ICN Management Considerations

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Outline

- Introduction
- Why ICN Management
- The NDN Case
- Considerations on NetInf
- Conclusion

Introduction

- IP-based, host-centric networking was built with a low set of requirements
- Management, security, mobility
  - All came afterwards as “add-ons”
  - Difficult to integrate all “add-ons” simultaneously
- ICN establishes a new intercommunication paradigm
  - Taking into consideration today’s requirements and use patterns
  - Enabling and facilitating continuous evolution and support for new scenarios

ICN Network Management

- It is important to consider in ICN operational aspects, other than internetworking, right from the start
  - Collect requirements
  - Verify experiences
- But more importantly
  - Accelerate real-world deployment of ICN
  - Address future opportunities in network management

Why ICN Management?

- ICN may require managing more than i/f's, services, etc., for instance:
  - Mechanisms for building optimized content dissemination systems could be part of this work
  - Caching vs. enabling i/f's to access local networks etc.
- New challenges for "classic" topics
  - How do we apply typical host-centric management procedures in an information-centric network?
- Leverage ICN primitives in management
  - Consider information-centric procedures

Two Aspects

- How do we manage information-centric networks?
- How do we use ICN primitives in network management?

About the Draft

- The “ICN Management Considerations” draft, aims to:
  - Draw attention to the importance of management procedures for real-world ICN deployments
    - Engage the IRTF community
  - List considerations for generic ICN deployment management procedures
  - Illustrate an example from an NDN deployment
  - Consider NetInf deployment

NDN Overview

- Provides hierarchical, human-readable namespace
  - To address and route data objects
  - Content is requested via *Interest* packets
  - Content is provided in *Data* packets
- Stores content locally on the nodes from the source to the requester (Content Store – CS)
- Keeps track of pending *Interests*, mapping them to a corresponding egress interface (PIT)
- Interfaces with other aspects (e.g., routing) to determine the *Strategy* in terms of *Interest* forwarding (FIB)

NDN Management

- Several management opportunities arise, for example:
  - How to combine network-side and client-side information, in order to optimize
    - interface selection?
    - forwarding strategy?
  - How to use NDN-specific mechanisms (*Interest+Data* exchange, names) to support those management procedures?

NDN Management Framework

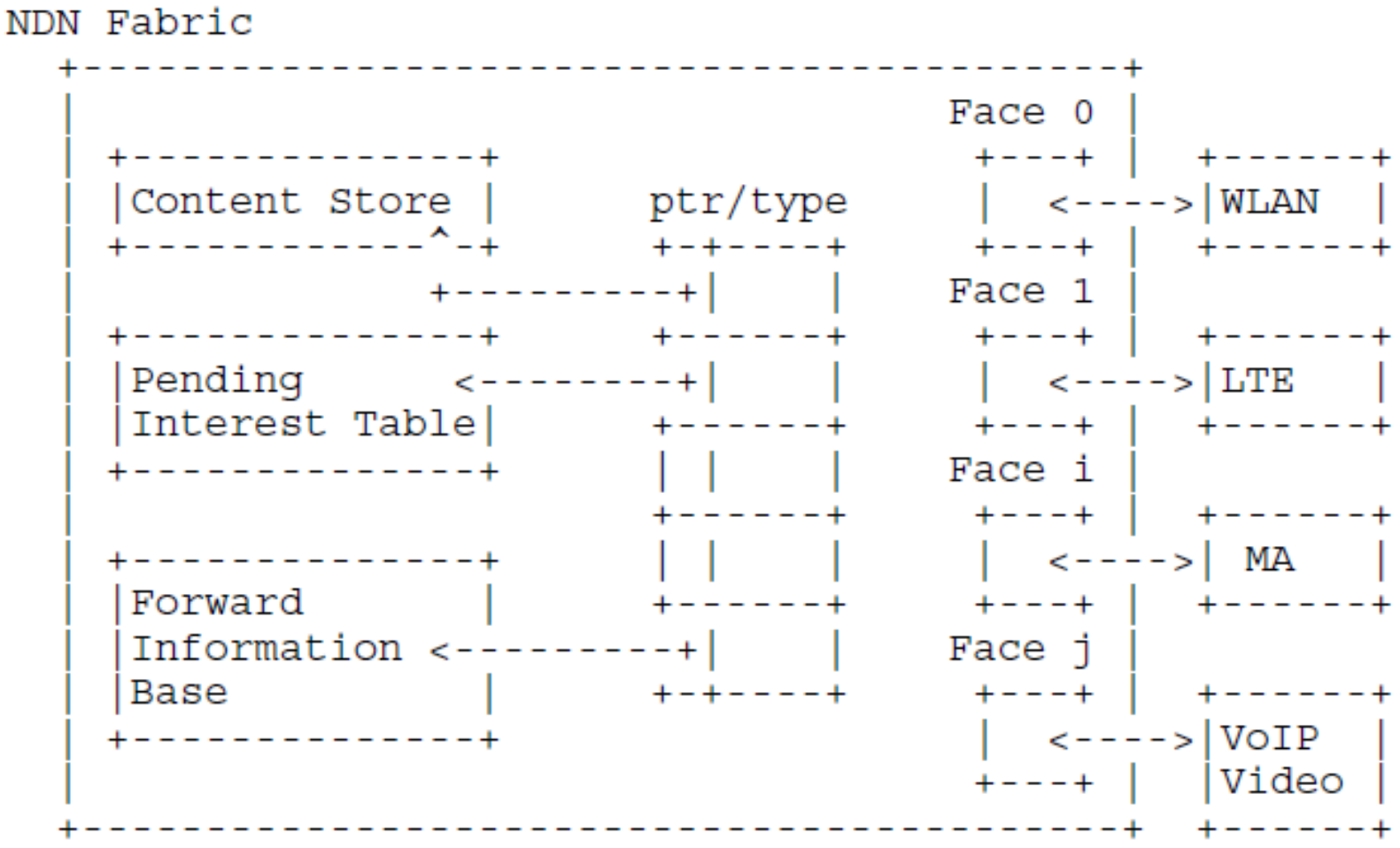


Figure 1. NDN Management Framework

The NDN Case: Management Agent

- Residing in the Mobile Node
  - Interfaces with network adapters, applications and the NDN fabric
  - Able to read requirements (from applications), network conditions (from the adapters) and fine-tune NDN behavior, e.g. optimized interface selection
- Residing in the Network
  - Interfaces with network equipment and content sources
  - Able to determine network status and interface with other network mechanisms (e.g., policy, AAA, etc.)

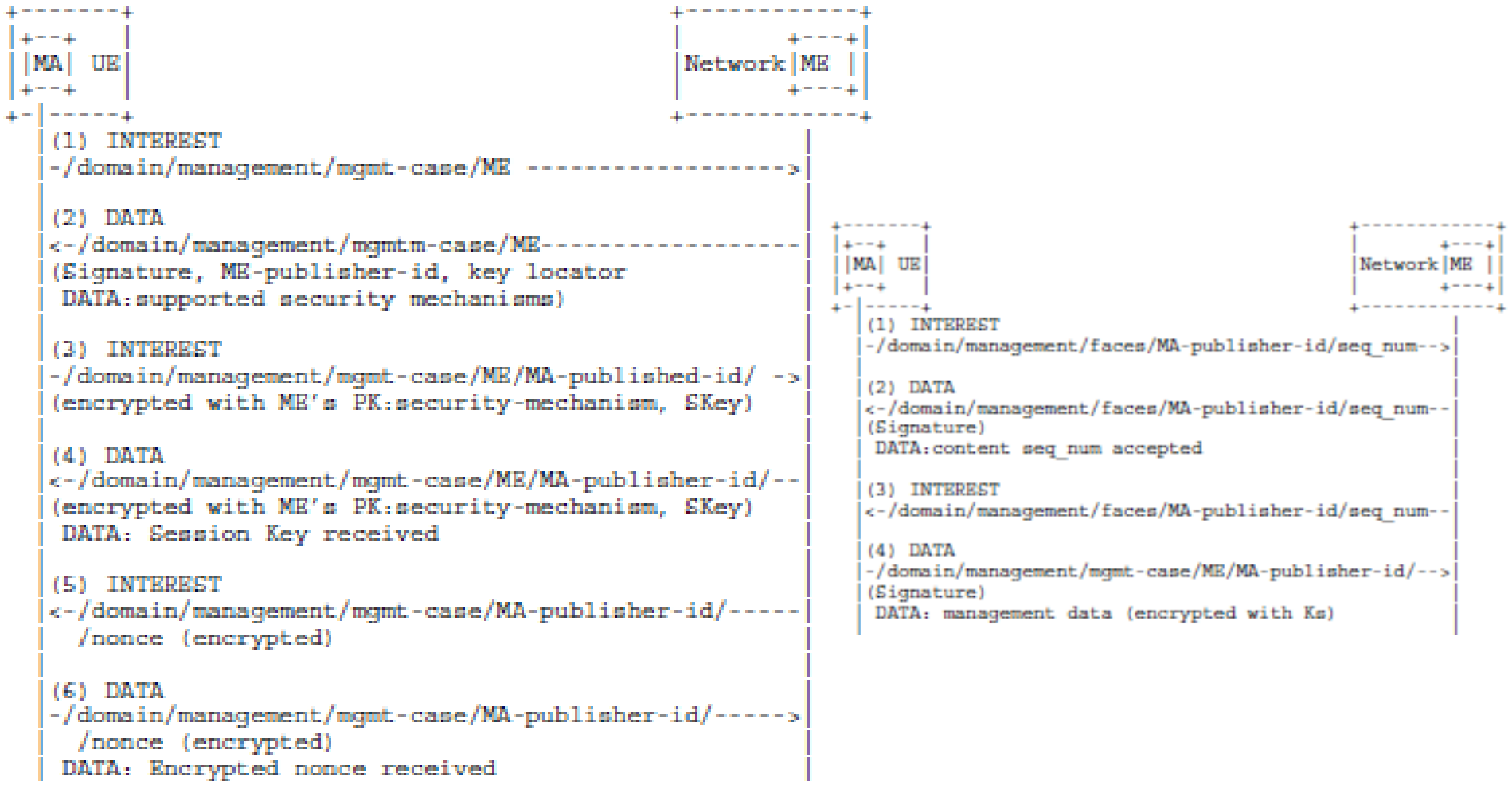
The NDN Case: MA Interaction

- The MA in the network can interact with the MA in the mobile node
  - Use case: optimized connectivity for the mobile node, taking into consideration
    - current network conditions
    - application/user requirements
  - Use case: other scenarios
    - E.g., Load Balancing

NDN Enhancements

- Enable NDN fabric to be controlled via an *Interest+Data* exchange
- Other mechanisms needed:
  - Support of management procedures discovery
  - Asynchronous information exchange
- Both leverage the intrinsic security procedures provided by NDN

The NDN Case



Based on: D. Corujo, I. Vidal, J. Garcia-Reinoso, R. L. Aguiar, "A Named Data Networking Flexible Framework for Management Communications", *IEEE Commun. Mag.*, vol. 50, no. 12, pp. 36-43, Dec. 2012

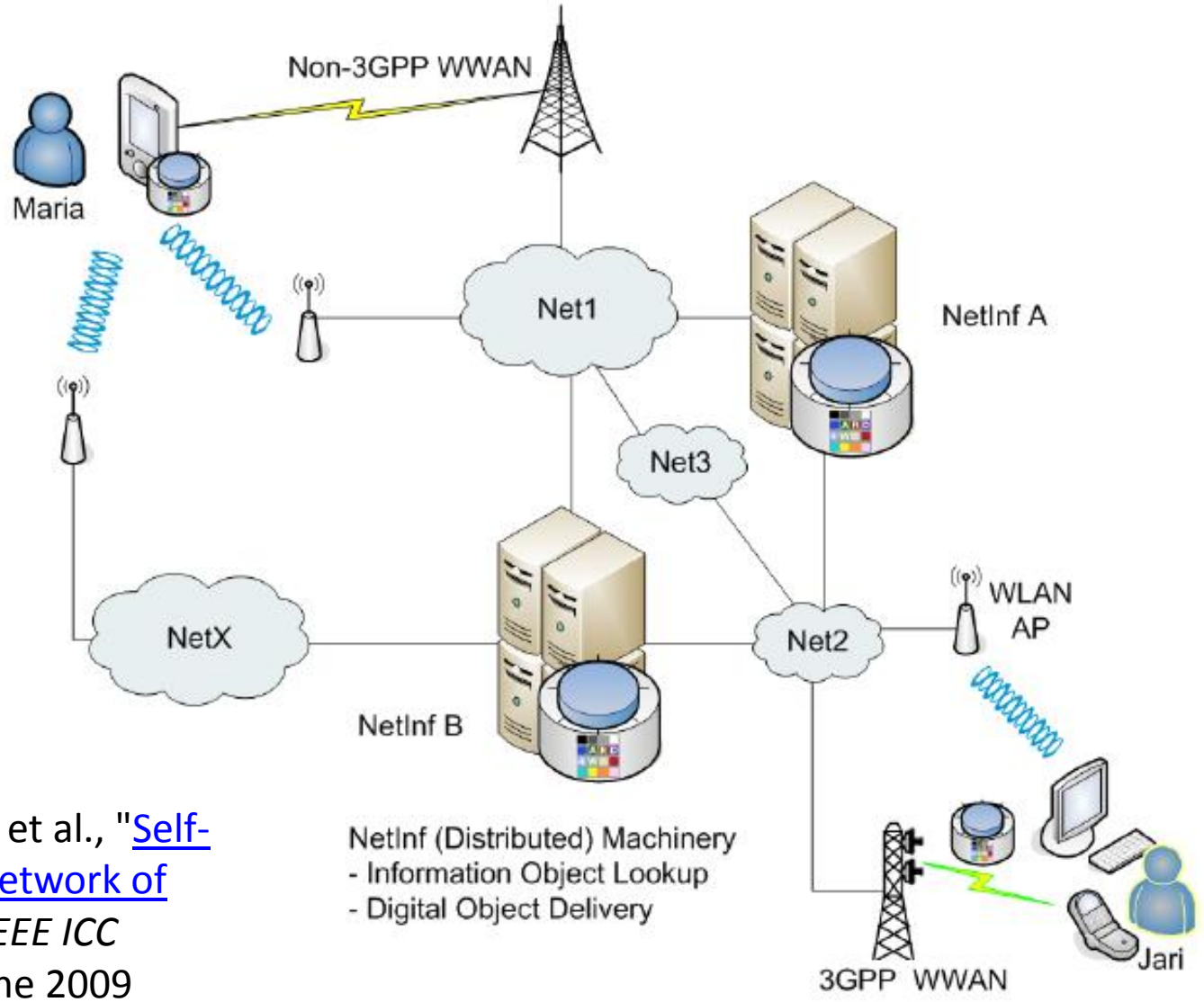
The NDN Case

- These mechanisms were implemented and validated in a testbed based on the CCNx implementation
- Considered the Always Best Connected use-case scenario and deployed it
- Demonstrated that optimal link connectivity is one of the possibilities allowed by this generic management framework

NetInf Management Considerations

- New management primitives
  - Allowing management to become information-centric, despite its traditional host-centric nature
- ICN suitability for self-management mechanisms
- Examples
  - Caching decisions
  - Controlling multi-access support
  - Content adaptation
  - Traffic Engineering

NetInf Mobile Multiaccess



From: K. Pentikousis, et al., "Self-Management for a Network of Information", *Proc. IEEE ICC Workshops 2009* , June 2009

Way Forward

- The draft was presented on Monday morning in ICNRG and was well-received
  - But not a WI in ICNRG now
- Future prospects of this work in NMRG
  - NMRG interest in this work?
  - Network management considerations WI draft?
  - Extend/enhance NDN MA proposal as a separate draft?

Thank you!

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