Why Should Semantic Routing Worry You?

What must we do? What must we not do?

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Just Follow Good Engineering Practices?

- None of this should come as a surprise
  - But we need to constrain how we think about Semantic Routing
- Scope the requirements
  - What problems are we *really* solving?
- Design well
  - Keep it simple
- Test carefully
  - Think hard and use realistic networks with plenty of failure cases
- But…
  - The Internet routing system is fragile
  - Routing is complicated
  - History tells us that design is often incomplete, and testing is patchy
- Expand on the presentation at IETF-113
  - Reference draft-king-irtf-challenges-in-routing

Specific Concerns around Semantic Routing

- Backwards compatibility
- Deployability
- Wide/general utility
- Future-proofing
- Scalability and stability
- Manageability
- Privacy and security

Backward Compatibility

- It would be nice to not break the Internet
- New approaches must coexist with existing techniques

- Some of this plays into Deployability…

Deployability

- All approaches are likely to need software/firmware updates
  - Means brownfield deployments are 'hard'
- Replacing IPv6 with something new seems like a poor choice
- But there are still options for deployment
  - Overlay ("layer 3.5")
  - Underlay ("layer 2.75")
  - Coexistence ("ships in the night")
  - Greenfield, silos, walled gardens
- Refer to Dirk's architecture discussion coming next

Wide/General Utility

- "Walled garden" solutions can be effective
  - Efficiently solve a niche problem in a private network
  - No worries about interworking
- But
  - Development costs mount as the number of niches multiplies
  - Wheels get reinvented and mistakes are repeated
  - Deployment gets complex as functional domains overlap
- Questions are about interconnections and interoperability
  - What happens if a packet "escapes" from the walled garden?
  - "The whole point of the Internet is end-to-end connectivity"
- Wouldn't it be nice if we could invent one solution that addresses multiple/all current and future requirements?...

Future-Proofing

- It seems unlikely that we can capture every feature and requirement
- Solutions should be extensible by design
  - Easy to add new features
  - Forward and backward compatibility built in
- In practice, that means
  - Leave some space in encodings for additional data
  - Use extensible encoding techniques (such as TLVs)
- But beware of the effect that has on scalability…

Scalability and Stability

- Scalability applies across the routing and forwarding components
- Extensible encapsulation encodings run the risk of growing large
  - Simply too much data in the packet header ("cell tax")
  - Hard to parse at line rate
- Support for additional information distributed by routing protocols
  - How much information?
  - How often do changes need to be flooded?
- What happens when there is a change in the network?
- Do all network nodes need the same information and algorithms?

Manageability

- Why do we always leave OAM until after we have developed protocols?

- Semantic Routing may have specific OAM challenges
  - Complex to look at the network and know how packets will be forwarded
  - Packet traces can tell you how a packet was forwarded but not:
    - How the previous packet was forwarded
    - How the next packet will be forwarded

Privacy and Security

- Security may be more about subversion of the network
  - More information used to determining forwarding increase the attack surface
  - If the network is fragile it is easier to break it
- Privacy is about working out what the users might be doing
  - It must not be possible to determine a user's identity from Semantic Routing
    - That is, no further than can be done from source and destination addresses
  - It must not be possible to determine which applications a user is running
    - That is, no further than can be done by inspecting pattens of traffic
  - Semantic Routing must not add information to the packet that violates this
- Consider also Net Neutrality
- There is _no_ trade-off between information to route/forward and privacy
  - Semantic Routing must use abstract parameters to select forwarding behavior

What to do with this?

- Take these thoughts forward into discussion of Semantic Routing
- What are the architectural decisions?
- Which protocol approaches to choose?
- Whether to do this at all?