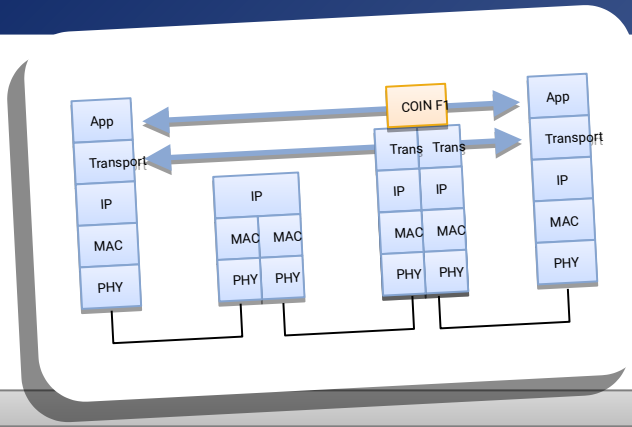
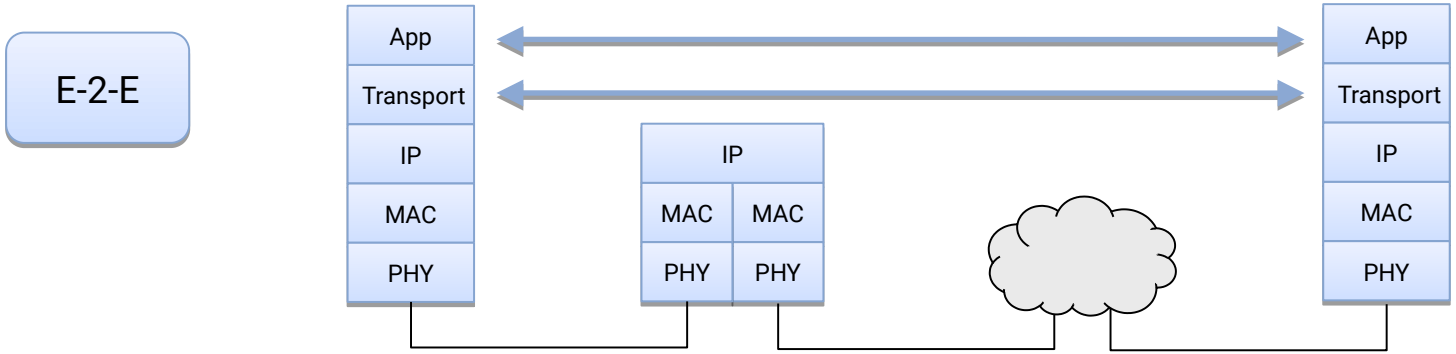


Transport Issues of Computing in the Network

https://www.ietf.org/id/draft-kunze-coinrg-transport-issues-00.txt

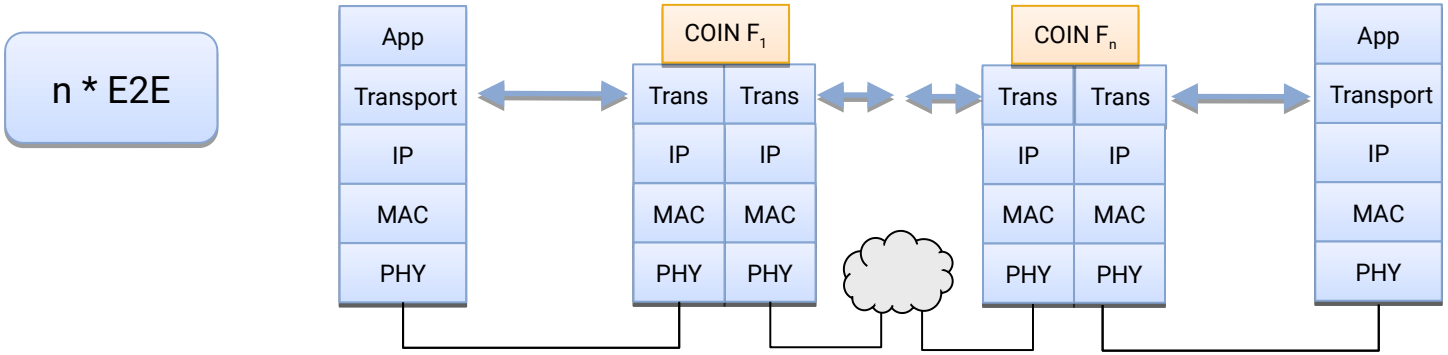
Ike Kunze, Klaus Wehrle

Classical End-to-end Principle



- Original design principle
  - All computing (=modifying application payload) is done at the network endpoints
  - Classic notion of an end-2-end transport session
  - Except for “some” transparent middleboxes changing headers

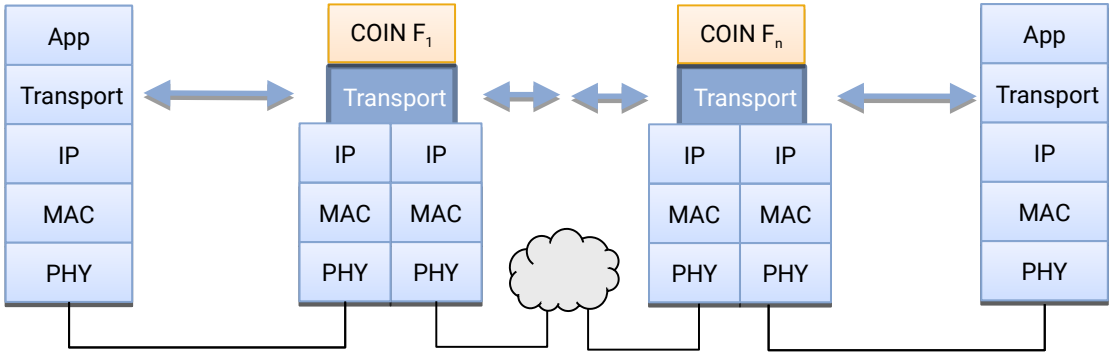
End-to-end Principle with Computing in the Network?



- COIN
  - Purposefully and explicitly process packets in the network (either Edge-clouds or on-path)
  - Breaking the end-to-end principle between source and destination
    - Here: Concatenation of multiple transport sessions: E-2-E + E-2-E … + E-2-E (basically service chaining)
    - Makes transport issues easier, but looses E-2-E notion between source and destination
    - Concatenation of intermediate end-points will then be an application issue

End-to-end Principle with Computing in the Network?

E-2(I-2)*E



- COIN
  - Purposefully and explicitly process packets in the network (either Edge-clouds or on-path)
  - Breaking the end-to-end principle between source and destination
    - Here: Keeping E-to-E notion between source and destination
    - Requires new or adapted transport protocols E-I_1-..-I_n-E (End-to-Intermediate-to-Interm.-…-to-End)
    - Concatenation of intermediate elements is handled on layer 3 and 4, will be configured by application via API

Intention of draft-kunze-transport-issues

- **There is no simple solution**
- **Start a discussion about how the issues should be addressed**
  - Connecting discussions of different groups of the IETF/IRTF
  - Plus issues that are not addressed yet
- **This draft as a starting point, raising open issues**
  - Addressing
  - Flow Granularity
  - Authentication
  - Security
  - Advanced Transport Features

Addressing

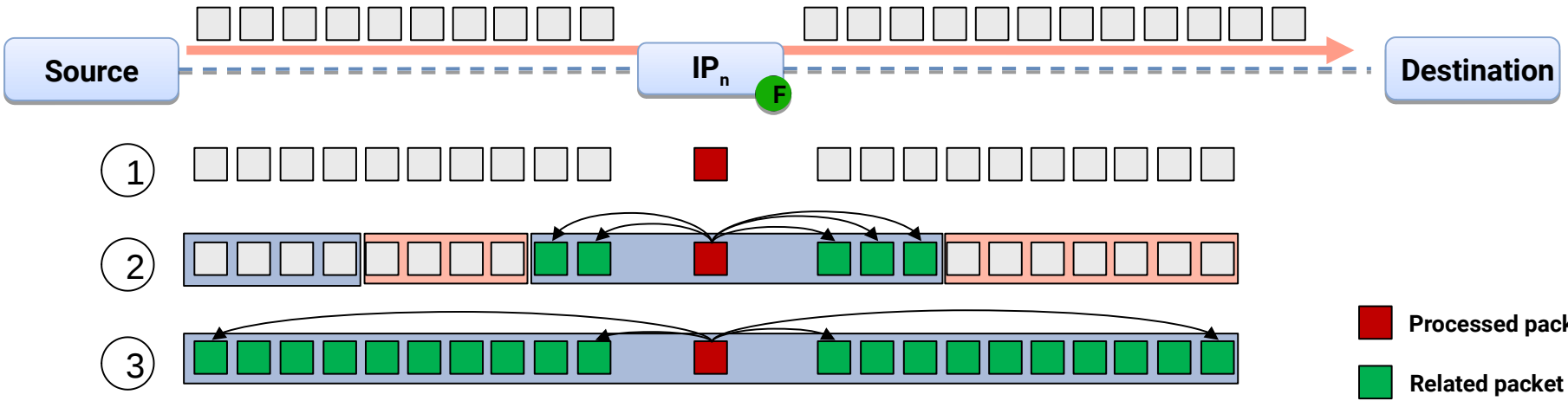
Addressing options

- Whom to address?
  - Address based: sequence of IP + port?
  - Content/function based: specify the compute function? Anycast mode?
  - Or location-based?
- How strict to address?
  - Loose routing
  - Strict routing
- What kind of communication pattern among functional units?
  - 1:1, 1:n, n:m

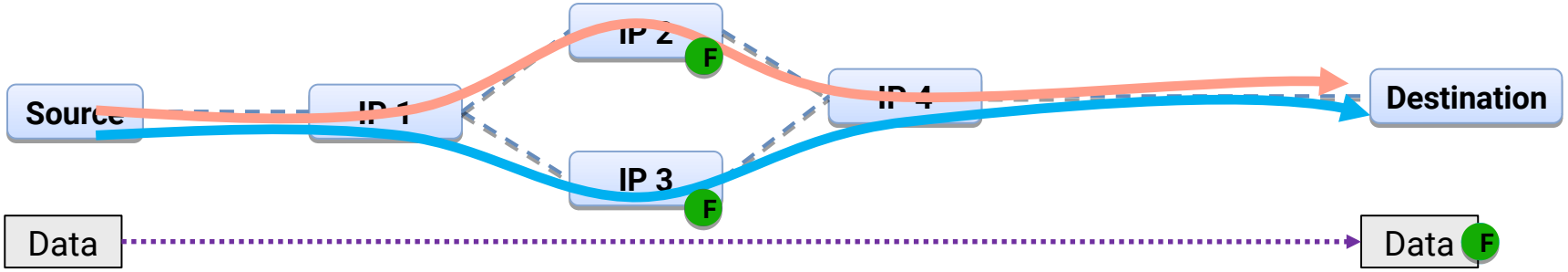
SPRING WG:
Segment Routing using MPLS and IPv6

Flow Granularity

- **What is the processing granularity?**
  - Packet-based? ⇨ no/little state required in processing nodes
  - Message-based? ⇨ medium/high state required …
  - Stream-based? ⇨ state required on application (low to high state required)



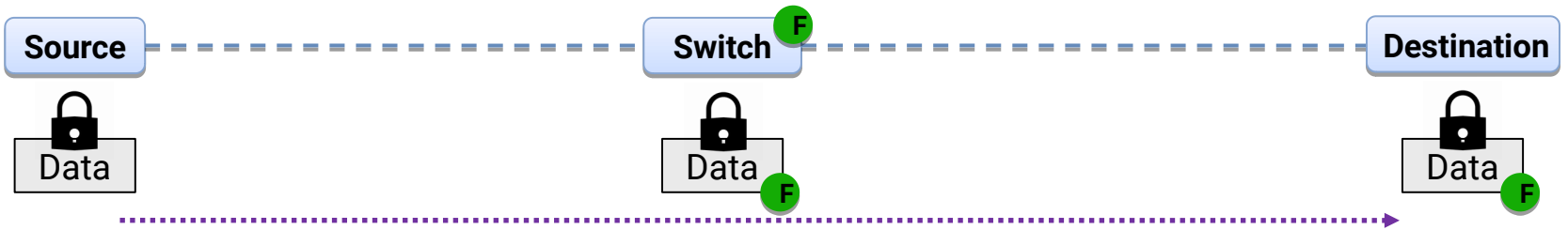
Authentication



- **Which switch has done the changes?**
  - What was changed?
  - Who made the changes?
  - How synchronizing states?
- **How to authenticate packet modifications made by intermediate nodes?**

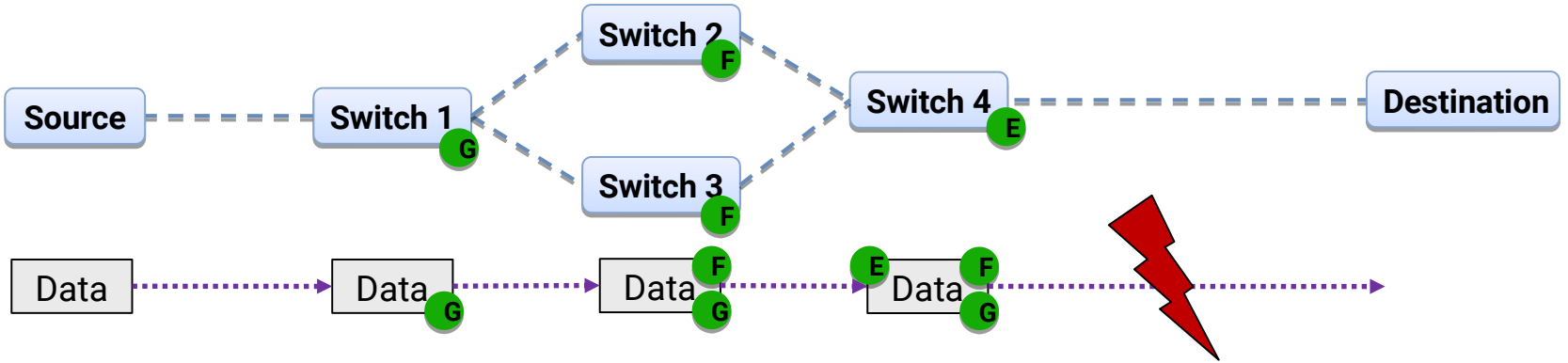
ACE WG (Authentication and Authorization for Constrained Environments)

Encryption



- **In-network processing currently working on plain text data**
  - Encrypted payload is an option that should not be ruled out
  - New transport protocols (eg. QUIC) encrypt headers & payload
- **How can in-network computing work on encrypted data?**
  - Decryption in intermediate nodes?
  - Option headers with payload for intermediate nodes? Possibly encrypted with session keys?
  - Homomorphic encryption?

Advanced Transport Features - Retransmissions



- **Who does the retransmission?**
  1. Sender
  2. Last successful position
- **How to deal with (changed) state in the intermediate nodes when packet is dropped later on the path?**
  - Do we want the notion of a transaction that should be revocable?

LOOPS BOF (Local Optimizations on Path Segments)
- Local packet loss recovery

Advanced Transport Features

- **Other features that cause similar questions of ”who is in charge?”**
  - Congestion control
  - Flow control
  - Flow ordering/Sequence numbers
- **Different features impose different requirements**
- **Which set of transport features should be supported by COIN?**
  - Depends on application …

Application Scenarios

- **Required transport feature set depends on application scenario**

Datacenter

- Full control over network
- High load
- Reliable communication needed
  - Retransmissions
  - Congestion control

Industrial networks

- Full control over network
- Low-latency communication
- Reliable communication needed
  - No retransmissions

Internet

- Little to no control over the whole network
- Untrusted nodes involved
- Encrypted traffic
- Diverse application needs

Conclusion

- **Solutions to the transport issues vital for the success of COIN**
  - One-fits-all solution unlikely
  - Highly application-specific requirements

- **Create awareness and consider expertise of other IETF/IRTF groups!**
  - Addressing: SPRING WG
  - Authentication: ACE WG
  - Retransmissions: LOOPS BOF
  - …

- **Goal until next meeting:**
  - Collect feedback on raised questions and suggest first transport solutions