Security and Privacy features of the overlay-based ICN/IP coexistence architectures

Security and privacy are crucial to the modern Internet, therefore all potential future Internet architectures must be thoroughly analysed for the support of the security and privacy features.

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1.INTRODUCTION

Information-Centric Networking (ICN) is a common approach to future Internet architectures. As opposed to the current host-centric Internet architecture, ICN focuses on data regardless of where it is located and employs in-network caching to improve scalability and availability [1].
Transitioning to the new architecture right away is hard, therefore there will be some period of coexistence of the new and old architectures. This research focuses on **overlay-based coexistence architectures**. These architectures use underlying protocols such as IP to carry ICN packets without changing them from one network node to another [3].

2.OBJECTIVE

> What security and privacy features are supported in the overlay-based ICN/IP coexistence architectures?

3.METHODOLOGY

The three most popular overlay architectures were chosen: **NDN** [5], **PURSUIT** [4], and **NetInf** [2].
These architectures are analysed in order to determine which of the following security and privacy features are supported in each architecture:

- Security - **availability**, **access control**, **data integrity**, **nonrepudiation**, **data authentication**
- Privacy - **anonymity**, **data confidentiality**, **unlinkability**

The analysis is performed by the means of an in-depth review of the relevant literature.

4.ANALYSIS

Table 1 below provides an overview of the results of the analysis of security and privacy features (S&P) for NDN, PURSUIT, and NetInf.

S&P feature	NDN	PURSUIT	NetInf
Availability	+	+	+
Access Control	+	+	+
Data Integrity	+	+	+
Nonrepudiation	+	+	-
Data Authentication	+	+	+-
Anonymity	+	+	+
Data Confidentiality	+	+	+
Unlinkability	+	+	+

Table 1: Support of security and privacy features in different overlay ICN architectures (“+” - *supported*, “-” - *not supported*, “+-” - *partially supported*)

As can be concluded from Table 1, **only NDN and PURSUIT support all eight security and privacy features**. Meanwhile, **NetInf is lacking nonrepudiation and hence cannot also fully supports data authentication**. In order for NetInf to support all eight features, it should implement data origin authentication and nonrepudiation. Both can be achieved if the content is augmented with the producer’s private key. The analysis shows that there is still work and research to be done in this area before new architecture can be deployed globally, however, the results are already quite promising. **All three investigated architectures support the features that are inherent to ICN, such as availability and anonymity.** NDN and PURSUIT have better support of S&P features than Net-Inf. Therefore, they are more secure as an overlay-based ICN/IP coexistence architecture.

5.RESULTS

Two out of the three architectures that were analysed support all eight security and privacy features, while the third one is missing one security feature completely and one more feature is supported only partially, namely nonrepudiation and data authentication.
This means that overlay-based architectures have extensive support of security and privacy features, however, there are still points for improvement.

6.CONCLUSION

This research aimed to answer the question of what security and privacy (S&P) features are supported by overlay-based ICN/IP coexistence architectures. The three most popular overlay architectures were chosen for this - NDN, PURSUIT, and NetInf. These architectures were analysed to find whether or not they support common S&P features. We have reached the conclusion that NDN and PURSUIT support all eight S&P features which were used, while NetInf is missing the support for nonrepudiation and has only partial support for data authentication.
In general, NDN, PURSUIT and NetInf have a good support for privacy and security, but it is still too early to deploy such architectures in the real world.

REFERENCES

[1] Bengt Ahlgren, Christian Dannewitz, Claudio Imbrenda,Dirk Kutscher, and B¨orje Ohlman.A survey ofinformation-centric networking.IEEE CommunicationsMagazine - IEEE Commun. Mag., 50:26-36, 07 2012.
[2] Christian Dannewitz, Dirk Kutscher, B¨orje Ohlman,Stephen Farrell, Bengt Ahlgren, and Holger Karl. Network of information (netinf) - an information-centricnetworking architecture.Computer Communications,36:721-735, 04 2013.
[3] Eduardo Rosa and Fl´avio Silva. Enabling native coexistence between icn and tcp/ip architectures over the same domain. pages 13-19, 12 2020.
[4] Nikos Fotiou, Pekka Nikander, Dirk Trossen, and George C. Polyzos. Developing information network-ing further: From psirp to pursuit. In Ioannis Tomkos, Christos J. Bouras, Georgios Ellinas, Panagiotis Demestichas, and Prasun Sinha, editors, Broadband Communications, Networks, and Systems, pages 1-13, Berlin,Heidelberg, 2012. Springer Berlin Heidelberg.
[5] Tamer Refaei, Jamie Ma, Sean Ha, and Sarah Liu. Integrating ip and ndn through an extensible ip-ndn gateway.pages 224-225, 09 2017.