An IPv4 End of Life Plan
A Shared Vision for IPv6

from IETF IntArea with
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Why Has the Transition to IPv6 Been Soooo Slow?

Is it the Vendors?

Is it Lazy Operators, as the IPv6 Idealists Complain?

Is it Lack of Content?

Is it That Applications do not Support IPv6?

Is it CPE?

Is it the End User Host Stack?

Is it Because There Are Only 430 Transition Mechanisms?

Transition Depended on All of Those at the Same Time!

a Recipe for Failure

But There is One Much Larger Problem

IPv6 is On the Wire INCOMPATIBLE with IPv4

And it had a New Business Model (remember TLA/NLA) and No Feature Parity with IPv4

It Was Not Transition, It Was a Leap!

How Did This Happen?

Arrogance & Operational Cluelessness in the IETF

IPv6 is Incompatible With IPv4 and There Was No Realistic Transition Plan!

But it is Too Late
We Have No Alternative

We are
Out of IPv4 Space

The IPv4 Internet Was a Simple Place Where Packets Flowed Freely Between Us

But We Can Easily Destroy the Environment in the Next Year or Two


128 bits
CGN
32 bits

There is One Serious Problem With CGNs

We are the Salmon

and When They Say "Service Continuity" What They Mean is They are NOT Transitioning to IPv6

IPv4 Life Support

And They are Not Going to Remove the Grand Coulee Dam

And Carriers are Not Going to Remove the Multi-Million Dollar NATs

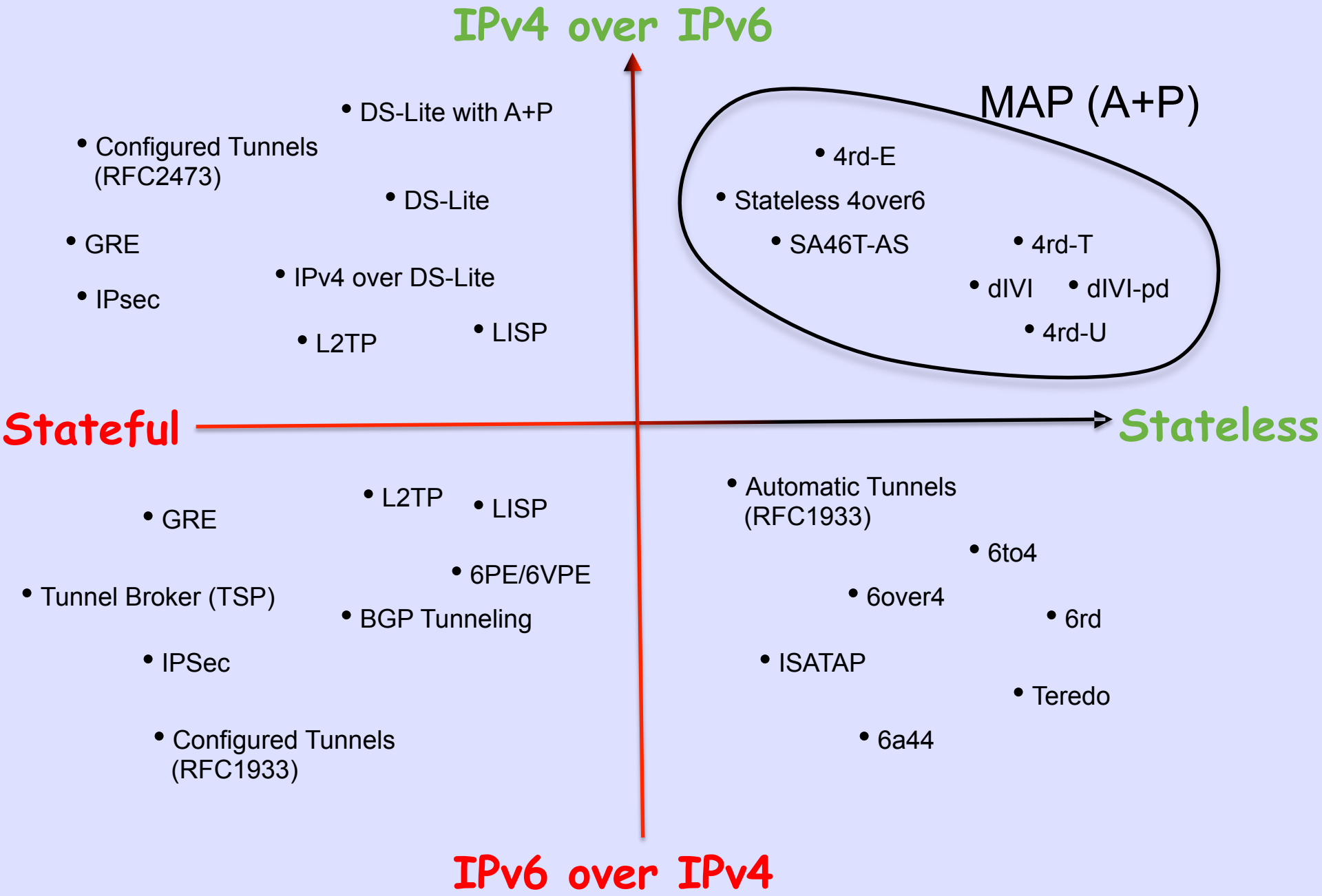
End to End and the Principle of the Stupid Core and Smart Edge

Smart Edge & Stupid Core

- Traditional Voice has stupid edge devices, phone instruments, and a very smart expensive core
- The Internet has a smart edge, computers with operating systems, applications, …, and a simple stupid core, which just does packet forwarding
- Adding an entirely new Internet service is just a matter of distributing an application to a few consenting desktops (until NATs)
- Compare that to adding a service to Voice

Think About a World Where You Can Not Deploy New Protocols (e.g. Skype) Without AT&T's Lawyers' Approval

But On-the-Wire Incompatibility of IPv4 and IPv6, Transition Leaves No Choice but Translation and/or Encapsulation


IPv4 over IPv6
MAP (A+P)
4rd-E
Stateless 4over6
SA46T-AS
4rd-T
dIVI
dIVI-pd
4rd-U
DS-Lite with A+P
Configured Tunnels (RFC2473)
DS-Lite
GRE
IPv4 over DS-Lite
IPsec
L2TP
LISP
Stateful
Stateless
L2TP
LISP
GRE
6PE/6VPE
Tunnel Broker (TSP)
BGP Tunneling
IPSec
Configured Tunnels (RFC1933)
Automatic Tunnels (RFC1933)
6to4
6over4
6rd
ISATAP
Teredo
6a44
IPv6 over IPv4

Stateful vs. Stateless Tunneling

"**Stateful Tunneling**" (e.g. L2TP)

- Dynamic or "per-tunnel" information must be distributed throughout tunnel endpoints
- Mapping function based on synchronized state built and destroyed on demand by tunneling system
- Scale is typically proportional to the amount of traffic and number of tunnel endpoints
- Control protocol, keepalives, etc. are needed between the endpoints
- Does more than "just tunnel"
- IPv4 and IPv6 addressing remain independent

"**Stateless Tunneling**" (e.g. 6rd)

- A single common configuration must be distributed to all tunnel endpoints
- Mapping function is based on an algorithmic mapping from existing state and common config
- Scale is proportional only to the amount of traffic (point to multipoint)
- No control protocol needed between endpoints (aside from troubleshooting)
- Very focused on one specific goal
- IPv4 and IPv6 addressing are coupled via algorithmic mapping

Work on Mechanisms Which are Actual Progress Toward IPv6

Prefer Mechanisms Which are Simple, Stateless, Use IPv6 not IPv4, …

Keep State at the Edge Not the Core

Use Mechanisms Which Preserve e2e and the Other Basic Principles as Much as Possible

Tunnel if you Have to NAT only if you're Desperate

The Salmon are Swimming Happily Under the Water