

Future Internets

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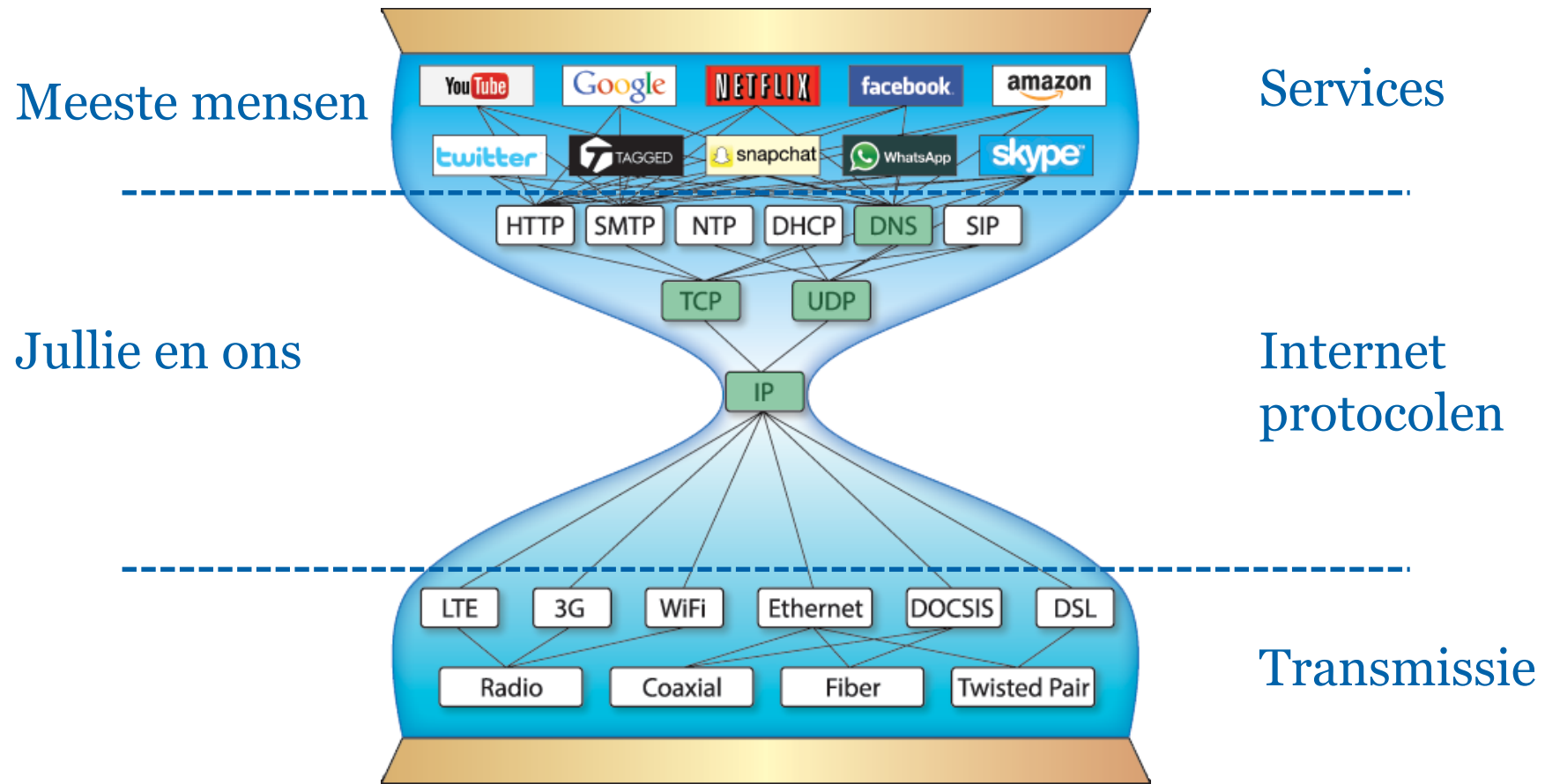


Doel van vandaag

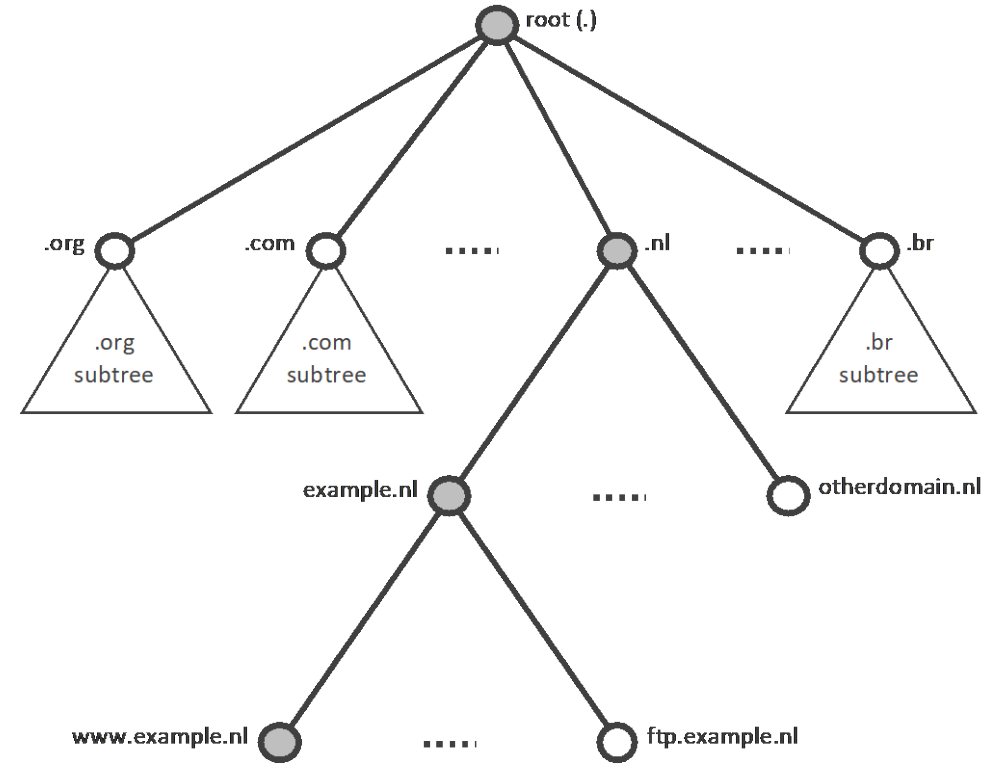
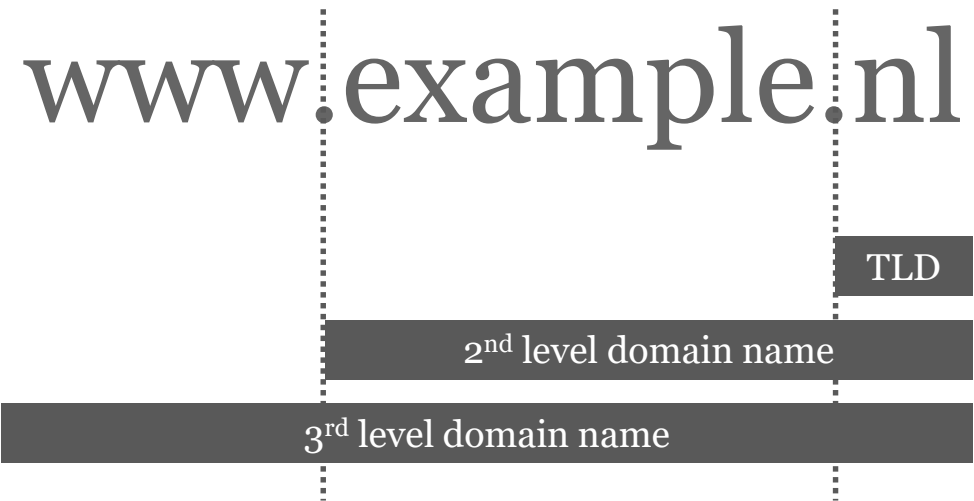
- Discussiëren over redenen om Internet architectuur aan te passen (of juist niet)
- Introductie:
 - Wat geleerd over het huidige Internet?
 - Enkele nieuwe inter-domein genetwerkte systemen
 - Wat gaan we hier aan doen?
- Discussie: Wat voor soort nieuw inter-domein genetwerkt systeem?
- Aanpak: uitleg concepten (± 30 min), discussie (± 30 min)

Wat geleerd over het huidige internet

De protocollen en services

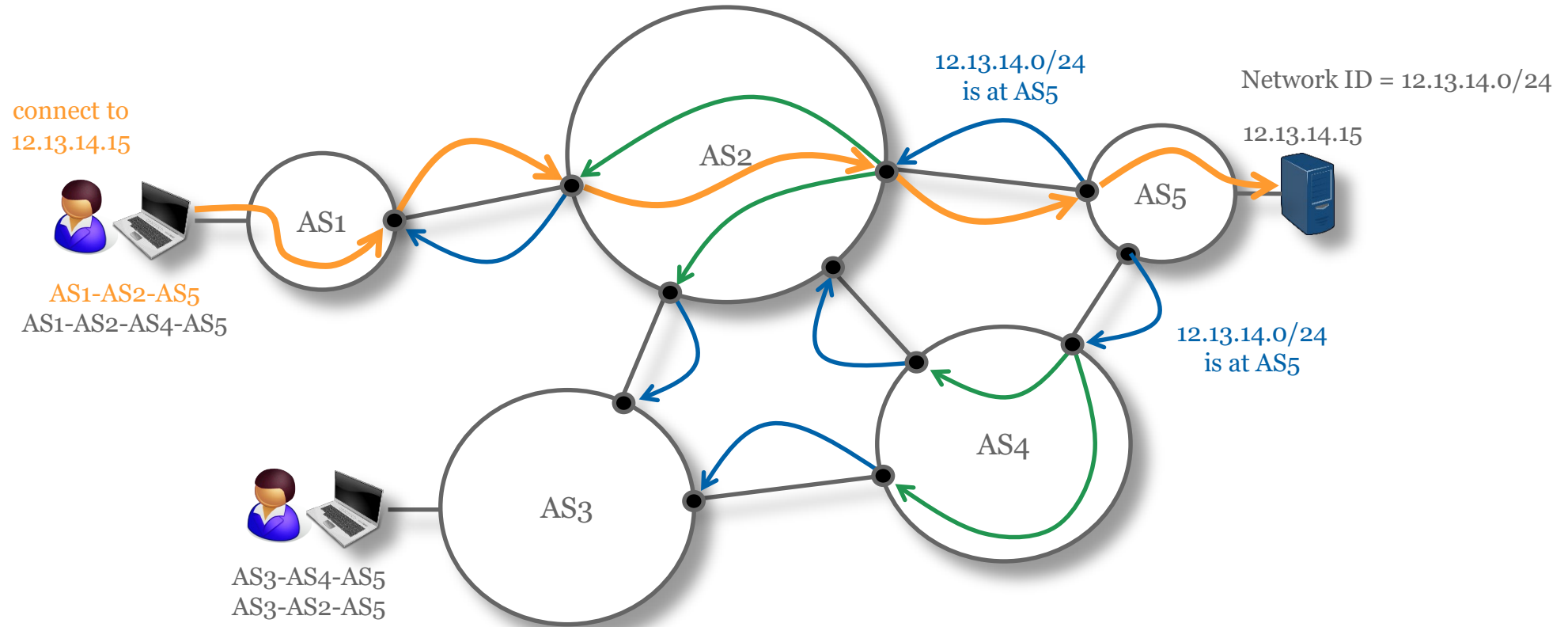


Domein namen



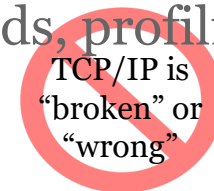
Routing en forwarding

- ← BGP announcement
- ← Internal BGP announcement
- Data flow
- Peering (configured)

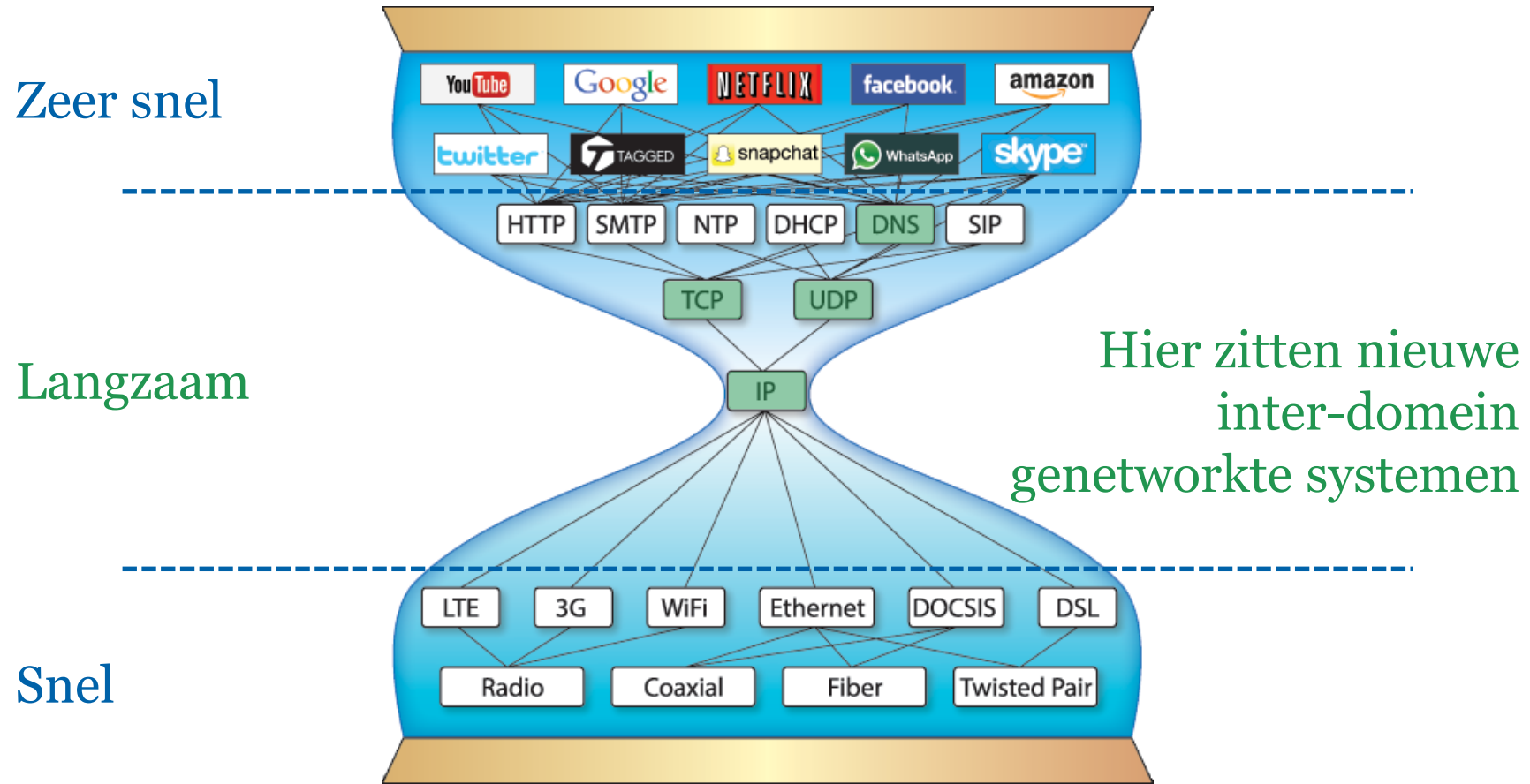


Wat geleerd over huidige Internet

- Thin waist **enabled** worldwide deployment
 - Simple network layer (IP+BGP), no strict QoS demands on underlying layers
 - Stateless, unreliable, unordered, best-effort delivery
- Issues learned:
 - Designed for point-to-point applications (“conversations”), not for multipoint (“dissemination”)
 - Security is an add-on, not an integral part of the core protocols (e.g., DDoS, route hijacks)
 - Does not support mobility (movement between networks)
 - No support for quality guarantees (e.g., latency guarantees for autonomous vehicles)
 - Local incidents may have global effects (e.g., a CA compromise, route hijacks)
 - No path control and verification for applications which need it
 - No influence (self-determination/transparency) on the use of user-data (ads, profiling, steering)



Veranderingen



Voorbeelden:

SCION

NDN

RINA

ManyNets

XIA

MobilityFirst

Nebula

Service-centric networking

FII

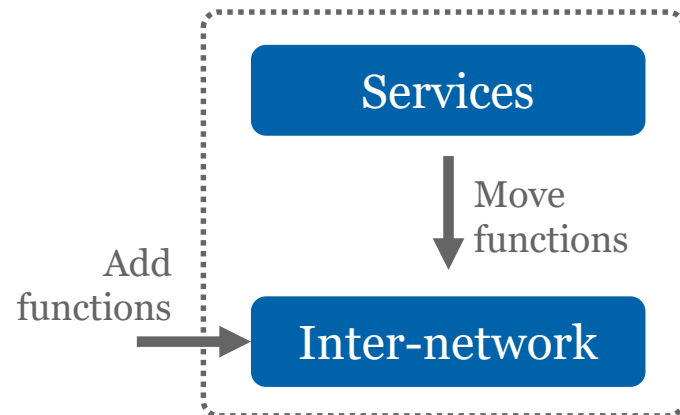
B4

...

Enkele nieuwe inter-domein genetwerkte systemen

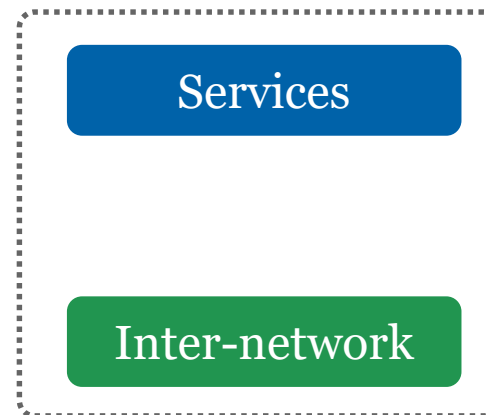
Types of changes proposed

Type 1: functional
Move functions/services in
the network



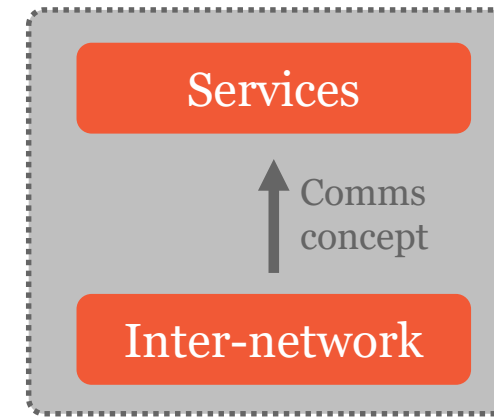
SCION
RINA
MobilityFirst
XIA
...

Type 2: frameworks
New generic architecture for
protocol stacks and/or
(protocol) interfaces



RINA (layers)
XIA (addresses)
FII (interfaces)

Type 3: comms concepts
Network provides other
comms abstraction than IP's
host-based model



Data-centric
Service-centric
XIA, FII (future concepts)
ManyNets

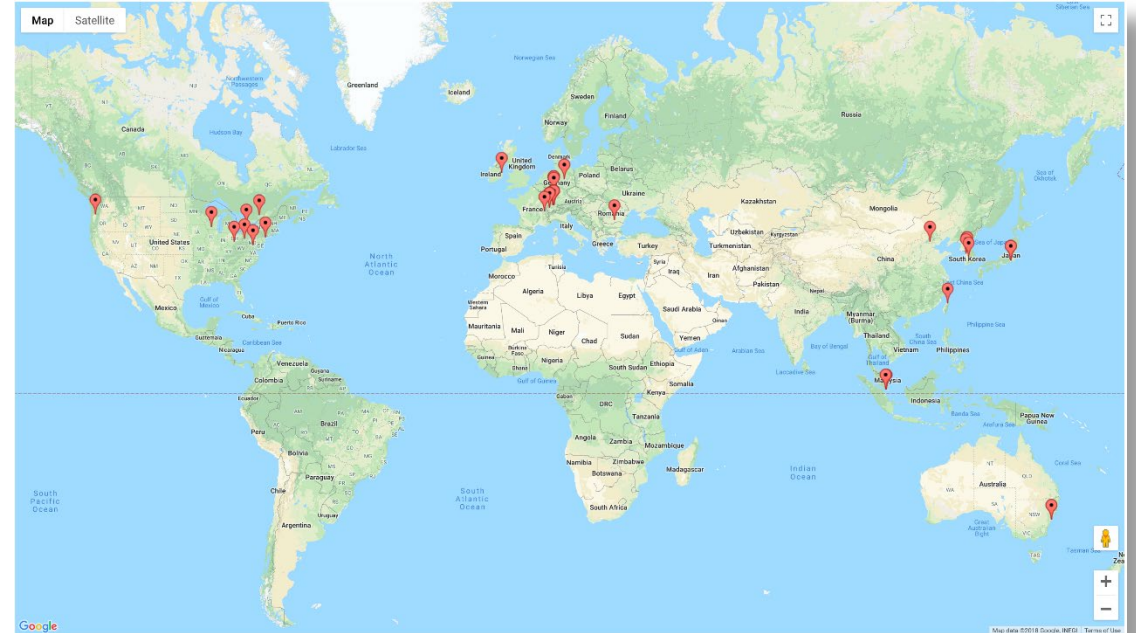
SCION

- Goal: increase control over and transparency, security, and availability of end-to-end communications for “high-end” applications (e.g., energy, finance, airports, medical)
- Isolation domain (ISD) = group of networks (autonomous systems)
 - Set of CAs (Certification Authority) per ISD to supports heterogeneous trust (no single trust root)
 - Isolates failures (e.g., effects of CA compromises) and control plane message flooding
- Key functions
 - Application and operator-controlled AS-level routing with path verification
 - Global certificate verifiability using chaining of ISD-specific CAs + trust agility
 - Name resolution by mapping domain names to <ISD_ID, AS_ID, (local IP address)>



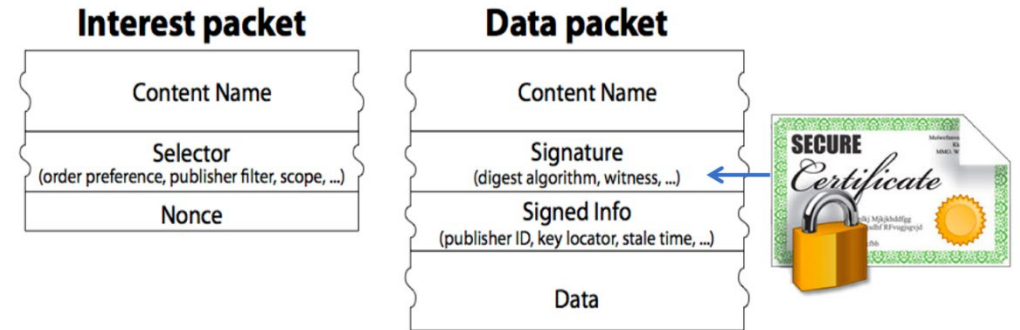
SCION deployment

- Open source software
- Active testbed (36 nodes)
- Papers, tutorials, related IRTF WG
- ~75fte in 2009-2016
- IP-over-SCION, SCION-to-IP gateway, SCION islands through IP tunnels, etc.

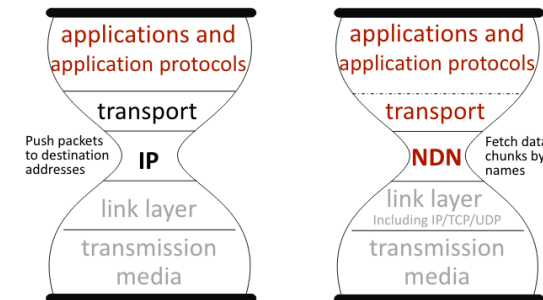


Named Data Networking (NDN)

- Goal: better support for content dissemination (multi-point comms)
- Approach:
 - Content is authentic if it has been signed by the source (e.g., a newspaper)
 - Content can reside anywhere (incl. in the network) -> new distribution models
 - Need content? Just name it and the network will get it for you from wherever
 - So, named data instead of named hosts



```
get(/livingroom/thermostat/status)
get(/com/youtube/starwars/trailer)
get(/acm/sigcomm17/video/monday/_f45/_s23)
```

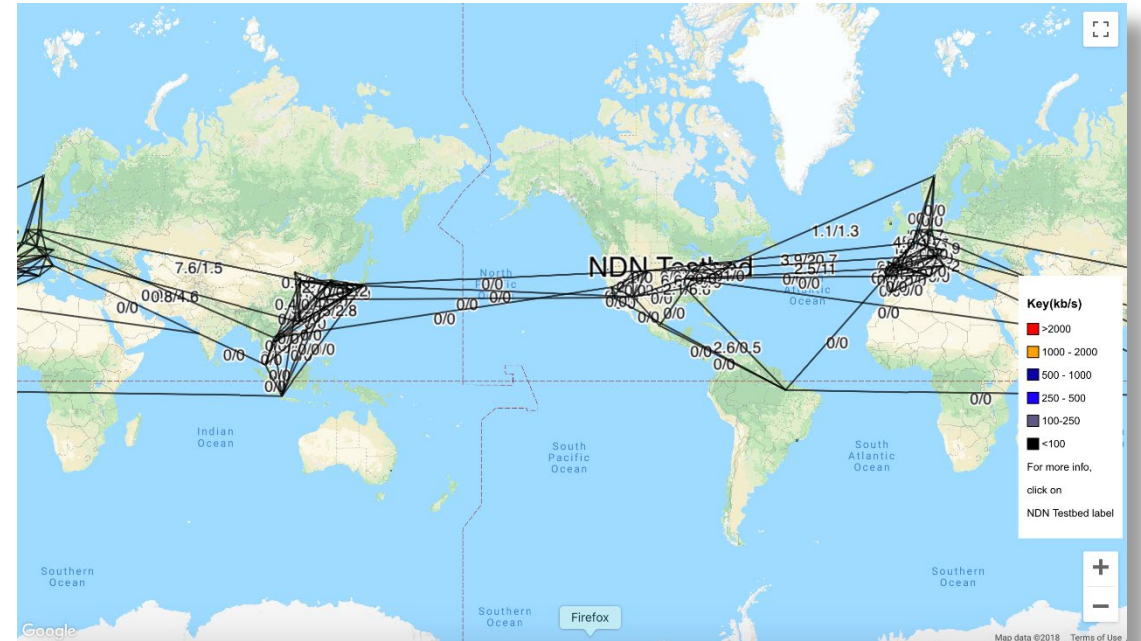


Data is the Thin Waist



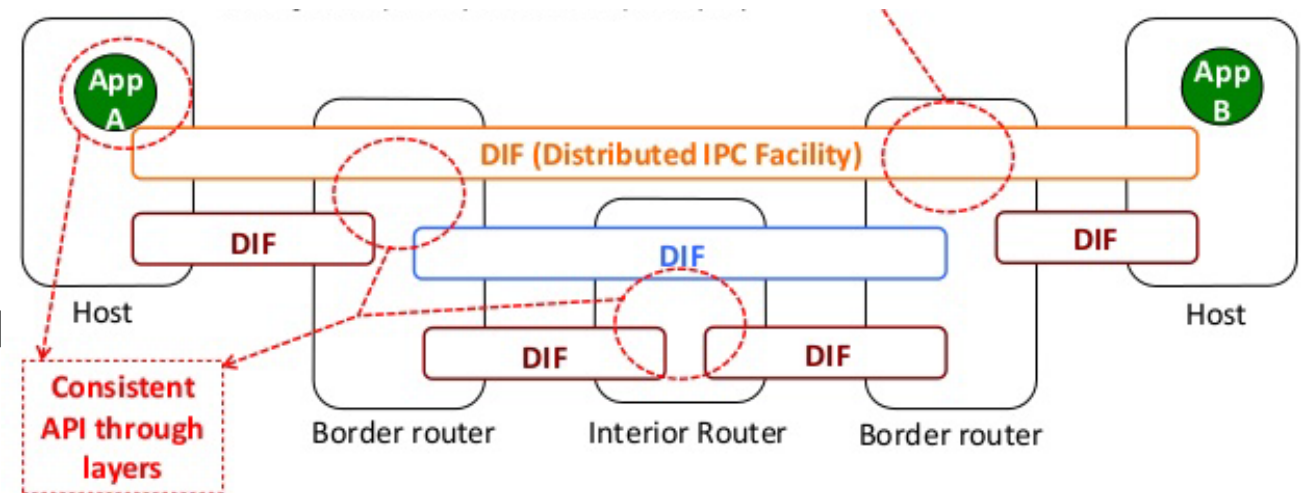
NDN deployment

- Open source software
- Active testbed (46 nodes, 128 links)
- Papers, workshops, IRTF WG (ICN)
- NSF co-funded (\$13.5M in 2010-2016)
- IP-over-NDN, NDN-over-IP



RINA

- It is an architecture, not a protocol
- The network layer provide InterProcess communication (IPC).
- The control of each layer is the same, but there are pluggable functions (around routing, transport and management [QoS]). A layer is a Distributed IPC Facility (DIF).
- The DIF is used in a recursive way.
- Allows for incremental deployment
- Status: Some implementation, ideas of wide area testbeds, researchy



RINA deployment

- Open source software (4 implementations)
- Small testbed
- Papers, workshops, ETSI document
- Several projects (around ~7MEuro, ~6ofte in 2008-2018)
<http://pouzinsociety.org/research/projects>
- IP-over-RINA; RINA-over-IP; and RINA-beside-IP



Wat gaan we hier aan doen?

S3I??? programma

- Veiligheid, stabiliteit en zelf-determinatie/transparantie
- Partnership tussen: NLnet Labs, SIDN Labs (coördinator), SURFnet, UTwente en UvA
- En we staan open voor andere partners
- Doel:
Put Dutch and European internet communities in leading position in the field of secure, stable and self-determined/transparent inter-domain networked systems
- Motivatie...
- Aanpak...

Motivatie

- Verliezen van controle over het Internet (gebruiker, service-provider en maatschappij)
- Er zijn grootschalige bedreigingen (e.g., routing hijacks, DDoS attacks, phishing, niet transparant gebruik van user data of gedrag, enz.)
- Voor nieuwe toepassingen (drones, Internet of Things, self-driving cars, etc.) real-time datatransfer zal andere netwerk technologieën stimuleren.
- Nieuwe technieken kunnen ons helpen (zoals programmeerbare netwerk en cloud services, scheiding van data en controle). Deze concepten kunnen nieuwe inter-domein genetwerkte systemen ondersteunen (zoals: SCION, NDN of RINA)
- We verwachten dan andere netwerken technologieën in parallel met Internet, met gateways voor interconnectiviteit
- Net als in de jaren 1980s/90s; Nederland (en Europa) kan weer het centrum van expertise worden voor deze nieuwe inter-domein genetwerkte systemen

Basis aanpak

- De focus zal liggen op wat mensen en providers van belang vinden, dus we pakken realistische problemen aan.
- De focus is op controle over en veiligheid, stabiliteit en zelf-determinatie/transparantie van inter-domain genetwerkte systems.
- De focus is op bestaande initiatieven die gebruik maken van open source code met een actieve community en test-bed, en bijvoorkeur ondersteund door IETF/IRTF en/of andere standard/recommendatie partijen.
- We nemen een hands-on and experimentele aanpak
- Multi-domein, governance, trust en deployment aspecten worden vanaf het begin meegenomen.
- We dissemineren actief onze resultaten en aanbevelingen via Nederlandse, Europese en wereldwijde academische en operationele communities. Eveneens worden linken gelegd met politiek en het brede publiek.

Gestarte activiteiten

- NCSRA-III project proposal towards NWO (UvA en UTwente)...
- Testbed:
 - National P4 testbed...
 - Familiarise with SCION and meet SCION developers (ETZ, Zurich, April) (SIDN)...
 - Get contacts around RINA (Workshop on the Recursive InterNetwork Architecture, Paris, Feb)
 - Familiarise with P4 (P4 hackathon, Frankfurt, March)
 - “P4 Programming BoF; exploring R&E community use cases” (TNC19 samen met GÉANT, June)

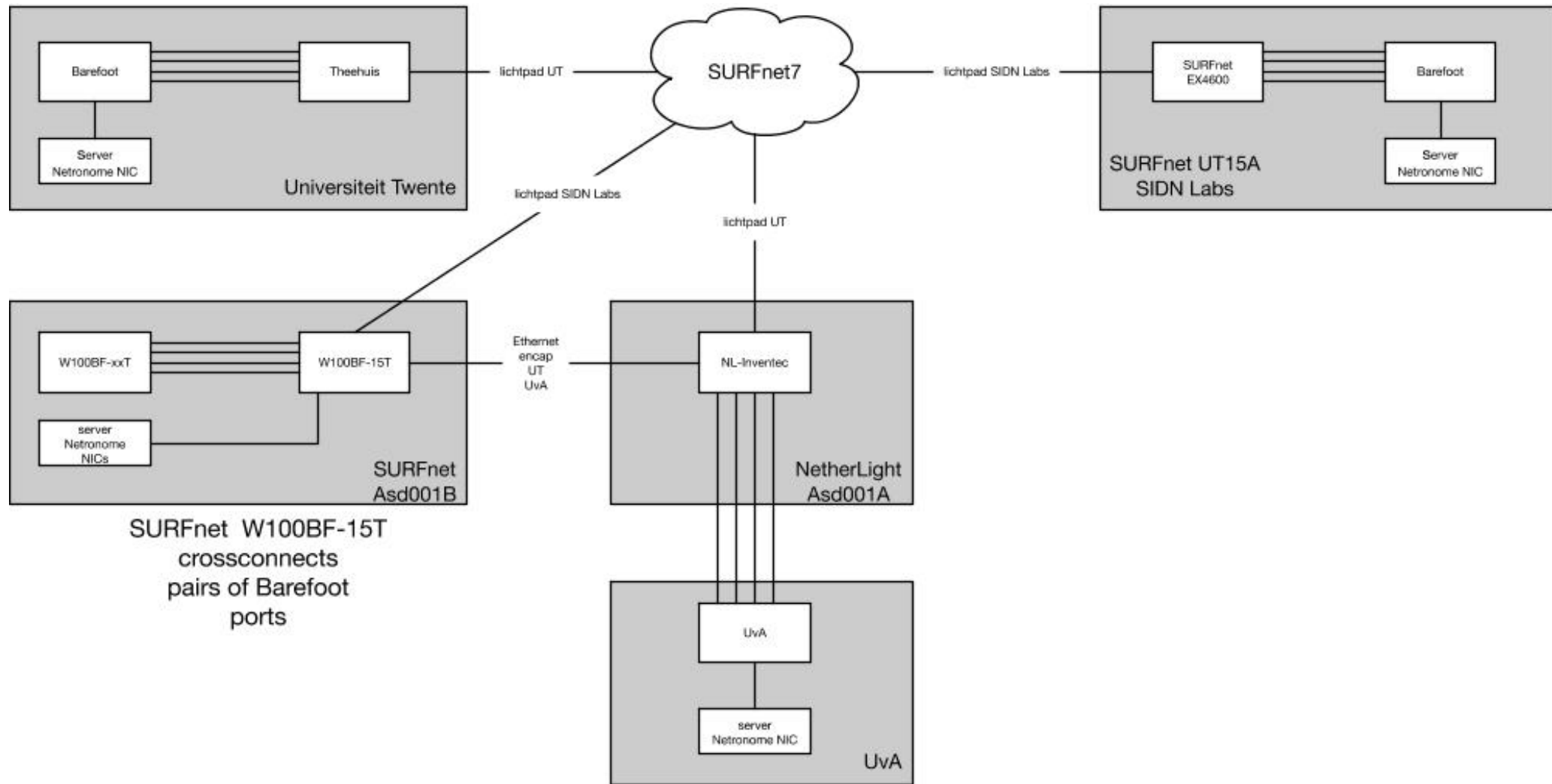
NCSRA-III project voorstel

- NWO's Cyber Security call
- Title: User-driven path verification and control for inter-domain networked systems
- Goal is to provide users with more transparency and enable new types of services
- Pre-proposal accepted and final proposal due on April 16
- Approach:
 - Attestation of properties of routers on a path (e.g. certified and cryptographic proof of manufacturer of device)
 - Include results in existing systems (IP/SCION/RINA/...)
 - Evaluation using S3I test-bed

Test-bed

- Will provide actual/concrete technical knowledge
- A means of working together and forming a team
- Come up with relevant technologies as demos/use cases.
- Determine maturity of P4 implementations for technologies such as: SCION, NDN and RINA.
- Show case network slicing (multiple networks on one physical infrastructure)
- Showcase "multi administrative domain"
- Implementatie:
 - P4 programmeerbare Barefoot switches
 - servers met P4/eBPF programmeerbare Netronome smart NICs topologie
 - SURFnet7 lichtpaden voor onderlinge connectiviteit

Concept test-bed topologie



Familiarise with SCION

- Connected a node (AS) to the international SCION test-bed
- Developed a first prototype of SCION in P4
 - Runs in simulation environment
 - Supports core features of the SCION protocols
 - Made a SCION application: netcat
 - Next step is to test it on real devices
- In contact with the SCION team
 - Bug fixes and discussion on protocol
- Visit planned to ETH and SWITCH in April

Discussie: Wat voor soort nieuw inter-domein genetwerkt systeem?

Meer details m.b.t aanpak

- Tot op welke laag? Alleen netwerk laag of ook hoger?
- Wat voor invloed moeten we uitoefenen en naar welke partijen?
- Spanning tussen evolutie en revolutie van inter-domain genetwerkte systemen.
- Moeten we sommige termen verder aanscherpen, wetende wat we kunnen in 2 tot 4 jaar (zoals transparantie <-> zelf-determinatie)?
- Afhankelijk van scope: moeten we multidisciplinair worden (in de toekomst)?
- Slicing van netwerken (een enkele fysieke infrastructuur wordt door meerdere netwerk protocollen gebruikt): zal dat meer future-proof mogelijkheden geven
- Deze inter-domein genetwerkte system worden gebruikt/geleverd/gecontroleerd door: gebruikers, service-providers en maatschappij. Zijn er andere belangrijke sub-groepen? Wat voor eisen stellen die m.b.t. veiligheid, stabiliteit en zelf-determinatie/transparantie?
- Zijn die eisen verenigbaar? Waar wel, waar niet?
- Ideeën over use cases?
- Welke van de genoemde nieuwe inter-domein genetwerkte systemen mapt het best op deze eisen?
- Hoe is de link tussen netwerk en applicaties?

Further reading

Further reading

1. David Barrera, Laurent Chuat, Adrian Perrig, Raphael M. Reischuk and Pawel Szalachowski, “The SCION Internet Architecture”, Communications of the ACM 60 (6), June 2017
2. Van Jacobson, Diana K. Smetters, James D. Thornton, Michael F. Plass, Nicholas H. Briggs, Rebecca L. Braynard, “Networking Named Content”, CoNEXT’09, Dec. 2009, Rome, Italy
3. F. Goldstein and J. Day, “Moving beyond TCP/IP”, Pouzin Society, Apr 2010, <http://rina.tssg.org/docs/PSOC-MovingBeyondTCP.pdf>
4. M. Ammar, “Ex uno pluria: The Service-Infrastructure Cycle, Ossification, and the Fragmentation of the Internet”, ACM SIGCOMM Computer Communication Review, Vol. 48, Issue 1, January 2018
5. P. Bossharty, D. Daly, G. Gibby, M. Izzardy, N. McKeownz, J. Rexford, C. Schlesinger, D. Talaycoy, A. Vahdat, G. Varghesex, and D. Walker, “P4: Programming Protocol-Independent Packet Processors”, ACM SIGCOMM Computer Communication Review, Volume 44, Issue 3, July 2014, Pages 87-95

Volg ons

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Dankjewel!

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