

# Semantic Routing and its Home in COIN

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# Purposes Today

- Introduce Semantic Routing and related topics
- Flag up recent work and work in progress
- Explain what we do (and don't) want to do
- Find out what parts sit comfortably inside COIN
- Encourage others to join us and tell us about their work
- Non-purposes (at this stage)
  - Detailed rehashing of what is in I-Ds, papers, and email threads
  - Debate the value or lack of value to Semantic Routing

# Questions to Answer

- What is Semantic Routing ***and what is it not?***
  - How is Semantic Routing different from traditional routing?
- When does Semantic Routing use network programming?
  - Is this type of network programming of interest to COIN?
- How could Semantic Routing use compute in the network?
  - Is this type of compute in the network of interest to COIN?
- Summary of what has been said on the mailing list (see next slide)
- What communities already exist?
  - What work is already going on?
- What work do we want to do (and not do)?
  - Does COIN want to hear about this work as it progresses?
  - What parts of this work are not relevant/interesting to COIN?
- Can we bring any of this work to COIN in the future?
  - Please. We would like to.
  - Is anyone going to object to that?

# What is Semantic Routing?

- Background
  - See the thread on the COIN list
  - Read draft-farrel-irtf-introduction-to-semantic-routing
- We are dealing with IP-level packet routing and forwarding
- How is this different from routing today?
  - Function enabled allows packets (micro-flows) to receive different forwarding treatment in the network
    - Allows support of varying types of service
    - Makes better use of network resources
  - Making routing/forwarding decisions based on information not normally used for those purposes
    - Information may already be carried in existing packet fields
    - Information may be added to existing fields through “overloading”
    - Information may be carried in new fields
  - Making advanced forwarding decisions beyond simple table look-up
- Forwarding tables may be derived in devices or pushed southbound
  - See Network Programming slide to follow
- Routing algorithms may be run centrally or distributed
  - See Compute In The Network slide to follow
- Where is the “formal definition”
  - See slide 7

# Network Programming and Semantic Routing

- Background
  - See the thread on the COIN list
  - Read draft-boucadair-irtf-sdn-and-semantic-routing
- Is there a difference between “programmability” and “programming”?
- For Semantic Routing, this is chiefly about programming forwarding tables
  - Based on SDN architecture
  - Assumes that routing algorithms are run centrally
    - Distributed and hybrid realisations also possible
    - (See next slide for compute in network with network programming)
- This is **one** approach to Semantic Routing
  - It does not change the forwarding action (still table look-up)
  - It does provide additional and reduced functions compared to distributed algorithms
  - It does mitigate some risks of Semantic Routing, and it introduces others
  - It needs coordination with packet marking
- Is COIN interested?
  - The SDN/programming aspects of this don't seem radical or new
  - The routing algorithms and related issues are new – are they in scope for COIN?

# Compute in the Network & Semantic Routing

- Background
  - See the thread on the COIN list
- This could be about:
  - Building forwarding tables using algorithms installed on the network nodes
  - Using an algorithm to actively determining the forwarding actions per packet
- Algorithms could be:
  - Built into the network devices as happens today for routing algorithms
  - Installed in the devices using network programming
- This is not algorithms or programs carried in the packets themselves (i.e., not Active Networking)
- Semantic Routing works with all approaches (including centralised algorithms per previous slide)
  - So compute in the network is **one** facilitator or tool
- Is COIN interested?
  - Assume that “static” algorithms as used today is not so interesting
  - Assume that algorithms that are installed by programming could be in scope
  - What programmability (in the network) does Semantic Routing require? What would it drive?

# What Points Were Made on the List?

- Isn't this an engineering problem, not a research problem?
  - There seem to be a lot of related research projects and papers
  - We are not looking for a solution
- Haven't we always done Semantic Routing?
  - To some extent, all routing is Semantic Routing
  - But routing for a wide variety of needs lacks a generic approach and proper research
- Where is the distinction between routing and forwarding?
  - It's complicated, but forwarding without a sound view of routing will result in loops and dropped packets
  - The "easy" part is programming the forwarding plane and doing the lookups
- Doesn't Semantic Routing need a unifying abstraction?
  - Yes!
- Where is the "academic" (i.e., rigorous) definition of Semantic Routing?
  - It is needed, but there is plenty of related work out there
- Isn't standardisation out of scope for an RG?
  - Absolutely, yes. But understanding what would need to be standardised is in scope
- What is the network that COIN enables and where does Semantic Routing fit?
  - I think the RG needs to discuss this

# What's the Community?

- Background
  - draft-king-irtf-semantic-routing-survey
  - Wiki at <https://github.com/danielkinguk/sarah/>
- Some recent conferences and workshops
  - [ICT 21](#) - Special Session 1: Re-thinking the Data & Forwarding Plane for 6G and More
  - [IEEE HPSR 21](#) - Semantic Addressing and Routing for Future Networks (SARNET-21) Workshop Report
  - [2nd Workshop on New Internetworking Protocols, Architecture and Algorithms \(NIPAA-21\)](#) Virtual Event, November 1st, 2021. Organized by IEEE ICNP 2021
  - [6G Networking Symposium](#) 'What is wrong with networking' session
  - Three IETF "side meetings" associated to, but not fully about Semantic Routing
- Some I-Ds to act as anchors for discussion (not planning on RFCs)
  - draft-farrel-irtf-introduction-to-semantic-routing
  - draft-king-irtf-challenges-in-routing
  - draft-boucadair-irtf-sdn-and-semantic-routing
  - draft-king-irtf-semantic-routing-survey
- Semantic Address Routing and Hardware (SARAH) mailing list
  - **Interim** mailing list created because:
    - We found no where for the community to discuss and announce their work
    - We were unsure at the time if/where we should be active within the IRTF
  - <https://www.jiscmail.ac.uk/cgi-bin/webadmin?A0=SARAH>
  - Around 75 subscribers
    - Haven't checked for overlap with COIN's 258 subscribers

# What We Do and Don't Want to Do

- We don't want to spend time building or promoting solutions
  - They may exist as engineering projects
  - They may exist as research projects
- We **do** want to hear about research and experimentation
- We want to influence that research and experimentation through consideration of
  - the abstract concept
  - the architectures
  - the costs/benefits
  - the risks and challenges
- Also want to generalise the “challenges” for all routing research
  - Background
    - Thread on the mailing list
    - draft-king-irtf-challenges in routing
- We want to bring together the community of people researching in this area to get a wider view and share thoughts

# What's the Future For Semantic Routing in COIN?

- Which of these pieces can we bring to COIN? (Need views of IRTF Chair, COIN chairs, COIN community)
  - Surveying proposals and prior work related to semantic enhancements
  - What features and functions are demanded by new and developing applications that cannot be delivered using existing routing techniques?
  - Identifying existing and future challenges to the Internet routing systems that may be mitigated or exacerbated by semantic routing
  - Determining what the basis would be for deciding whether semantic routing and its required semantic enhancements is viable
  - Examining the implications and potential consequences of semantic routing and the necessary semantic enhancements to the Internet architecture
  - What programmability (in the network) does Semantic Routing require? What would it drive?
  - What questions (such as scalability, privacy, robustness, manageability, power consumption) are given insufficient attention during research into new approaches for routing?
  - Encouraging research and debate into semantic routing systems and architectures
  - Determining in what network scopes it is applicable to consider modifications to routing protocols and paradigms?
  - How can the existing routing infrastructure be protected from new developments in routing and the associated semantic enhancements?
  - All of the above
- What is the preferred way for us to participate in COIN?
- What do we do with the parts that don't fit in COIN?

DISCUSS