



Enabling ICN in the Internet Protocol: Analysis and Evaluation of the Hybrid-ICN Architecture

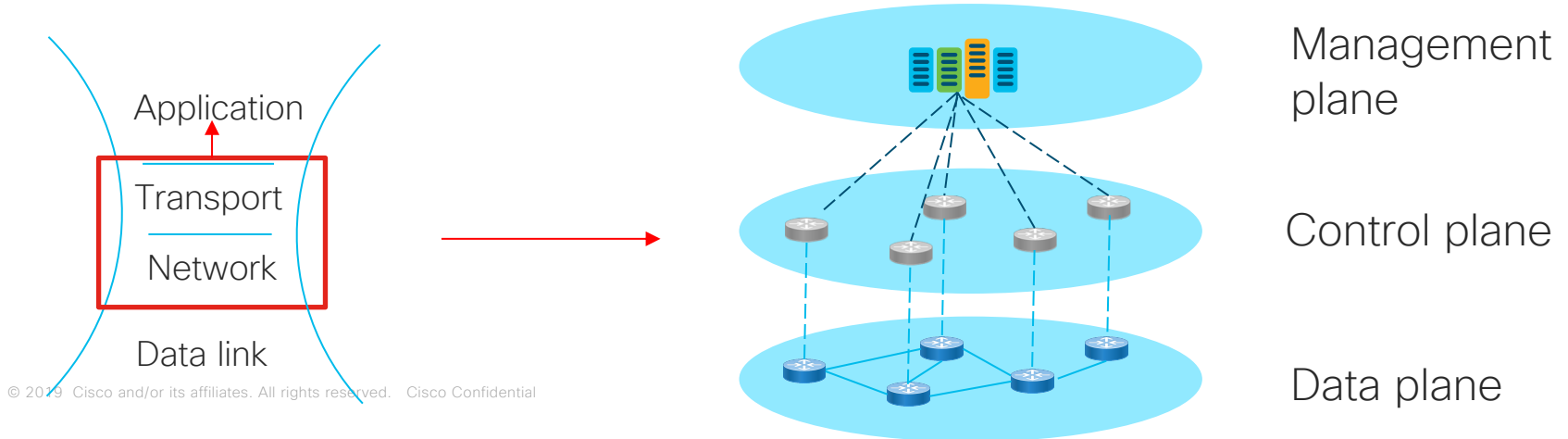
G. Carofiglio, L. Muscariello, J. Augé, M. Papalini, M. Sardara, A. Compagno

Speaker: Alberto Compagno

ACM ICN '19

ICN & Clean-slate approach

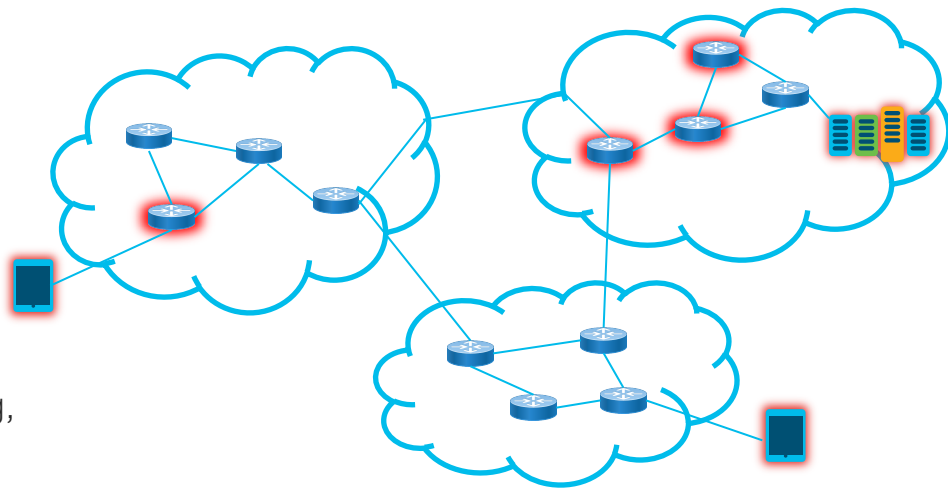
- Start point to design a new architecture
 - No constraints, easier to explore new alternatives
- Makes adoption harder
 - Incompatibility with existing hardware, protocols, applications



Hybrid-ICN – an evolutionary approach

Simplify deployment and adoption

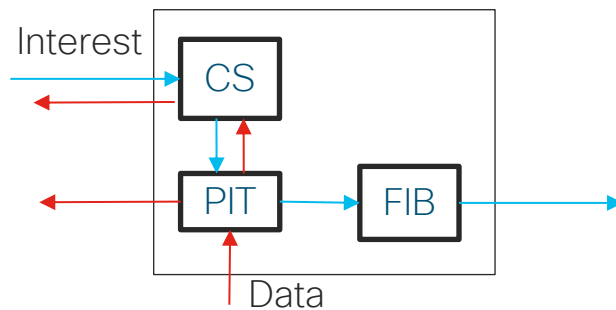
- Incremental deployment
 - End hosts and few network nodes
- Reuse as much as possible
 - Control & management planes, hardware, protocols, ICN research
- Preserve ICN features
 - Mobility, security, dynamic forwarding, caching, receiver-driven transport ...



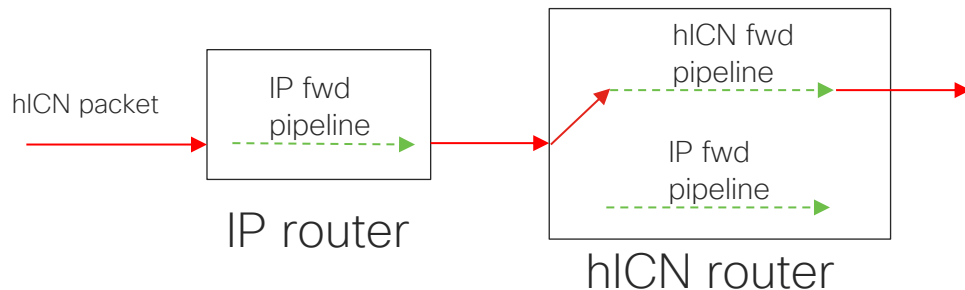
Hybrid-ICN... a new ICN architecture?

- Not exactly... inspired by CCNx
 - same data structures (PIT, CS)
 - same forwarding pipeline
 - same features

security, mobility, caching, multicast...



... but integrated into IPv6 and IPv4



- No isolated islands
- No overlay through encapsulation
....except for some specific case
- Reusability

hICN: how to simplify deployment

- 1 Naming
- 2 Packet Format
- 3 Insertion
- 4 Socket API

Naming

- A naming/addressing system has implications in:

IP

1 Name management/assignement

ICANN, IANA

RIR, LIR,
NIR, ISP...

DHCP, DHCPv6,
IPAM tools

2 Data plane

FIB, longest-prefix match

3 Control plane

BGP, OSPF, SDN-approaches ...

4 Hardware offloading

ACL, segmentation

Can we use IP to name data?

- CCNx name:

ccnx:/foo/bar/1

Segmentation info

Name segments

- hICN name:

2001:0:0:0:0:0:0:1

Segmentation info

1

Name segments

Name prefix

Full Name

CCNx semantics (RFC 8569):

- Composition of name segments
- First few seg. are routable
- Name is unbounded (in theory)
- Not required to be human readable

48 >=	16 <=	64
Routing prefix	Sub net	Interface id

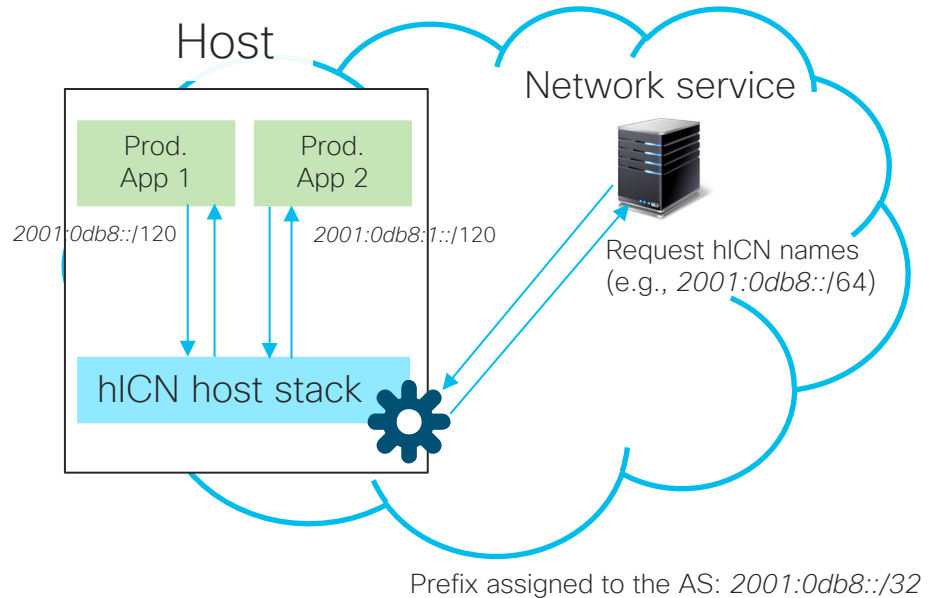
64	64
Routable name prefix	Data identifier

Names management

Namespaces are IP networks assigned to AS-es

Ntw service to distribute names:

- E.g., DHCP
- Assigns them to producer applications
 - under lease, names are reused
- Location-independent names ?
 - Within the same AS with intra-domain producer mobility protocols

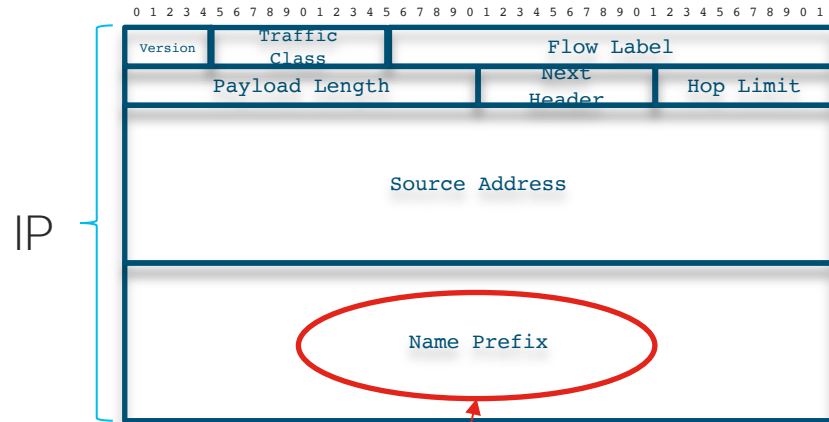


Packet format L3

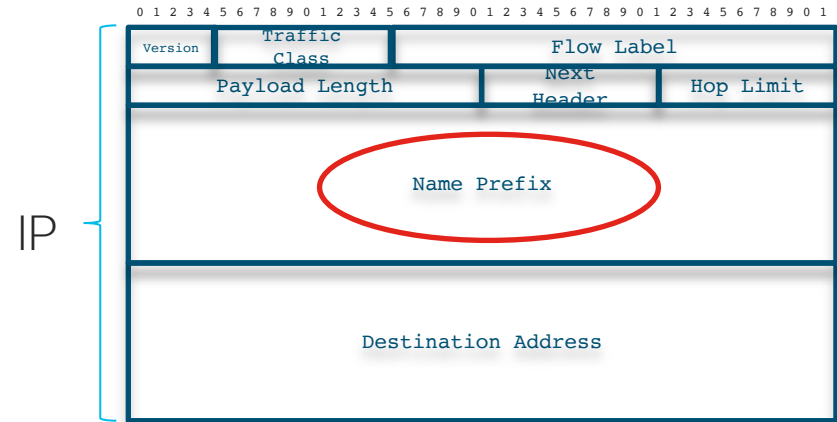
IP packet format to:

- be compatible with hardware
- avoid encapsulation over IP

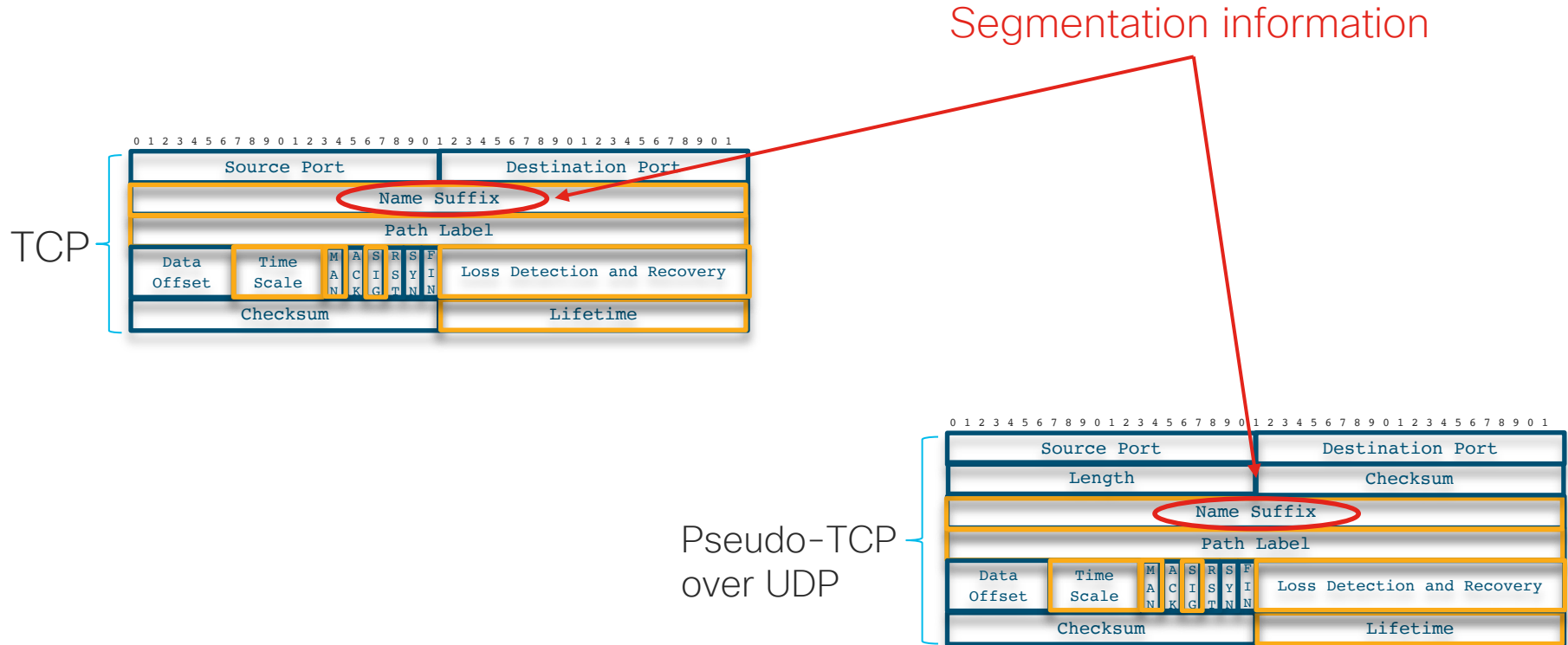
Interest packet



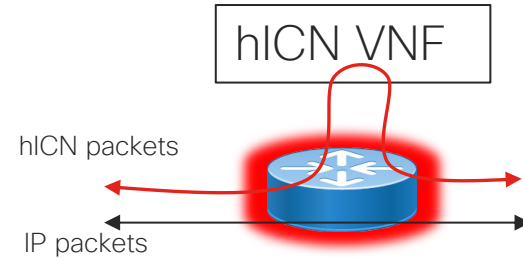
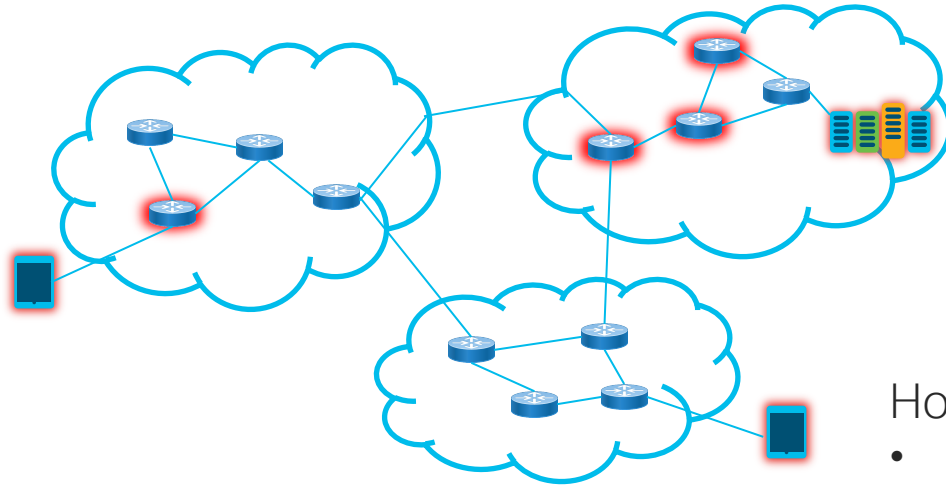
Data packet



Packet format L4



Insertion into existing IP networks

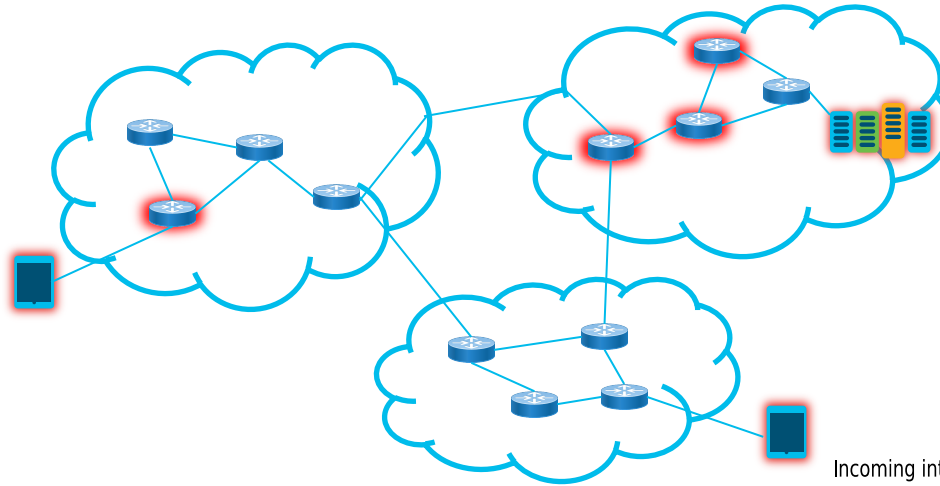


How do we set routing?

- OSPF, BPG... -> limited multipath, multisource

Enabling a new router/host does not require any configuration on any other ip or hICN router

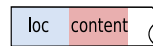
How does forwarding work?



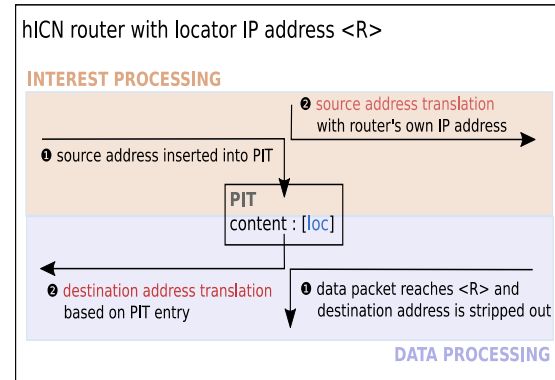
- Interests are forwarded by name
- Data pkts. are forwarded using the PIT

How do we get IP router to forward data pkts. ?

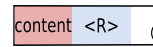
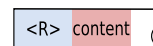
Incoming interest



Outgoing data



Outgoing interest

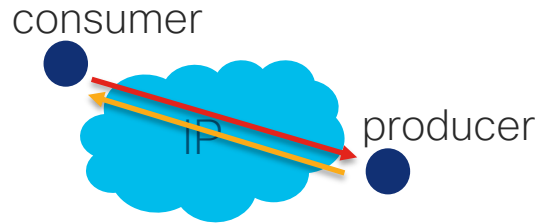


Incoming Data

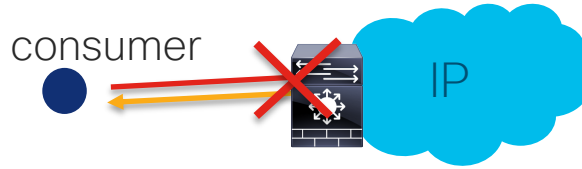
Feasibility

Can hICN traffic traverse the current internet?

- End-to-End reachability



- Middleboxes Traversal



- Compatibility with regular IP routers



Controlled End-To-End Deployments

- hICN enabled in set of representative nodes at the edge
- Content transfer from an hICN-enabled producer to an hICN-enabled consumer
- IP only path
- Producer's IP address as unique content name

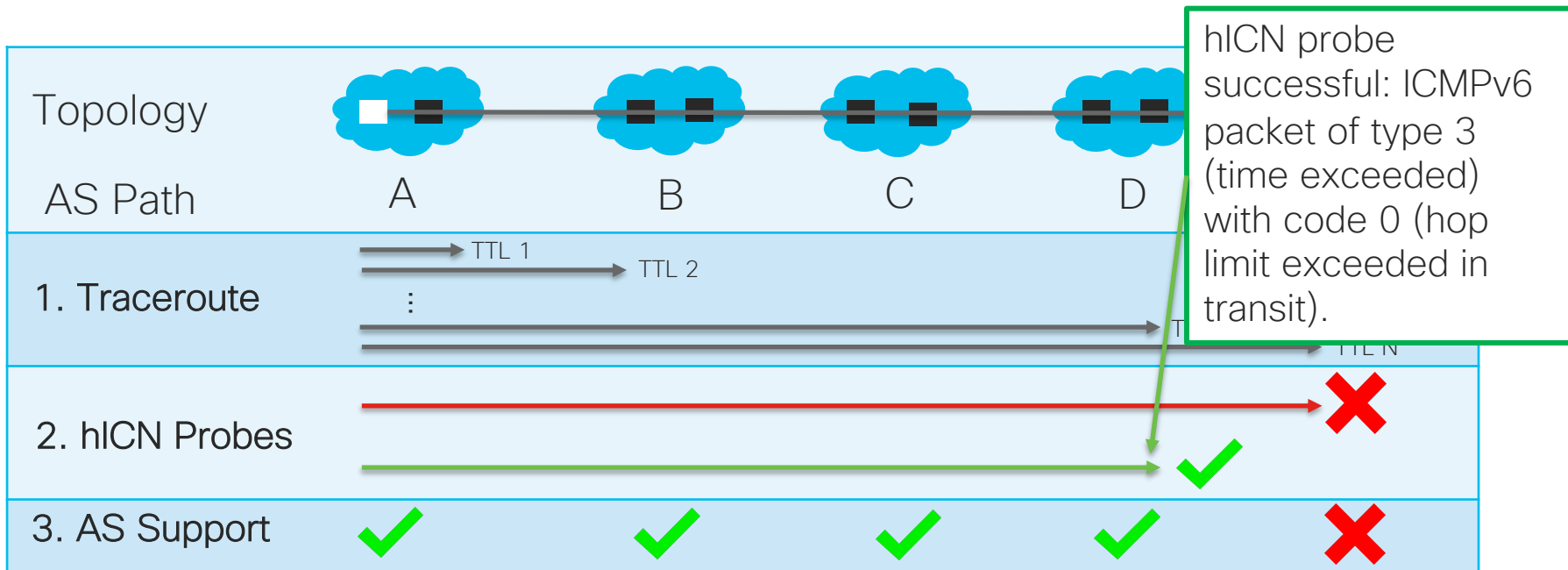
Context	Issues	Counter-Measure
Academic	None	None
DC / Cloud	None	None
Residential	Stateful Firewall	Well known DST port SYN Interests / RST/ACK Data
Enterprise	Security Appliance	First-hop Tunnel

Large Scale Measurements - Dataset

- 48619 prefixes announced by 14398 ASes
- 14455 ASes in the routing system at the time of writing
- Dataset almost covers the entire (IPv6) Internet.
- IP-AS Mapping: Team-Cymru IP-to-ASN + PeeringDB

Large Scale Measurements - Methodology

- Traceroute-like approach



Large Scale Measurements - Results

	Total #AS	# AS	Coverage Ratio %	# AS	hICN Support Ratio %
Cable/DSL/ISP	2291	1169	51.03	1032	88.28
Content	914	480	52.52	423	88.13
Academic	290	181	62.41	160	88.40
Enterprise	257	90	35.02	81	90.00
Non-Profit	211	103	48.8	85	82.52
Not Disclosed	850	355	41.76	309	87.04
Service Provider	1483	991	66.82	912	92.03
Route Server	18	10	55.5	10	100.00
Unknown	8104	2530	31.21	2155	85.17
TOTAL	14418	5909	40.98	5166	87.4

Conclusion

- hICN is inspired by CCNx architecture
- Evolutionary approach to:
 - simplify deployment
 - increase adoption
- Maintain ICN features
- Feasibility tests show hICN traverses most of the AS-es

Internet-Draft: draft-muscariello-intarea-hicn-02

Project: <https://wiki.fd.io/view/HICN>

Email: acompagn@cisco.com

