IPv6 Migration & IPv4 Conservation Phases for ISPs

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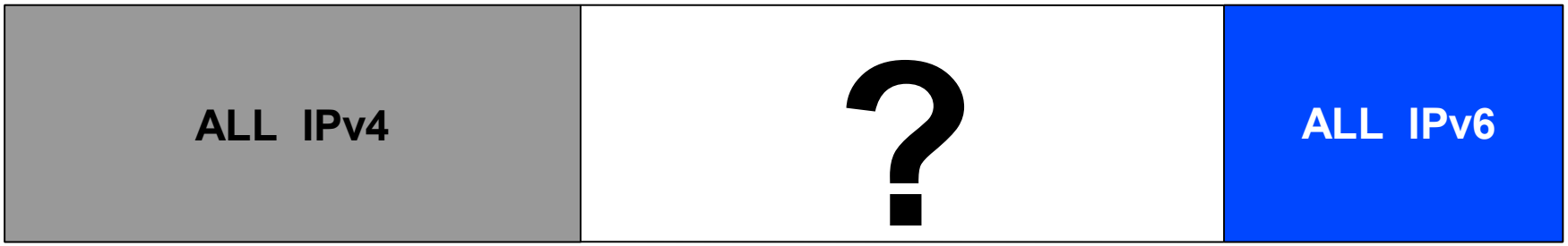
Internet and end of IPv4



- By 2012, many clients will not get public IPv4 addresses
- These clients will have to reach IPv4 websites and applications

Problem Definition

Problem #1:

IPv4 is depleted while content is mostly IPv4

Problem Definition Continued

Problem #2:

IPv6 needs to be deployed while most access networks are IPv4 only

Solution Approaches

- Solving problem #1 (no IPv4)
  - If needed, Carrier Grade NAT (CGN or LSN)
  - Above *does not* solve IPv6 migration need
- Solving problem #2 (need IPv6)
  - Dual Stack end to end (DS)
  - Tunneling v6-in-v4 and vice versa (TUNL)
  - Translation, v6 client to v4 content (TRAN)

Migration Approach Issues

- CGN: Multi-level NAT, NAT444, can break apps
- CGN: Difficult to trace for Lawful Intercept

- DS: End-to-End DS major project for ISP, 2 to 5 years to implement in access: Chg CPEs & gear

- TRAN: 2-way Translation (NAT-PT) deprecated
- TRAN: 1-way TRAN is NAT64/DNS64, assumes IPv6-only hosts **and** websites avoid v4 literals

Dual-Stack Perspective

- Dual-Stack end-to-end is needed & a priority
- Start from core and go out to customer CPE

- BUT for most operators core is easy (few months work), while edge and access are difficult due to legacy equipment (likely few years work)
- IPv6 is needed in the interim, *thus*
- Tunneling is a requirement, connects the Dual-Stack core to IPv6 at homes

Tunneling Notes & Protocols

- Tunneling has worked for IPv6 access
  - Used in past 10 years by tunnel brokers
  - Stable implementations
  - Rapid IPv6 deployment
  - Low latency if tunnel server within ISP
- Many types of IPv6-in-IPv4 tunnels: Teredo, ISATAP, 6to4, TSP, 6RD, L2TP
- Reverse Tunnels: DS-Lite and DSTM

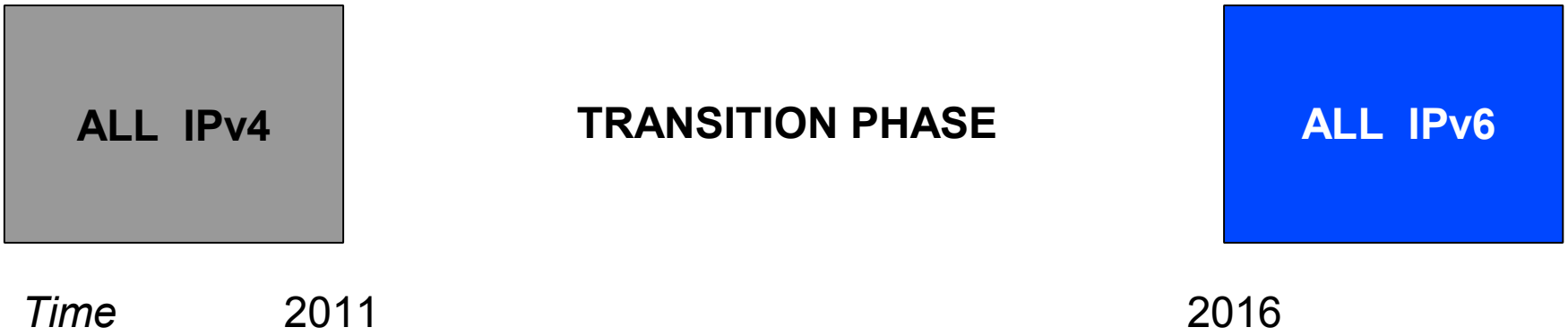
Comparing Solutions

	CRITERIA				
SOLUTION	Host Stability	Cost	Time	Over IPv4	Enables IPv6
CGN	x	✓	✓	✓	x
Dual-Stack	✓	x	x	✓	✓
Tunneling	✓	✓	✓	✓	✓
Translation	x	✓	✓	x	✓

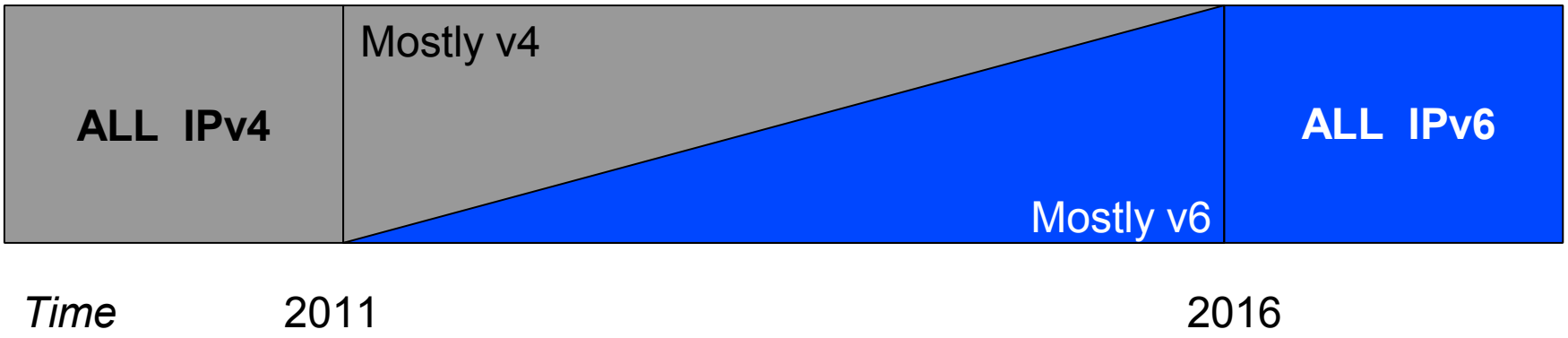
“Carrier Grade” Tunneling

- v6-in-v4 tunneling use **TSP, 6RD or L2TP**
  - CPEs **&** Servers available for them now
  - The 3 protocols are IETF ratified
- Reverse tunnels v4-in-v6 in near future
  - DS-Lite is *NAT44 in an IPv6/DS network*
  - Can use private IPv4 to avoid depletion
- **Avoid** Teredo, ISATAP and 6to4
  - No prefix assigment to end user (/56, /48 etc), unstablity, can't handle NAT

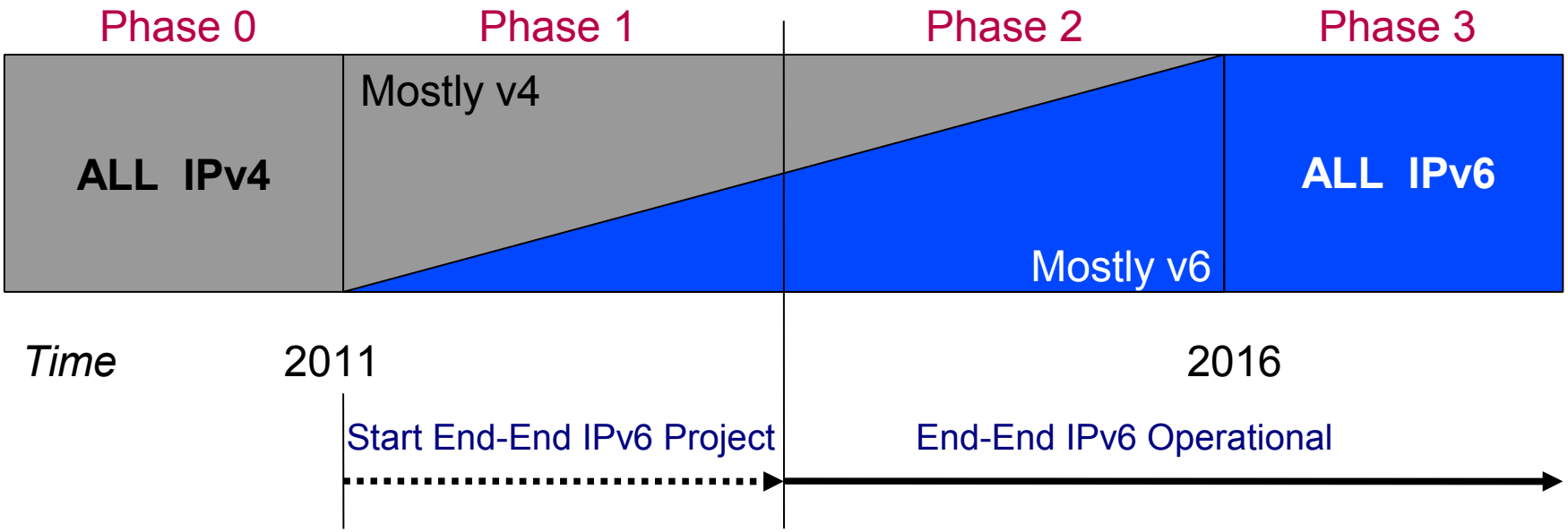
IPv6 Access Transition Phases



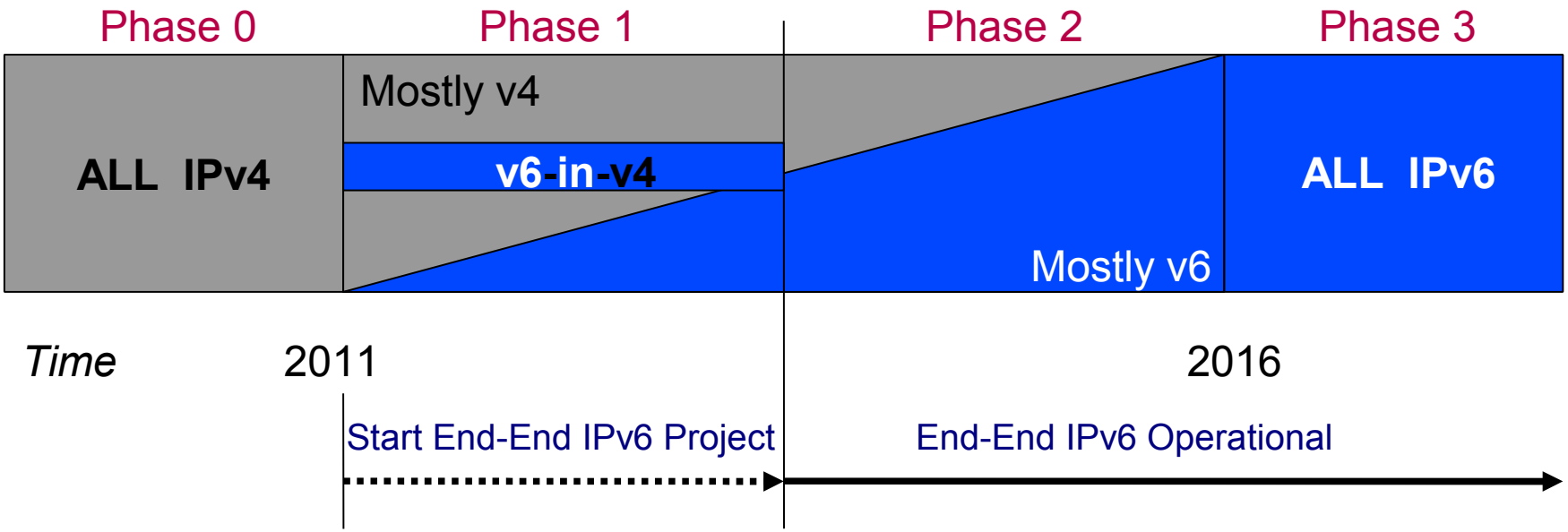
IPv6 Access Transition Phases



IPv6 Access Transition Phases

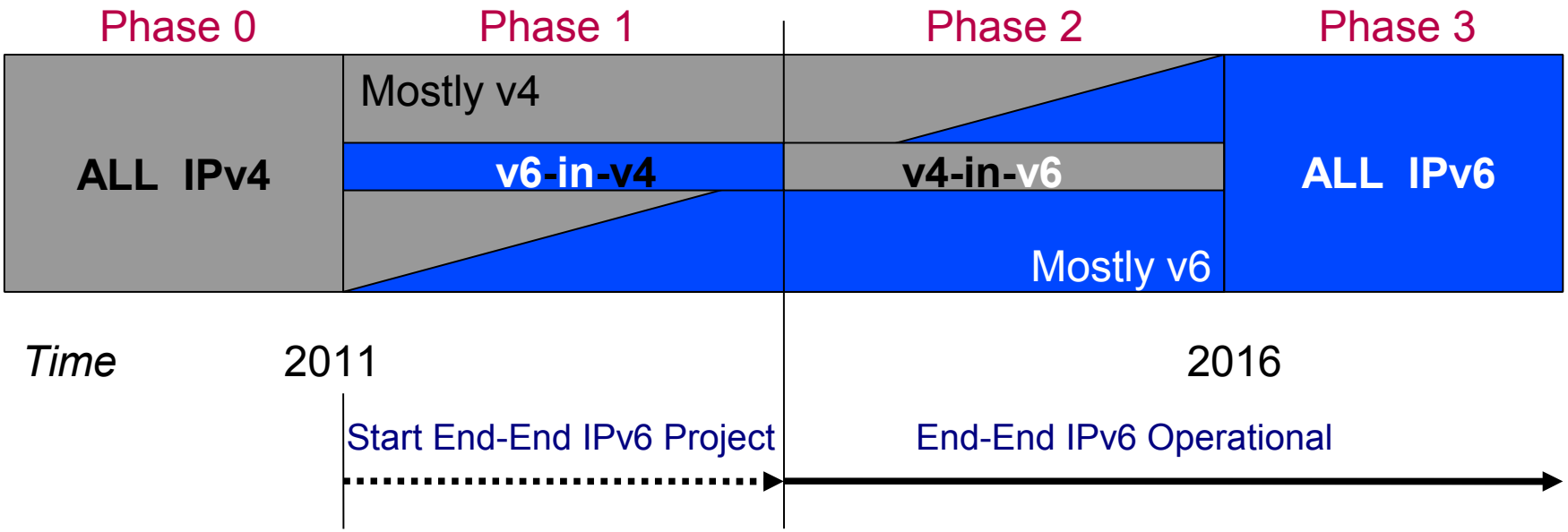


IPv6 Access Transition Phases



Phase 1: Offer subscribers **IPv6 immediately** over tunneling
don't wait for End-End IPv6 to be ready

IPv6 Access Transition Phases



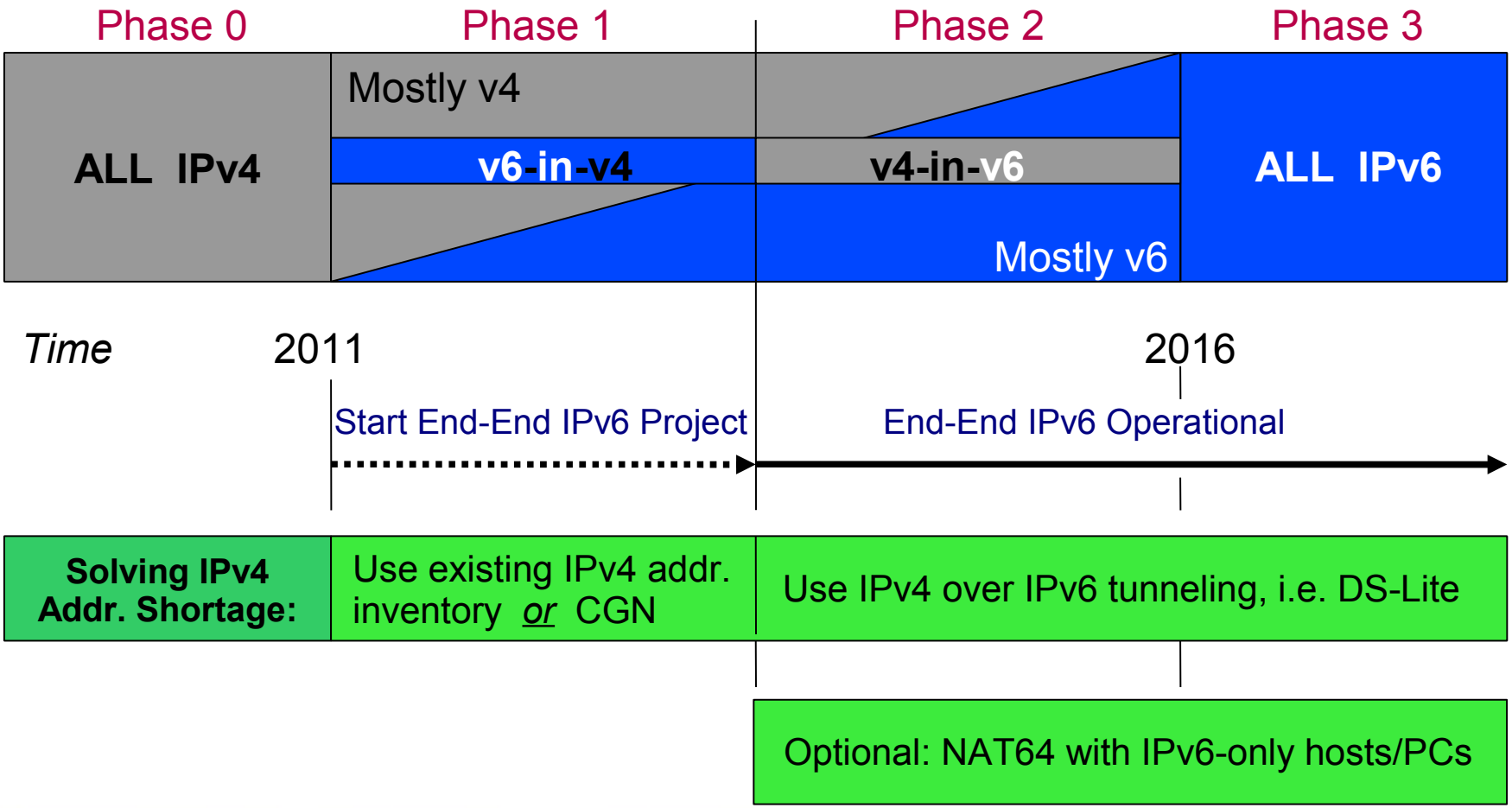
Phase 1: Offer subscribers **IPv6 immediately** over tunneling, don't wait for End-End IPv6 to be ready

Phase 2: Plan to offer subscribers private **IPv4** addresses over IPv6 network

Transition Status

- Previous steps solved Problem #2:
  - Deploying IPv6 in a structured approach
- How about Problem #1 ?
  - IPv4 depletion is a major issue

IPv6 Access Transition Phases



Dual-Stack Notes

- Dual-Stack (DS) is needed BUT :

- DS starts working only in Phase-2
  - IPv6 needed before reaching Phase-2
  - Implement IPv6 using tunneling
- DS does NOT solve IPv4 depletion
  - DS still needs a *public* IPv4 address
  - Solve with IPv4 private addr. using DS-Lite

Project Phase 1

- 3 Aims :
  - Rapid IPv6 to end user using TSP or 6RD tunnels *on existing IPv4 access.* Core Network Dual-Stack upgrade, ready in a short period (typically a few months)
  - **IF** IPv4 addresses scarce then implement CGN, while tunneling IPv6 within it
  - Start long term IPv6 project to enable all Dual-Stack end-to-end, needs 2 to 5 yrs

Project Phase 2

- 2 Aims :
  - After Dual-Stack is done implement private IPv4 in IPv6 (reverse tunneling) using DS-Lite to conserve IPv4
  - Re-use TSP & 6RD CPEs and tunnel servers from Phase 1 to get reverse tunneling. Implement DS-Lite in same CPE that ran TSP or 6RD in Phase 1.

Project Phase 3

- Aim :
  - Run IPv6-only network, with limited v4 connectivity at core as needed
  - At CPE continue implementing private IPv4-in-IPv6 using DS-Lite to access legacy IPv4 websites and apps

Action Plan Summary

- Start transition now, it will take time !
- Training, assesment & planning = first steps
- Devote a team & budget to the project
- Assume no new public IPv4 addresses
- Phase 1 is very critical for rest of project
- Give customers *IPv6 in 2011* via tunneling
- Plan to run IPv4 inside IPv6 future network

Questions ?