

Things researchers should think about when making proposals to introduce new approaches in Internet routing

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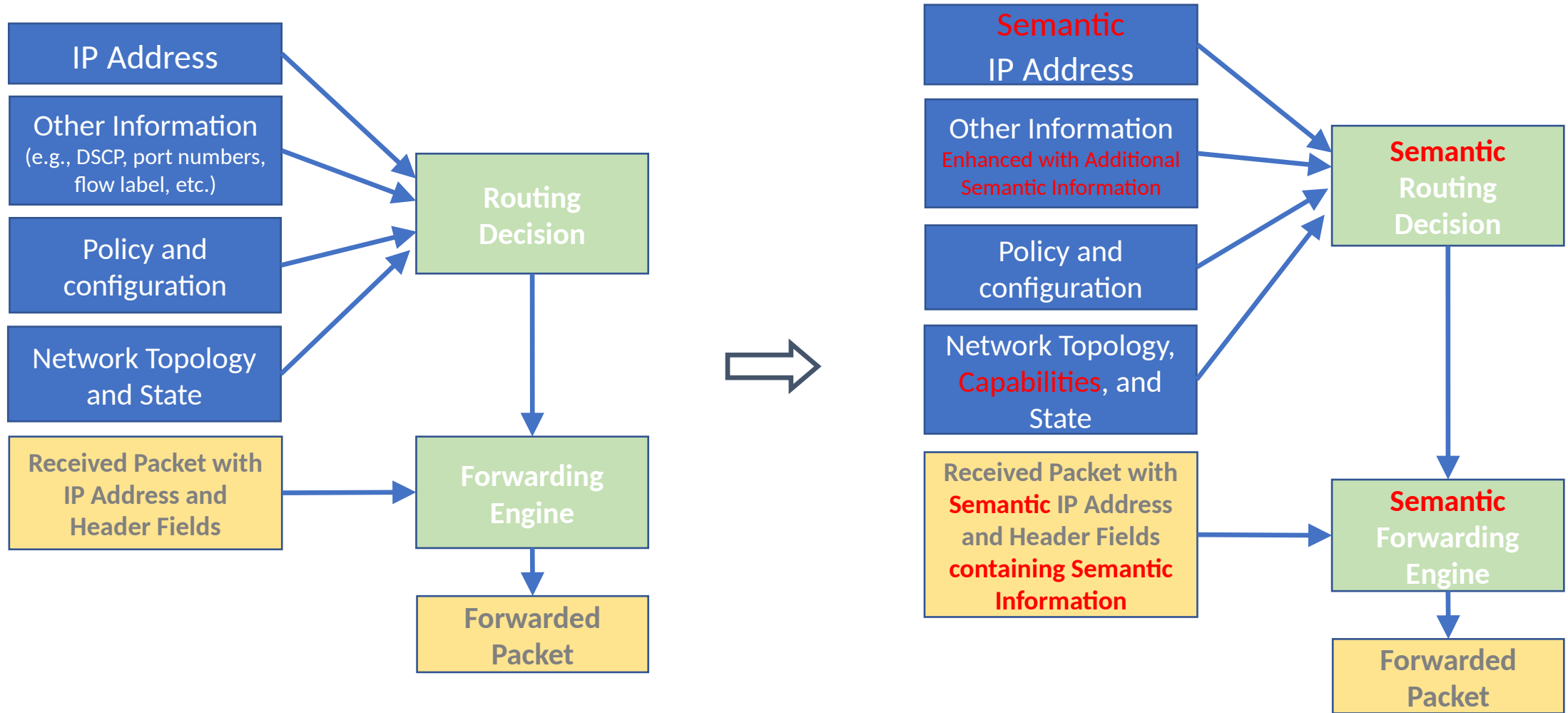
What Are the “Challenges”?

- Things that are not always fully considered in new routing proposals
 - Network stability and scalability
 - Security, privacy, and manageability
 - Interactions with other protocols and other parts of the network
- Fragilities in the current routing system
 - What breaks, where are the risks?
- Architectural considerations
 - What is the architectural view?
 - What changes? Is it an evolution or a revolution?
- Questions that should be asked during research and development
 - What is the deployment architecture?
 - What traffic patterns are assumed?
 - What is the techno-economic motivation?
- Research Principles that should be followed
 - Independent reproducibility
 - Testing on complex networks with realistic traffic flows
- We are not attacking or criticising
 - Trying to help everyone be more successful

Before We Go On : What Is Semantic Routing?

- Packet-level, Layer 3, hop-by-hop routing and forwarding
 - Not overlays because that is not hop-by-hop
 - Not traffic Engineering because that is less reactive/dynamic
- Historically network-wide routing algorithms have been used to generate forwarding instructions in each node
 - Distributed, but identical algorithms (e.g., SPF)
 - Centralised planning algorithms
 - Based on information known about or gathered from the network
- Originally just about reachability (destination address)
 - More sophistication added with DiffServ, multi-topology, Traffic Engineering
 - Forwarding relies on some form of packet marking (even an address is a marker)
- In Semantic Routing additional information is placed in the packet
 - Describes the treatment the packet should receive and functions to apply
 - Routing determines next hops for each piece of information
 - Forwarding acts on the instructions from routing and the information in the packet
- “All routing and forwarding is semantic routing and forwarding”
 - Yes, and we’re looking at how this is extended and what the implications are

Architecturally, It Looks Like No Big Deal



- But this is an overly-simplistic functional representation
 - What are the architectural implications of adding more information and more decisions?
 - And what are the consequences for the existing routing system?

Background To This Work

- A group of us noticed that there are many proposals for adding semantics to packets
 - More information in address fields
 - Overloading existing header fields
 - Adding new information in shims or extension headers
- A couple of new drafts exploring the applicability of SDN in the Semantic Routing world
 - [draft-boucadair-irtf-sdn-and-semantic-routing](#)
 - [draft-bellavista-semantic-sdn-mom](#)
- We started a survey of old and more recent work
 - Research and engineering proposals
 - Surprised ourselves by how often this has been proposed
 - In many cases the purpose is to achieve different forwarding behaviours based on advanced routing algorithms
 - In a lot of cases the intention is to apply the mechanism within a “limited domain” [RFC8799]
 - Very many different motivations and use cases
- Began to think about the common themes in researching, testing, and developing these ideas
 - Potential impact and risks of applying new Semantic Routing schemes to complex packet routing systems
 - Overlap between Semantic Routing and established practices like SDN
 - Risks and benefits of having different network nodes apply different routing/forwarding algorithms in one network
 - Lessons learned from policy-based routing and proliferation of static routes
 - The benefits of a single Semantic Routing scheme for all packets compared to a mix of multiple concurrent schemes
- This led us to formulate a set of “challenges and research questions”
 - The object being to highlight the risks and make sure that due consideration is given to the issues

Why Talk to You About This?

- Challenges Apply More Widely
 - We started with Semantic Routing
 - These challenges have more broad applicability to all routing work
- Not trying to teach you what you already know
 - Probable that this group has some experience in routing
- Want to firm up this work with opinions from the real world
 - Which of the things we have identified are really not a problem?
 - Where have we missed the point?
 - What have we left out?

Some details...

1. What is the target scope?

- Global
- Inter-domain
- Backbone
- Overlay
- Domain with gateways
- Isolated domain

How are domains walled and how are they identified?

2. What is the impact on existing routing systems?

- Ships in the night?
- Isolated domains?
- Seamless interworking?

What happens if packets “escape” into older systems?

...more details...

3. How are path characteristics described?

- Destination
- Length
- Quality
- Resilience
- Security

Do packets need to be marked or carry additional information?

Do networks need to gather additional information?

4. Can we meet the requirements / solve the challenges with existing tools?

- Is additional/new hardware needed?
- Do we need new routing protocols or can we tweak existing ones?
- Do we optimise or generalise?

...still more details...

5. Do we need new management tools and techniques?
 - How do we instrument for the new functionality?
 - How do we debug and operate the network?
6. What is the impact on the security of the system?
 - Does it open up possible attacks or improve security/privacy?
7. What is the impact on scalability?
 - Routing and forwarding table sizes
 - Volume of routing data to be exchanged
 - Routing convergence times
8. Is broadcast and multicast supported?
9. Does anything need to be standardised?
 - If it is in a proprietary and isolated domain, then maybe not

What Are We Going to Do With This Work?

- Not completely sure!
- Where to discuss it?
 - IRTF doesn't seem to have a home for it
 - We have a mailing list for Semantic Routing discussions
 - <https://www.jiscmail.ac.uk/cgi-bin/webadmin?A0=SARAH>
 - Maybe the chairs would be happy to let us talk about it on the RTGWG list
- Develop the draft
 - Turn it into a general document, not just Semantic Routing?
 - Polish and extend the text
 - More issues and questions can be added
 - Seems like it might be a useful thing to publish
 - RTGWG?

Discuss

- Useful or waste of time?
- Things we have wrong?
- Additional ideas for inclusion?
- Where should we discuss it?

