big switch
networks

Hard Problems in SDN

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Outline

- Level Setting and Framework
- *Sexy* problems (that I'm not going to talk about)
- My (not so sexy) Problems
  - Forwarding Memory Abstractions
  - Mixed OpenFlow + Non-OpenFlow Networks
  - Controller/Application ("north bound") API distractions
- Food for Thought

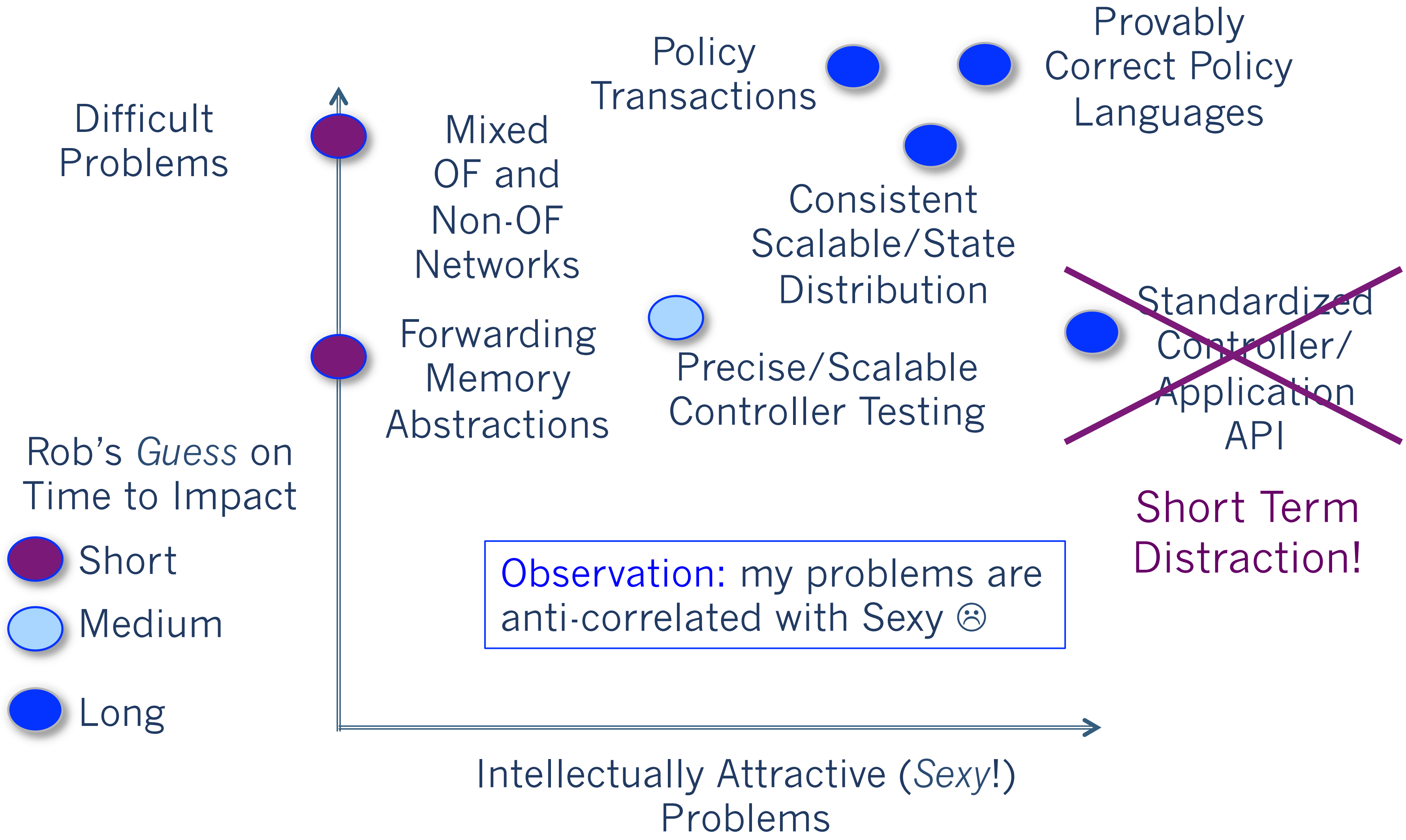
Level Setting

big switch networks

- Who am I?
  - Day job: Principal Architect for Big Switch Networks
  - Side job: Chair of Open Networking Foundation “archWG”
  - Background: Research, campus networking/sysadmin

- (Not so hidden) Agenda
  - Try to motivate researchers to focus on the right problems
    - So we can all work together, increase impact
  - (re)Socialize working code for problem solving in IETF/IRTF
    - The real purpose of SDN is that *anyone* can write code again
  - Intentionally inflammatory statements – fodder for panel!

Problems Framework



Difficult Problems

Mixed OF and Non-OF Networks

Forwarding Memory Abstractions

Policy Transactions

Provably Correct Policy Languages

Consistent Scalable/State Distribution

Precise/Scalable Controller Testing

~~Standardized Controller/Application API~~

Short Term Distraction!

Rob's *Guess* on Time to Impact

● Short

○ Medium

● Long

Observation: my problems are anti-correlated with Sexy ☹

Intellectually Attractive (*Sexy*!) Problems

Cliff Notes Version of Framework

All of these are great ideas… that are hard to use right now

- Policy Transactions:
  - Enforce policy only at first hop/ingress
  - Transactions are trivial if only one place to update
- Provably Correct Policy Languages
  - Need to rewrite a lot of code – not practical
  - If non-networking is an example, domain specific wins
- Consistent/Scalable State Distribution
  - Very hard from engineering perspective
  - Largely solved from research perspective – e.g., routing protocols, distributed agreement protocols, etc.

Not So Sexy Problems

Potential for short-term impact

Technical:

- Forwarding Memory Abstractions
- Mixed OF and Non-OF Networks
- Testing: lots of good work being done, I won't add to it here

Non-Technical:

- Convincing people that the controller/application API is a short-term distraction

Forwarding Memory Abstractions

- Lots of forwarding memory types
  - CAM, TCAM, LPM, FPGA, network processors, CPUs, tree mem
- Every type of memory has different trade-offs
  - Latency, capacity, width, programmability
- Lots of potential for caching and memory hierarchies
  - Lots of research shows packets of Zipf-like lookups
- “Real” boxes use complex combinations of forwarding mem
- Hard question: how do we abstract these memories and their capabilities?
- How does a controller reason about how to best use them?

Mixing OpenFlow and Non-OF

Lots of work and lots of room for optimizations

- Interoperability is easier
  - Needed for incremental deployments: meet the bar
  - But still – litany of protocols to re-implement
- But optimizations are possible!
  - Needed for incremental improvements: exceed the bar
  - Big potential for bootstrapping new protocols
  - Need to understand and "out fox" Non-OF control logic
- Examples:
  - Use multiple paths between STP and OpenFlow networks
  - Re-advertise Weird SDN routing protocols via BGP

Standardizing Controller/App API

Asbestos underwear == On

- This is (currently) a distraction: solve other issues first
  - Please avoid and we'll discuss in more detail in $N years
- Technical: How do you standardize an API before the apps?
  - New apps are coming all of the time in SDN – that's the point!
  - Let's build some running code together: platform + apps
  - Open source + de facto standards == path to experience
  - Still need to understand what works and what does not
- Non-Technical: App portability doesn't exist anywhere else!
  - No standard exists for PC vs. Linux vs. Mac Apps
  - No standard exists for Android vs. iPhone vs. XXX Apps
  - Can you name one? Where the standard was created before a de facto standard emerged?

Conclusions and Food For Thought

None of this is my unique insight.

- Research is really good at solving problems ~2 years out
- Industry seems tunnel-focused at ~6 months out
- Technology moves faster than 2 years, but slower than 6 months
  - How do we best bridge this gap?
- “Skate to the puck”
  - But how far out?
  - What is an acceptable miss rate?
- SDN is an unprecedented way for researchers and operators to become *directly* involved in solving real problems now

Blank

Notes

- Policy transactions
- Provably correct languages
- Testing
- SDN state distribution