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***Network Coding for Content-Centric
Networking / Named Data Networking:
Requirements and Challenges***

draft-matsuzono-nwcrg-nwc-ccn-reqs-00

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Motivation

- NC (Network Coding) for CCN/NDN is an attractive research topic
 - Interesting papers presented at good venues and journal
 - e.g. Infocom, IEEE Trans. Multimedia, etc.
 - Presentations at Network Coding Research Group (NWCRG) meeting@Prague
 - Introduction of NC for CCN/NDN (incl. paper at Infocom 2016) (Cedric)
 - Low Latency Low Loss Streaming using In-Network Coding and Caching (Infocom 2017) (Hitoshi)
 - Agreed on clarification of the requirements and potential challenges for “NC for CCN/NDN”

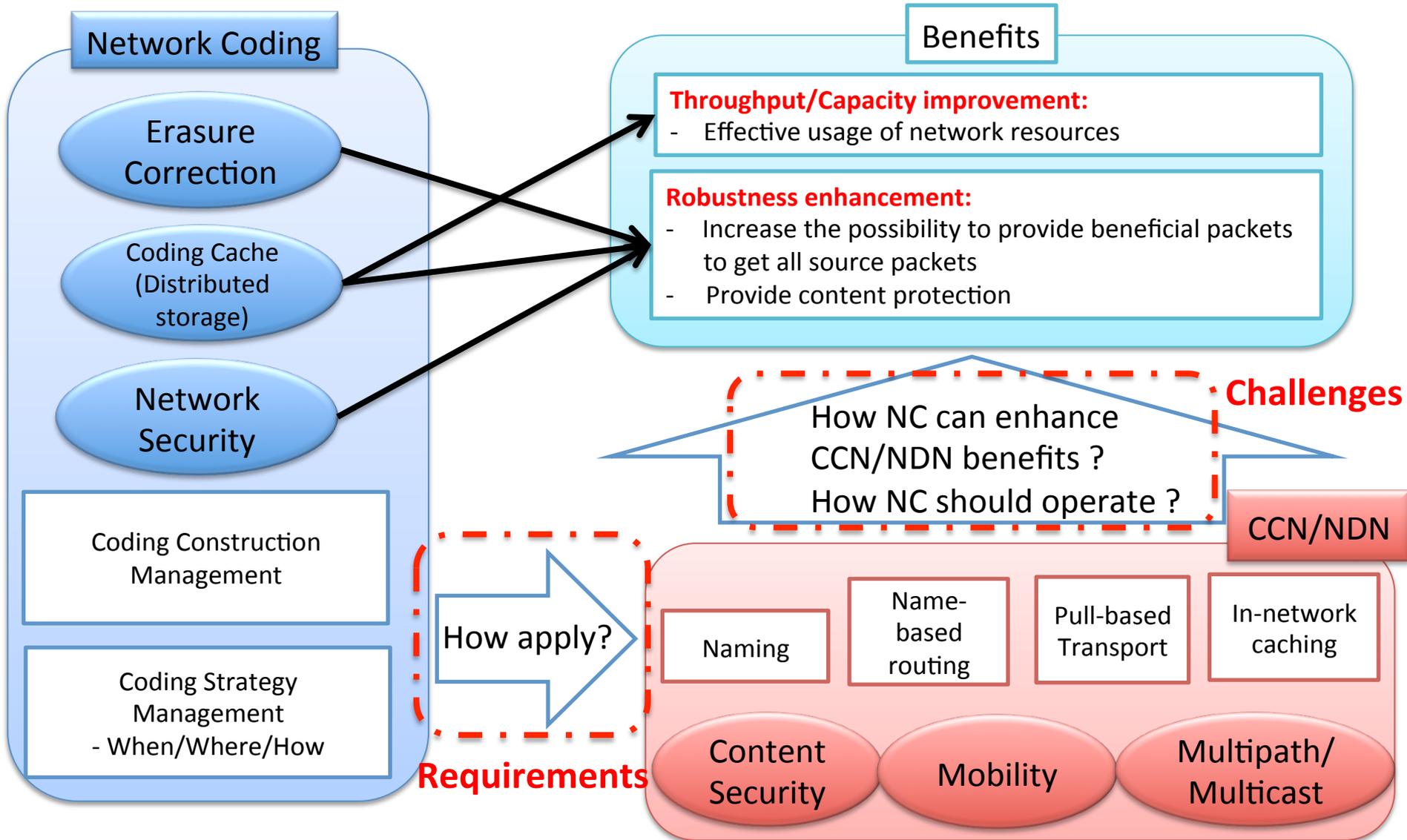
Purpose

- ICNRG documents (RFC7476/7933/7927) simply introduce benefits of applying NC into CCN/NDN
- Describe sufficient information and clarification of the requirements and challenges
 - Establish common understanding about NC for CCN/NDN
 - Provide useful insights to developers who apply NC into CCN/NDN

Structure (-00)

- Table of contents
 1. Introduction
 - Current research outcomes
 - Out of Scope
 2. Terminology
 - Definitions
 - CCN/NDN Background
 3. Advantage given by NC and CCN/NDN
 4. Requirements
 - Considering how NC can be applied to the CCN/NDN architecture
 - Clarifying the requirements
 5. Challenges
 - Describing potential challenges for making CCN/NDN communication better using NC technology
 6. Security Considerations
 7. References

CCN/NDN Components and Advantages given by NC for CCN/NDN



NC Requirements for CCN/NDN

- Naming

- Coded Data with a unique name
 - Adding an encoding vector ($[1,0,0,0]$) and the identifier of generation (K)
 - e.g., /CCN.com/video-A/ K /1000
 - Consumer needs to know the naming structure to retrieve it.
 - Content requestor determines the encoding vector to be used, in stead of content producer
- Coded Data with no unique name (i.e., name undefined a priori)
 - Specify the coding information into a metadata filed in the payload
 - Nodes would need prior decoding for generating innovative coded packets

Original Pkt

Name: /CCN.com/video-A/%01

Interest Pkt

Name: /CCN.com/video-A/%01

Coded Pkt

Name: ?????

Interest Pkt

Name: ?????

NC Requirements for CCN/NDN

- Transport

- Describe NC scope
 - 1) Nodes can update data packets that are being received in transit ?
 - It would require the integrity mechanisms
 - 2) Or a node executes NC only when the received Interest for the coded Data can be satisfied ? (like end-to-end manner)
 - It would require a mechanism to ensure who executes NC.
- Describe basic operation at consumer/router/publisher
 - Consider how to provide innovative data packets, especially in the case that coded data has no unique name
 - Consumer would need to issue interests with some information
 - Router would need to maintain tally of the interests for a specific name and generation
 - Router wouldn't need to do Interest aggregation and needs to make specific PIT entries

NC Requirements for CCN/NDN

- Others

- In-network caching
 - Caching of coded packets may require some mechanism to validate coded packets, so as to avoid cache pollution attack
 - Decode and check the reconstructed original Data?
- Security and privacy
 - Consider how intermediate routers can modify packets by performing additional network coding operations
 - Consider how routers can cache the coded data without publisher's validation
- Routing and forwarding
- Seamless mobility

Challenges

- Describing the potential ways to fulfill the described requirements
- Adopting Sliding or Elastic Window Coding
- Rate and congestion control
- Routing scalability
- Etc.

Next Step

- Improve the draft
 - Have more detailed outline and scenarios
 - TBDs will be addressed
- Clarify the requirements and potential challenges in more detail
 - Investigate “block coding” vs. “sliding window coding” approaches
- Etc.