Sweet Little Lies: 
Fake Topologies for Flexible Routing

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HotNets

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Joint work with

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Fibbing
Fibbing

control routers’ FIB, lying to routers
Fibbing

control routers’ FIB, lying to routers
We use lies to overcome inflexibilities of traditional networks
We use lies to work around challenges of OpenFlow-like networks
We use lies to combine the advantages of OpenFlow and of traditional networking.
Operators need flexibility for intra-domain routing

- fine-grained traffic engineering
  optimize the available resources

- provision backup paths
  quickly and predictably react to failures

- deploy advanced services
  *e.g.*, steer traffic through middleboxes
Consider this network where a source sends traffic to 2 destinations.
As congestion appears on the (C,D) link, operators may want to divert the blue flow to A.
Moving only the orange flow to A is **impossible** with an IGP as both destinations are connected to D.

**initial**

![Initial network diagram]

**desired**

![Desired network diagram]

*impossible by reweighing the IGP links*
Currently, operators have two ways to improve flexibility:

- virtual circuit based solutions (MPLS)
- SDN based solutions (OpenFlow)
Both solutions come at a significant cost

- virtual circuit based solutions (MPLS)
  control- and data-plane overhead

- SDN based solutions (OpenFlow)
  deployment costs, new challenges of a novel paradigm
Fibbing achieves flexible routing in an existing network, “à la SDN”
Fibbing achieves flexible routing in an existing network, “à la SDN”

unmodified routers
(checked in testbed!)
Fibbing achieves flexible routing in an existing network, "à la SDN".
The Fibbing controller *program* routers!
(bypassing proprietary configuration languages)
The controller uses an API that *all* routers understand (hint: not OpenFlow)
Link-state IGPs are actually good for something, to control router behavior

- messages are standardized
  all routers must speak the same language

- behaviors are well-defined and understood
  e.g., shortest-path routing

- implementations are robust and widely-deployed
  nearly all networks out there run OSPF or IS-IS
Fibbing achieves flexible routing in an existing network, “à la SDN”
the controller tricks IGP routers with small lies about fake nodes, links and destinations

Fibbing achieves flexible routing in an existing network, “à la SDN”
As congestion appears on the (C,D) link, operators may want to divert the blue flow to A.
Fibbing can move the orange flow by adding a fake node announcing the blue destination.
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Fibbing can move the orange flow by adding a fake node announcing the blue destination.
Fibbing works today!
(tested with off-the-shelf Cisco routers)
Is Fibbing expressive?

Does Fibbing scale?
Is Fibbing expressive? Yes!

Does Fibbing scale?
Fibbing is expressive

Theorem Any set of forwarding DAGs can be enforced by Fibbing
Fibbing is expressive

Theorem

Any set of forwarding DAGs can be enforced by Fibbing

paths to the same destination do not create loops
Fibbing enables high flexibility

Theorem

Any set of forwarding DAGs can be enforced by Fibbing

- fine-grained traffic steering to middleboxes
- per-destination load balancing for traffic engineering
- backup paths provisioning
Is Fibbing expressive?

Does Fibbing scale? Yes!
Fibbing can scale and quickly react to failures

- computing augmented topologies of limited size
  - we have an ILP to strategically place fake nodes

- pre-computing response to failures
  - to quickly repair augmented topologies

- applying quickly failure responses
  - relying on the effectiveness of IGP for failure reaction
Given a physical topology and a set of path requirements, a linear program computes an optimized virtual topology.
Few lies can realize multiple shortest-path deviations (preliminary evaluation on Rocketfuel)
Fibbing enables flexible routing à la SDN, today!

Reduce controller concerns
most of the heavy work is still done by the routers

Maintains operators’ mental model
good old protocols running, easier troubleshooting

Facilitates SDN deployment
unified interface to routers and SDN switches
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Tell me lies, tell me sweet little lies
— Fleetwood Mac

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