Semantic Routing and its Home in COIN

Adrian Farrel (adrian@olddog.co.uk)
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
  • 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