

University
of
St Andrews



UNIVERSITY OF
CAMBRIDGE

IPv10.0: A Strawman Design Beyond IPv6

ReArch 2009

Rome, Italy

1 December, 2009

Ken Carlberg

Saleem Bhatti

Jon Crowcroft

Once upon a time...

- The Internet was unknown by the general public
- Best Effort was the only game in town
- People used Telnet

And then THEY came...

And then THEY came...

- And brought the need for
 - Security, more services models, and...

Next Generation IP

Problems with IPv4

- Running out of address space
 - A/B/C class hierarchy was too inefficient
 - '92-'93 estimates of Class-B depletion by 2000
 - Near-term solutions:
 - Class-less Inter-Domain Routing (CIDR)
 - Network Address Translators (NAT)
 - » Has become the continuing solution
- Associated routing table size explosion
 - Solutions:
 - New lookup algorithms reduced impact
 - Faster hardware
 - Multi-homing has renewed the problem

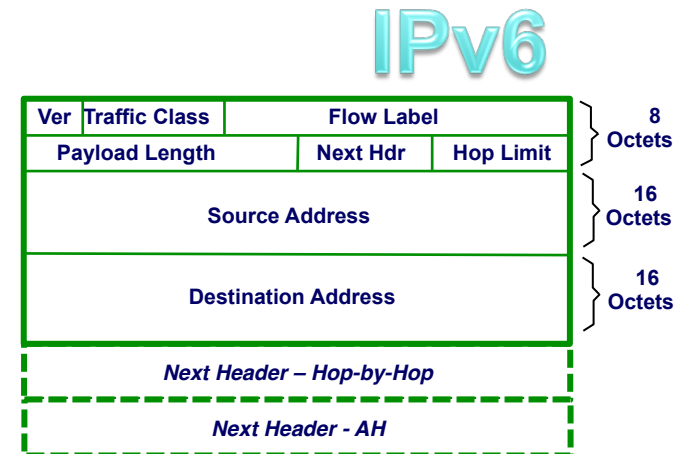
Next Generation IP: Background

- Simple IP (or Steve's IP)
 - Theme: Minimize header
 - Add more extensibility (e.g., one or more Next Header)
 - Flow Identifier (reflected current state-of-the-art work)
 - Larger flat address structure
- The P Internet Protocol (or Paul's IP)
 - Change addressing to Locator & Identifier split
 - Hierarchical and variable length Locator
 - Implied source routing
- The Grand Compromise of '94: Simple IP-Plus
 - Simple IP with hierarchical addresses of Paul's IP
 - Becomes IPv6 (RFC-1883)
 - HOWEVER, in '98, RFC-2460 removes hierarchical addresses

Critique

Not much of an architectural change...

- Large 128 bit addresses
 - Retains Locator & Identifier
 - Providers still cling to NATs
 - No economic incentives to migrate
- Same size diff-serv field
- Multiple Next Headers
 - Only inserted by source
 - Encapsulation or Multi-Protocol Label Switching (MPLS) is the work-around
- *End-to-End Flow Labels*
 - “Market” uses island(s) of cut-through routing (e.g., MPLS)
- Note: ‘08 report shows IPv6 traffic is 1/100 of 1% of all IP traffic



....Does “more” qualify as an architectural change?

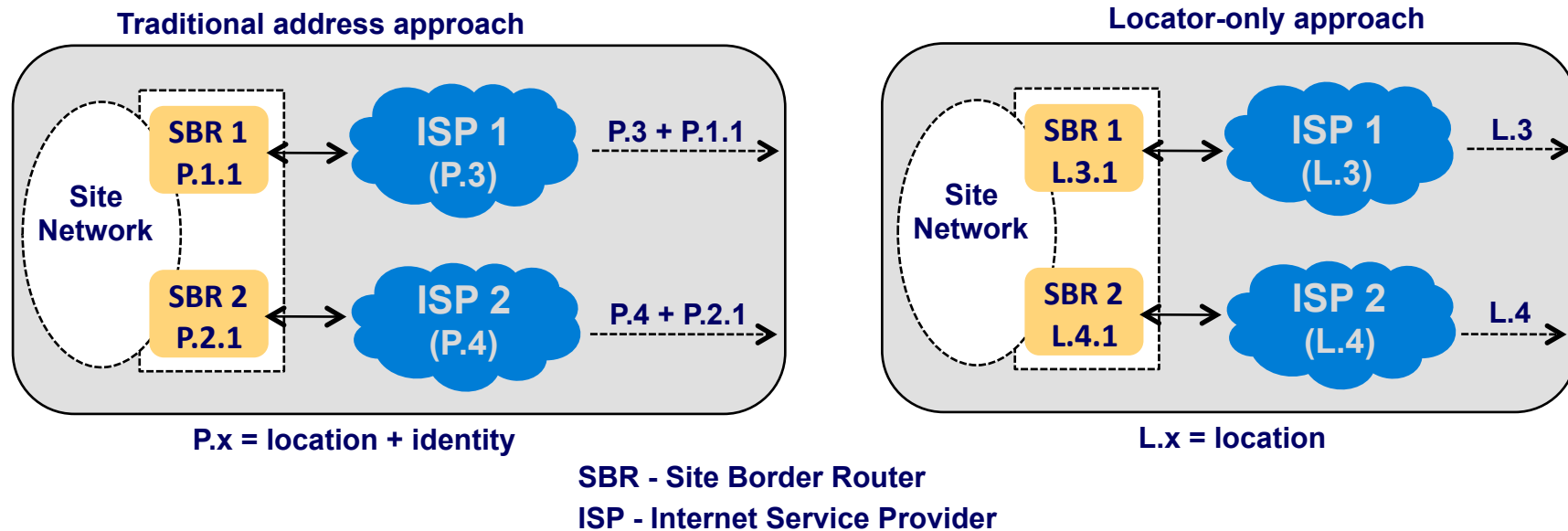
....Where are the “must have” features?

Locator / Identifier Split

- Four significant discussions in ARPAnet/Internet history
 - '77 (TCP and mobility)
 - '92-93 (Paul's Internet Protocol work),
 - '96 (O'Dell 8+8 proposal),
 - '07 (Internet Architecture Board report)
- Three Current efforts
 - Host Identity Protocol (HIP)
 - Locator/Identifier Separation Protocol (LISP)
 - Identifier Locator Network Protocol (ILNP)

Locator / Identifier Split (cont.)

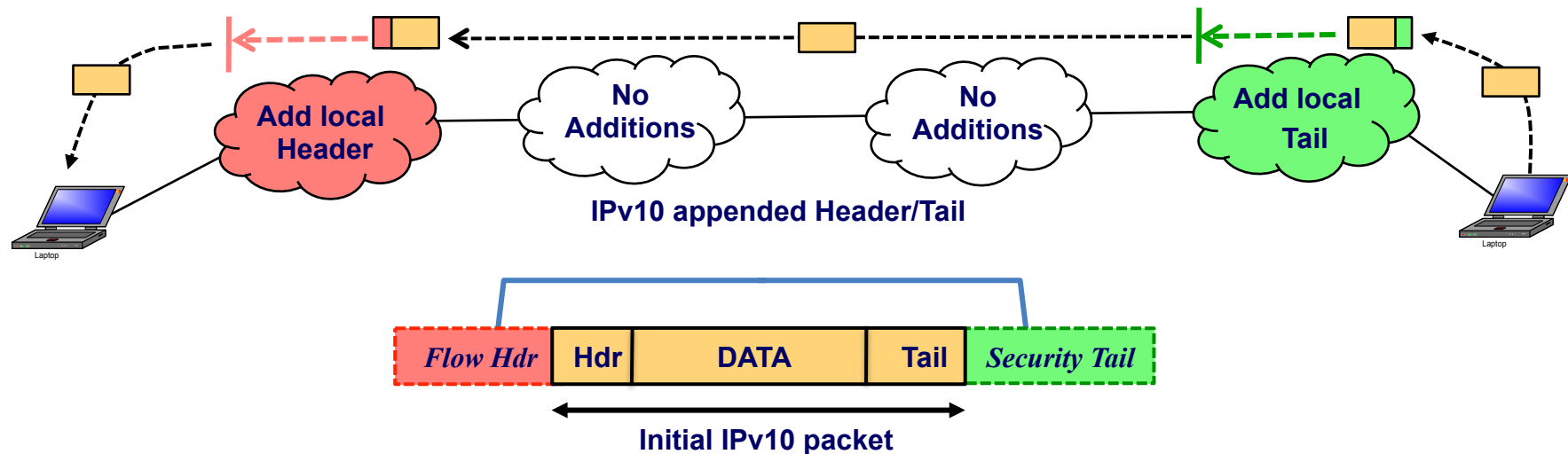
- Multi-Homing problem
 - Provider Independent prefixes tend to be popular, but are non-aggregable
- ILNP Example
 - Locators are from Internet Service Provider and are always Provider Aggregable



IPv10.0 Design

- Retain minimalism and extensibility of IPv6
- Incorporate Identifier / Locator Split
- Introduce Tails
 - Change state-insertion model: temporary Headers and Tails

...a starting point for future discussions

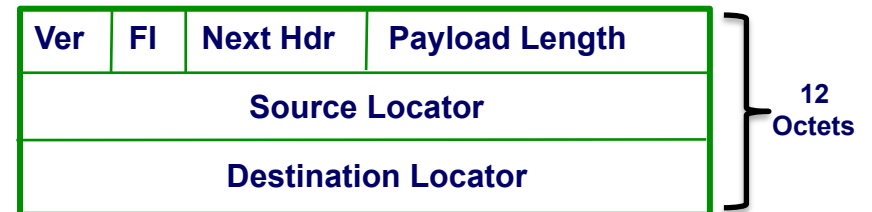


IPv10.0 Design (cont.)

- Header

- Header navigation
- Forwarding information

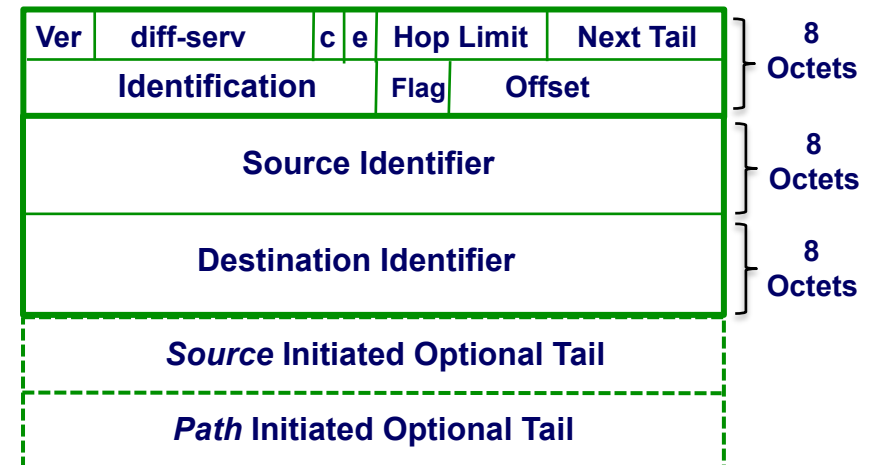
Header



- Trailer

- Trailer navigation
- End-to-end information
- Diff-serv
-Non-forwarding information

Trailer



Final Thoughts

- Impact of Tails
 - Change the end-to-end model of constructing headers
 - Facilitate temporary insertion of overhead information
 - Avoid inefficient encapsulation
 - Foster need to go beyond current ASIC header lookup limitation
- Should we be more radical in our design?
 - Are there “must have” features in IPv10.0?