



Overcoming IPv6 deployment challenges

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Agenda

Fundamental challenges:

Perceptions

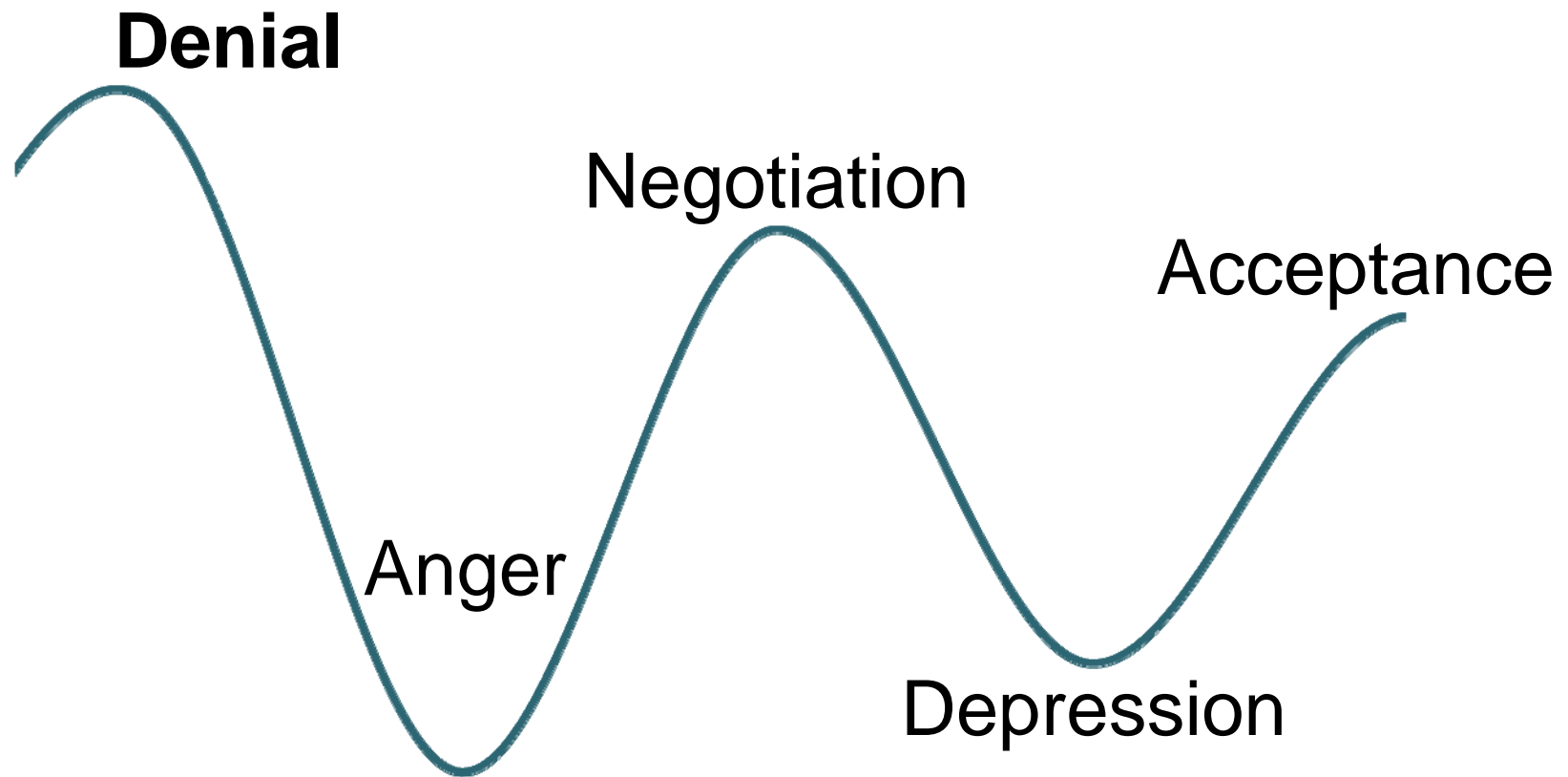
Timing

Business

Technology

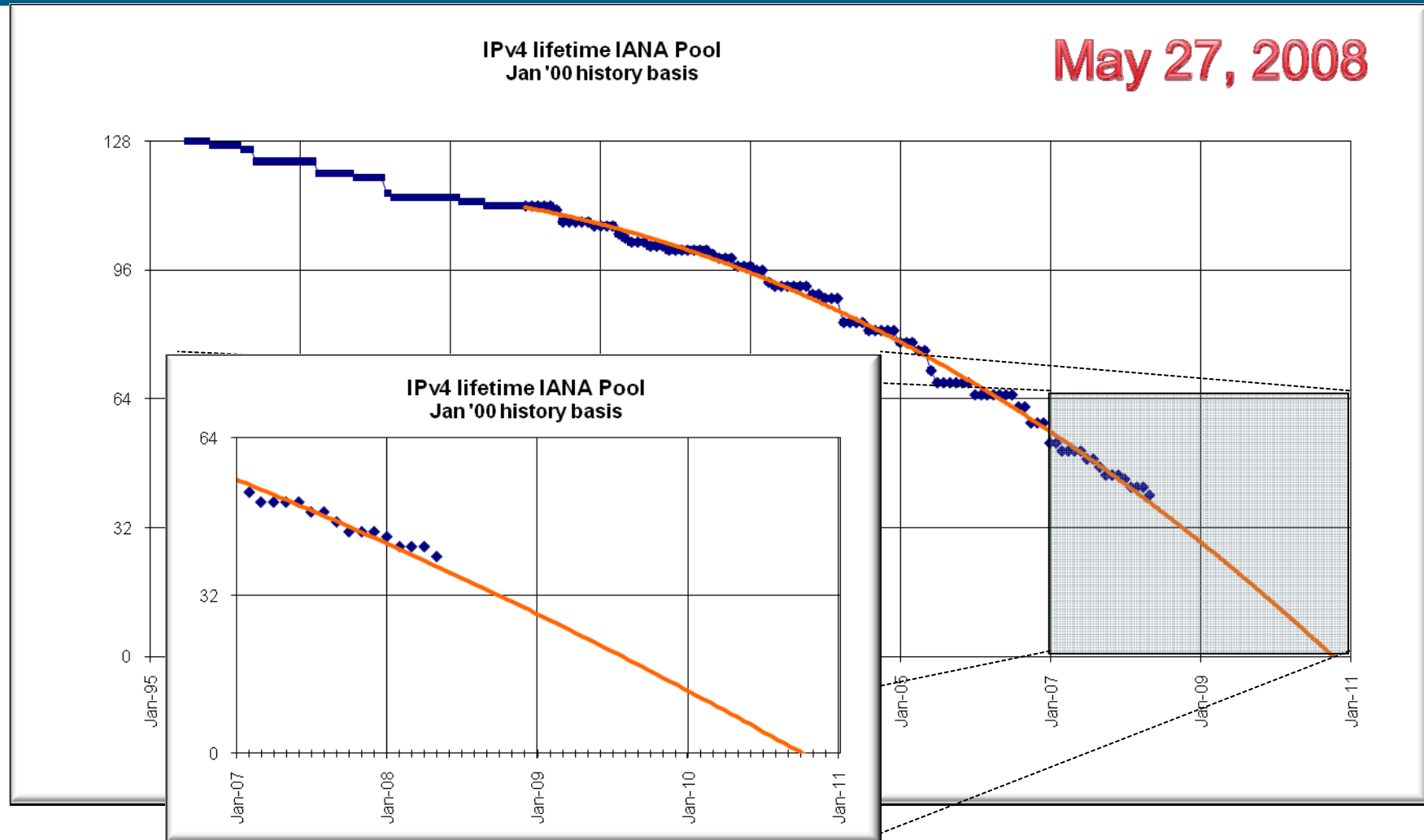
Perception

IPv4 to IPv6 transition and the stages of grief



Perception - Denial

May 27, 2008



Perception



Perception - Anger at IPv6-only events

- **Distraught 'IPv4 experts' are having difficulties:**
 - **IPv6-only exposes IPv4 dependencies in applications and middleware.**
 - “Thunderbird and Firefox disable IPv6 dns by default”
 - **Failures when translating between versions exposes the invalid assumptions that some ISPs have been making.**
 - “Linux NAT-PT (napt) has stability issues and wedges”
 - **Provisioning model assumptions are exposed by new ways of handling addressing.**
 - “it's a real pain in the ass to get DHCPv6 working”
 - “why doesn't the RA include the DNS service”
 - **Typing ' : ' instead of ' . ' in a literal address exposes how resistant people are to change.**

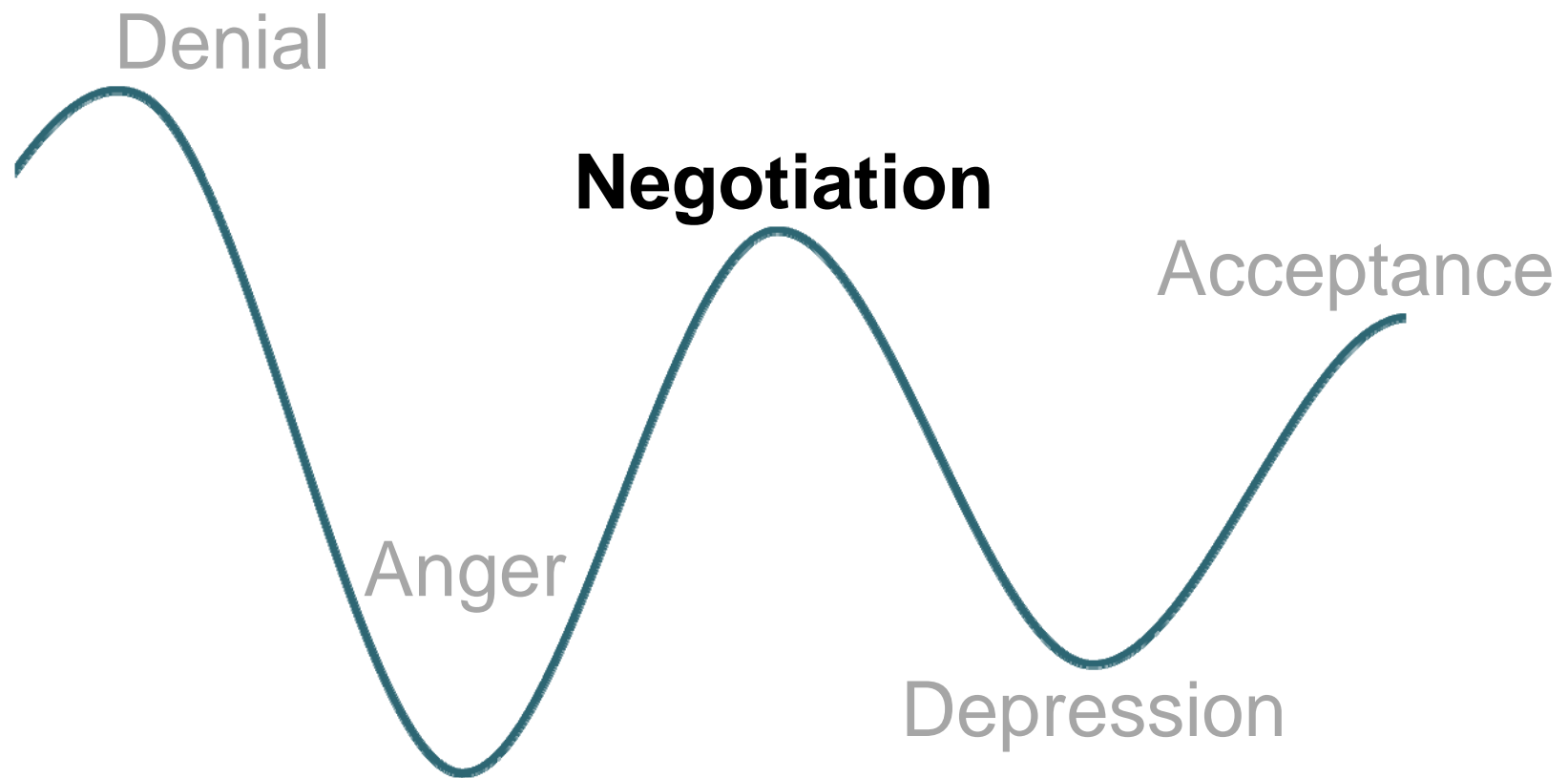
“why do we have to type colon instead of dot like in a real address”



Perception - Anger

- ***“Tunnels are a security threat ...”***
 - *Tunnels are just framing with an IPv4 bit pattern.*
- ***“It is just more bits ...”***
 - *Starting with this perspective will ensure confusion at every difference.*
- ***“64 bit subnets are a waste of space ...”***
 - *The original proposal was for a 64 bit address, and even that provided 3 orders of magnitude more space than the design goal. The ISPs at the time didn't think there would be enough hierarchy with so few bits, so the entire space was given to routing and arguments for the host part began. Now the ISPs are arguing that they still don't have enough ...*
- ***“Nobody needs more than one subnet ...”***
 - *Need to drop IPv4-think focused on number of devices, and recognize that IPv6 allows describing a customer as a routing aggregate. Assuming a single subnet locks the deployment to a single service description.*

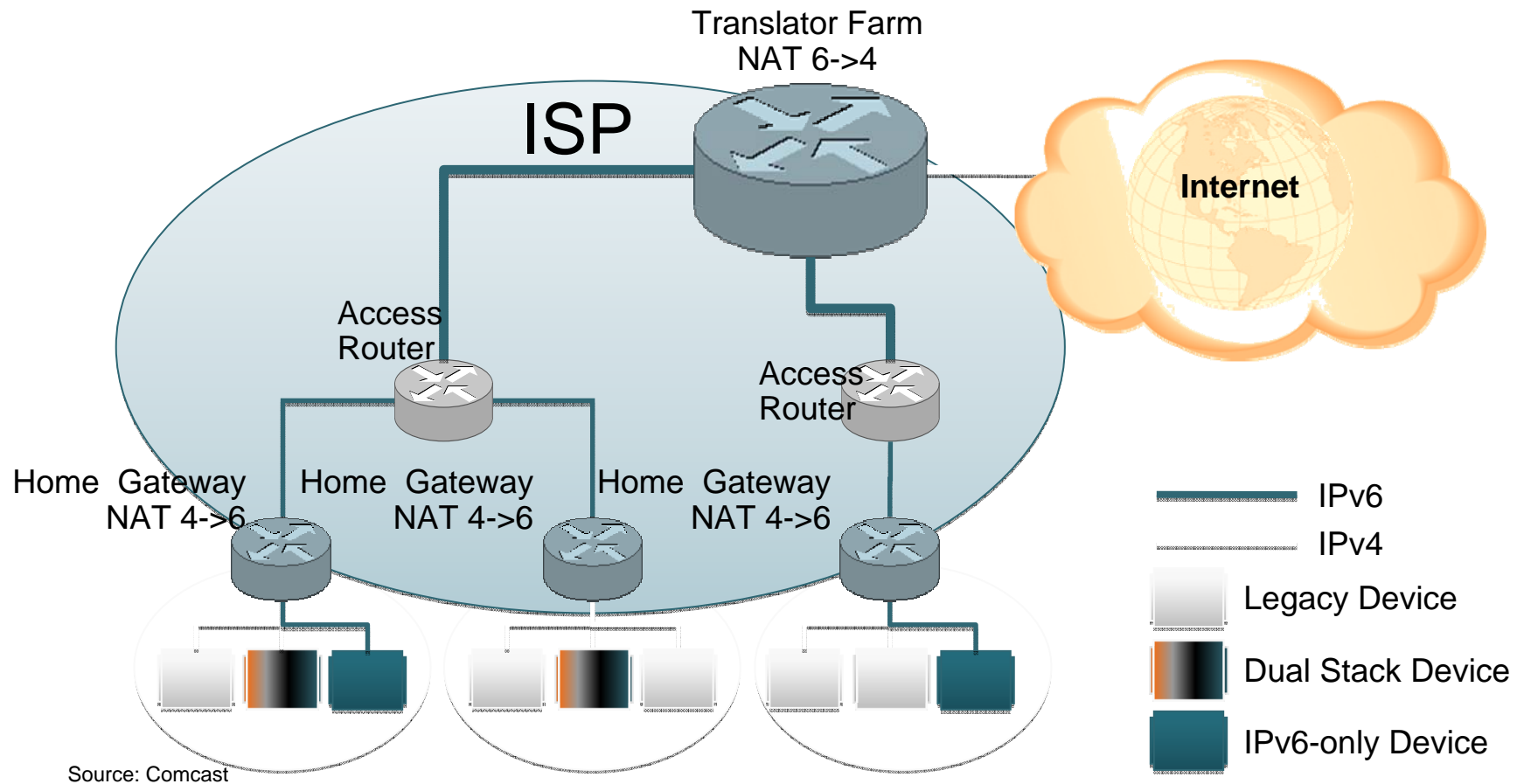
Perception



Perception - Negotiation

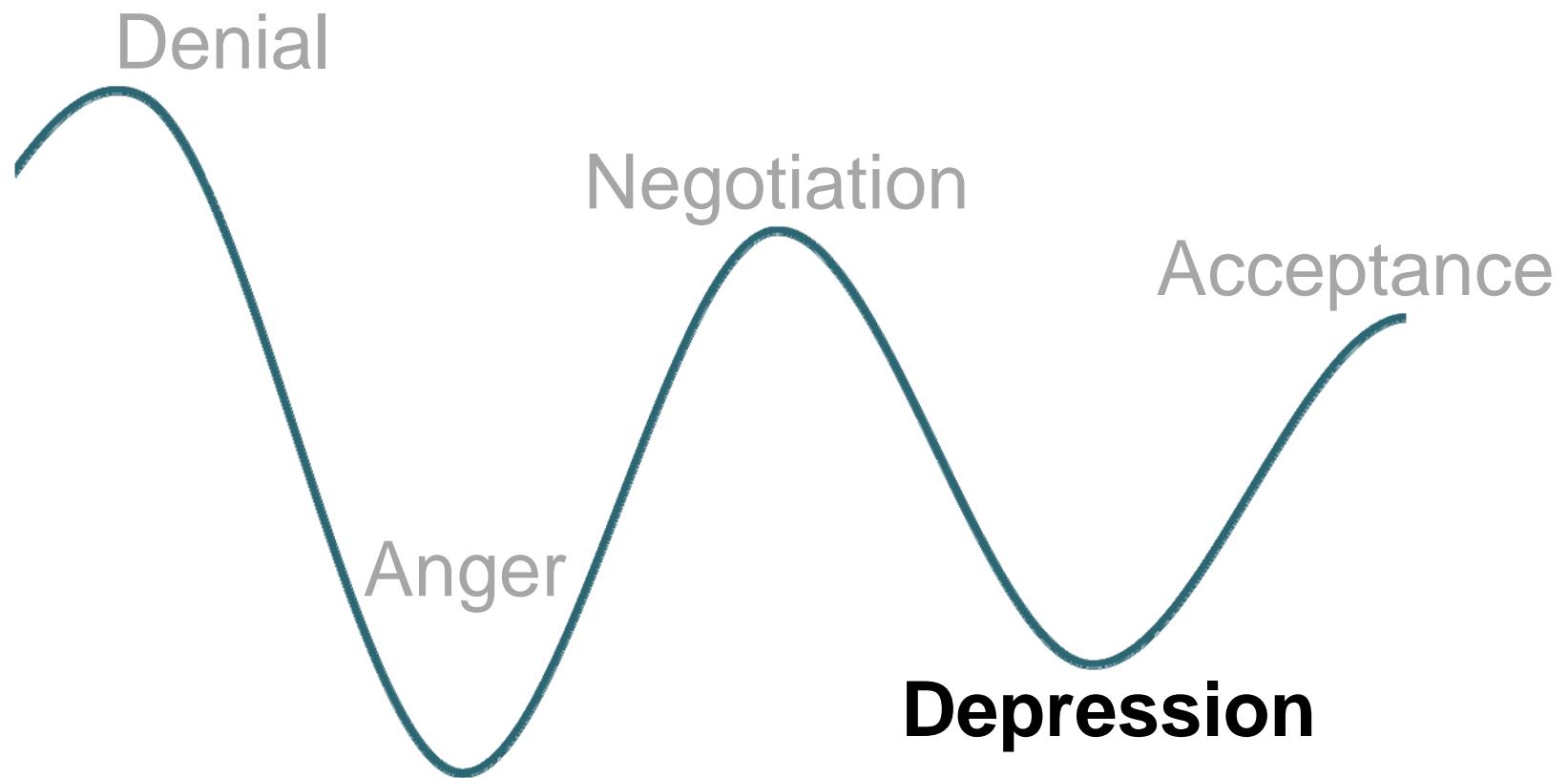
- ***“The Class-E space has lots of room ...”***
 - *Existing deployed systems will not accept configuration into that space, or even talk to it if a new system were to be put there. Even so this is less than 1 year’s allocations.*
- ***“Carrier based nat will solve the problem...”***
 - *nat at the edge ‘works’ because protocols like UPNP open holes to allow applications to work. UPNP is a link-scope protocol with no security functions.*
 - *the private IPv4 address space is not big enough for some deployment models which include multiple addresses per device and coordination with external content partners.*

Perception - Negotiation & Carrier NAT



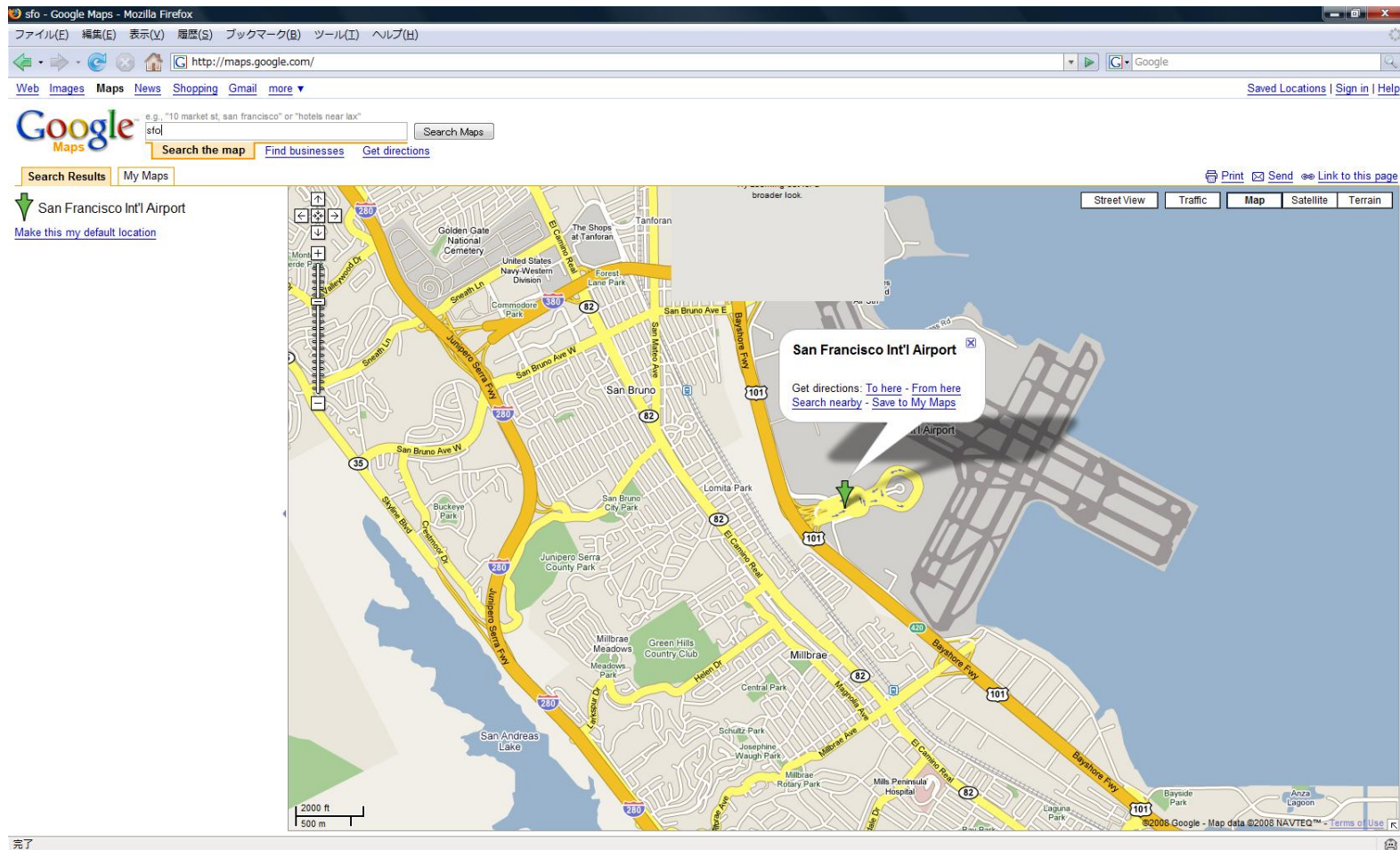
SNAT proposal suggests a soft-wire tunnel between the CPE device and a carrier based NAT.

Perception



Perception - Depression : AJAX (1)

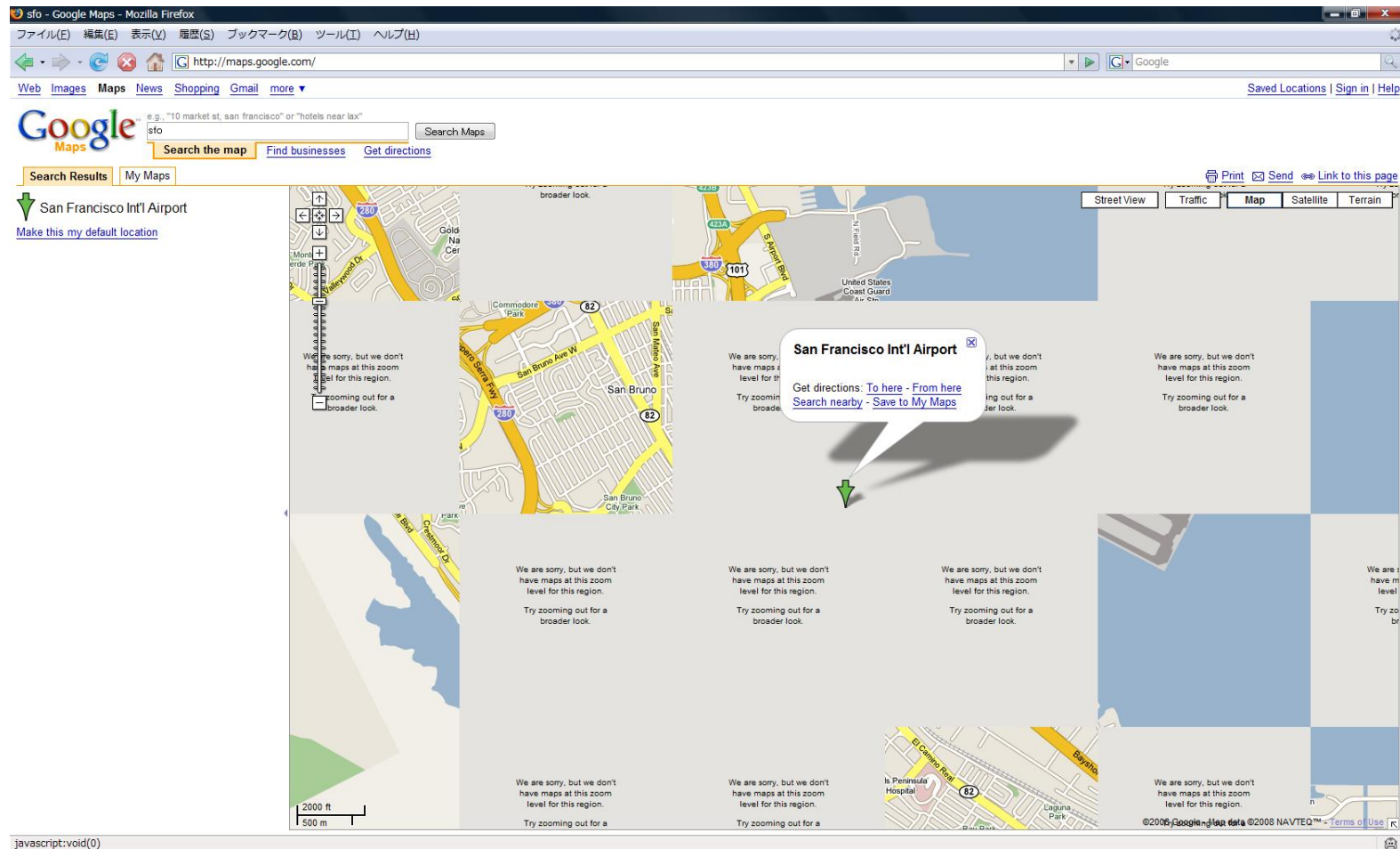
Max 20 Connections



Source: Shin Miyakawa , Ph.D. NTT Communications Corporation

Perception - Depression : AJAX (2)

Max 10 Connections



Source: Shin Miyakawa , Ph.D. NTT Communications Corporation

Perception - Depression : AJAX (3)

Max 5 Connections

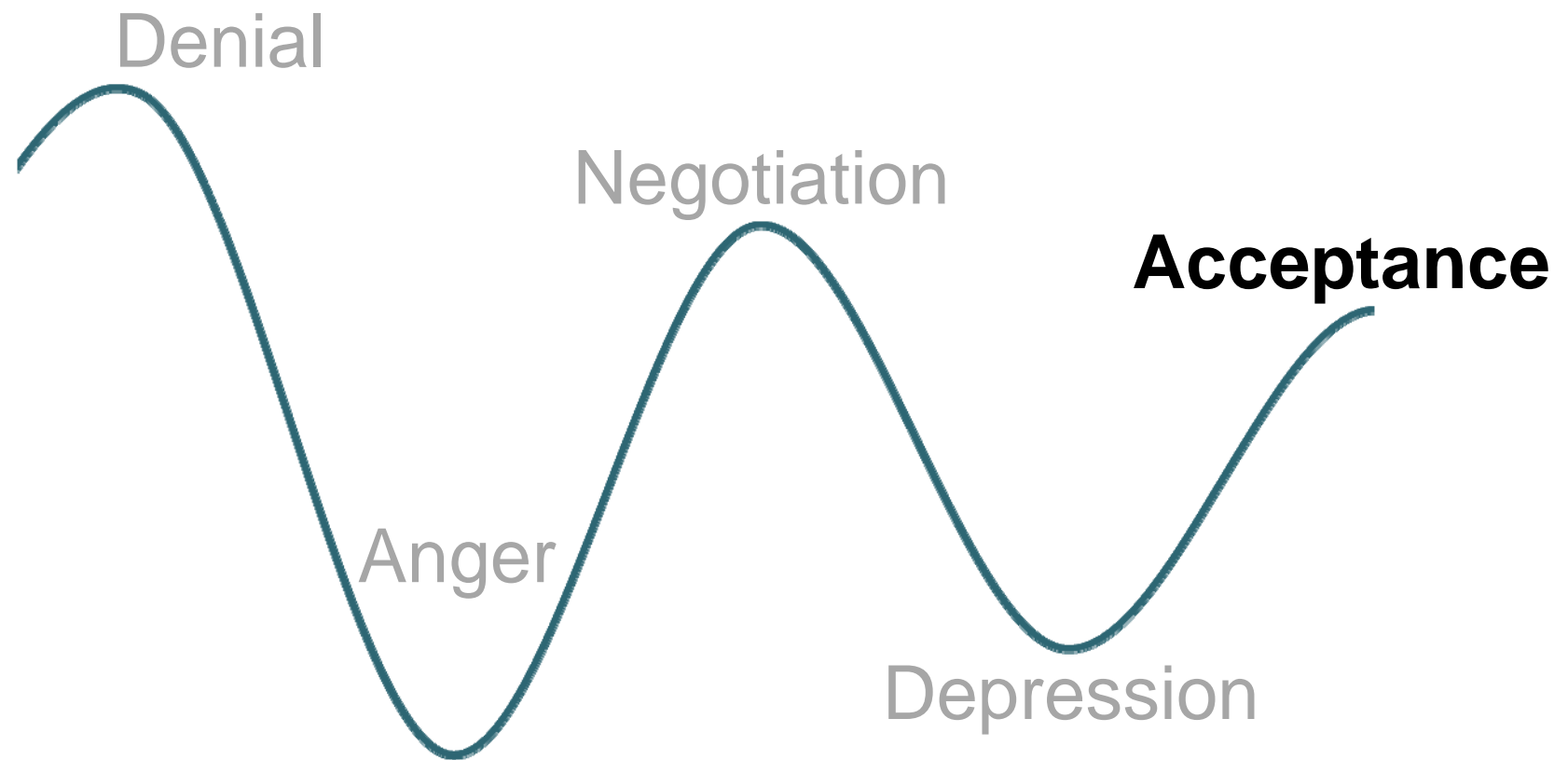


Source: Shin Miyakawa , Ph.D. NTT Communications Corporation

Perception - Depression : AJAX (4)

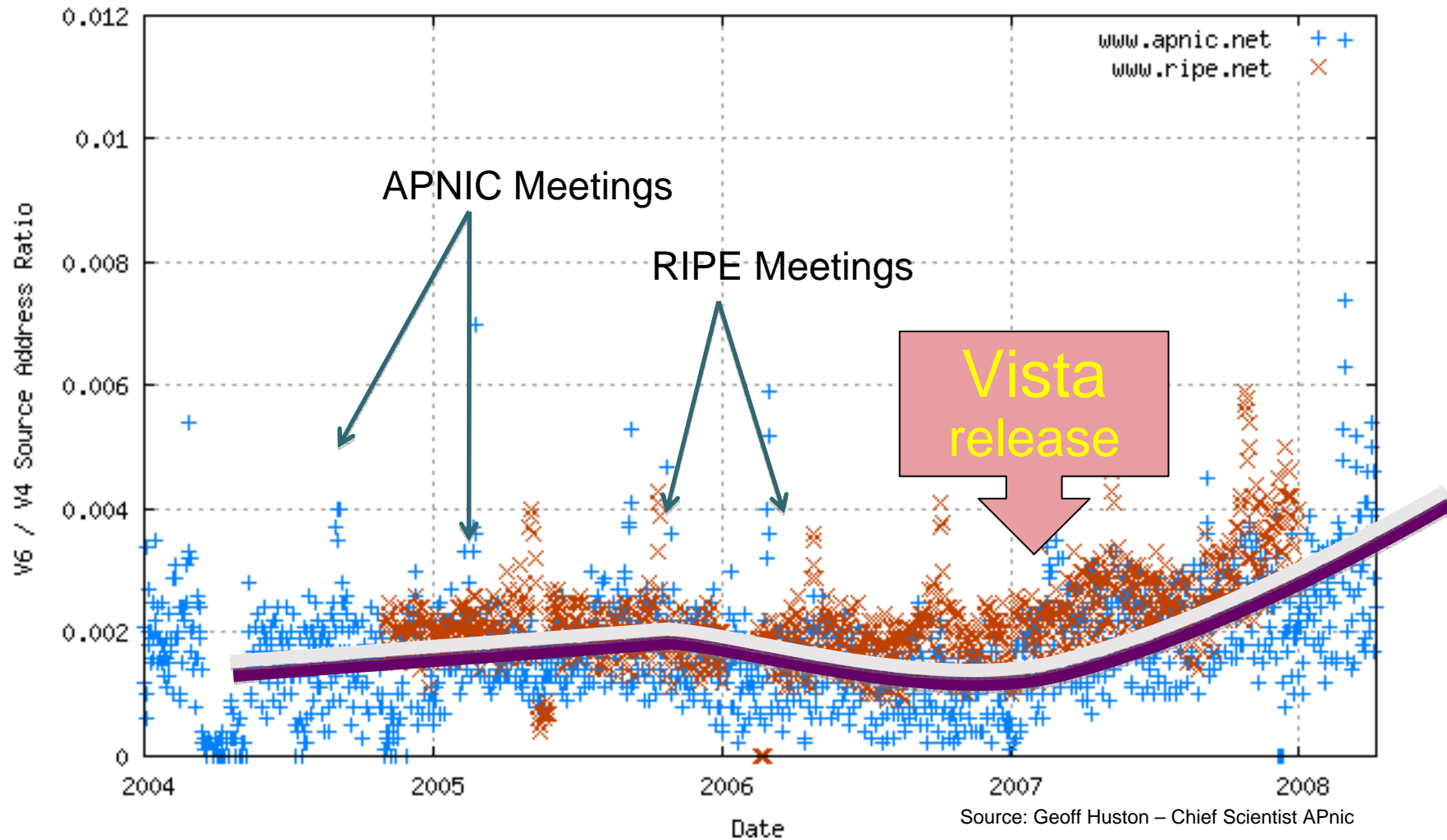
- **Google Maps opens ~ 70 parallel connections**
- **iTunes store has been shown to open as many as 300 parallel connections**
- **New apps that have not emerged yet ???**
- **IPv4/nat multiplexes multiple users through the port range, so 64k divided by 300 parallel connections results in ~200 customers per ISP based nat address (assuming each customer is only allowed to run one simultaneous instance of iTunes or similar apps).**
- **Services generally don't allow connections from the same host to span multiple public side addresses, so use of more ports on another address will cause the application to fail.**
- **Reuse of port pairs can't be guaranteed with a high rate of churn in the port pool, so the likelihood of matching src/dst port pairs to popular sites will expose the probability of TCP sequence number overlap between unrelated connections, and/or TCP Time-Wait at the server.**

Perception



Perception - Acceptance

IPv6 activity at RIPE & APnic web sites



Content sites are taking initial steps

ipv6.google.com - IPv6 enabled search page



Agenda

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Perceptions

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Technology

Timing - Evolution or Revolution ??

A. Integrate dual-stack and tunneling as appropriate within the existing network.

- Minimize expense by multiplexing protocols where possible, and/or running one over the other when necessary.

B. Greenfield deployment of new services on IPv6-only network.

- Completely isolated network ensures no disruption to existing revenue stream. Potentially complications from managing two networks.

Timing - Crisis

- **IPv6-only to IPv4-only operation**
 - nat-pt exists, but is very problematic to operate
 - application proxies work in some cases, but require per application infrastructure
 - barrage of new proposals in the IETF, but none are likely to be standardized before needed, let alone appear in products

Timing - Industry Norms

- **Operations forum group-think lead to a deny-until-crisis mode, resulting in the current just-short-of-panic reactions.**
- **Protocol differences create an operational experience vacuum.**
- **Competitive concerns frequently outweigh any desire for shared knowledge and best practice documents.**

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Business - Revenue

- IPv6 is **NOT** a feature! While everyone wants a source of additional revenue, fundamental transport is difficult to monetize.
 - IPv6 is a defensive play as carriers will have to absorb the costs of an IPv4 routing system (that will be growing unconstrained once the pool is gone and addresses are traded on eBay) until they can get their customers to leave IPv4 behind.
- Revenue generating applications are most likely to be peer-to-peer, because client-server can be hacked in using nat.
 - p2p will impact asymmetric traffic flow assumptions

Business - Costs

- **The largest cost for most network managers will be training.**
 - It is packet based, and starts with the letters IP, but other than that it is a different protocol.
- **Another major cost will be retooling custom apps and scripts.**
 - Frequent shortcuts assuming an address will always be 32 bits.
- **Is IPv6 deployment an opportunity to integrate other engineering changes that have not been large enough to justify by themselves?**
 - What costs will be attributed to IPv6 vs. general evolution?

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Technology

- **IPv6-only?**
 - Dual-stack allows both IPv4 & IPv6 apps, but fails if there is no IPv4 address available.
- **DNS**
 - Has the handset vendor figured out that asking for both A & AAAA at once will avoid timing out one before looking for the other?
- **Diagnostics**
 - If part of the path is tunneled, visibility will be limited.
- **User Interface**
 - handset screen sizes and IPv6 address lengths ?!?!?

Technology

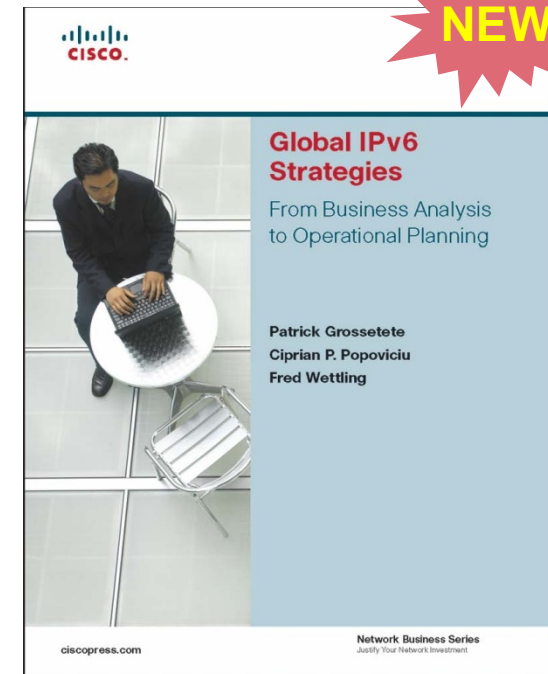
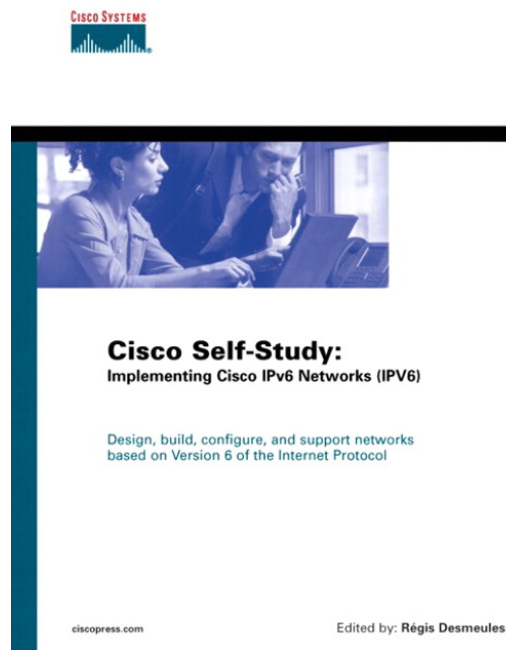
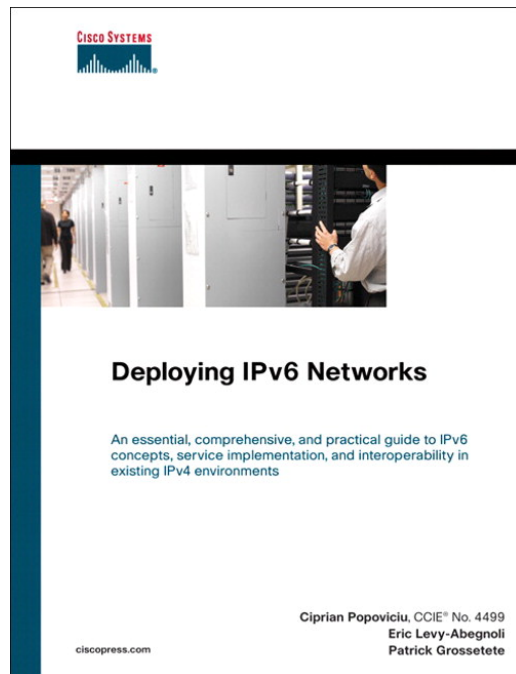
- **Multiple IPv6 addresses on the interface**
 - isolate telephony from other functions?
- **Prefix length**
 - dedicate subnet for management vs. user functions?
- **Header size**
 - compression is a trade-off between cpu vs. radio capacity
- **IPsec**
 - RFCs state must be available in the products, but end system manager retain the option about if & when to use. Requires a key infrastructure.

Summary

- **Assess the current situation and the realistic prospects for the rate of change.**
- **Recognize that a one-size-fits-all solution will be sub-optimal for everyone.**
- **Train the architects and planners now so that they can develop a sound implementation plan.**
- **Accept that the biggest challenge to overcome in an IPv6 deployment is getting everyone on the same page ...**



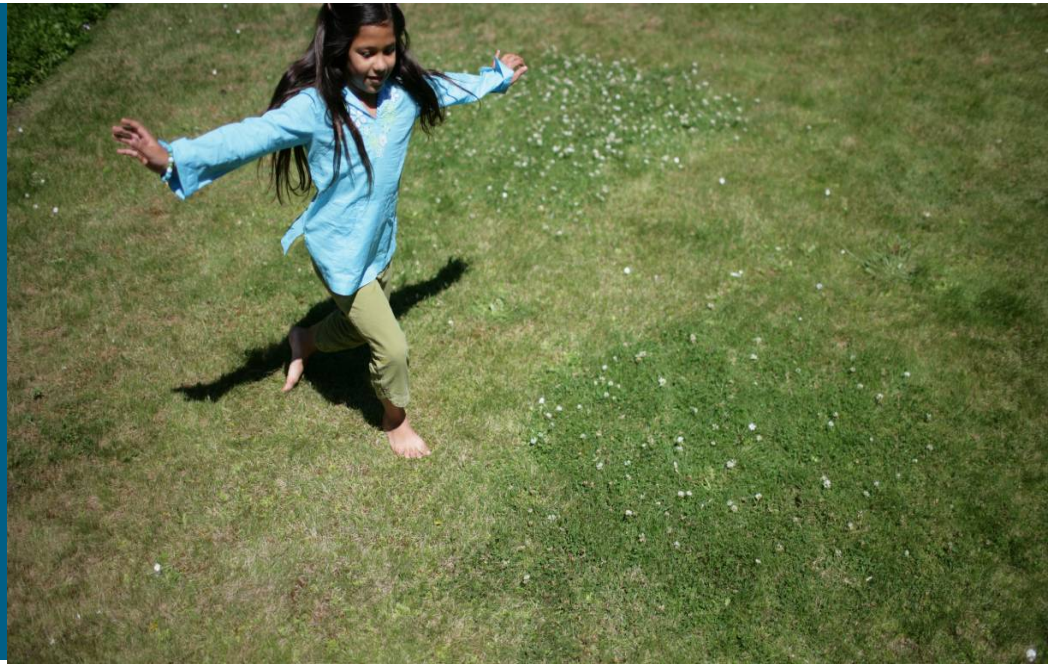
Cisco Press Books



More Information

- CCO IPv6 - <http://www.cisco.com/ipv6>
- The ABC of IPv6
http://www.cisco.com/en/US/products/sw/iosswrel/ios_abcs_ios_the_abcs_ip_version_6_listing.html
- IPv6 Application Notes
http://www.cisco.com/warp/public/732/Tech/ipv6/ipv6_techdoc.shtml
- ICMPv6 Packet Types and Codes TechNote:
<http://www.cisco.com/warp/customer/105/icmpv6codes.html>
- Cisco IOS IPv6 Product Manager – pgrosset@cisco.com

Cisco IPv6 Solutions



- **Long standing support for IPv6 by Cisco**

IETF Working Group Chairs: IPv6; ngtrans; v6ops; dhcpv6; mipv6; roll; software

Cisco engineers originated many IETF proposals

IPv6, MP-BGP4, NAT-PT, 6PE/6VPE, DHCPv6 PD, ...

Founding member of the IPv6 Forum

Founding partner of 6Net

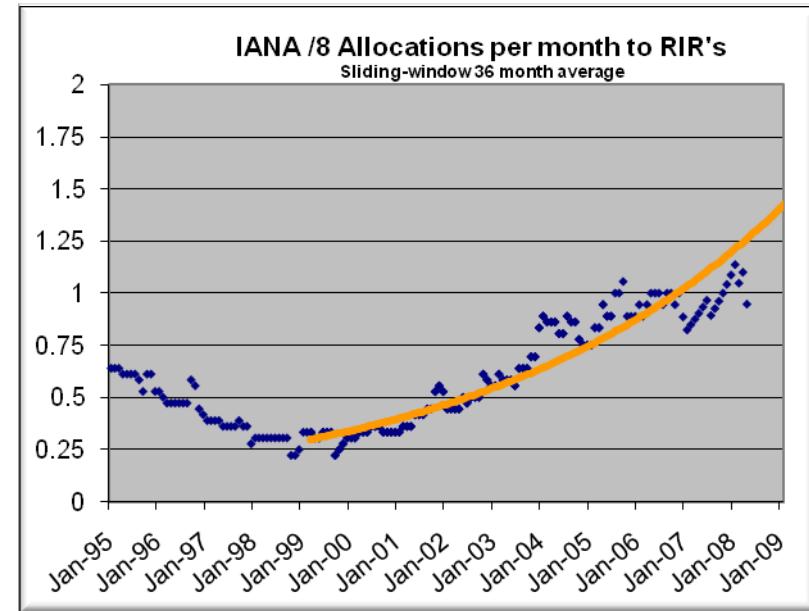
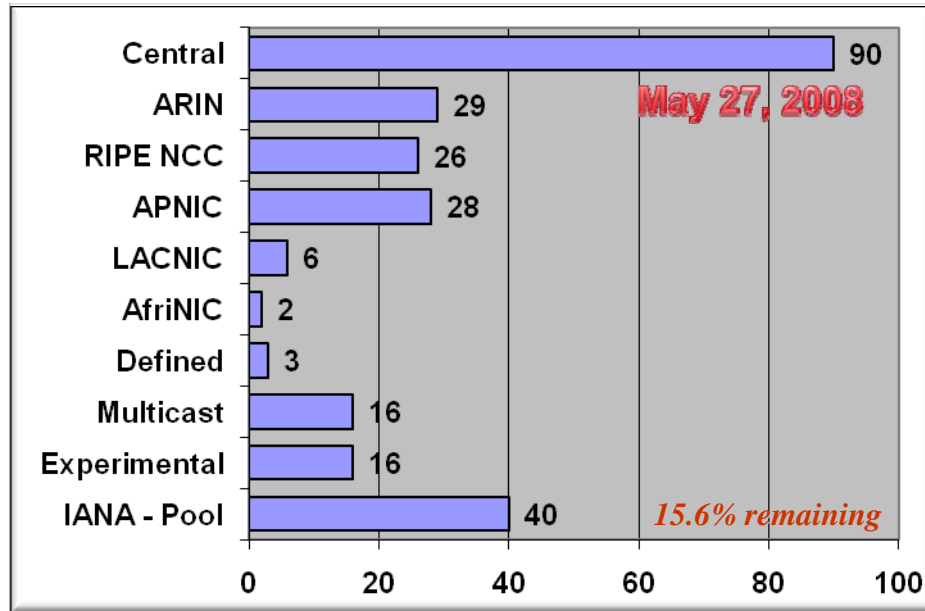
IPv6 Ready Logo

Mobile Networking demo – IPv6 Promotion council

“Jun Murai award”



IPv4 address allocations by /8



- Consumption is accelerating despite increasingly intense conservation efforts.

- Growth is occurring in all regions**

While many argue that North America is not affected due to historical allocations, consumption of the remaining IPv4 free pool continues globally.

