ICN-IP Underlay Coexistence Approaches

Research question: What are the security and privacy features supported by different underlay-based ICN-IP coexistence architectures?

Made by: Cesar van der Poel (C.B.vanderPoel-1@student.tudelft.nl)
Responsible Professor: Prof. Mauro Conti (M.Conti@tudelft.nl)
Supervisor: Dr. Chhagan Lal (C.Lal@tudelft.nl)

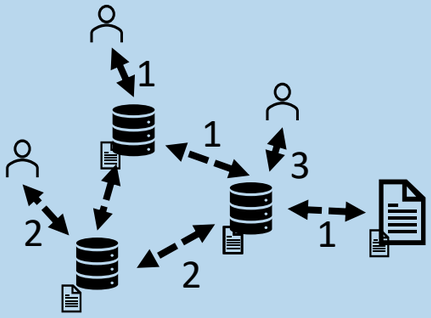

Fig. 1: An illustration of ICN; only request 1 is handled by the server, 2 and 3 are handled by consulting one or more caches

1. Background

- Information Centric Networking [1], Fig. 1
- Content, not host
- Caching
  - Serve subsequent requests
  - Less traffic and load
- Unfeasible to "replace" internet at once
  - Coexistence

Fig. 2: Underlay architectures allow for coexistence by mapping IP packets to ICN packets via gateways (round arrows). This way, IP packets can be "tunnelled" (dotted line) over ICN networks to reach IP servers (top right), or be handled by caches (bottom left).

2. Method

- Literature study
- Identify architectures
- Privacy and security requirements
- Investigate requirement support per architecture
- Summarize conclusion
  - Trade-offs

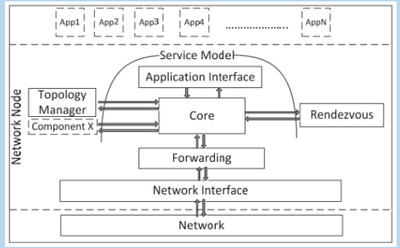

Fig. 3: The POINT architecture does not use routers for routing, but instead calculates the route content should take before requesting it. Nodes in the network then forward it following this route [3].

3. Underlay

- Different coexistence approaches [2]
  - Overlay
  - Hybrid
  - Underlay, Fig. 2
- POINT [3], Fig. 3
- CableLabs [4], Fig. 4
- DOCTOR [5], Fig. 5
- Different workings, affect requirements?

4. Privacy and security

- Safe transition
- Privacy, security of architecture
  - Anonymity
  - Request secrecy
  - Confidentiality
  - Unlinkability
  - Availability
  - Integrity
  - Access control
  - Non-repudiation
- Support more -> safer

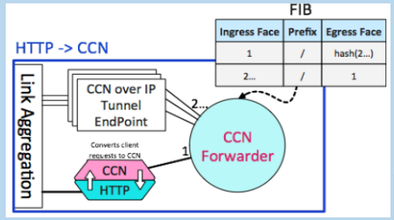

Fig. 4: CableLabs places clusters of ICN nodes inside the IP network. From the perspective of the IP network, this ICN network functions as one big caching server [4].

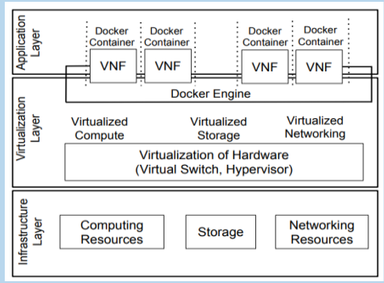

Fig. 5: The DOCTOR architecture uses Virtualised Network Functions (VNF) for increased flexibility. The nodes can run multiple VNFs (for example IP and ICN) in parallel. This does not, however, remove the need for gateways [5].

5. Results

- Approximately same requirements satisfied
  - No real trade-offs
- Deployment, usability

	POINT	CableLabs	DOCTOR
Anonymity	Largely	Mostly	Largely
Request secrecy	Partially	Largely	Partially
Confidentiality	Not	Not	Partially
Unlinkability	Partially	Largely	Largely
Availability	Mostly	Mostly	Mostly
Integrity	Partially	Partially	Largely
Access Control	Not	Not	Not
Non-repudiation	Not	Not	Partially

6. Future work

- Compare overlay/hybrid
  - Different approach, affects requirements
- Satisfy all requirements
  - Improve, redesign, mitigate violations
- Transition approach
  - Where to start, who to involve

References

[1] F. Almeida, "Information Centric Networks – Design Issues, Principles and Approaches," Accessed: May 18, 2021. [Online]. Available: https://www.academia.edu/19555977/Information_Centric_Networks_Design_Issues_Principles_and_Approaches.

[2] A. Rahman, D. Trossen, D. Kutscher, and R. Ravindran, "RFC 8763: Deployment Considerations for Information-Centric Networking (ICN)," p. 30.

[3] D. Trossen, M. J. Reed, J. Riihijärvi, M. Georgiades, N. Fotiou, and G. Xylomenos, "IP over ICN - The better IP?," in *2015 European Conference on Networks and Communications (EuCNC)*, Jun. 2015, pp. 413–417, doi: 10.1109/EuCNC.2015.7194109.

[4] G. White and G. Rutz, "Content Delivery with Content-Centric Networking," Feb. 2016, [Online]. Available: https://www.cablelabs.com/wp-content/uploads/2016/02/Content-Delivery-with-Content-Centric-Networking-Feb-2016.pdf.

[5] "DOCTOR project." http://www.doctor-project.org/index.htm (accessed Apr. 29, 2021).