Network routing management by user-guided synthesis

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Network “policies”

- Term of art for the “units” of operator goals

- Desired properties about traffic flow
  - Maintain traffic level below a threshold
  - Pin certain flows to chosen network paths

- Route selection and dissemination
  - Prefer routes through neighbor A
  - Don’t tell neighbor B any of my routes to C
How to configure routers

- Static configuration governs dynamic state
- Still basically a command line model
- Access control over certain parts of the configuration “tree”
How to configure networks

- Almost all interesting policies require action across multiple devices
- We can only configure one-by-one
- Support for correctness: zero

“Mark with tag 17”

“If you see tag 17, then…”
Synthesis for policy composition

“How can I do [...] these policies [...] at once?”

- Requires reasoning about non-interference in the dynamic routing protocol, not just in the static configuration.

- Requires consideration of failure scenarios, not just the given network diagram.
Current capabilities

- Test whether given policies lead to protocol convergence in all failure scenarios
- Deduce ‘safe’ ranges for parameter changes, to maintain convergence property
- Find minimal sequence of changes for given configuration to conform to new policies
- Do traffic engineering subject to policy constraints
Advance the state of the art

“You should design how you want traffic to flow under normal operation and under fault scenarios and then design metric standard with satisfies those requirements. I prefer to do this with pen and paper add coffee if so inclined.”

http://networkengineering.stackexchange.com/questions/2765/using-latency-to-calculate-ospf-metrics

- No more reliance on pen and paper
- Reduced probability of caffeine poisoning
- Empower operators with appropriate tools
- Iterative, exploratory design – with confidence
The grand vision

- Dirty-slate SDN commoditizes routers
- Meaningful isolation between multiple management processes
  
  *No more dark magic*

- Complementary to work on transactional semantics for network update, router APIs, visualization, integration with other sysadmin tools