Community Viewing meets Network Coding: New Strategies for Distribution, Consumption and Protection of TV Content

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Disruptions and Challenges for Content Distribution

- Social and converged video experiences
  - "Social TV" Phenomenon
  - Redefine performance metrics
  - Add user behavior
- Heterogeneous and Mobile Technology Internet
  - Use the device and network ecosystem for best experience
  - Leverage Peer to Peer for community viewing
  - Stateless implementation for robustness
- Content-centric Networking
  - Combine storage and transmission
  - Address content protection and security with minimal disruption

Elements of Strategy

- Data are algebraic entities
  - Can be added, multiplied by factors etc.
- Combine analytical and user measurements for QoE
- Content protection is not just DRM
- Devices do not end at their shells
- Networks do not end at the gateways

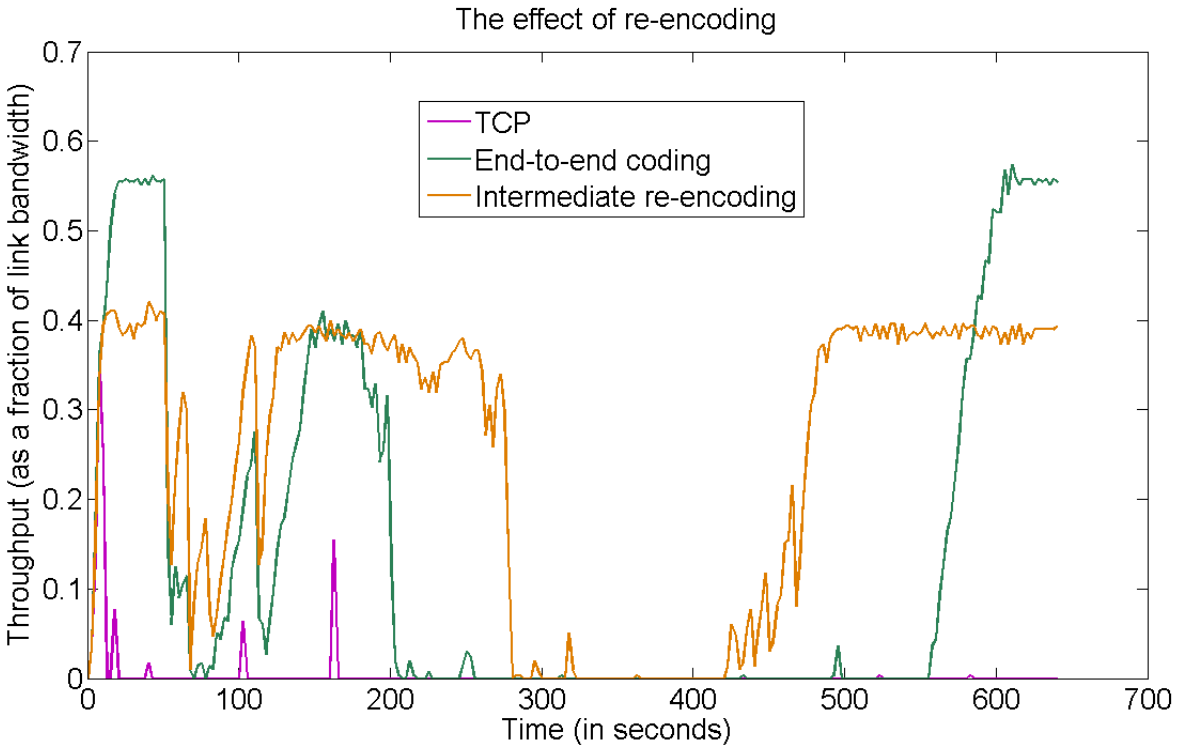
Our research

- Goals:
  - Reduce delay and minimize interruptions for video and converged applications
  - P2P as a legitimate means of transmission
  - Content protection with a layered architecture
  - "Community" viewing and distribution
  - Enables multi-definition of "cost"
- Generic Principle:
  - Add network coding when/where appropriate

Example: Live Streaming

- Use case
  - User initially buffers a fraction of the file, then starts the playback
- QoE metric
  1. Initial waiting time
  2. Probability of interruption in media playback
- Heterogeneous access cost
  - Design resource allocation policies to minimize the access cost given QoE requirements

Example: TCP/NC results



TCP	End-to-end coding	Re-encoding at node 3 only
0.0042 Mbps	0.1420 Mbps	0.2448 Mbps

Time average throughput (over 641 seconds)

(assuming each link has a bandwidth of 1 Mbps in the absence of erasures)

New Research

- Next generation "social TV" concepts
  - Use P2P and social consumption settings
  - Minimize disruptions and signaling overhead
  - Use multilayer video encoding
- Show that Network Coding can provide video content protection in a social viewing context
  - Video distribution among mobile users in close proximity (locality)

Use Case

- Peer to peer distribution:
  - Registered (premium) users see the content directly
    - Content protection keys derived locally
    - Unequal protection of network coded packets speeds up decryption of the video stream
  - Ad viewing is mandatory for non premium users
    - Contains the content keys
    - Can be local or server-based
  - Minimize the interaction with key distribution servers

Future Work

- Combine dissemination and protection
  - Protect protection to UGC and other ancillary information (including widgets) independently of the commercial content
- Analysis
  - Minimize the signaling in mobile CDN and community viewing examples
  - Favor stateless approaches for reliability and efficiency
  - Add network combining for added performance

Conclusion

- Our research aims at improving the quality of experience for distributed content and social viewing:
  - Device and network
  - Content protection and discovery
  - User behavior and expectations
- Promising results provided by combinations of architecture, network coding, content differentiation and user studies