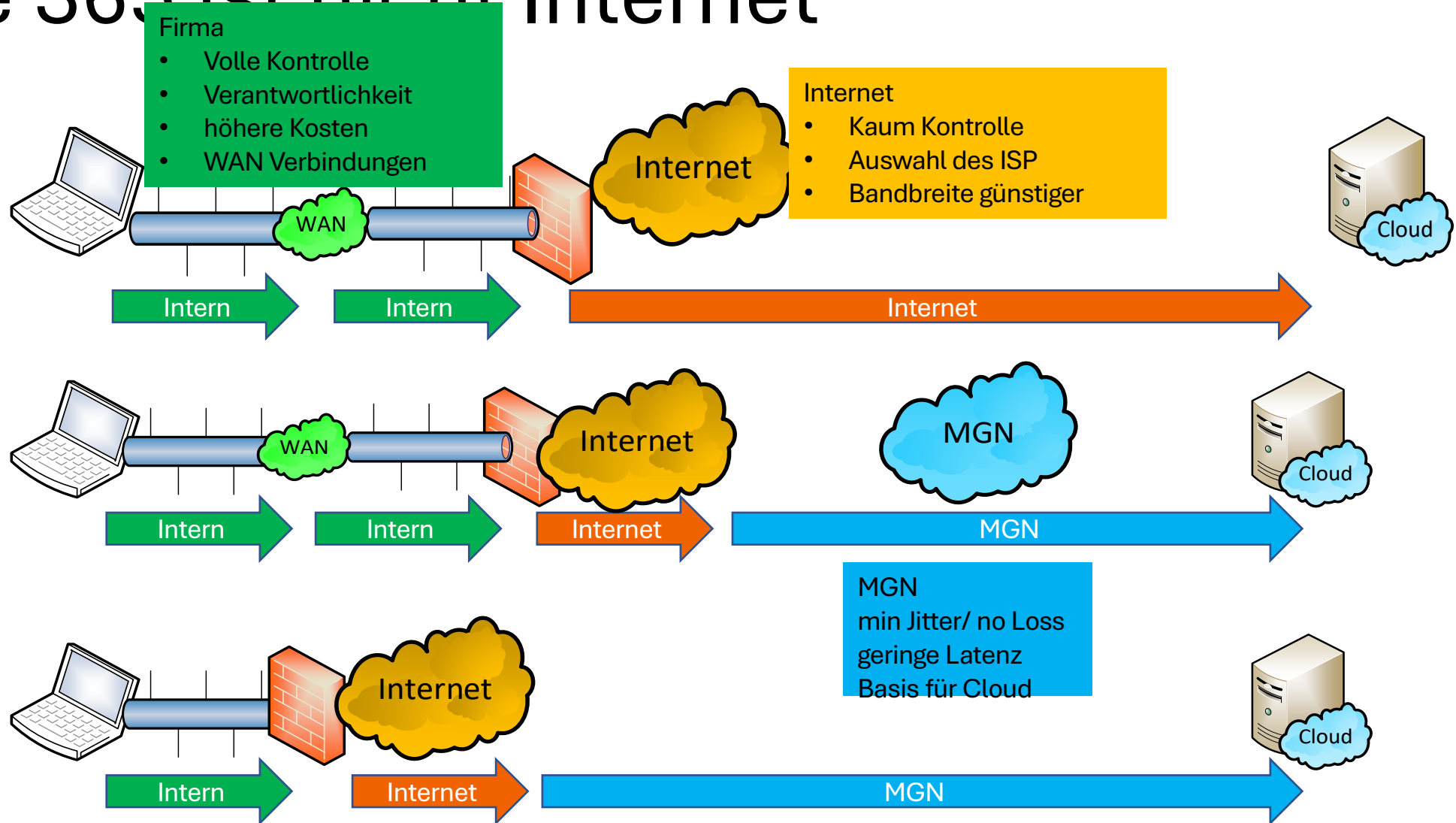
<https://o365datacentermap.azurewebsites.net/>



Lokaler Breakout vs. zentraler Breakout



Office 365 ist nicht Internet



Optimierung nach Office 365 Zielen

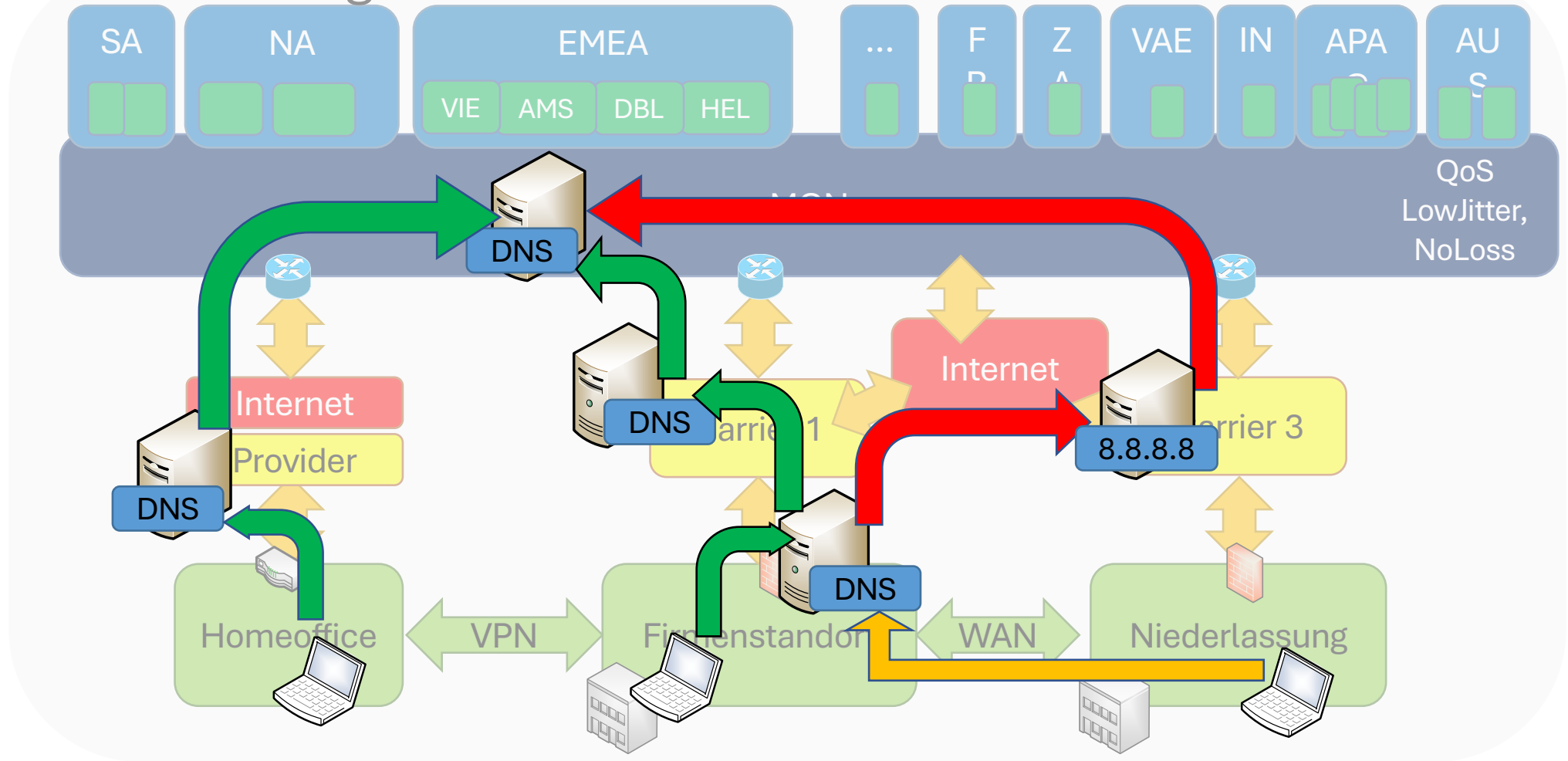
		Dienste und URLs
Optimieren <ul style="list-style-type: none"> Teams Exchange SharePoint OneDrive 	<ul style="list-style-type: none"> Viel Volumen Kritische Latenzzeit Hohe Last Keine Authentifizierung Keine SSL Inspection Ohne Proxy 	<ul style="list-style-type: none"> URL: outlook.office365.com:443 (Outlook) URL: outlook.office.com:443 (OWA) URL: <tenant>.sharepoint.com:443 URL: <tenant>-my.sharepoint.com:443 URL: teams.microsoft.com:443 Teams UDP 3478-3481 (Audio/Video) (13.107.64.0/18, 52.112.0.0/14, 52.120.0.0/14) Einige Subnetze
<ul style="list-style-type: none"> EVOSTS 	<ul style="list-style-type: none"> MFA/Conditional Access 	<ul style="list-style-type: none"> Sonderfall mit VPN und Source-IP
Erlaubt (Partner)	<ul style="list-style-type: none"> Proxy möglich Weniger Last 	<ul style="list-style-type: none"> Andere Tenants (*.sharepoint.com) Office Telemetry, Office Activation Low Volume Dienste (Flow, Delve etc.) ...
Rest (Internet)	<ul style="list-style-type: none"> SSL Inspektion Virenschutz Authentifizierung Jugendschutz 	<ul style="list-style-type: none"> Partner Allgemeines Internet Malware-Sites

TCP Level 400

- DNS
- Windows Size
- Port-Limits
- TCP-Chimney
- Window size / RSS
- SACK



DNS-Auflösung



www.ungefiltert-surfen.de

← → ↻ ungefiltert-surfen.de/nameserver/br.html



Öffentliche Nameserver

DNS-Server aus Brasilien

The table below is limited to the 100 recently checked servers.

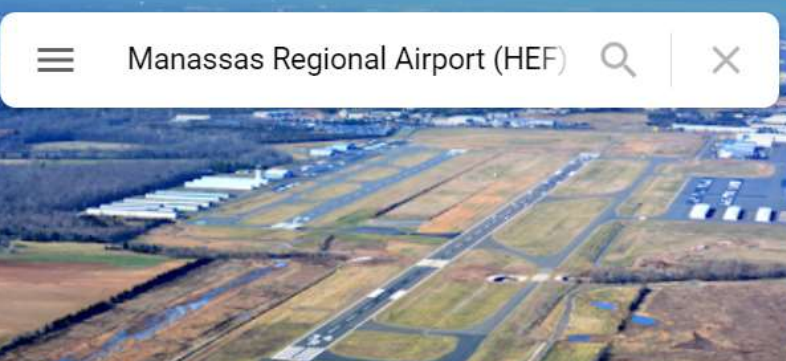
IPv4/IPv6 Adresse	Standort	Software / Version	zuletzt überprüft	Status	Reliability	Whois
201.48.108.106 mail.suporterei.com.br.	Indalatuba		vor 6 Stunden	✔ gültig	100 %	Whois
200.195.174.67 mail.whbbrasil.com.br.	Curitiba	dnsmasq-2.79	vor 6 Stunden	✔ gültig	100 %	Whois
200.155.74.15 a-mail.mopen.com.br.			vor 6 Stunden	✔ gültig	99 %	Whois
201.30.92.45 win.dataseek.com.br.			vor 6 Stunden	✔ gültig	84 %	Whois
200.212.2.125 checkout0.aslanet.com.br.			vor 6 Stunden	✔ gültig	100 %	Whois
45.227.59.227	Sao Vicente	9.10.3-P4-Ubuntu	vor 6 Stunden	✔ gültig	99 %	Whois
45.227.59.226	Sao Vicente	9.10.3-P4-Ubuntu	vor 6 Stunden	✔ gültig	99 %	Whois
200.159.11.202 200-159-11-202.customer.tdatabrasil.net.br.	São Paulo		vor 6 Stunden	✔ gültig	95 %	Whois
45.7.216.13	Caucaia		vor 6 Stunden	✔ gültig	100 %	Whois

Beispiel falscher DNS-Server

```
C:\>nslookup outlook.office365.com
Server: home1.bellatlant.net
Address: 199.45.32.43

Nicht autorisierende Antwort:
Name: outlook.office365.com
Address: 199.45.32.43

C:\>tracert 52.96.87.210
```



```
Routenverfolgung zu 52.96.87.210 über maximal 30 Hops
```

1	2 ms	1 ms	1 ms	fritz.box [192.168.178.1]
2	5 ms	4 ms	5 ms	p3e9bf2dc.dip0.t-ipconnect.de [62.155.242.220]
3	12 ms	11 ms	12 ms	d-ed5-i.D.DE.NET.DTAG.DE [62.154.5.213]
4	12 ms	12 ms	12 ms	80.157.204.58
5	16 ms	15 ms	16 ms	ae18.cr3-ams1.ip4.gtt.net [213.200.117.218]
A1 6	16 ms	16 ms	16 ms	ip4.gtt.net [154.14.37.246]
7	16 ms	16 ms	16 ms	ae25-0.icr01.ams21.ntwk.msn.net [104.44.239.75]
8	97 ms	96 ms	96 ms	be-100-0.ibr01.ams21.ntwk.msn.net [104.44.22.235]
9	97 ms	96 ms	96 ms	be-8-0.ibr01.dub08.ntwk.msn.net [104.44.19.212]
10	97 ms	96 ms	96 ms	be-7-0.ibr01.sx171.ntwk.msn.net [104.44.16.116]

DNS Round Robin / TTL

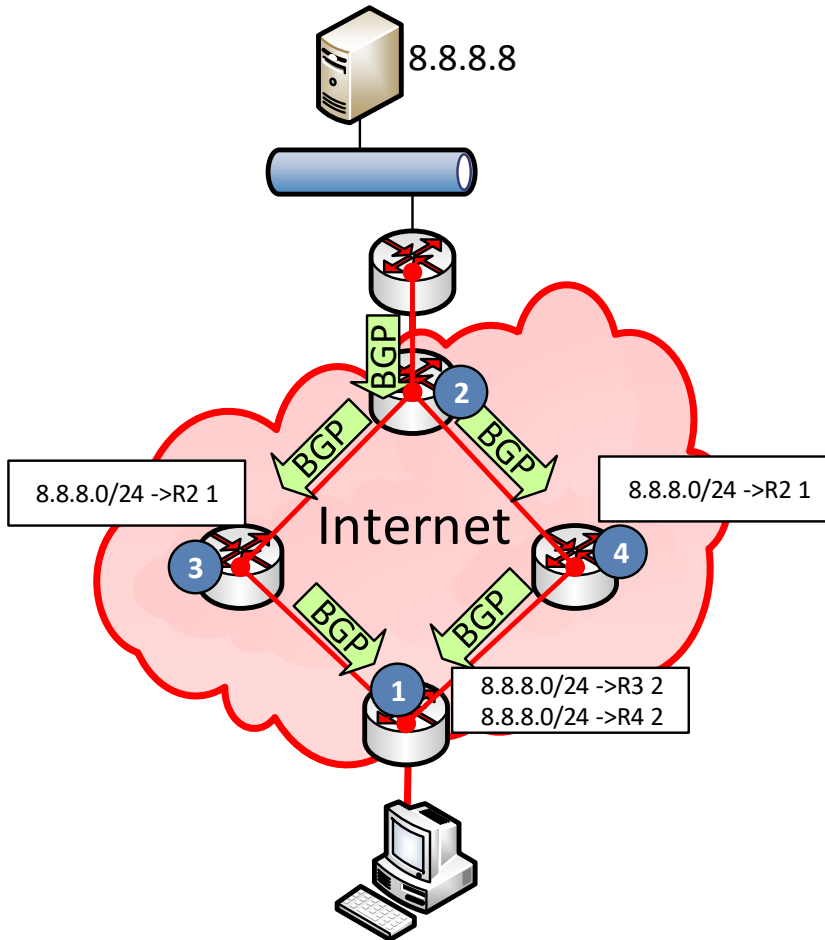
```
PowerShell 7 (x64)
PS C:\> Get-DnsClientCache outlook.office365.com | ft -AutoSize
```

Entry	RecordName	RecordType	Status	Section	TimeToLive	Data
outlook.office365.com	outlook.office365.com	CNAME	Success	Answer	2	outlook.ms-acdc.office.com
outlook.office365.com	outlook.ms-acdc.office.com	CNAME	Success	Answer	2	FRA-efz.ms-acdc.office.com
outlook.office365.com	FRA-efz.ms-acdc.office.com	AAAA	Success	Answer	2	2603:1026:200:63::2
outlook.office365.com	FRA-efz.ms-acdc.office.com	AAAA	Success	Answer	2	2603:1026:207:131::2
outlook.office365.com	FRA-efz.ms-acdc.office.com	AAAA	Success	Answer	2	2603:1026:207:cd::2
outlook.office365.com	outlook.office365.com	CNAME	Success	Answer	8	outlook.ms-acdc.office.com
outlook.office365.com	outlook.ms-acdc.office.com	CNAME	Success	Answer	8	FRA-efz.ms-acdc.office.com
outlook.office365.com	FRA-efz.ms-acdc.office.com	A	Success	Answer	8	40.101.19.162
outlook.office365.com	FRA-efz.ms-acdc.office.com	A	Success	Answer	8	40.101.121.34
outlook.office365.com	FRA-efz.ms-acdc.office.com	A	Success	Answer	8	40.101.80.2

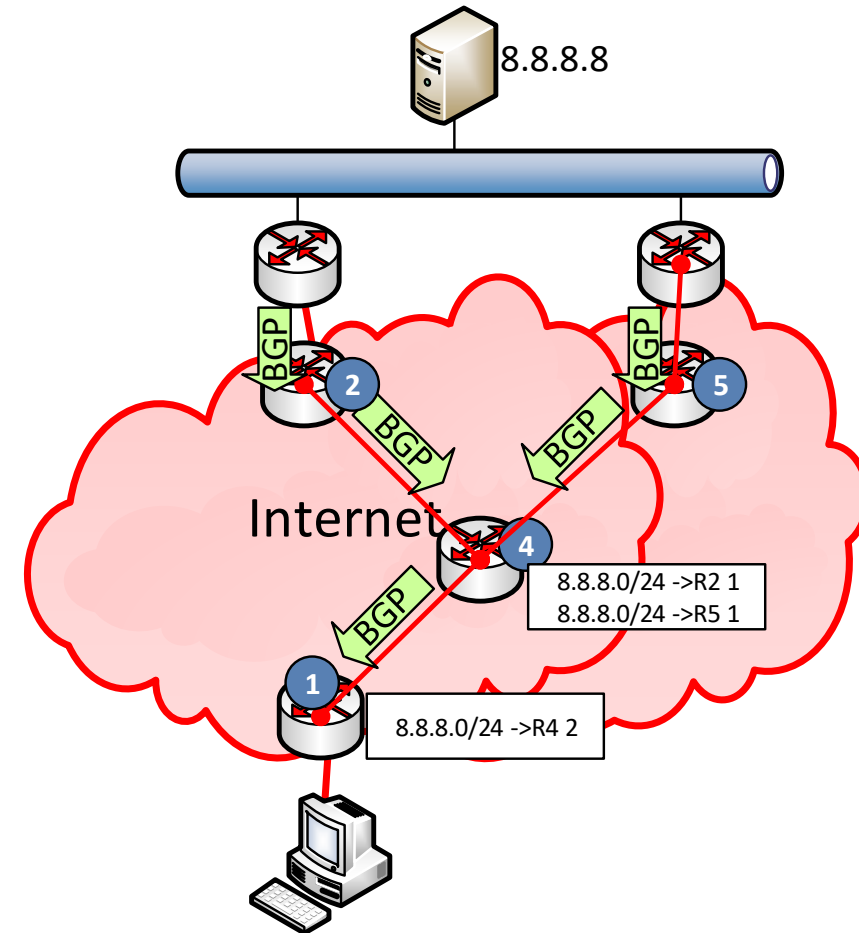
- outlook.office365.com ist CNAME auf outlook.ms-acdc.office.com
- outlook.ms-acdc.office.com ist CNAME auf <region>.ms-acdc.office.com
- <region>.ms-acdc.office.com verweist auf mehrere A-Records
- Alle Einträge haben einen sehr kurzen TTL

Anycast DNS mit IP-Routing

Redundanz im Internet



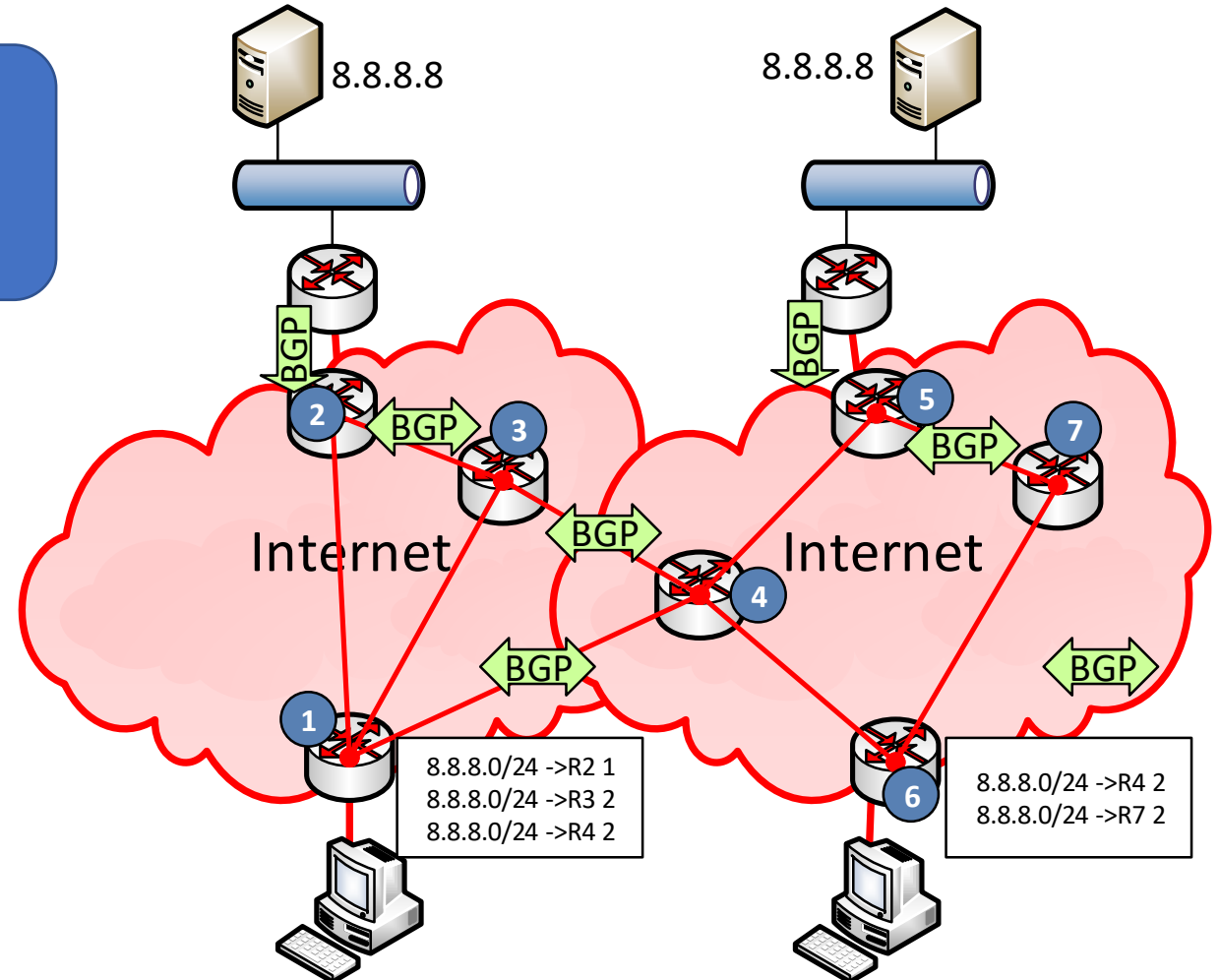
Redundanz beim Anbieter



Anycast DNS mit Office 365

Mildert DNS-Fehlkonfigurationen ab

- Identische Services
- Verschiedene Standorte
- „Nächster Zugang“ per BGP
- Kein Geo-DNS erforderlich
- Hohe Verfügbarkeit
- Hohe Skalierbarkeit



DNS by Service

	Name	IP	Target
Exchange Online	GeoDNS outlook.office365.com AnyCastDNS (partiell) (outlook.office.com)	AMS-efz.ms-acdc.office.com FRA-efz.ms-acdc.office.com LHR-efz.ms-acdc.office.com SFX-efz.ms-acdc.office.com SJC-efz.ms-acdc.office.com CPQ-efz.ms-acdc.office.com	Unterschiedliche Adressen
SharePoint/OneDrive	Anycast DNS <tenant>.sharepoint.com <tenant>-my.sharepoint.com	spo-0004.spo-msedge.net	13.107.136.9
Teams HTTP	Anycast DNS teams.microsoft.com	s-0005.s-msedge.net o.a.	52.113.194.132 2620:1ec:42::132
Teams RTP	GeoDNS worldaz.tr.teams.microsoft.com	Abhängig von der Region	13.107.64.0/18 52.112.0.0/14 52.120.0.0/14
SfB Online	IP-Adressen	No DNS, Inband	

TCP Level 400

- Windows Size
- Port-Limits
- TCP-Chimney
- Window size / RSS
- SACK



Big Fat Pipe Problem und Latenzzeit

- 1x PC + 1x Server
 - CPU unlimited
 - Disk unlimited
 - LAN Unlimited
- 1x WAN-Link
 - „Unlimited“ Bandwidth
 - 20ms Roundtrip Time



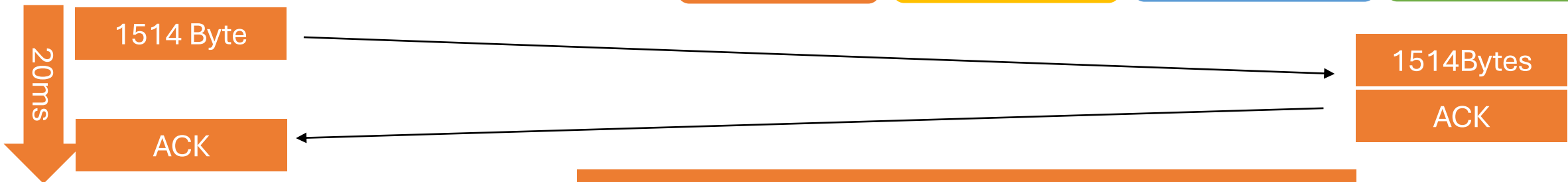
Quiz: Welchen Durchsatz kann ich per FTP erreichen ?

Bis 1 MBit

1-10 MBit

10-100 MBit

>100 MBit

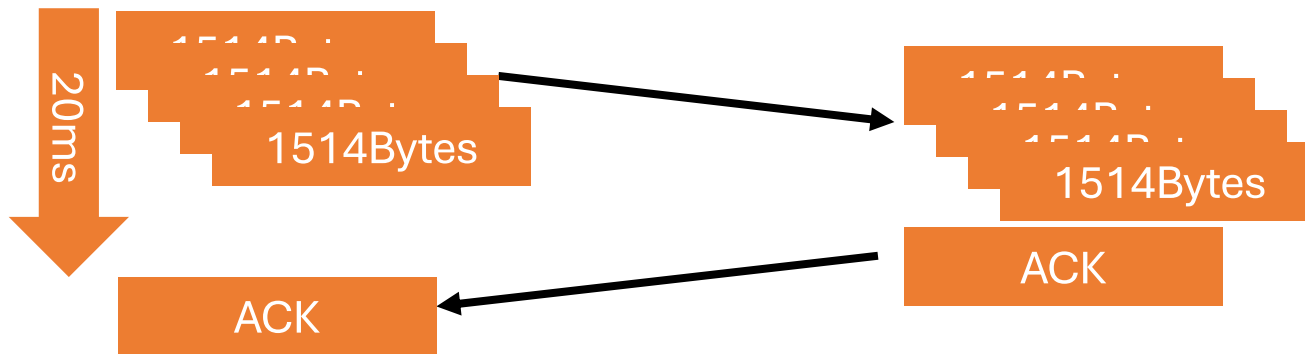


$50 \text{ Pakete} * 1514 \text{ Bytes} = 75 \text{ kByte/Sek} = 750 \text{ kbit/Sek}$



Windows Scaling und Latenz

- Sende mehr Pakete als Block und ACK verzögert
 - Sender und Empfänger müssen Puffer vorhalten
z.B. um verlorene Pakete neu zu senden und im Ziel zusammzusetzen
 - Aushandlung des Buffers erforderlich (max. 1 GB, Win2008: 16MB)
 - „RFC1323 TCP Extensions for High Performance“
 - Selective Ack (SACK)



[https://docs.microsoft.com/en-us/previous-versions/technet-magazine/cc162519\(v=msdn.10\)](https://docs.microsoft.com/en-us/previous-versions/technet-magazine/cc162519(v=msdn.10))

https://www.msxfaq.de/netzwerk/grundlagen/tcp_retransmit_und_sack.htm

```
> Frame 885: 271 bytes on wire (2168 bits), 271 bytes captured
> Ethernet II, Src: Portwell_49:4f:68 (00:90:fb:49:4f:68), Dst
> Internet Protocol Version 4, Src: 40.97.134.18, Dst: 192.168
  > Transmission Control Protocol, Src Port: 443, Dst Port: 49870
    Source Port: 443
    Destination Port: 49870
    [Stream index: 28]
    [TCP Segment Len: 217]
    Sequence number: 5544 (relative sequence number)
    [Next sequence number: 5761 (relative sequence number)]
    Acknowledgment number: 2783 (relative ack number)
    0101 .... = Header Length: 20 bytes (5)
  > Flags: 0x018 (PSH, ACK)
    Window size value: 65535
    [Calculated window size: 1048560]
    [Window size scaling factor: 16]
    Checksum: 0x8fa4 [unverified]
    [Checksum Status: Unverified]
```

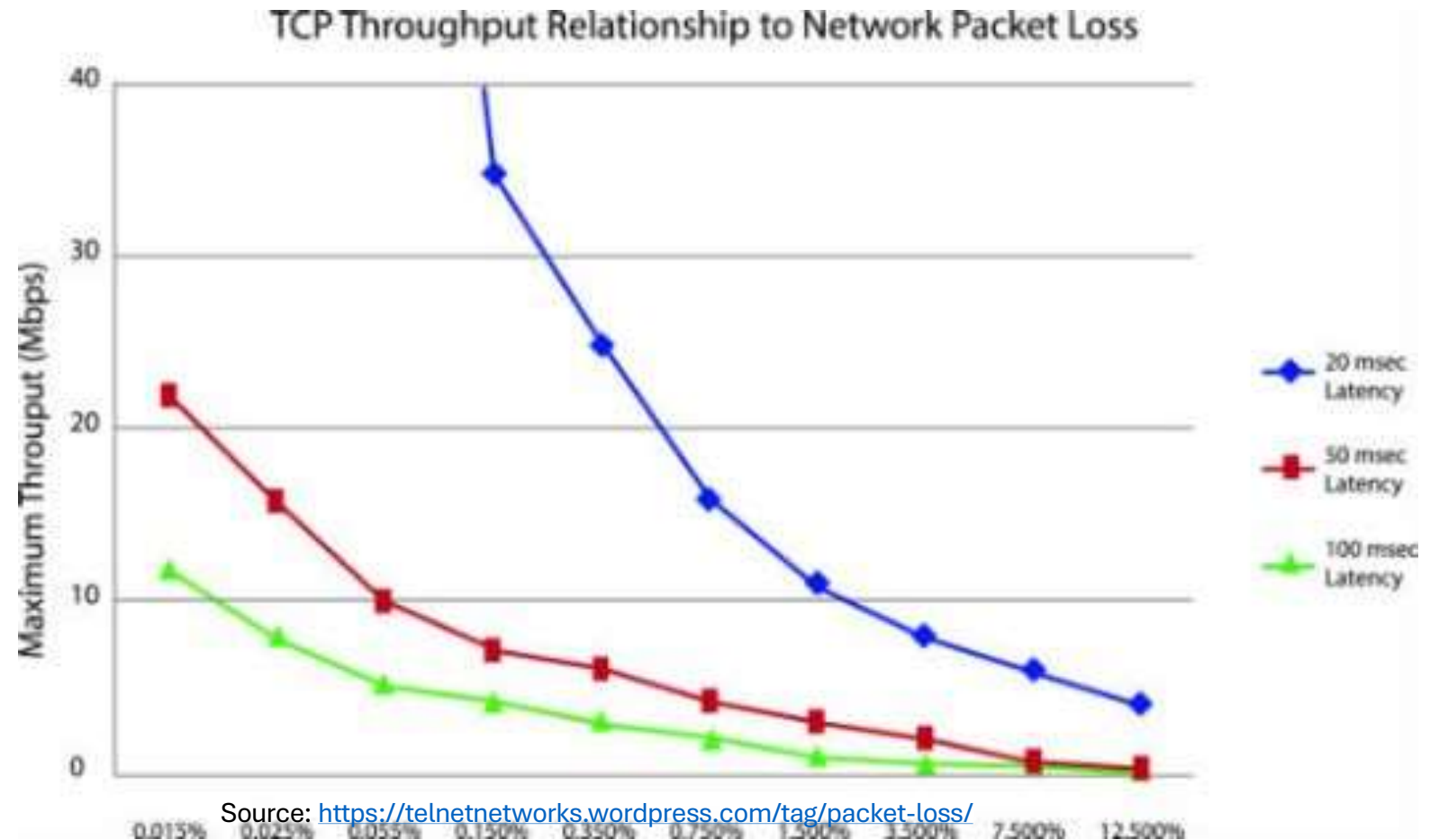
Windowsize und Latenz = Durchsatz

Applikation	Windowsize	1ms	20ms	50ms	100ms	200ms
Exchange Webservices (EWS)	1.048.560	GB	50MB/s	20MB/s	10MB/s	5MB/s
OneDrive 10MB Upload	1.059.840	GB	50MB/s	20MB/s	10MB/s	5MB/s
SharePoint 12MB Download	4.273.920	GB	208MB/s	84MB/s	42MB/s	21MB/s
End2end-http Outlook	1.588.480	GB	75MB/s	30MB/s	15MB/s	7,5MB/s
Outlook Client	525.568	GB	25MB/s	10MB/s	5MB/s	2,5MB/s
SFTP using SSH 1and1	131584	GB	6MB/s	2,4MB/s	1,2MB/s	660kB/s
SMB im LAN	2.102.272	GB+	na	na	na	na

Das sind „gemessene Wert“. Aber prüft die effektive Windowsize? Spielverderber Firewall

Paket Loss und Durchsatz

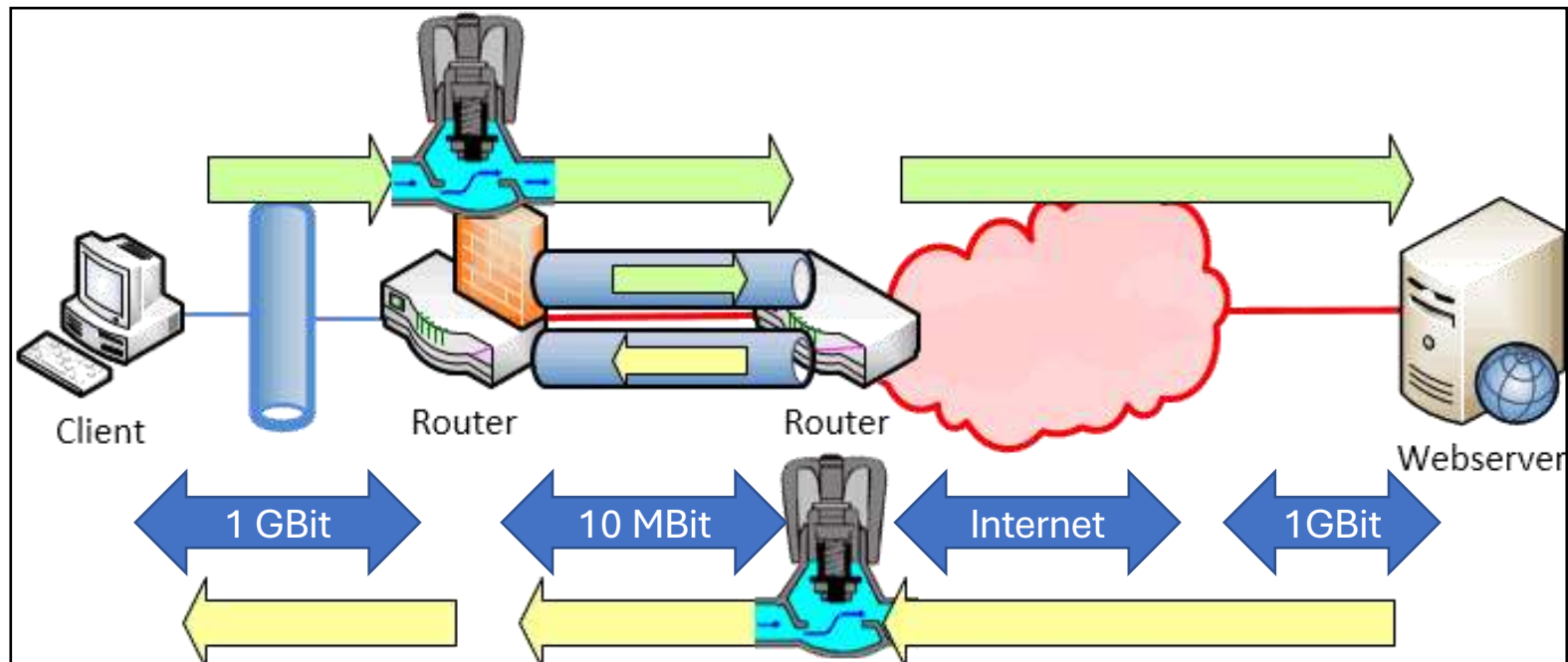
- Gründe für Paketverlust
 - Queue-Überlauf
 - Link-Congestion
- TCP-Reaktion
 - Drosselung der Senderate
 - TCP Retransmit
- VoIP
 - RTCP-Meldung
 - Bitraten-Anpassung
 - Codec-Anpassung



Quiz: Kann ich eingehenden HTTPS-Verkehr steuern?

- Ausgehend kann eine Firewall Pakete drosseln
- Eingehend könnte es der ISP – macht er aber nicht

Für TCP kann ich ACK-Pakete künstlich „verschlechtern“



Latenz ist pro Connection -> viele Connections

- Beispiel Outlook
- Beispiel Teams

Outlook-Verbindungsstatus

Allgemein Lokales Postfach

Aktivität

VID	SMTP-Adresse	Servername	Status	Proto...	Authn	Verschl...	Typ	Anfr/Fehle
6	Frank.Carius@Netat...	https://outlook.office365.com/...	hergestellt	HTTP	Träger*	SSL	Exchange-Verzei...	60/3
12	...	https://outlook.office365.com/...	hergestellt	HTTP	Klartext*	SSL	Exchange-Verzei...	58/2
		https://outlook.office365.com/...	hergestellt	HTTP	Träger*	SSL	Exchange-Verzei...	376/4
		https://outlook.office365.com/...	hergestellt	HTTP	Klartext*	SSL	Exchange-Verzei...	63/2
		https://outlook.office365.com/...	hergestellt	HTTP	Träger*	SSL	Exchange-E-Mail	3913/4
		work.de/map...	hergestellt	HTTP	Nego*	SSL	Exchange-E-Mail	90/11
		https://outlook.office365.com/...	hergestellt	HTTP	Träger*	SSL	Exchange-E-Mail	14711/6
		https://outlook.office365.com/...	hergestellt	HTTP	Klartext*	SSL	Exchange-E-Mail	169/5
		https://outlook.office365.com/...	hergestellt	HTTP	Klartext*	SSL	Exchange-E-Mail	783/4
		https://outlook.office365.com/...	hergestellt	HTTP	Träger*	SSL	Exchange-E-Mail	173/2
		work.de/map...	hergestellt	HTTP	Nego*	SSL	Exchange-E-Mail	113/13
		https://outlook.office365.com/...	hergestellt	HTTP	Klartext*	SSL	Exchange-E-Mail	64/6
		https://outlook.office365.com/...	hergestellt	HTTP	Träger*	SSL	Exchange-E-Mail	72/3
		https://outlook.office365.com/...	hergestellt	HTTP	Träger*	SSL	Exchange-E-Mail	97/4
		https://outlook.office365.com/...	hergestellt	HTTP	Klartext*	SSL	Exchange-E-Mail	2470/6
		https://outlook.office365.com/...	hergestellt	HTTP	Träger*	SSL	Exchange-E-Mail	12/0

TCP-Verbindungen

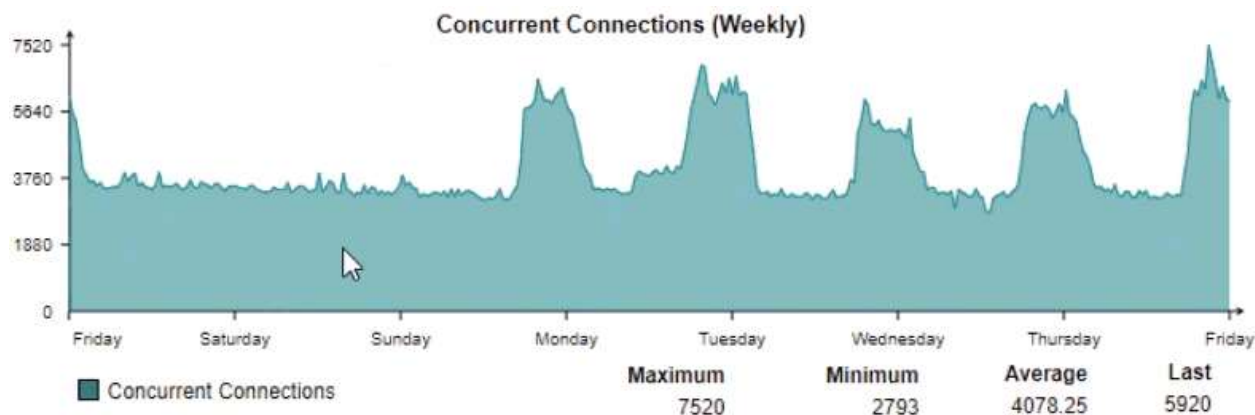
Gefiltert von "OUTLOOK.EXE, Teams.exe, Teams.exe"

Prozess	PID	Lokale Adresse	Lokale...	Remoteadresse	Remoteport	Paketverlust (%)	Latenz (ms)
Teams.exe	14412	172.18.241.38	58440	52.114.128.13	443	0	414
Teams.exe	14412	172.18.241.38	58439	52.114.88.46	443	0	76
Teams.exe	13952	172.18.241.38	58447	52.114.74.39	443	0	74
Teams.exe	14412	172.18.241.38	58457	52.178.94.2	443	-	-
Teams.exe	13952	172.18.241.38	58448	52.113.194.131	443	-	-
Teams.exe	14412	172.18.241.38	58435	52.113.194.131	443	-	-
Teams.exe	13952	172.18.241.38	58417	52.114.76.35	443	-	-
OUTLOOK.EXE	22632	172.18.241.38	58520	40.101.12.18	443	0	1.190
OUTLOOK.EXE	22632	172.18.241.38	58519	40.101.12.18	443	0	567
OUTLOOK.EXE	22632	172.18.241.38	58507	40.101.12.18	443	0	553
OUTLOOK.EXE	22632	172.18.241.38	58499	40.101.12.18	443	0	523
OUTLOOK.EXE	22632	172.18.241.38	58517	40.101.12.18	443	0	491
OUTLOOK.EXE	22632	172.18.241.38	58497	40.101.12.18	443	0	490
OUTLOOK.EXE	22632	172.18.241.38	58493	40.101.12.18	443	0	461
OUTLOOK.EXE	22632	172.18.241.38	58506	52.114.76.35	443	0	420
OUTLOOK.EXE	22632	172.18.241.38	58487	40.101.12.18	443	0	397
OUTLOOK.EXE	22632	172.18.241.38	58490	40.101.12.18	443	0	342
OUTLOOK.EXE	22632	172.18.241.38	58485	40.101.12.18	443	0	318
OUTLOOK.EXE	22632	172.18.241.38	58521	40.101.12.18	443	0	301
OUTLOOK.EXE	22632	172.18.241.38	58510	40.101.12.18	443	0	272
OUTLOOK.EXE	22632	172.18.241.38	58503	40.101.12.18	443	0	188
OUTLOOK.EXE	22632	172.18.241.38	58486	40.101.12.18	443	0	186
OUTLOOK.EXE	22632	172.18.241.38	58501	40.101.12.18	443	0	182

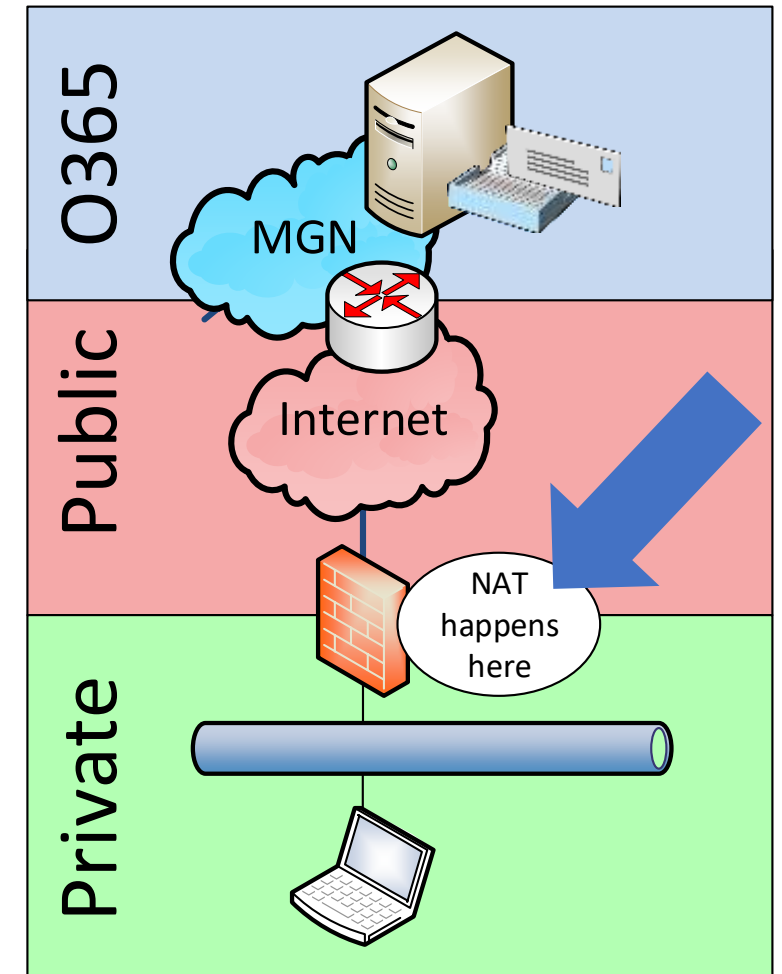


Private Adressen und öffentliche Ports

- Internet nutzt öffentliche Adressen
- Clients sind hinter privaten Adressen
- IP-Translation erforderlich
- Proxy und NAT sind die Komponenten
- Quizfragen:
 - Wie viele ausgehende Source-Port hat ein System?
 - Wie viele gleichzeitige Verbindungen macht ein Client ?
 - Wie lange bleibt die Verbindung aktiv?
 - Wie viele Clients passen hinter eine öffentliche IP-Adresse?



Quelle: Sophos UTM: Logging&Reporting / Networkusage



NAT/Proxy ärgern – Connection Limit

- 1000 Outlook Benutzer mit 10 Verbindungen/Client
- Kann mein Proxy/NAT-Router das ab ?
- PowerShell kann viele Verbindungen öffnen
 - Invoke-WebRequest oder Invoke-RestMethod machen pooling ☹️
 - System.Net.Http.HttpClient funktioniert 😊

```
Add-Type -AssemblyName System.Net.Http;
write-host " Start TCP Connections $((get-nettcpconnection).count)"
1..1000|% {
    write-progress "Loop $($_) of 1000"
    $winhttpclient = new-object System.Net.Http.HttpClient;
    $winhttpclient.DefaultRequestHeaders.add("User-Agent", "Mozilla/5.0");
    $null = $winhttpclient.GetStringAsync("https://outlook.office365.com/favicon.ico")
}
write-host " End TCP Connections $((get-nettcpconnection).count)"
```


MTU und ICMP

- Maximalgröße auf dem „Kabel“
 - Welche Bytes zählen?
 - Achtung DSLite
 - Achtung. Azure VPN
https://www.msxfaq.de/cloud/azure/azure_vpn_und_mtu.
- Fragmentierung
 - Ineffektiv
 - Passiert nicht mehr
 - IPv6 fragmentiert nicht mehr
 - ICMP „Exceeded“ Meldung
- Best Practice
 - Endgeräte handeln maximale Größe aus
 - ICMP (Typ=3, Code=4) zulassen

```

> Frame 422: 70 bytes on wire (560 bits), 70 bytes captured on interface 0
> Ethernet II, Src: AvmAudio_98:0c:97 (e0:28:6d:98:0c:97), Dst: 192.168.178.1
> Internet Protocol Version 4, Src: 192.168.178.50, Dst: 192.168.178.1
  > Internet Control Message Protocol
    Type: 3 (Destination unreachable)
    Code: 4 (Fragmentation needed)
    Checksum: 0x510e [correct]
    [Checksum Status: Good]
    Unused: 0000
    MTU of next hop: 1492
  > Internet Protocol Version 4, Src: 192.168.178.50, Dst: 192.168.178.1
    
```

```

> Frame 1: 1514 bytes on wire (12112 bits), 1514 bytes captured on interface 0
> Ethernet II, Src: Universa_5d:79:e1 (e0:4f:43:5d:79:e1), Dst: 192.168.178.1
  > Internet Protocol Version 4, Src: 192.168.178.50, Dst: 192.168.178.1
    0100 .... = Version: 4
    .... 0101 = Header Length: 20 bytes (5)
  > Differentiated Services Field: 0x00 (DSCP: CS0, ECN: Not-ECT)
    Total Length: 1500
    Identification: 0xdd85
  > Flags: 0x4000, Don't Fragment
    Time to live: 128
    Protocol: ICMP (1)
    Header checksum: 0x0000 [Header checksum status: Good]
    Source: 192.168.178.50
    Destination: 192.168.178.1
  > Internet Control Message Protocol
    Type: 8 (Echo (ping))
    Code: 0
    Checksum: 0x3d49 [correct]
    [Checksum Status: Good]
    Identifier (BE): 1 (0x00000001)
    Identifier (LE): 256 (0x00000100)
    Sequence number (BE): 1 (0x00000001)
    Sequence number (LE): 1 (0x00000001)
    [Response frame: 2]
  > Data (1472 bytes)
    
```

Medium	Typisch
Ethernet	1492
DSL	1464
Kabel Internet DSLite	1472
VPN/Freifunk	1372

FRITZ!Box 7490

Internet > Zugangsdaten

Internetzugang IPv6 LISP

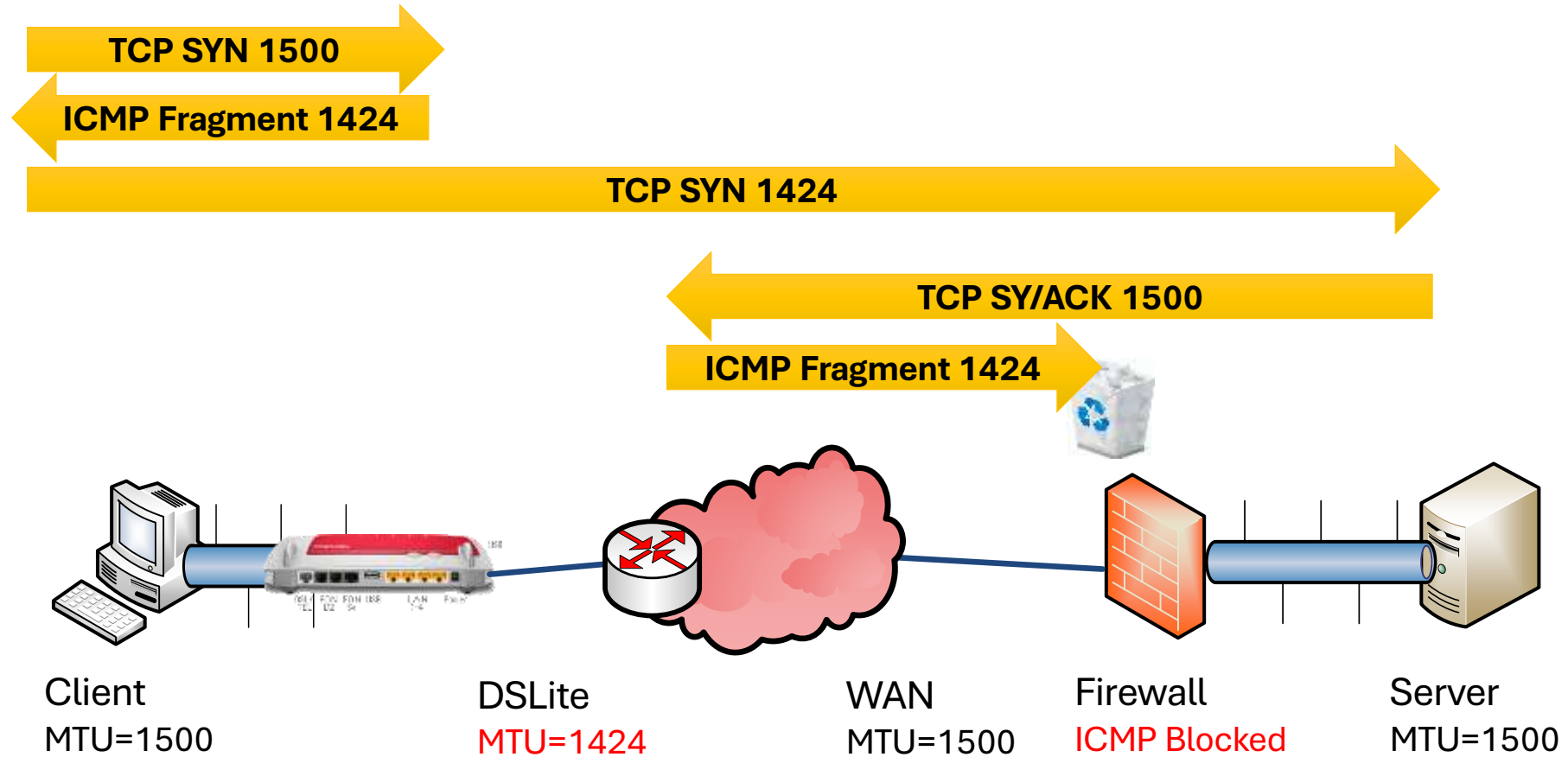
Bestimmte Länge für das LAN-Präfix anfordern

Länge Bit

Weitere Einstellungen

MTU manuell einstellen Byte

MTU und ICMP-Blockade – Reale Kundensituation



Teams und VoIP



Hinweis zu UDP 3478-3481 und TCP443

- **Firewall and proxy requirements**
- Microsoft Teams connects to Microsoft Online Services and needs internet connectivity for this. For Teams to function correctly, you must open TCP ports 80 and 443 from the clients to the internet, and UDP ports 3478 through 3481 from the clients to the internet. The TCP ports are used to connect to web-based content such as SharePoint Online, Exchange Online, and the Teams Chat services. Plug-ins and connectors also connect over these TCP ports. The four UDP ports are used for media such as audio and video, to ensure they flow correctly.
- Opening these ports is essential for a reliable Teams deployment. Blocking these ports is unsupported and will have an effect on media quality.
- Source: <https://docs.microsoft.com/en-us/microsoftteams/3-envision-evaluate-my-environment#firewall-and-proxy-requirements>

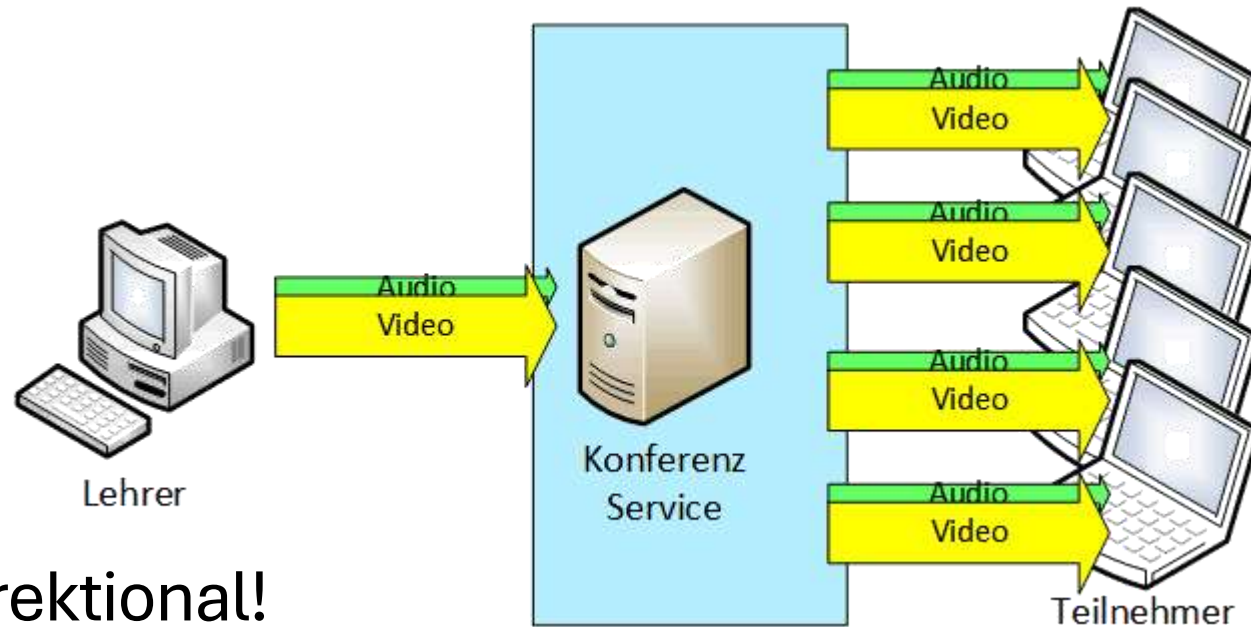
VoIP sind keine Daten

- Klassischer Datenverkehr
 - Stoßweise, d.h. Anforderung und Antwort
 - Keine Echtzeitübertragung
 - TCP sichert Verluste und Reihenfolge
 - Große Pakete (max. MTU-Size)
- VoIP Audio/Video
 - Viele kleine Pakete
Sprache sind 20ms Pakete a 160 Bytes (=64kbit)
 - Echtzeit
Kurze Laufzeiten
 - Paket Loss
Nachsenden sinnlos
 - Applikation muss Latenz, Jitter und Paketloss „sehen“
 - Kann Codec, Bitrate, NB/WB, Auflösung anpassen
 - „Artefakte“ bei Video, kurze Aussetzer bei Audio
 - UDP ist das präferierte Protokoll
- VoIP über TCP oder gar HTTPS
 - Datenverlust = Warten auf Nachlieferung
 - Aussetzer in der Sprache
 - „Stehendes Video“, längere Stille bei Audio

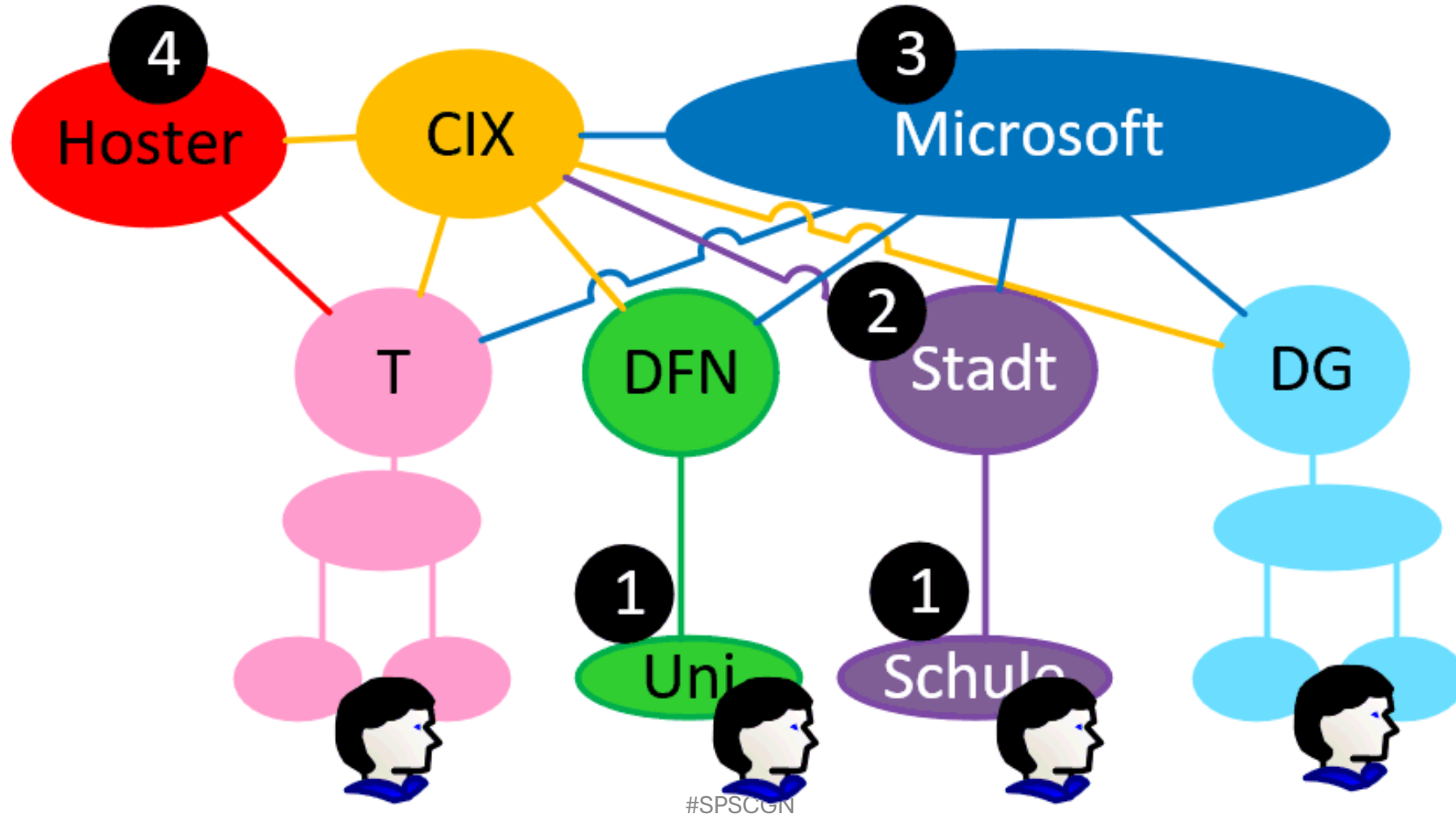
Kriterium	Daten	Audio/Video
Paketgröße	1500 kb	160 Bytes
Protokoll	TCP	UDP
Paketprofil	Stoßweise große Pakete	Kontinuierlich viele kleine Pakete
Paketverlust	TCP abgesichert	Nicht nachsenden
Reihenfolge	TCP abgesichert	Wenige ms
Adaption	Keine	Codec Auflösung WB/B
Sicherheit	HTTPS/IPSEC	SRTP

Teams Konferenzload

- Uni Paderborn
 - 20.000 Studenten
 - 10% „zuhause“
 - 2000 „Streams“
- Datenmenge
 - Audio: 100kBit
 - Video 1-2 Mbit
- Gesamt: 2-4 Gbit bidirektional!



Standort der Konferenz-MCU ?



worldaz.tr.teams.microsoft.com

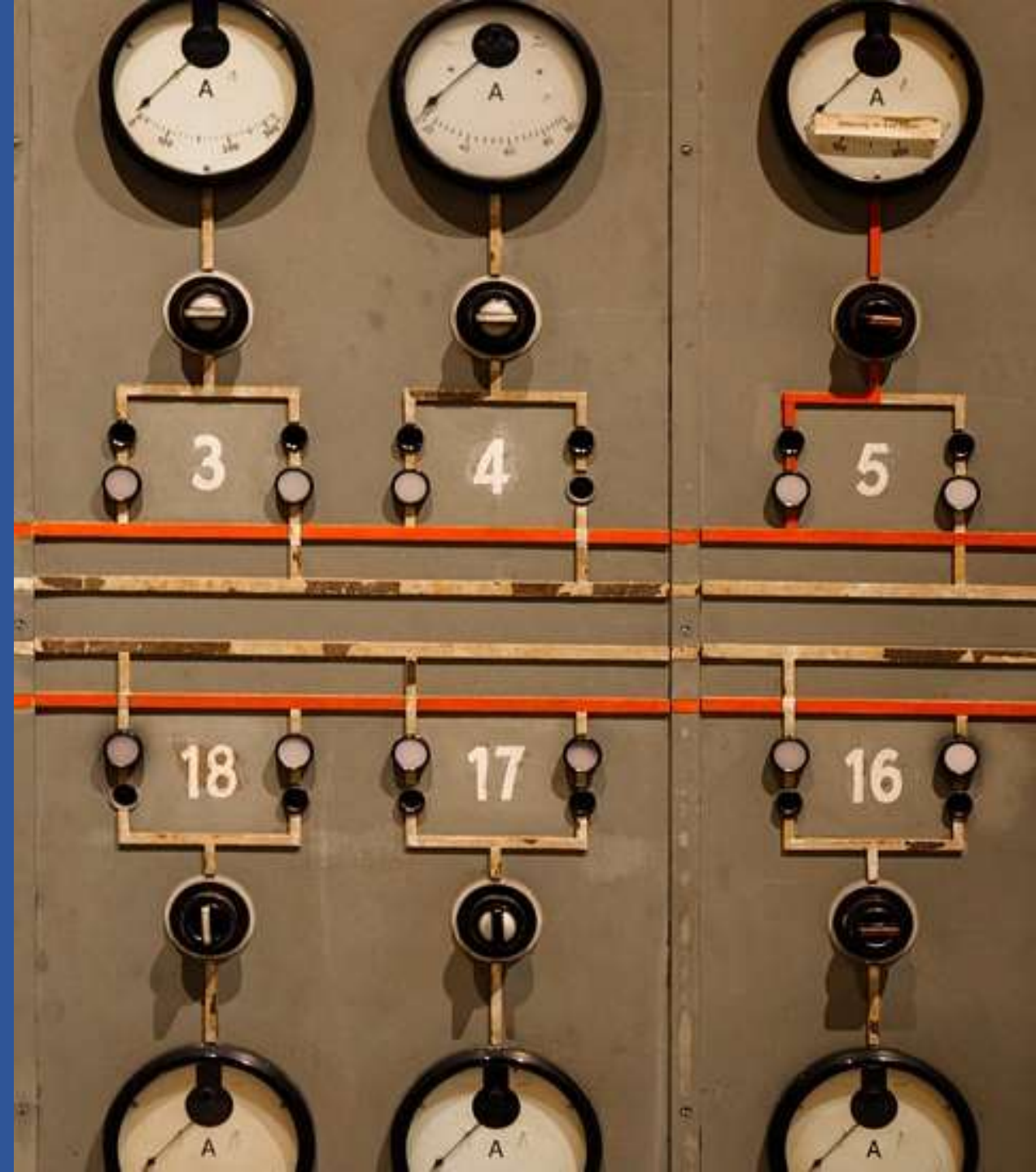
- Generische IP für Transport Relay
- Test durch Microsoft
- End2End UDP
- End2End UDP (CN)

```
PS C:\Users\fcadmin> .\end2end-udp3478.ps1
End2End-UDP3478:Start
Mode : END2END, continuous latency check and no distance check

PS C:\End2End> .\end2end-udp3478.ps1 -remotehost b-tr-teasc-asea-04.eastasia.cloudapp.azure.com -avgintervalsec 10
End2End-UDP3478:Start
Mode : END2END, continuous latency check and no distance check
MaxTTL : 128
MaxRetries : 0
AvgIntervalSec : 10
InterpacketsleepMS : 20
Sleeptime : 0
prtgpshurl :
TURN-Server : Use given DNS-Name: b-tr-teasc-asea-04.eastasia.cloudapp.azure.com IP=52.114.5.114
End2End-UDP3478:Start UDP-Client on 50019
End2End-UDP3478:Connect UDPCClient to 52.114.5.114:3478
Colorcode: <=100ms <=200ms >200ms
Legend: 100 pakets max: . = max<100ms W= max<200ms E=max>200ms
End2End-UDP3478:Keyboard: use X=End P=Pause
2021-04-09 08:59:20Z:RTT:(Min/Avg/Max):197/200/203 Total/Fail:043/000
2021-04-09 08:59:30Z:RTT:(Min/Avg/Max):197/200/202 Total/Fail:043/000
2021-04-09 08:59:40Z:RTT:(Min/Avg/Max):197/200/203 Total/Fail:043/000
2021-04-09 08:59:50Z:RTT:(Min/Avg/Max):198/200/204 Total/Fail:042/000
2021-04-09 09:00:01Z:RTT:(Min/Avg/Max):197/201/215 Total/Fail:043/000
2021-04-09 09:00:11Z:RTT:(Min/Avg/Max):198/200/202 Total/Fail:043/000
2021-04-09 09:00:21Z:RTT:(Min/Avg/Max):198/200/204 Total/Fail:043/000
```

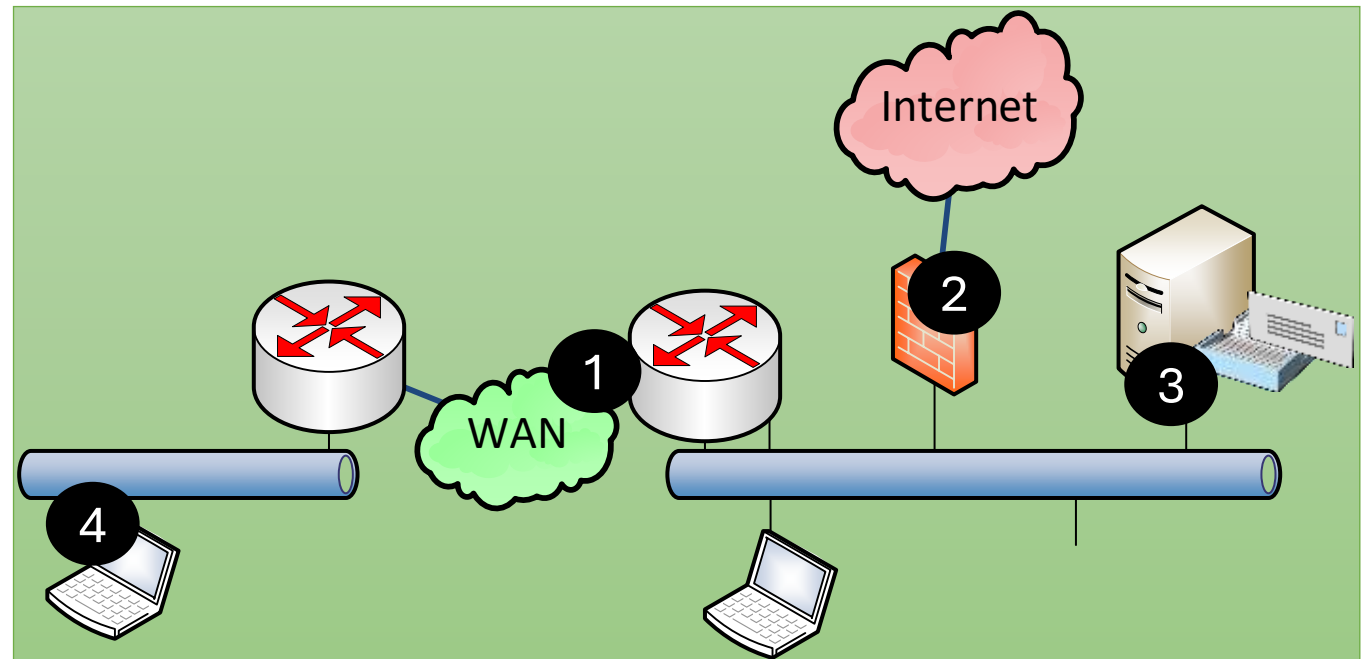

Netzwerk messen

- Wo messen?
- Bandbreite
- Auslastung
- Paketverlust
- Latenz



Monitoring bisher

- 1 • Eigene LAN/WAN-Verbindung
 - Bandbreite via SNMP
 - NetFlow für Verkehrsverteilung
- 2 • Internet
 - Bandbreite mittels SNMP
 - Proxylogs/URL-Logs
- 3 • Server
 - Perfmon
 - IIS-Logs
 - Eventlog
- 4 • Clients
 - Limitiert
 - Meist nicht gefordert



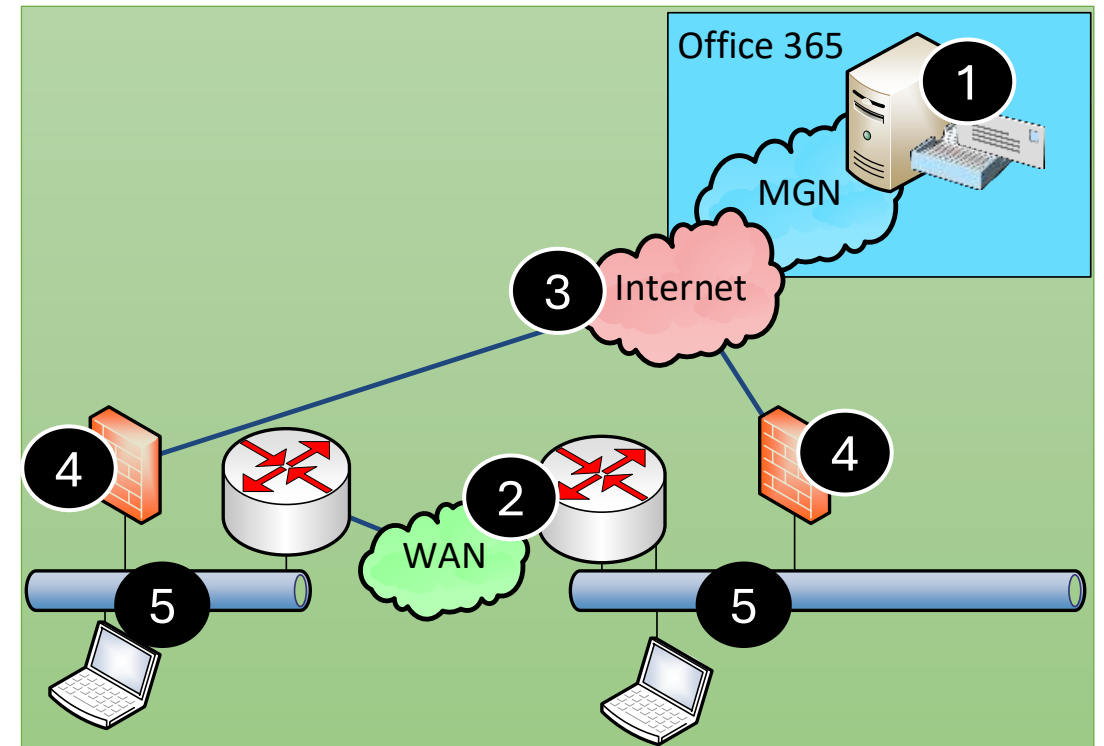
Alles ist unter Kontrolle.. Meistens....



Performance Monitoring mit Cloud

- 1 Dienste sind in der Cloud
 - Managed by Microsoft
- 2 Kein lokaler Verkehr
 - Lokaler Breakout
 - Umgeht eigenes WAN
- 3 Keine Daten vom ISP
- 4 Deutlich mehr „Internet Traffic“
- 5 Interne Links

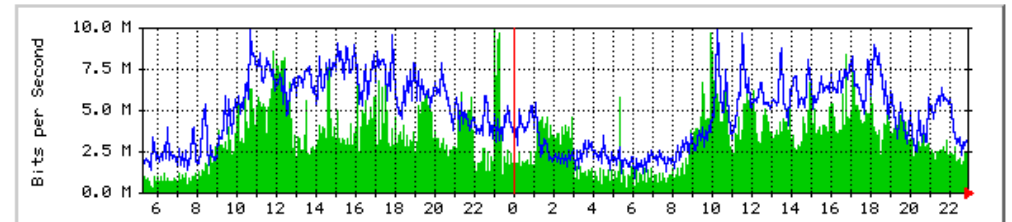
Anpassung der Überwachung
ist erforderlich



Bandbreite vs. Latenz

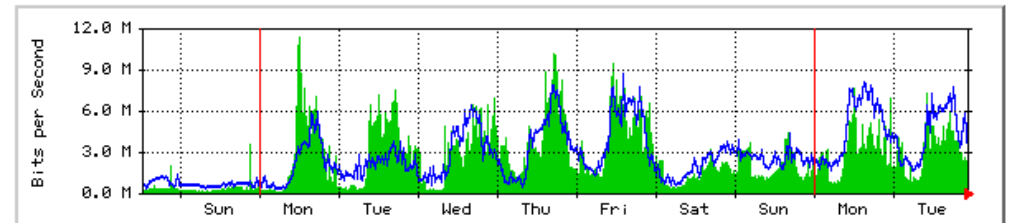
- NOC: Statement
 - Unser Netzwerk ist schnell
 - Nein, wir haben kein Bandbreitenproblem
- NOC: Monitoring per SNMP
 - Messung jede Minute
 - Trends bis zu 1 Jahr
- Aber!
 - Datenmenge und Bandbreite sind gar nicht primär wichtig
 - Latenzzeit ist viel wichtiger
 - Wenig Bandbreite erkennt man auch an schlechterer Latenz

Daily' Graph (5 Minute Average)



Max In: 9938.0 kb/s (9.9%) Average In: 3403.8 kb/s (3.4%) Current In: 1900.5 kb/s (1.9%)
Max Out: 9946.0 kb/s (9.9%) Average Out: 4820.8 kb/s (4.8%) Current Out: 3306.9 kb/s (3.3%)

Weekly' Graph (30 Minute Average)



Max In: 11.4 Mb/s (11.4%) Average In: 2755.3 kb/s (2.8%) Current In: 2139.7 kb/s (2.1%)
Max Out: 8678.4 kb/s (8.7%) Average Out: 2856.4 kb/s (2.9%) Current Out: 3002.0 kb/s (3.0%)

Frage: Wer misst heute schon "Latenzzeiten" im LAN/WAN?



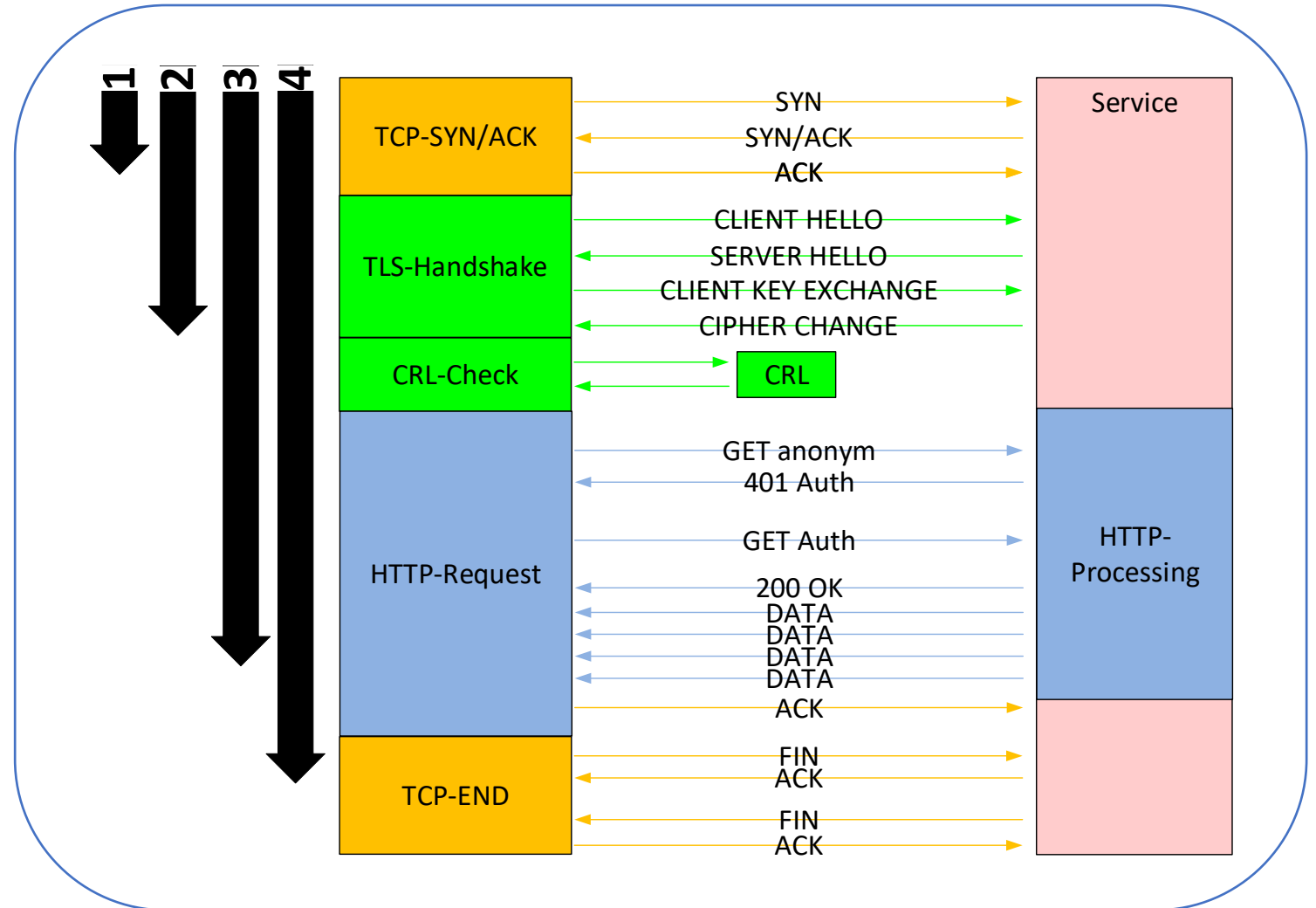
Latenz richtig messen

- Wichtig ist, was beim Anwender ankommt!



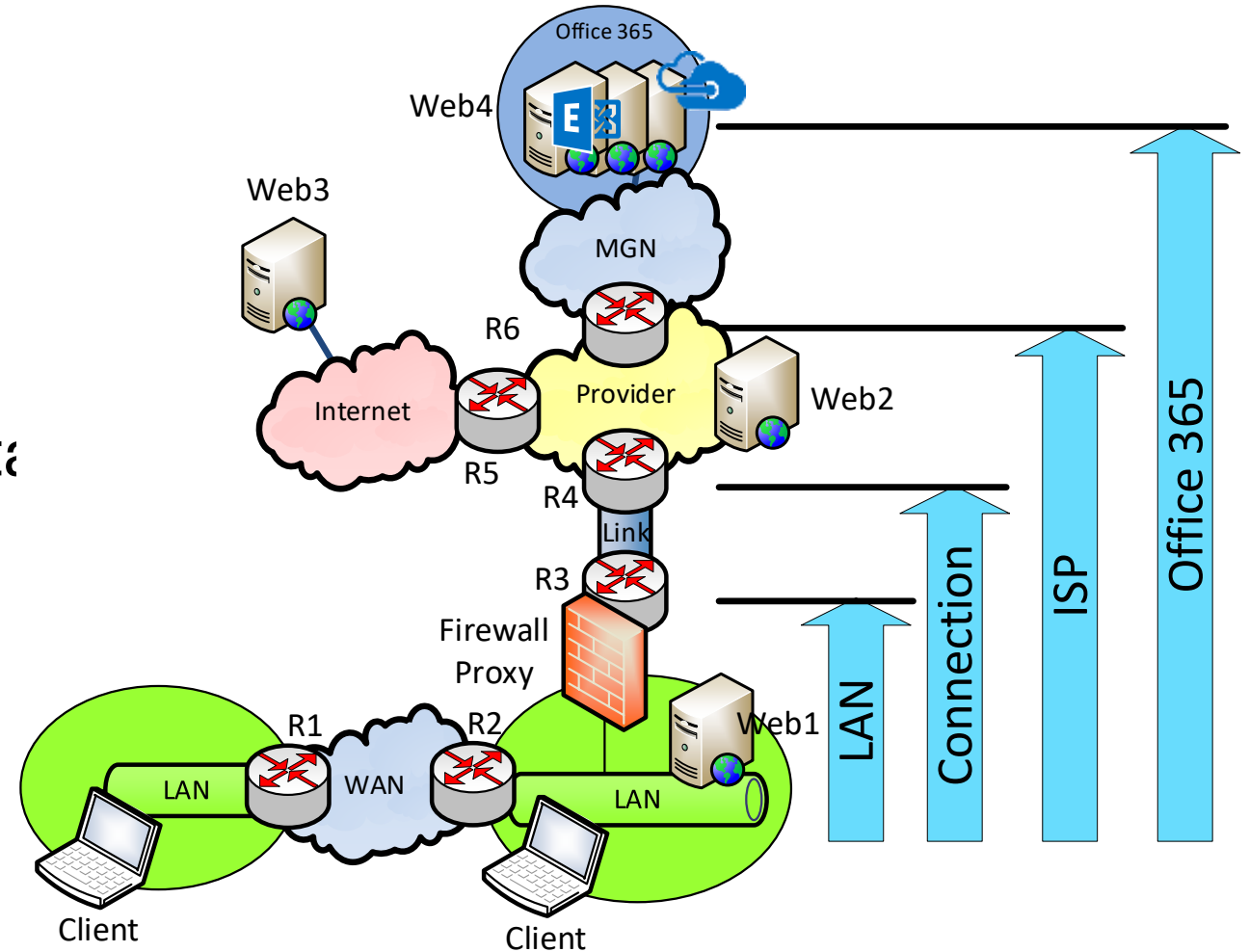
Was ist ein gültiges Protokoll?

- ICMP-Ping
 - Psping, Ping,
 - Traceroute
- TCP-Connect
 - PSping
- HTTP-Connect
 - DNS-Query
 - TLS-Handshake
- HTTP Download
 - URL-Abfragen
 - Content Size



Die richtige Gegenstelle?

- Office 365 ist wichtig
- Überwachung der Hops
- Der Client ist wichtig
- Überwachung der Zwischensta



Wie nützlich ist PING
?

Eingabeaufforderung

```
>ping outlook.office365.com
```

```
ping wird ausgeführt für eat-efz.ms
```

```
Antwort von 40.97.205.2: Bytes=32 Z
```

```
Antwort von 40.97.205.2: Bytes=32 Z
```

```
Antwort von 40.97.205.2: Bytes=32 Z
```

```
Antwort von 40.97.205.2: Bytes=32 Z
```

```
ping-Statistik für 40.97.205.2:
```

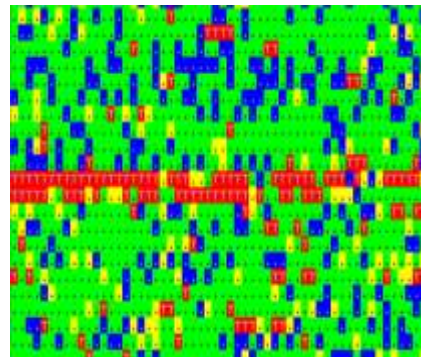
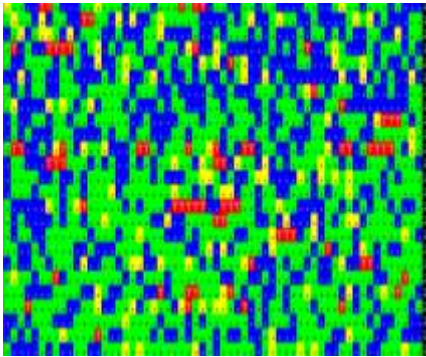
```
Pakete: Gesendet = 4, Empfangen  
(0% Verlust),
```

```
Zeitangaben in Millisek.:
```

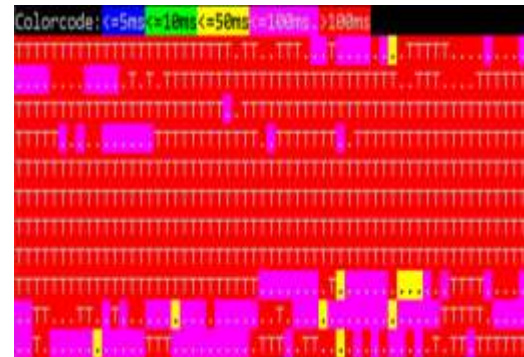
```
Minimum = 7ms, Maximum = 9ms, M
```


Beispiel: End2End-Ping

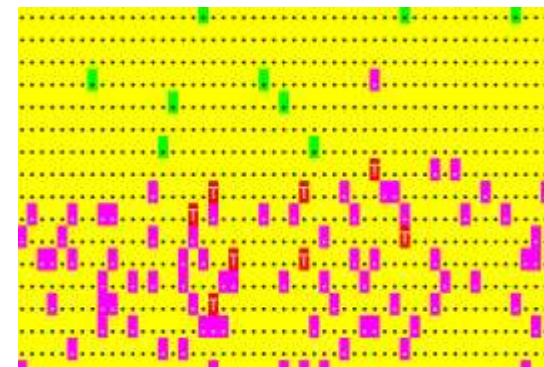
Bellevue Hotel 11:00pm/07:00am



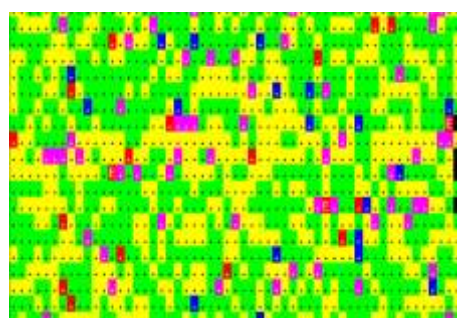
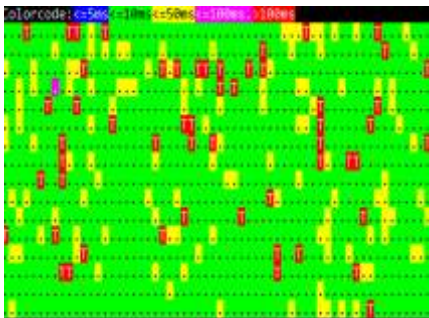
WifiOnICE



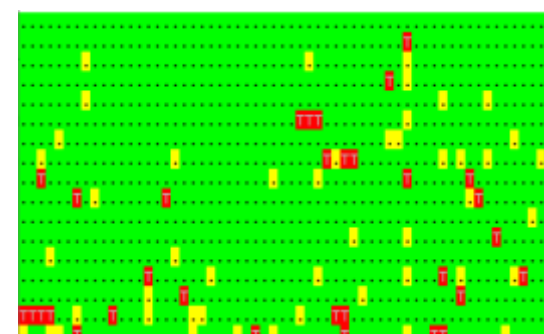
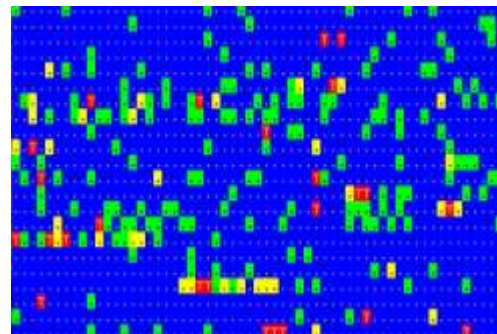
Home DSL 16/1



Hotel Frankfurt 01:00am, 07:00



MSTFGuest (Internet / Office365)



Latenzmessungen bei Providern

enterprise.verizon.com/terms/latency/



Wireless In Home Business

Solutions Products Resources Why Verizon

[Home](#) / [Terms and Conditions](#) / [Latency Statistics](#) ▾

+1-877-297-7816



Verizon Enterprise Latency Statistics (ms)												
	2019										2018	
	October	September	August	July	June	May	April	March	February	January	December	November
Trans Atlantic (90.000)	70.545	70.573	70.526	70.460	73.833	69.986	69.950	69.930	69.965	69.888	70.531	70.965
Europe (30.000)	11.901	11.452	11.459	11.194	10.978	11.706	11.234	10.592	11.099	11.478	10.954	10.070
North America (45.000)	30.526	29.767	31.340	31.396	30.927	31.352	31.531	33.523	33.782	36.083	36.084	39.243
Intra-Japan (30.000)	11.282	11.312	11.141	11.323	-	11.221	11.932	13.093	12.910	12.761	12.616	12.894
Trans Pacific (160.000)	101.320	99.414	99.400	99.399	134.714	99.336	99.320	99.238	99.237	99.242	99.240	99.250
Asia Pacific (125.000)	87.403	86.799	84.617	85.959	90.206	85.806	85.201	85.119	86.840	86.726	98.990	87.173
Latin America (140.000)	85.169	92.174	90.459	95.394	93.080	90.968	88.450	87.782	119.633	-	-	-
EMEA to Asia Pacific (250.000)	119.666	119.691	118.336	118.655	122.317	144.462	119.350	119.239	118.699	116.281	115.876	115.030

Checking HTTP

- Office 365 hat einige nette URLs für Tests
 - Anonym erreichbar
 - Kein Throttling

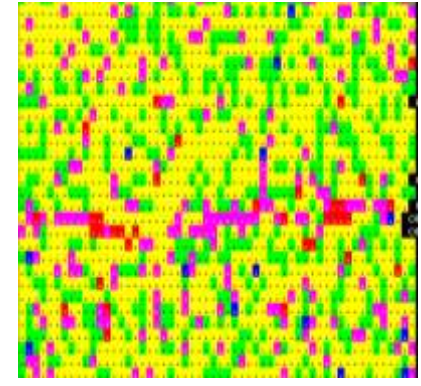
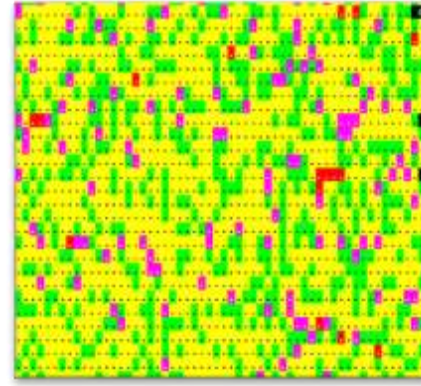
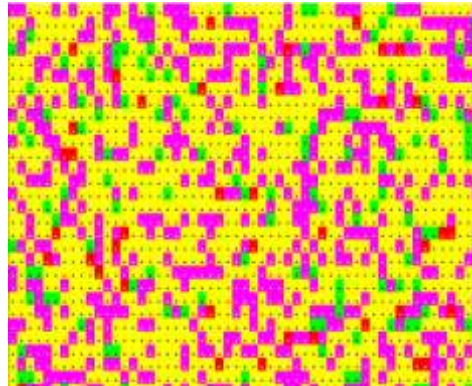
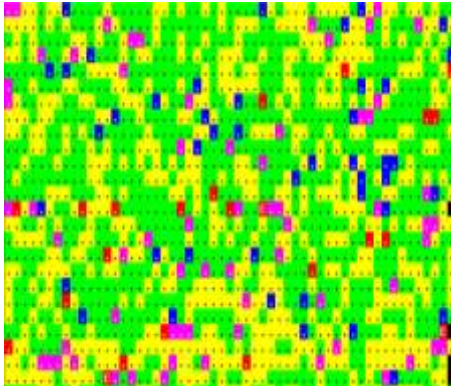
Bereich	URL	Size
Exchange	https://outlook.office365.com/owa/healthcheck.htm	50 Bytes
Exchange	https://outlook.office365.com/owa/favicon.ico	7886 Bytes
Exchange	https://outlook.office365.com/owa/smime/owasmime.msi	729088 Bytes
OneDrive	https://<tenant>-my.sharepoint.com/	193 Bytes
SharePoint	https://<tenant>.sharepoint.com/	190 Bytes
SharePoint	https://<tenant>.sharepoint.com/_layouts/15/SPAndroidAppManifest.aspx	308 Bytes
EvoSTS	https://login.microsoftonline.com/common/oauth2/authorize	138361 Bytes

- Einfach per PowerShell Invoke-WebRequest abrufbar
 - Parameter -UseBasicParsing und -MaxRedirects 0
 - Processindicator abschalten! `$ProgressPreference="SilentlyContinue"`
 - Method HEAD statt GET beschränkt die Datenmenge

End2End-http: favicon.ico

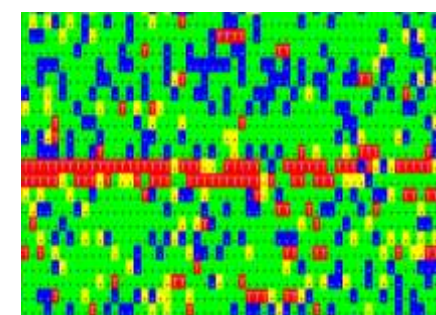
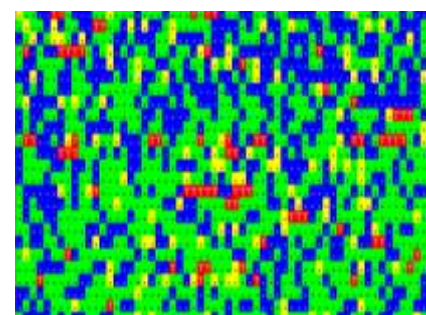
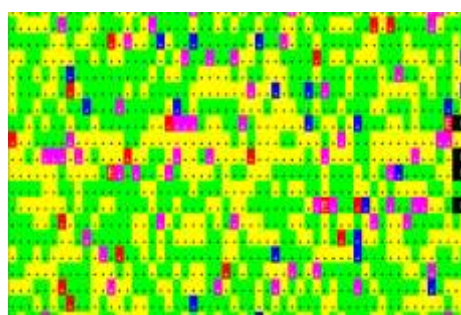
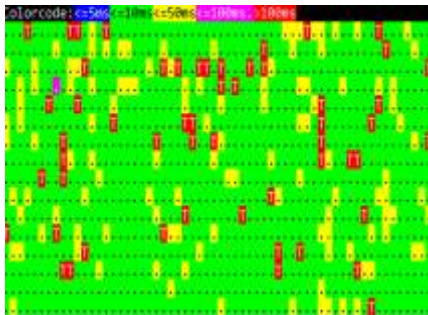
Frankfurt Hotel 01:00am/07:00am

Bellevue Hotel 01:00am / 07:00p



Vergleich zu ICMP

Vergleich zu ICMP



End2end-http mit 700k-Datei

- 700kByte in 105ms = ca. 66 Mbit !
- 700kByte in 5652 Sek = ca. 1,3 Mbit
 - 🔗 [Packetloss? Paralleler PING?](#)
- Farbcodierung von End2End-HTTP passt nicht
- Aber wollen Sie diese Dauerlast?

```
End2End-HTTP: URL = https://outlook.office365.com/owa/smime/owasmime.msi
Colorcode: <=20ms <=50ms <=100ms <=200ms >200ms
..... OK=27 Slow=9 Fail=0 MIN=153 AVG=692ms MAX=4251 X=End
..... OK=37 Slow=3 Fail=0 MIN=168 AVG=602ms MAX=5652 X=End
..... OK=42 Slow=2 Fail=0 MIN=156 AVG=354ms MAX=1388 X=End
..... OK=44 Slow=2 Fail=0 MIN=108 AVG=302ms MAX=1567 X=End
..... OK=48 Slow=1 Fail=0 MIN=123 AVG=222ms MAX=1012 X=End
..... OK=45 Slow=1 Fail=0 MIN=124 AVG=302ms MAX=1131 X=End
..... OK=42 Slow=2 Fail=0 MIN=105 AVG=346ms MAX=2217 X=End
..... OK=43 Slow=2 Fail=0 MIN=116 AVG=329ms MAX=1717 X=End
..... OK=46 Slow=0 Fail=0 MIN=131 AVG=278ms MAX=995 X=End
..... OK=35 Slow=5 Fail=1 MIN=150 AVG=405ms MAX=1053 X=End
```



End2End-EWS Fiddler

Progress Telerik Fiddler Web Debugger

File Edit Rules Tools View Help Exchange Online (Disabled)

#	Overall_Ela...	Result	Prot...	Host	URL
1	0:00:00.262	200	HTTPS	www.fiddler2.com	/UpdateCheck.aspx?isBet...
3	0:00:01.098	200	HTTPS	dc.services.visualstudi...	/v2/track
5	0:00:00.766	404	HTTPS	netatwork.de	/autodiscover/autodiscov...
7	0:00:00.242	401	HTTPS	autodiscover.netatwor...	/autodiscover/autodiscov...
9	0:00:00.210	401	HTTPS	autodiscover.netatwor...	/autodiscover/autodiscov...
10	0:00:00.293	200	HTTPS	autodiscover.netatwor...	/autodiscover/autodiscov...
14	0:00:40.088	200	HTTPS	eastus2.notifications.t...	/users/8:orgid:0d63cd34-...
15	0:00:00.016	302	HTTP	autodiscover.netatwor...	/autodiscover/autodiscov...
17	0:00:00.010	401	HTTPS	autodiscover-s.outlook...	/autodiscover/autodiscov...
18	0:00:01.807	200	HTTPS	autodiscover-s.outlook...	/autodiscover/autodiscov...
20	0:00:00.023	401	HTTPS	outlook.office365.com	/EWS/Exchange.asmx
21	0:00:00.423	200	HTTPS	outlook.office365.com	/EWS/Exchange.asmx
22	0:00:00.091	401	HTTPS	outlook.office365.com	/EWS/Exchange.asmx
23	0:00:00.201	200	HTTPS	outlook.office365.com	/EWS/Exchange.asmx
24	0:00:00.009	401	HTTPS	outlook.office365.com	/EWS/Exchange.asmx
25	0:00:00.199	200	HTTPS	outlook.office365.com	/EWS/Exchange.asmx
26	0:00:00.061	401	HTTPS	outlook.office365.com	/EWS/Exchange.asmx
27	0:00:00.201	200	HTTPS	outlook.office365.com	/EWS/Exchange.asmx
29	0:00:00.094	401	HTTPS	outlook.office365.com	/EWS/Exchange.asmx
30	0:00:00.197	200	HTTPS	outlook.office365.com	/EWS/Exchange.asmx

Response Headers

HTTP/1.1 200 OK

Cache

Cache-Control: private
Date: Mon, 18 Mar 2019 12:22:08 GMT
Vary: Accept-Encoding

Cookies / Login

Set-Cookie: exchangeproxycookie=ff2d2bfb560141d3a294a087ecc2b87e; path=/

Entity

Content-Length: 3547
Content-Type: text/xml; charset=utf-8

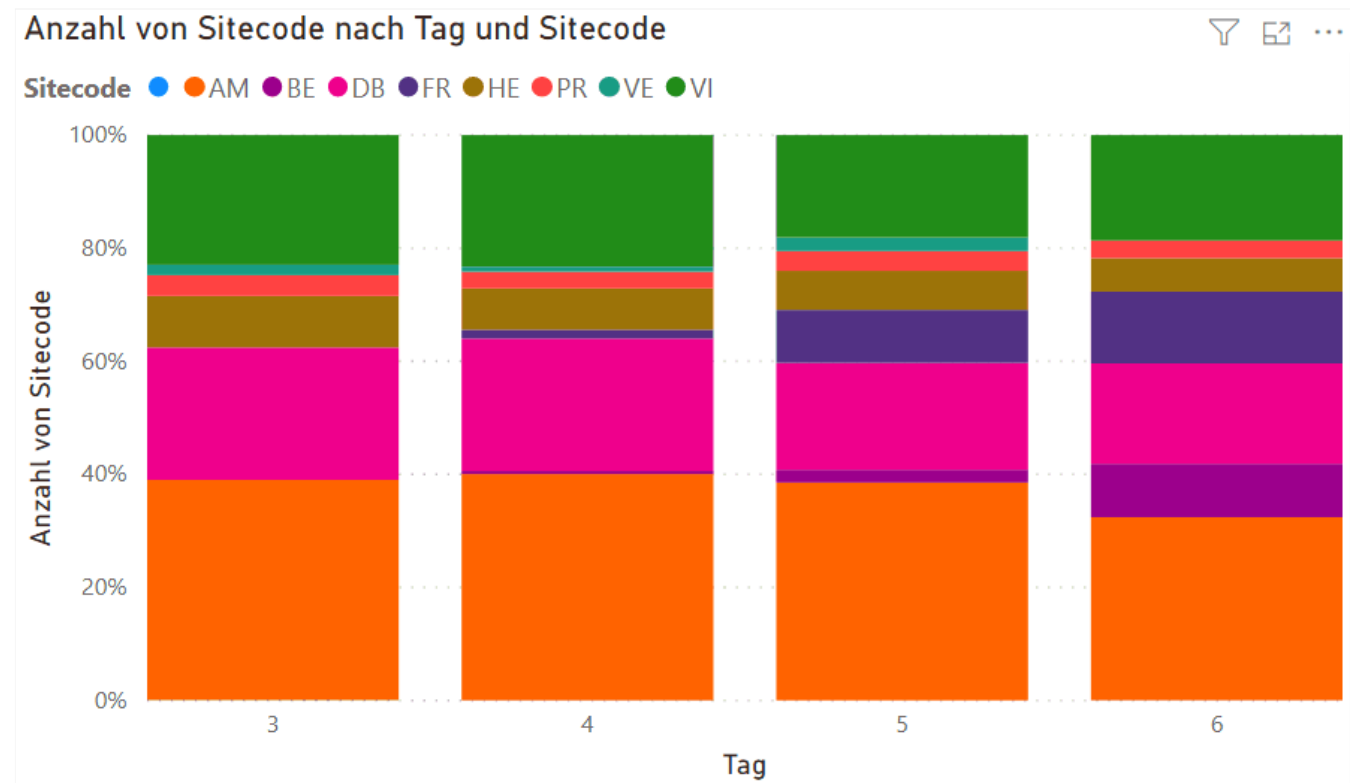
Miscellaneous

request-id: ab475c60-41d4-44d5-bd68-38c8804ba5e0
Server: Microsoft-IIS/10.0
X-AspNet-Version: 4.0.30319
X-BackendHttpStatus: 200
X-BackendHttpStatus: 200
X-BEServer: AM6PR04MB5013
X-BeSkU: WCS5
X-CalculatedBETarget: AM6PR04MB5013.eurprd04.prod.outlook.com
X-CalculatedFETarget: AM6PR0402CU001.internal.outlook.com
X-DiagInfo: AM6PR04MB5013
x-EwsHandler: FindItem
X-FEProxyInfo: AM6PR0402CA0034.EURPRD04.PROD.OUTLOOK.COM
X-FEServer: AM6PR0402CA0034
X-FEServer: MWHPR2201CA0074
X-Powered-By: ASP.NET
X-RUM-Validated: 1



Standortcode über Zeiten

- Ein Client mit End2End-HTTP
- Verschiedene Frontend Sites
- Frankfurt/Berlin geht online
3. Dez 2019 – 6. Dez 2019



SharePoint Online

- Protokoll: HTTPS
- URL
 - ❓ <tenantname>.sharepoint.com
 - ❓ <tenantname>-my.sharepoint.com
- End2EndHTTP
 - ❓ Messung nur bis FrontEnd-Server
 - ❓ Aber „interne Verarbeitung“ sichtbar
- <https://www.msxfaq.de/tools/end2end/end2end-sharepoint.htm>
- (Invoke-WebRequest https://<tenant>.sharepoint.com/_layouts/15/SPAndroidAppManifest.aspx).headers

```

GET https://msxfaq.sharepoint.com/_layouts/15/SPAndroidAppManifest.aspx HTTP/1.1
User-Agent: Mozilla/5.0 (Windows NT; Windows NT 10.0; de-DE)
WindowsPowerShell/5.1.18362.145
Host: msxfaq.sharepoint.com

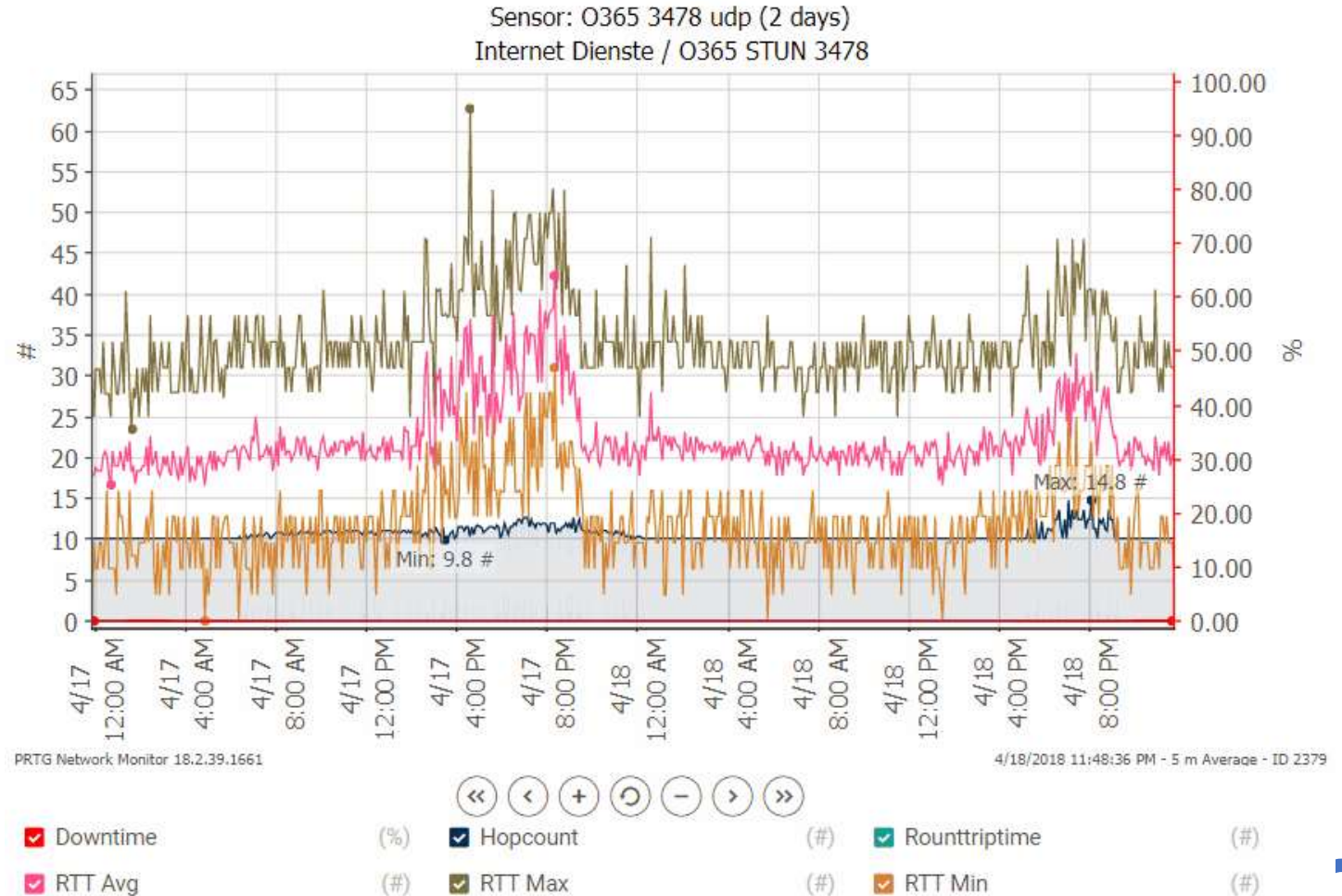
Response Headers
HTTP/1.1 200 OK

Cache
Cookies / Login
Entity
Miscellaneous
  MicrosoftSharePointTeamServices: 16.0.0.19520
  MS-CV: nyKrwC5AAJC/RLp6XAYIcA.0
  request.id: c0ab229f-402e-9000-bf44-ba7a5c062570
  SPisLatency: 1
  SPRequestDuration: 112
  SPRequestGuid: c0ab229f-402e-9000-bf44-ba7a5c062570
  X-AspNet-Version: 4.0.30319
  X-MS-Edge-Ref: Ref A: 187B1EDD2CCC4878B08FB6A7ED922BD5 Ref B: AM3EDGE0412 Ref C: 2019-12-18T10:30:32Z
  X-MS-InvokeApp: 1; RequireReadOnly
  X-Powered-By: ASP.NET
  X-SharePointHealthScore: 7
  
```



Beispiel: End2End-UDP3478

- PowerShell
 - ❓ 50 UDP-Pakete pro Sekunde
 - ❓ 160 Bytes = 1 VoIP Call
 - ❓ Gegenstelle: TURN-Server
 - ❓ Misst RTT und Hopcount
- Entfernung (grau)
 - ❓ 10 Hops Baseline
 - ❓ 03:00pm-11am
 - ❓ RTT higher
- RTT Min/Avg/Max
 - ❓ Still <100ms



Client Telemetry



End2End vom Anwender



- Client 1
 - ICMP + UDP + HTTP
- Client 1-3
 - Homeoffice mit VPN
 - Office
 - Homeoffice (Rot)
- Client UDP



Zusammenfassung

- 1 GB WAN ist nicht 1 GB LAN
- Latenzzeit ist der Schlüssel
- Korrekte und dennoch sichere Konfiguration
- Monitoring gehört an den Anfang der Pilotierung und endet nie



Feedback



<https://forms.office.com/r/W6VFDx7cdr>

[Feedback.spscgn.com](https://forms.office.com/r/W6VFDx7cdr)

Sponsor 2021



End

