Introduction and Overview

NETWORK CODING RESEARCH GROUP – NWCRG (PROPOSED)

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Agenda

1. NWCRG Overview (Victor / Brian) Provide brief overview of motivation, charter, history.
2. A view on placing network coding in the network (Muriel Medard, MIT).
3. Network Coding Research (Hamid R. Sadjadpour, UC Santa Cruz).
4. Content Network Coding on Androids: Energy Considerations (Joshua Joy, UCLA)
5. BRAVO – a practical, full implementation of a network coding system (Victor Firoiu, BAE Systems)
6. Overview of the Aalborg University Network Coding research and demonstrators (Frank H.P. Fitzek, Aalborg University)
7. Introduction to Kodo a cross-platform Network Coding Software Library (Morten V. Pedersen, Aalborg University)
8. Tetrys on-the-fly encoding: principles, results and demo (Jonathan Detchart, Institute Superieur de l'Aeronautique et de l'Espace - ISAE)
9. Discuss the Charter, who is interested to contribute and next steps
Introduction Outline

- Motivation
- Candidate Technical Areas
  - Architectural Considerations
  - End-to-end vs. hop-by-hop
  - Intra-flow and inter-flow
  - Application-layer
  - Service Paradigms
  - Security
  - Common algorithms, service descriptions, packet formats
- Proposed 2013 Activities
- IPR Notewell
Motivation: Research Advances

Research proved perf gains and practical algorithms
- Ahlswede et al, 2000
  - Netcoding multicast achieves max flow-min cut
- S Li et al 2003
  - Linear coding w/ finite symbol size- sufficient for mcast
- Koetter, Medard 2003
  - Algebraic framework for linear network-coding
  - Min-cut max-flow achieved w time-invariant solutions for networks with delay and cycles.
- Ho et al 2003
  - Distributed randomized network-coding
- Lun et al 2005
  - coding scheme for reliable comm over packet networks
- And many others. Much research remains to be done.
Motivation: matured implementations

- Network coding has matured over the past decade or so of research
  - Full network coding systems have been demonstrated
  - Ready for more widespread, practical applications
- Network coding has begun “popping up” in various IRTF, IETF, and other forums
  - Heavily applied in RMT Working group specifications for end-to-end reliable multicast with ALC and NORM protocols
  - These protocols have also been effectively applied to some non-multicast use cases
    - FecFrame WG defined some additional “building blocks” beyond RMT products
- More general applicability and opportunity seen with new paradigms such as Information Centric Networking and Software Defined Networking
Architectural Considerations

- Aspects of packet network systems
  - Control plane
  - Routing / forwarding plane
  - Transport
  - Physical layer
- How can network coding be effectively and pragmatically applied to a scalable, distributed network like the Internet?
  - Congestion control
  - End system vs. Intermediate System
  - Edge systems (e.g. wireless)
- Where does network coding provide benefit and where does it not?
More considerations

- **End-to-end vs. hop-by-hop**
  - Intermediate system forwarding more stateful and complex than existing typical forwarding paradigms
- **Intra-flow and inter-flow**
- **Application-layer use**
- **Service paradigms**
  - “Best Effort” delivery can become tunable
  - Content dissemination
  - Multimedia and other streaming
Possible new service paradigms

- “Best effort” can become tunable
- Content dissemination
- Multimedia streaming
- “Data swarming”
Security

- Likely several challenges here
- How to sign content that is re-encoded?
- Intermediate system participation
Areas for standardization

- Common encoding algorithms
- Protocols:
  - Network Coding Transport
  - Routing: subgraph construction
  - Forwarding on subgraphs
- Service descriptions
- Packet formats
Candidate 2013 Activities

- Develop NWCRG charter
- Contributions to NWCRG Wiki site to build a repository of shared information
  - Research results and open problems
  - Architectures, algorithms, protocols, software
- Network coding taxonomy
  - Consensus on key terminology and concepts
  - I.e., establish a language for IRTF interaction
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