



Rate-Controlled Pub/Sub with NDN

Motivation

In prior work [1], we proposed LL interests as an extension to Named-Data Networking (NDN) [2] to realize pub/sub functionality with NDN in the context of Time-Sensitive Networks (TSN). With those, a single interest can result in one or more data packets being delivered from the server to the client. This concept is implemented within the C++ implementation of NDN and is integrated into the EnGINE framework [3,4], enabling straightforward experimentation with the concept.

LL interests somewhat break the paradigms of NDN, where interests are used to realize rate control of data packets. The goal of this thesis would be to investigate and develop mechanisms that could realize rate control when LL interests are used. This would be combined with an investigation of how this rate control could interact and be realized with resource reservations present in TSN (e.g., with the CBS traffic shaper).

The resulting rate control mechanism should be combined (at least theoretically) with resource reservation solutions that respond according to the pre-allocated resources (if any), can adjust allocations dynamically, or work best-effort in the absence of allocation. All variants could rely on different utility functions for rate control (e.g., rate or delay-based ones).

Your Tasks

- Research related work and define a rate control mechanism for NDN with LL interests
- Implement this mechanism into NDN and integrate it with EnGINE
- Consider its theoretical interactions with resource reservation mechanisms
- Validate the functionality of your mechanism and compare it against normal NDN

Requirements

- General knowledge of computer networking
- Good knowledge of C++ and Python
- Knowledge of NDN/ICN concept, as well as TSN is a plus, but not a must and can be learned during thesis
- Knowledge of Ansible is a plus, but not a must and can be learned during thesis

References

- [1] Marcin Bosk and Jörg Ott. 2024. Towards Domain-Specific Time-Sensitive Information-Centric Networking Architecture. In 4th International Workshop on Time-Sensitive and Deterministic Networking (TENSOR), co-located with IFIP Networking 2024.
- [2] Lixia Zhang, Alexander Afanasyev, Jeffrey Burke, Van Jacobson, kc claffy, Patrick Crowley, Christos Papadopoulos, Lan Wang, and Beichuan Zhang. 2014. Named Data Networking. SIGCOMM Comput. Commun. Rev. 44, 3 (jul 2014), 66–73.
- [3] Rezabek, Filip, Marcin Bosk, Thomas Paul, Kilian Holzinger, Sebastian Gallenmüller, Angela Gonzalez, Abdoul Kane et al. "Engine: Flexible research infrastructure for reliable and scalable time sensitive networks." Journal of Network and Systems Management 30, no. 4 (2022): 74.
- [4] Marcin Bosk, Filip Rezabek, Kilian Holzinger, Angela Gonzalez Marino, Abdoul Aziz Kane, Francesc Fons, Jörg Ott, and Georg Carle. 2022. Methodology and Infrastructure for TSN-Based Reproducible Network Experiments. IEEE Access 10 (2022), 109203–109239.

Contact

Marcin Bosk
Email: bosk@in.tum.de

