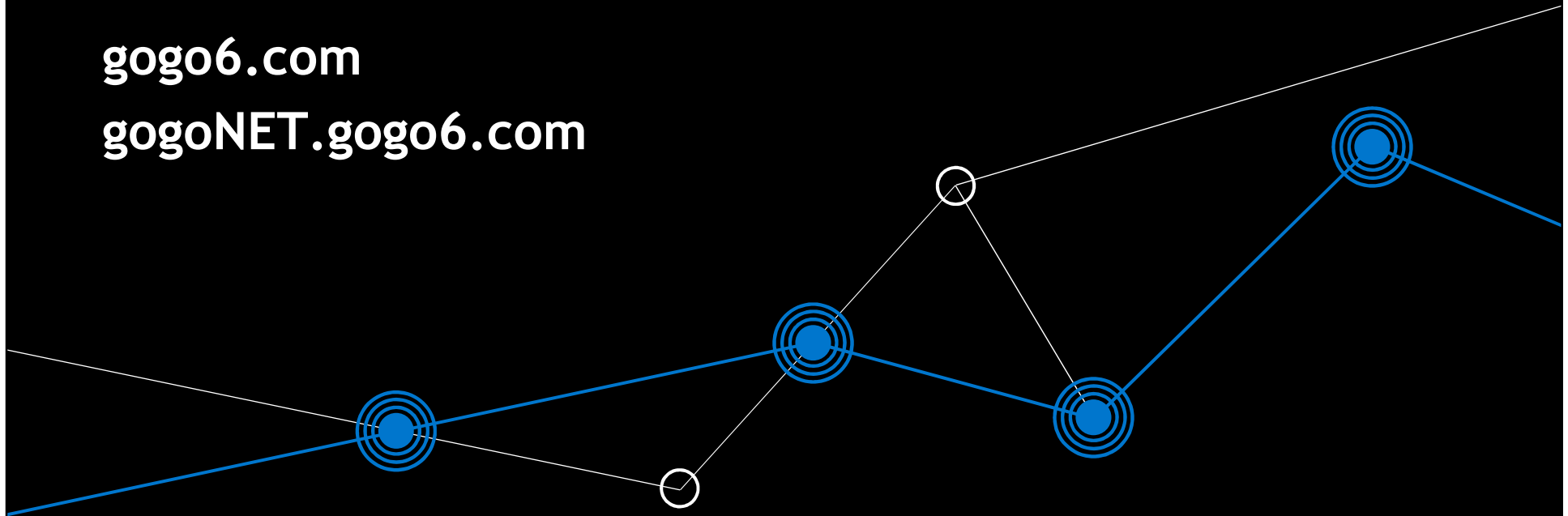


IPv6 Solutions for Trials and Beyond

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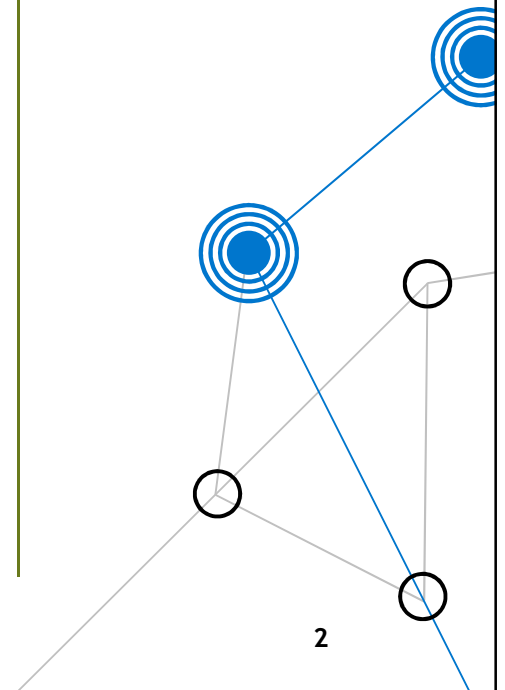
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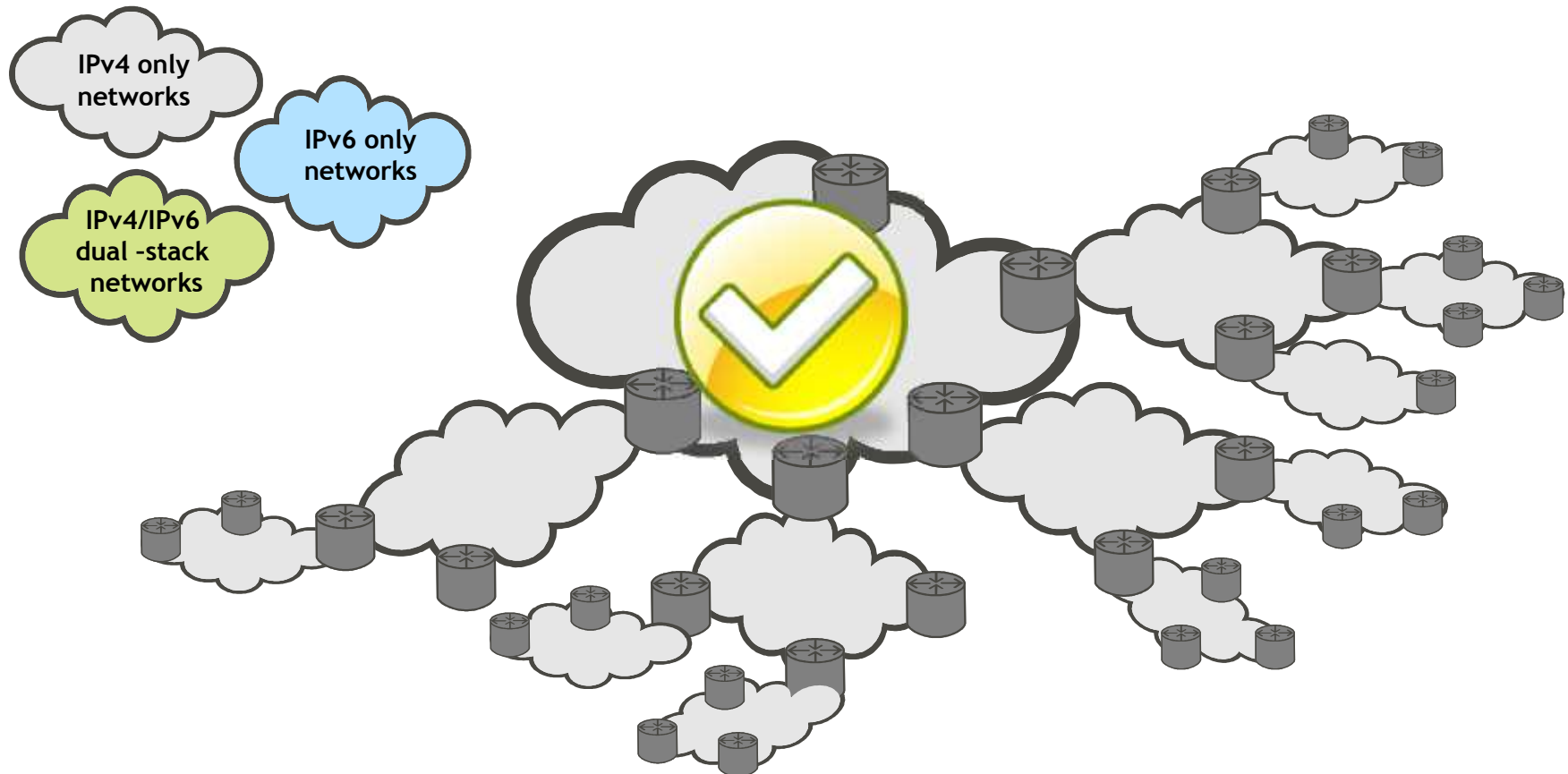
gogo6 deployment

The road to IPv6





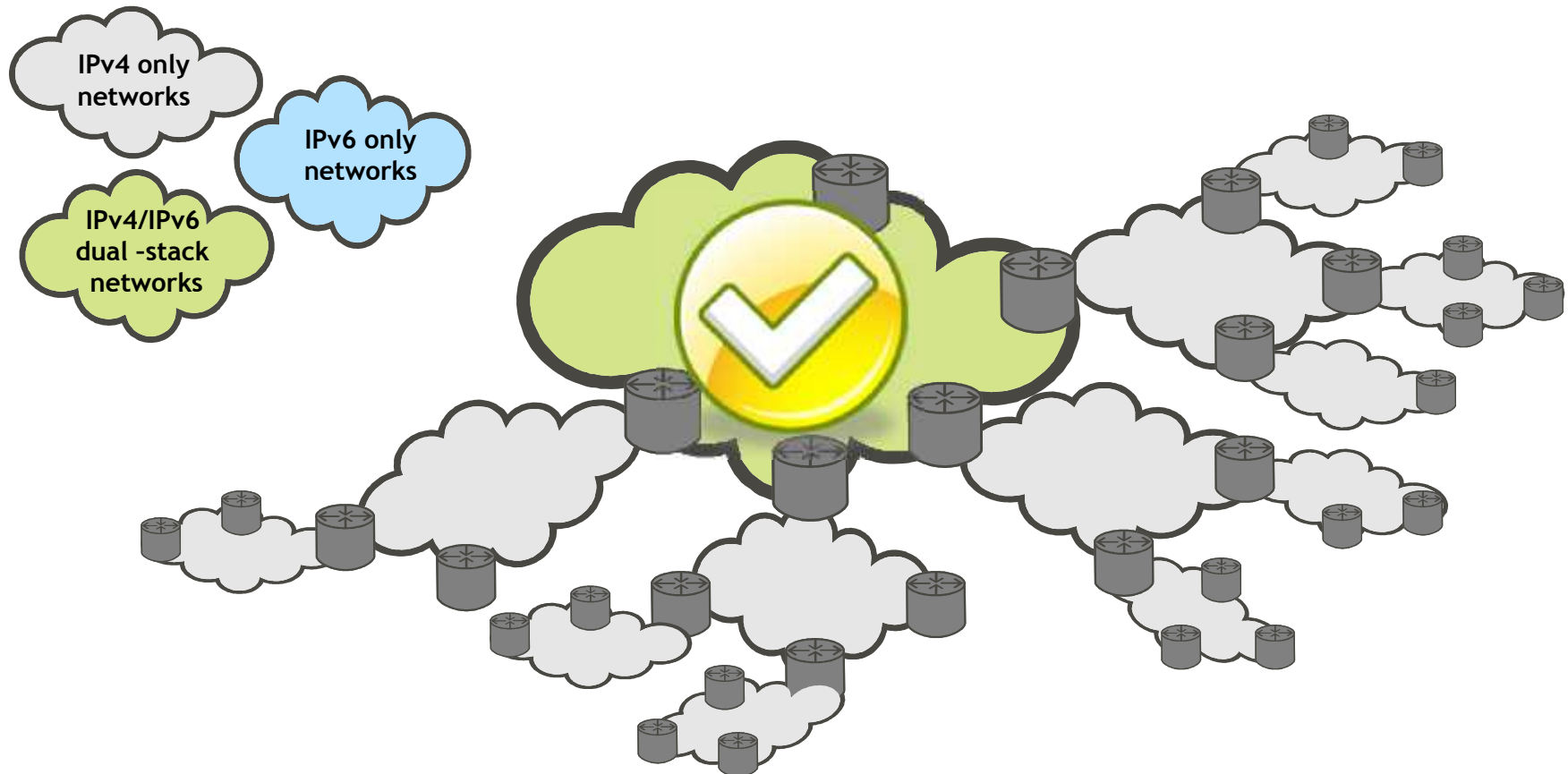
Phase 0 : All IPv4

-  v6 in v4 tunnels (TSP or 6RD)
-  v4 in v6 tunnels (DSTM or DS-lite)



Phase 1 : Build Dual Stack Core Networks

-  v6 in v4 tunnels (TSP or 6RD)
-  v4 in v6 tunnels (DSTM or DS-lite)





Phase 2 - IPv6 tunnels for trials and targeted customers

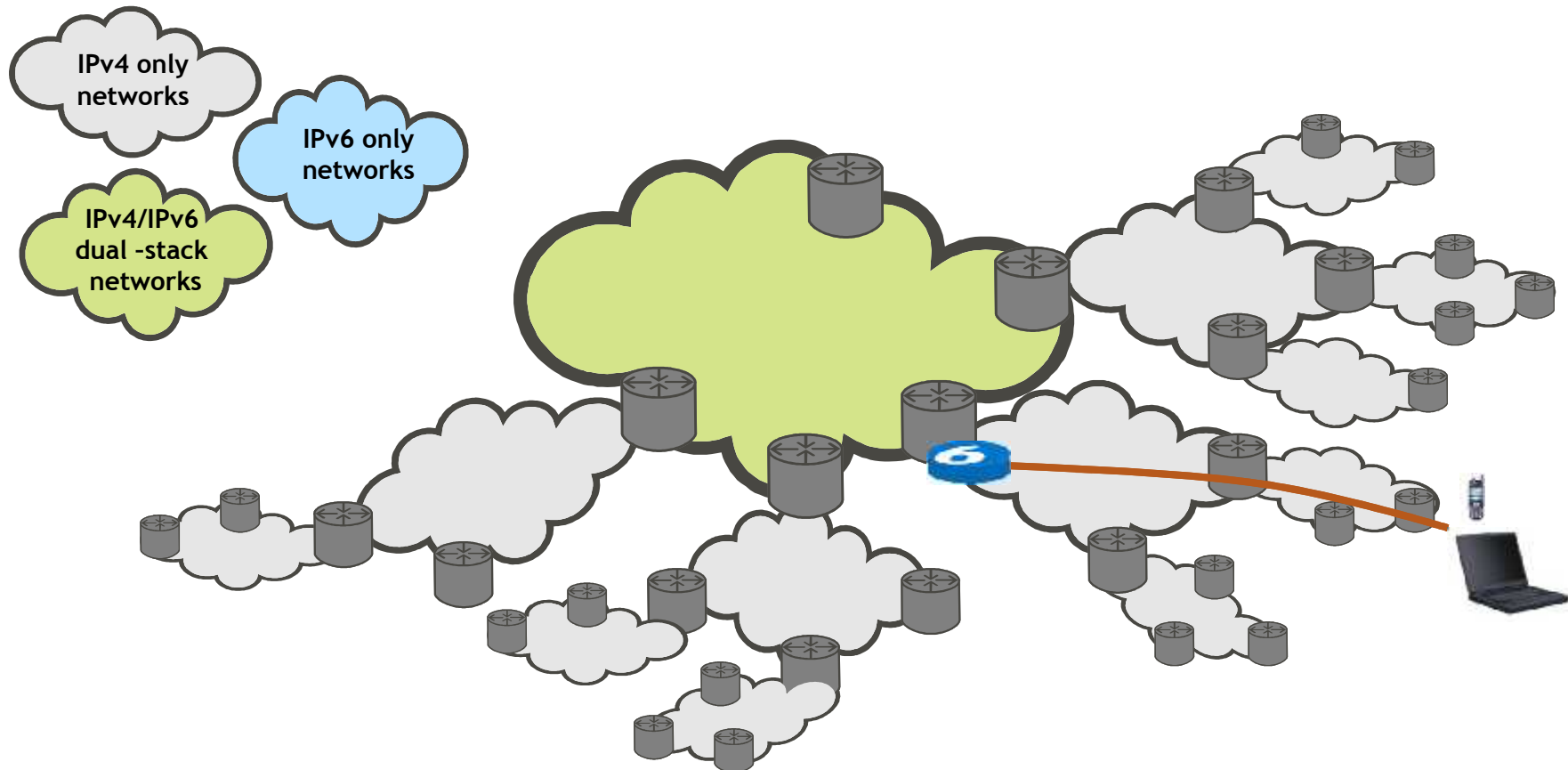
IPv6 over IPv4 tunneling is the first step to reach the end users

This is usually done as part of a limited trial which can later evolve into IPv6 deployment as a service offering

- IPv6 trials are an important part of building experience on operating IPv6 networks
- Need to ensure management equipment is IPv6 ready and that staff are IPv6 trained and knows how to manage the new technology

Phase 2 - IPv6 tunnels for trials and targeted customers *(phase1 building dual stack core)*

-  v6 in v4 tunnels (TSP or 6RD)
-  v4 in v6 tunnels (DSTM or DS-lite)



Phase 3 - After address exhaustion - IPv6-only Networks for IPv4 continuity

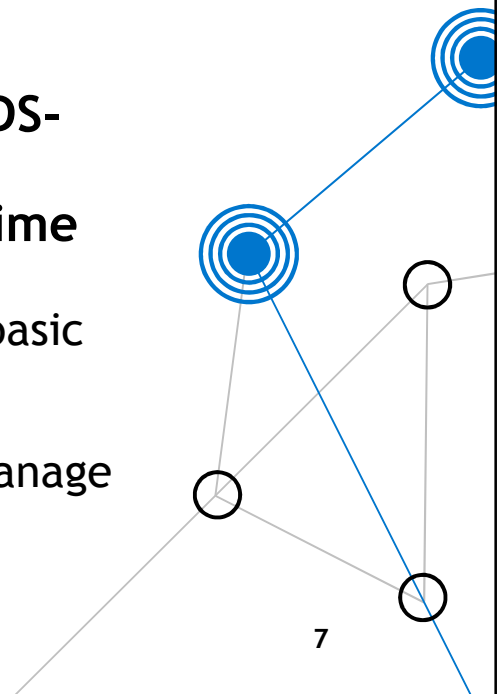
In order to add new customers when the IPv4 shortage becomes imminent, IPv6 only access networks become the most obvious choice

- The end user expects the operator to provide IPv4 support
- The service will appear to be IPv4 and IPv6 to the end user and all legacy applications will work while the operator significantly reduces the IPv4 usage and gets a network that is ready for the future
- No need to manage large private networks
- Access equipment only has to be IPv6

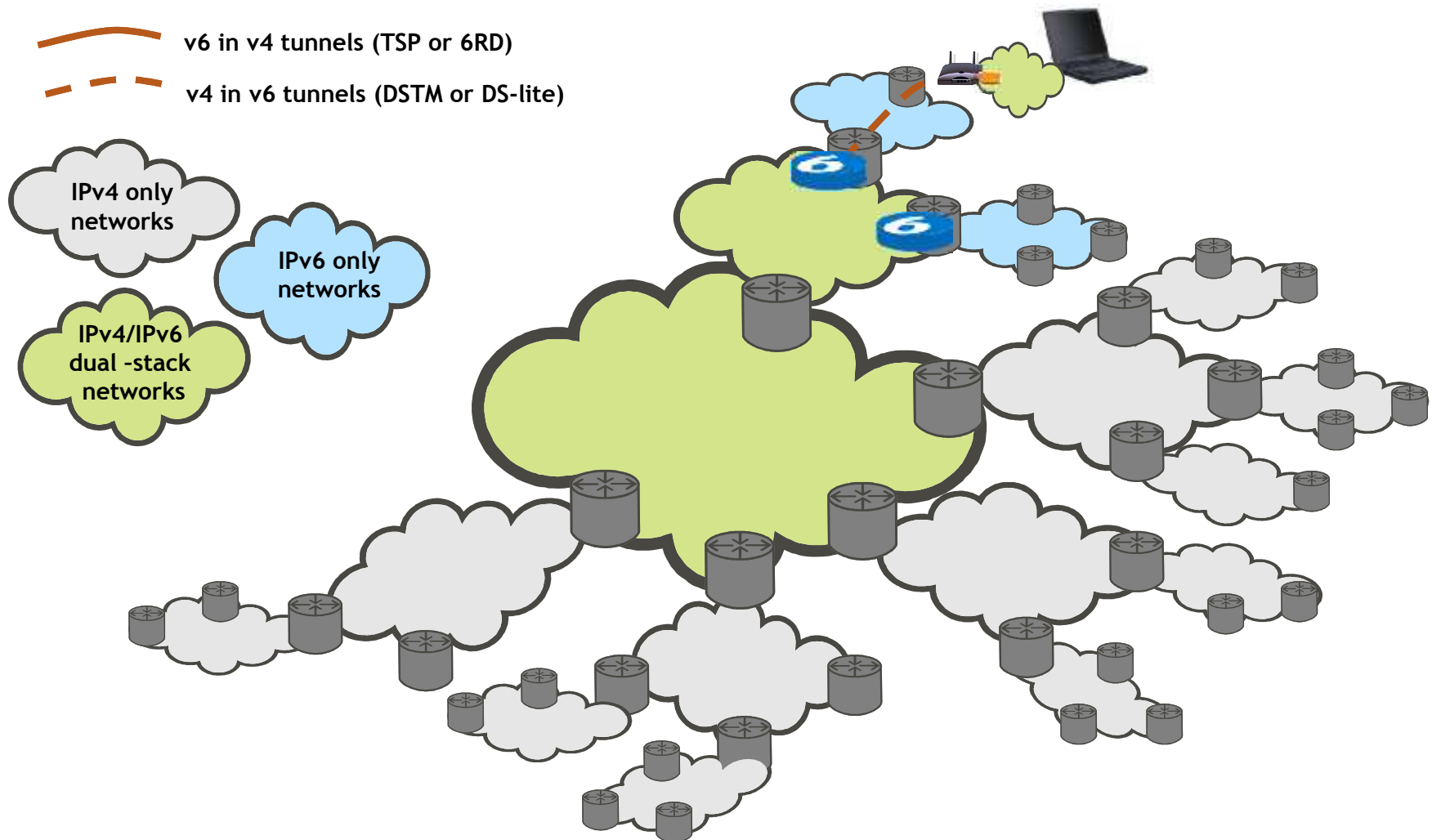
Can be done using IPv4 tunneling with either DSTM or DS-lite

This will be the dominant network solution for a long time to come

- Traffic volumes on IPv4 will diminish over time but the basic architecture will remain the same
- Distributed servers are required to provided good performance initially but over time fewer servers can manage more and more users as traffic volumes go down



Phase 3 - After address exhaustion - IPv6-only Networks for IPv4 continuity

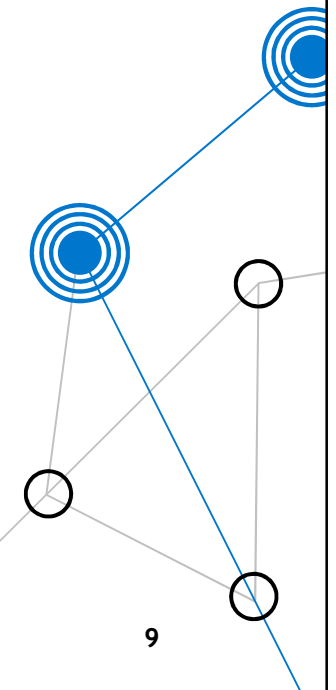


Phase 4 - Provide IPv6 connectivity to existing customers

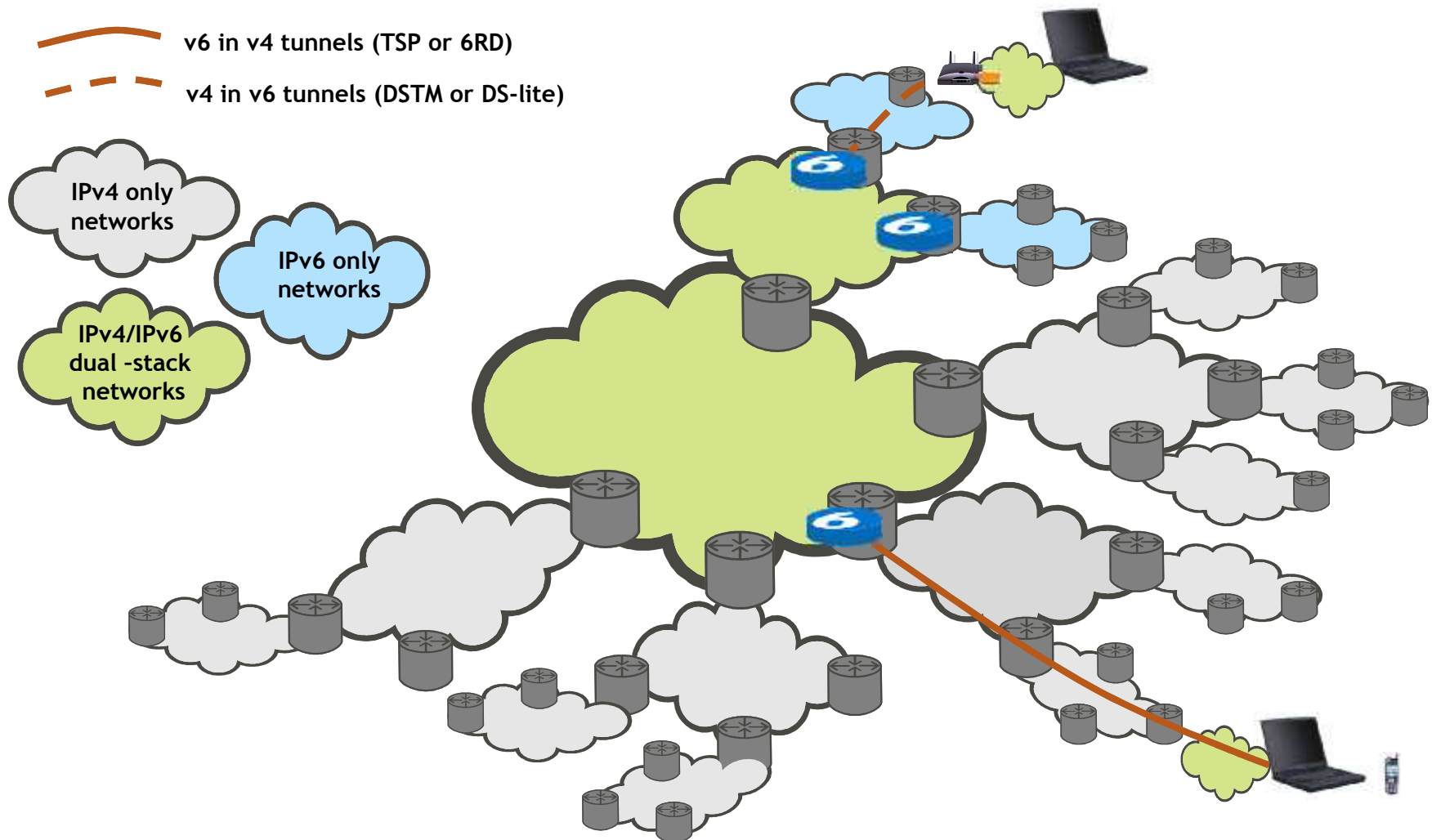
When IPv6 becomes more wide spread IPv6 support is added to existing networks

In most cases this means adding IPv6 using a tunneling solution like TSP or 6RD

- Upgrading of access equipment is many times not possible and if needs replacement it would be more likely it would be done as an IPv6 only network as in Phase 3 in order to simplify the network
- For layer 2 access networks upgrading to dual stack might be an option as fewer devices might be involved, the only real issue in this scenario is the customer equipment



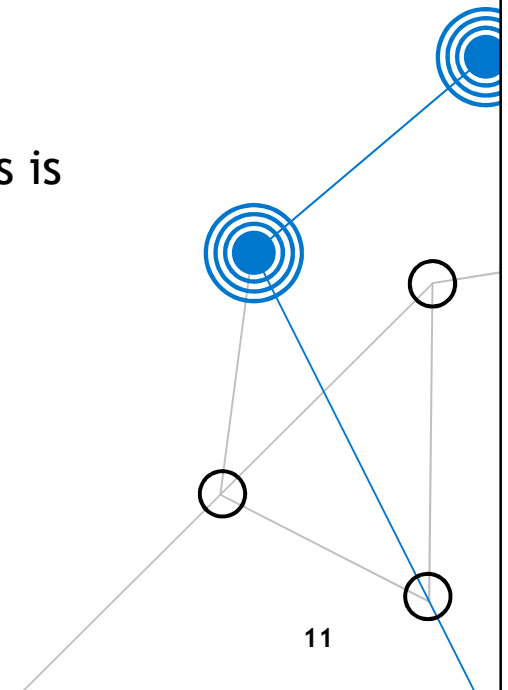
Phase 4 - Provide IPv6 connectivity to existing customers



Phase 5 - Expanding IPv6 throughout the network

The final phase of deployment is a network with IPv6 support throughout

- More and more networks will be IPv6 only as more customers are added or upgraded
 - As the network goes through equipment refresh cycles network segments will be moved to IPv6 only design in order to reuse IPv4 address in the best possible way and to get a homogenous network architecture
- Old networks have all had IPv6 support added on top
- Some networks where possible will be dual stack, this is likely going to include a majority of the enterprise connections



Traffic changes over time

Many users with little traffic in early IPv6 deployment

- Percentage of traffic on IPv6 will be small as content is limited in comparison to IPv4

Lots of traffic in IPv4 over IPv6 in early stage requiring servers close to the edge for optimal traffic flow

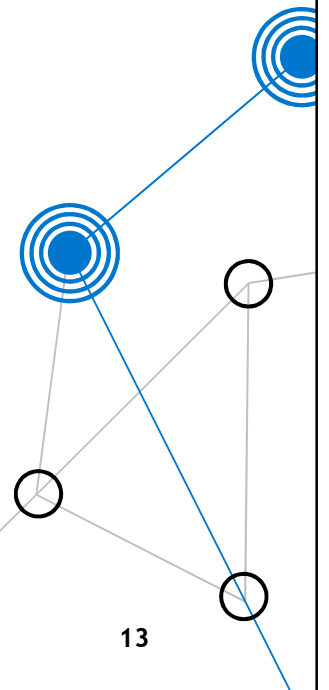
- Most users will use only IPv4 in the initial stage of a IPv6 with IPv4 tunneled on top as most applications are IPv4 only

Lots of traffic in IPv6 at later stage requiring servers at the edge for optimal traffic flow

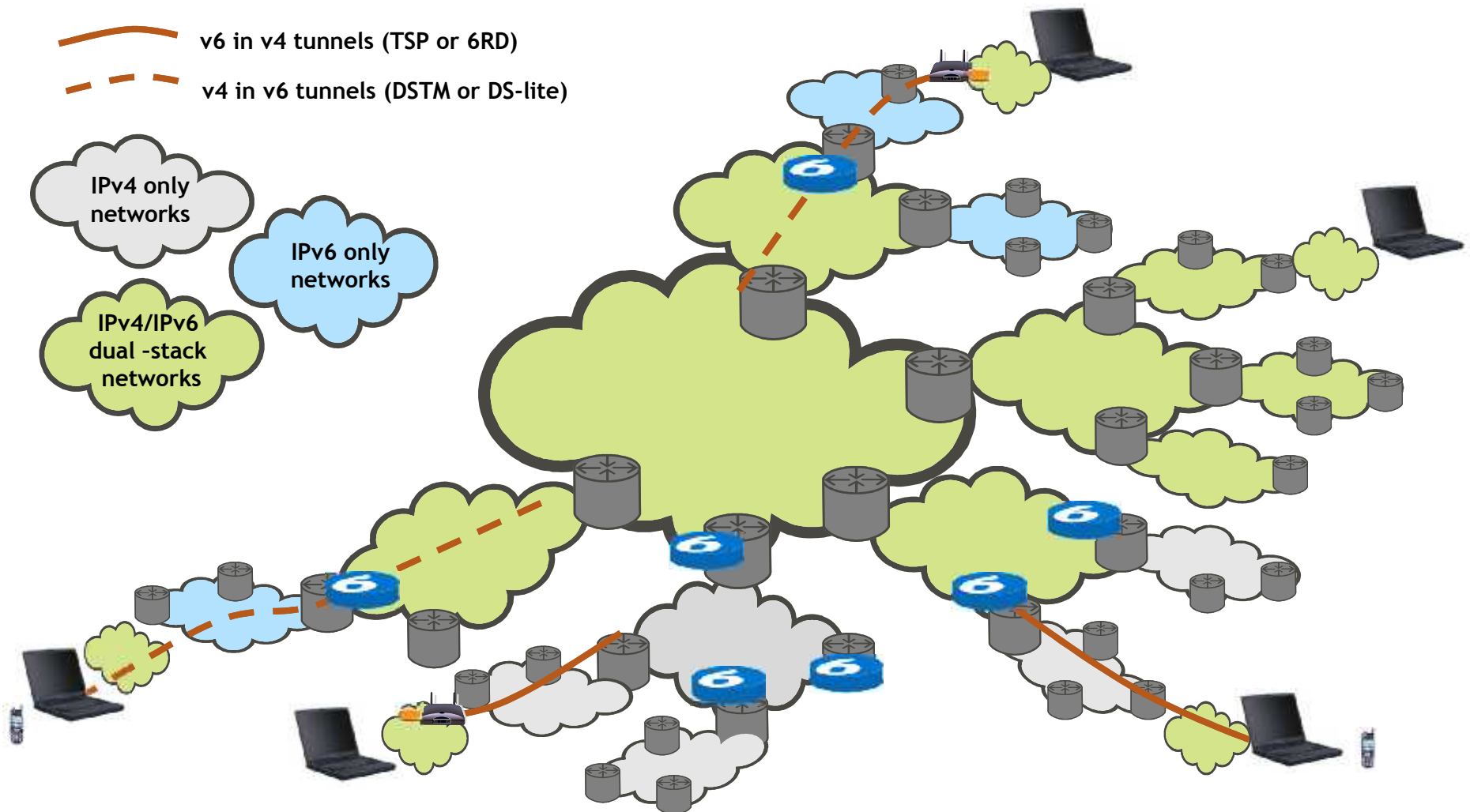
- When IPv6 becomes mature traffic volumes on IPv6 will grow significantly as it takes over most of the IPv4 traffic

Little traffic and lots users of v4 in v6 in later stages

- Most user will be stuck with some applications that are only IPv4 and will need some sort IPv4 connectivity even if the traffic volume will be small

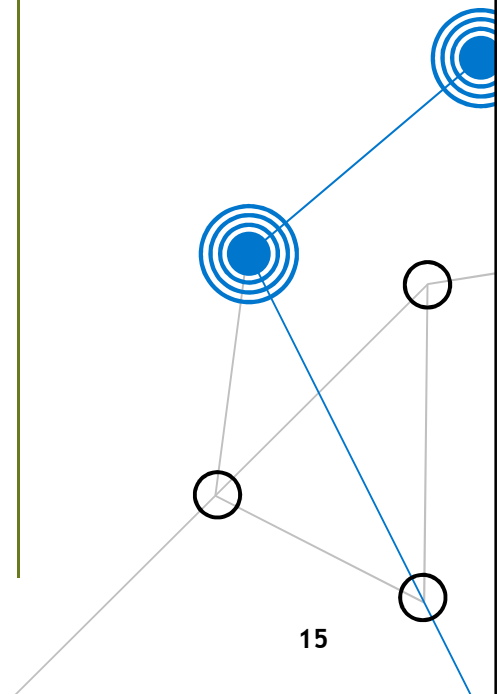


Traffic Evolution Changes the Network




Part 2

The products to get you to IPv6



Company Overview

100% Focus on IPv6

 IPv6 products, community and services

 **WARE**
Hardware and software for network operators to go v6

 **NET**
Social network and services for professionals to go v6

 **SERVER**

 **CPE**

 **CLIENT**



gogoWARE Overview

IPv6 industry's only *end-to-end* solution

gogoSERVER

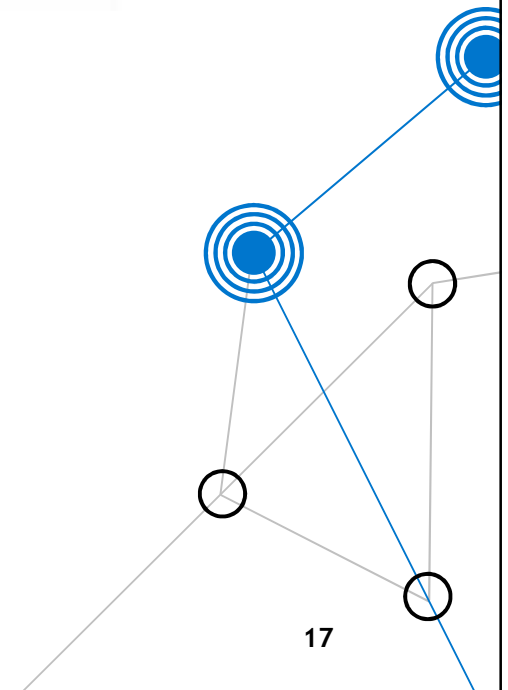
- Provide interoperability between IPv6 & IPv4 networks

gogoCPE

- Plug 'n' play hardware client

gogoCLIENT

- Open source software client



Mix of protocols for better flexibility

DS-lite, TSP, DSTM, 6RD

★ gogoSERVER tunnel endpoints:



gogoCPE plugged into home network



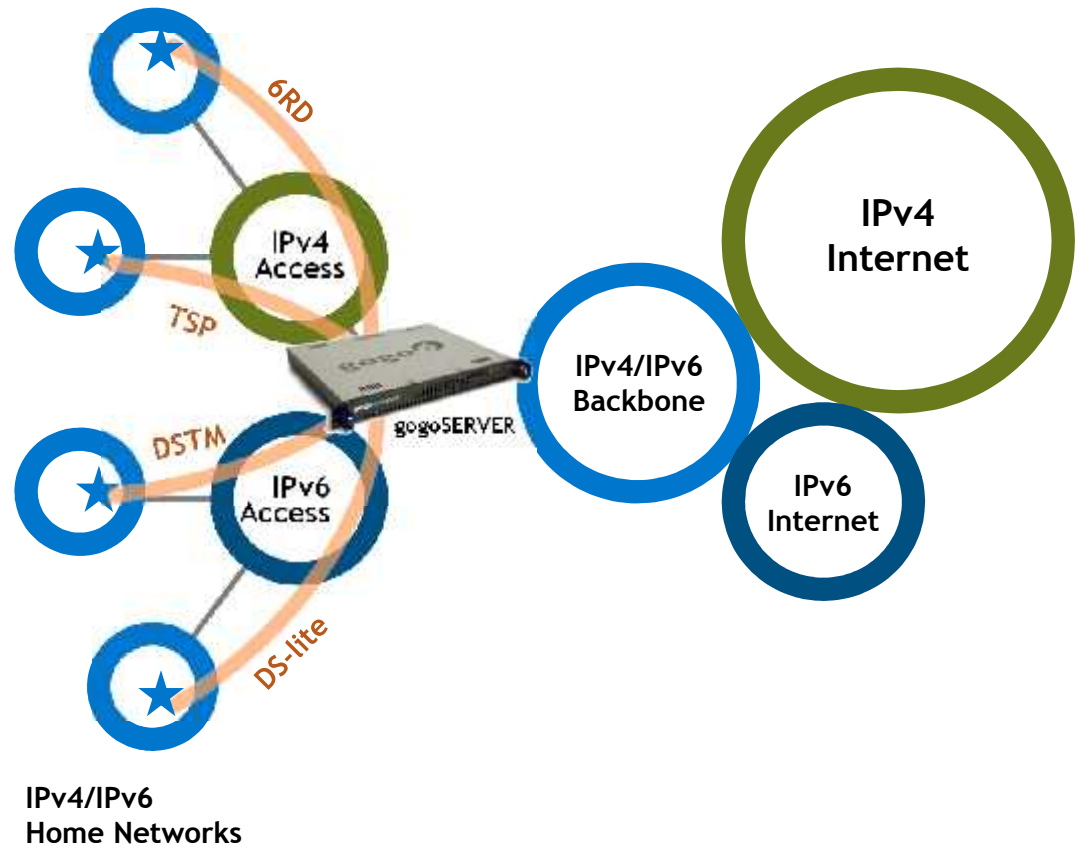
gogoCLIENT ported to modem/router



gogoCLIENT installed on home computer



gogoCLIENT installed on mobile device (currently not available)



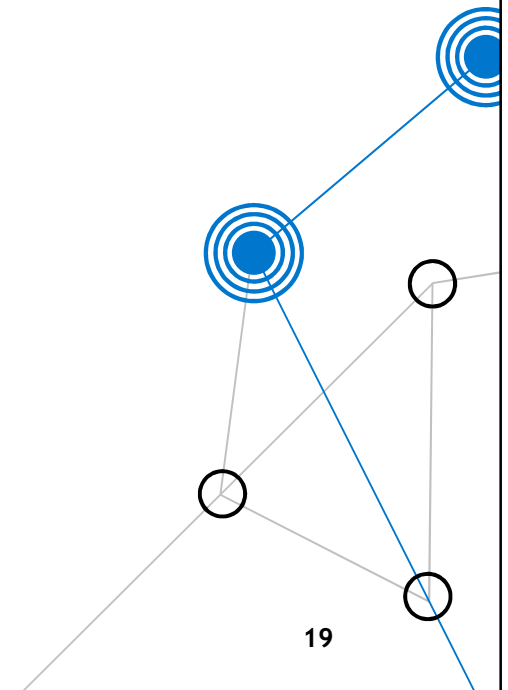
Protocols From a Deployment Perspective

IPv6 support in existing IPv4 networks

- TSP
 - + Works in all scenarios
 - All v6 traffic has to go through a server
- 6RD
 - + Local traffic can be peer to peer
 - Complicated to deploy (requires public IPv4 address)

IPv4 support in new IPv6 networks

- DSTM
 - + Possible to manage customers and assign addresses
 - Tunnel setup required
- DS-lite
 - + No tunnel setup required
 - Limited addresses options



gogoSERVER

1U tunnel broker server

2 x 1GbE interfaces

Supports both 6in4 and 4 in6 tunneling in one system

Protocol options: TSP, DS-lite, DSTM, 6RD

Up to 50,000 tunnels

IPv4 ->IPv6 & IPv6 ->IPv4 HTTP proxy

Internal user database or RADIUS support

Both internal and external logging options

IPv6 permanent (or temporary) addresses

Full NAT traversal for TSP

Node and network mobility with static addressing

IPv4 and IPv6 prefix delegation

Automatically update DNS information

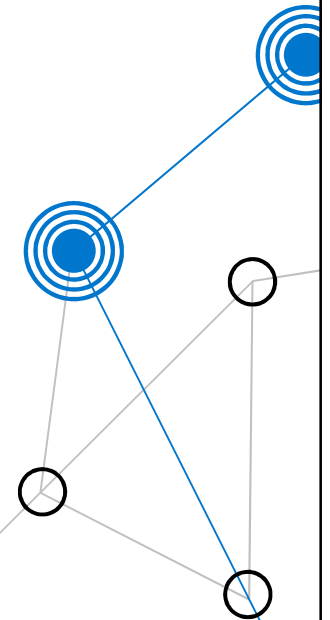
Monitoring



gogoSERVER Deployment

Moderate capacity (2x1Gb/s) but highly scalable in number of users to fit predicted growth profile

- Many users with little traffic in early IPv6 deployment
 - Percentage of traffic on IPv6 will be small as content is limited in comparison to IPv4
- Lots of traffic in IPv4 over IPv6 in early stage requiring servers close to the edge for optimal traffic flow
 - Most users will use only IPv4 in the initial stage of a IPv6 with IPv4 tunneled on top as most applications are IPv4 only
- Lots of traffic in IPv6 at later stage requiring servers at the edge for optimal traffic flow
 - When IPv6 becomes mature traffic volumes on IPv6 will grow significantly as it takes over most of the IPv4 traffic
- Little traffic and lots users of v4 in v6 in later stages
 - Most user will be stuck with some applications that are only IPv4 and will need some sort IPv4 connectivity even if the traffic volume will be small



gogoCPE

Plug 'n' play v6 adapter that eliminates client software
Provisions IPv6 or IPv4 to the home network
Cost effective and can be installed by user
Supports: DS-lite, 6RD, TSP, DSTM, L2TP



TSP, L2TP



DS-lite, DSTM



6RD

gogoCPE IPv6



Used to deploy IPv6 in existing networks

- When the existing home router isn't easily upgradeable by the operator

Plug and Play - No change to the network needed

- Connect to existing home router and only takes care of IPv6 traffic
- Tunnel through the NAT of the home router

TSP or L2TP versions available



6RD version to provide IPv6 in special scenarios where a device can't be upgraded

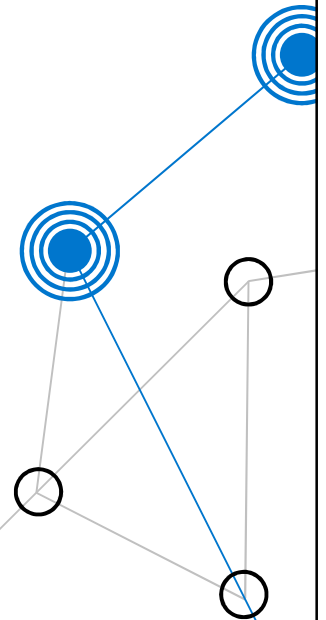
gogoCPE IPv4



Used to deploy IPv6 only access networks where there are legacy users

- A compliment to a new home router to make the migration as smooth as possible
- Allows user to keep the network as is

Can be used to provide IPv4 support to legacy devices in an enterprise/campus environment



gogoCLIENT

Small footprint - uses v6 resources already in OS

Source code and OPENWRT port available

Supports TSP, DSTM and DS-lite

Deployed in two ways:

1. Software downloaded to computer
 - Is available on Windows 7, 2000, Server 2003, XP, Linux, FreeBSD, OpenBSD, NetBSD, Solaris, OS X, VxWorks
2. Ported to various devices and handsets



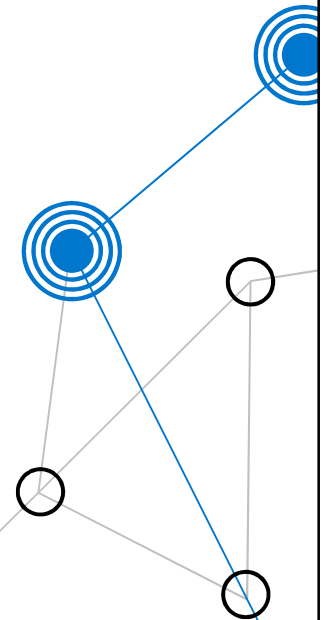
Summary

Address shortage will drive a move to IPv6 only networks

Multiple technologies exist and different ones will fit different use cases

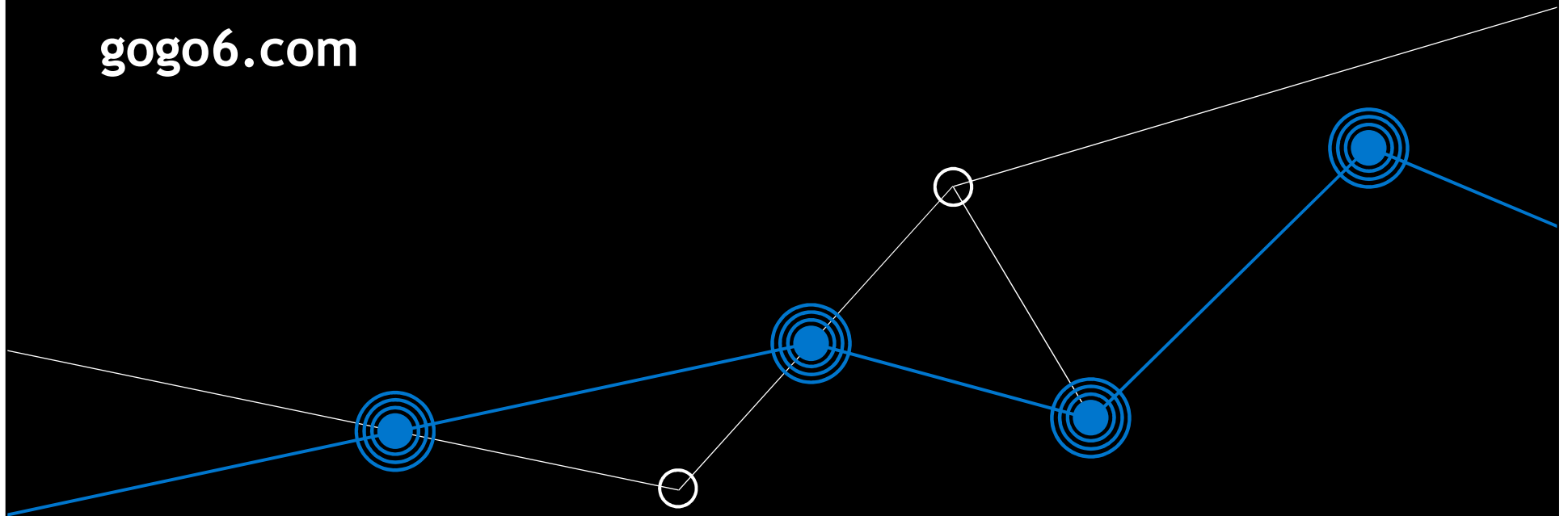
IPv4 will be majority of the traffic volume initially, even if IPv6 is deployed

IPv6 will slowly become the dominating but IPv4 support will have to remain for a long time to support customers legacy devices and applications



Thank you.

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November 2011