FEC and Network Coding for dummies

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Motivation

• comment made during IETF102 NWCRG

“99% of people using TCP don’t know how it works but think the opposite. We need a "network coding for dummies" document. It’s really important to have people think they understand how NC works for them to adopt the technology."

• what are the most basic yet essential messages to make people believe they understand?

• keep it small
  ✓ it’s not a tutorial
Idea 1-

- “We focus on networks where a packet either arrives or is lost”
  - we’re not at PHY-layer, we are above in the protocol stack and potential bit errors have either been fixed or the packet dropped
Idea 2-

• “Encoding consists in adding redundancy (i.e., repair packets) to the flow

• decoding consists in using redundancy (i.e., repair packets) to recover from packet losses”
Idea 3-

- “Math is not an obstacle to understand FEC and NC”
  - it’s essentially a matter of linear combination and linear system resolution (e.g., via basic Gaussian elimination)
  - details (e.g., computations in a certain Finite Field) can be complex, but mastering them is not required
Idea 4-

- “There are roughly two categories of FEC codes: block codes and sliding window codes”
  - block: segment the packet flow into blocks and apply FEC encoding per block, independently
  - sliding window: an encoding window slides progressively over the packet flow, the encoder computes a linear combination of packets in this encoding window
Idea 5-

- “Block FEC codes are great for bulk, non real-time traffic, sliding window FEC codes are great for real-time traffic”
  - … because splitting the application flow into blocks delays the moment when repair packets can be generated!
Idea 6-

- “Some codes are restricted to a **single encoder** (e.g., sender) and **single decoder** (e.g., receiver)”
  - usually called FEC

- “Other codes can be used within **intermediate nodes** (i.e., multiple encoders)”
  - usually called Network Coding (NC)
Idea 7 -

“With NC, network equipments can perform FEC encoding to improve network usage”

- trivial example where a network equipment could reduce traffic (it sends a single “P1 XOR P2” packet instead of sending both P1 and P2)

(Figure from Zverev Mihail, Ikerlan)
Idea 8-

• “One can use FEC and NC in a congestion friendly manner”
  ▪ only stupid persons will further overload a congested network with even more redundant traffic in the hope it may help!
Using it…

• already in github’s README.md
  - rg-materials repo
  - swif-codec repo
  - … and wherever it makes sense

• does it help? Feedback is welcome