

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

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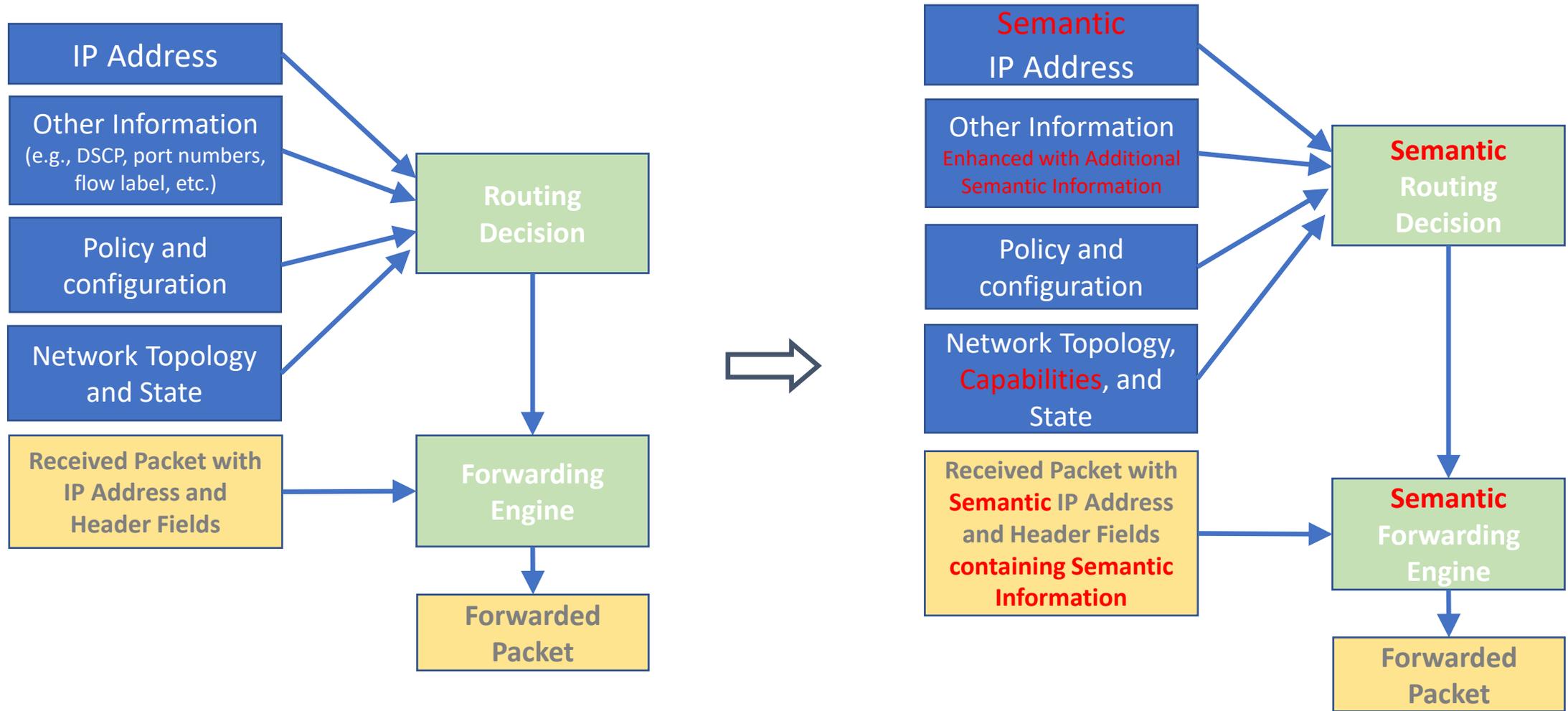
# What Are the “Challenges”?

- 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?

