Routing in Fat Trees (RIFT) Hackathon

Chaos Monkey Testing of RIFT Implementations

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What is RIFT?

- RIFT = Routing In Fat Trees
- A new link-state routing protocol optimized for “fat tree” topologies
- Main use case is large data center networks

RIFT Hackathon Participants

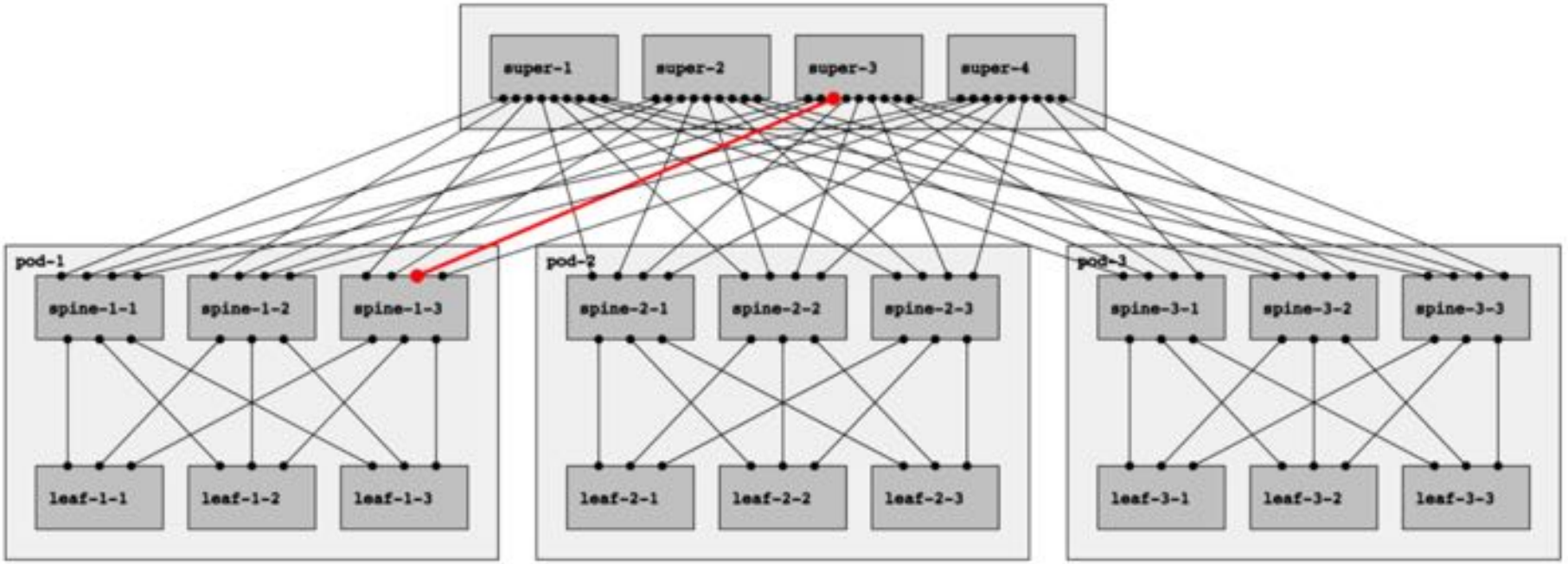
Artur Makutunowicz	LinkedIn
Bruno Rijsman	Individual
Pascal Thubert	Cisco
Tony Przygienda	Juniper Networks

RIFT Hackathon Activities

- Use open source RIFT-Python implementation.
- Generate configuration for large data center topology.
- Run topology in virtual machine (AWS instance).
- Automatically test correct initial convergence.
- Introduce a sequence of random “perturbations” in the topology.
- Automatically test correct initial re-convergence.
- For more details see:
  - http://bit.ly/rift-hackathon-ietf-104: hackathon instructions document
  - https://youtu.be/GqebgPmA4Xc: hackathon instructions video

Run fat tree topology in virtual machine

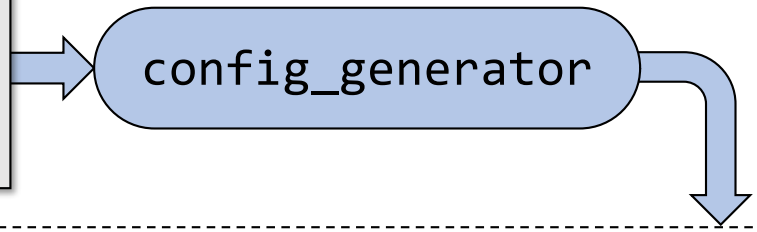
- Each RIFT-Python router runs in separate network namespace
- Use virtual Ethernet (veth) pairs to connect routers.



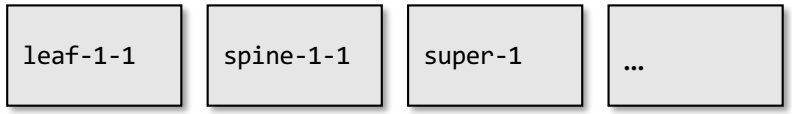
Generate topology and scripts

Meta-configuration

```
nr-pods: 3
nr-leaf-nodes-per-pod: 3
nr-spine-nodes-per-pod: 3
nr-superspine-nodes: 4
```

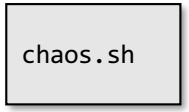


Configuration for each RIFT router

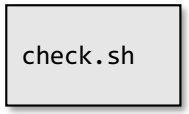


Scripts to start and stop topology

Scripts for “chaos monkey” perturbations



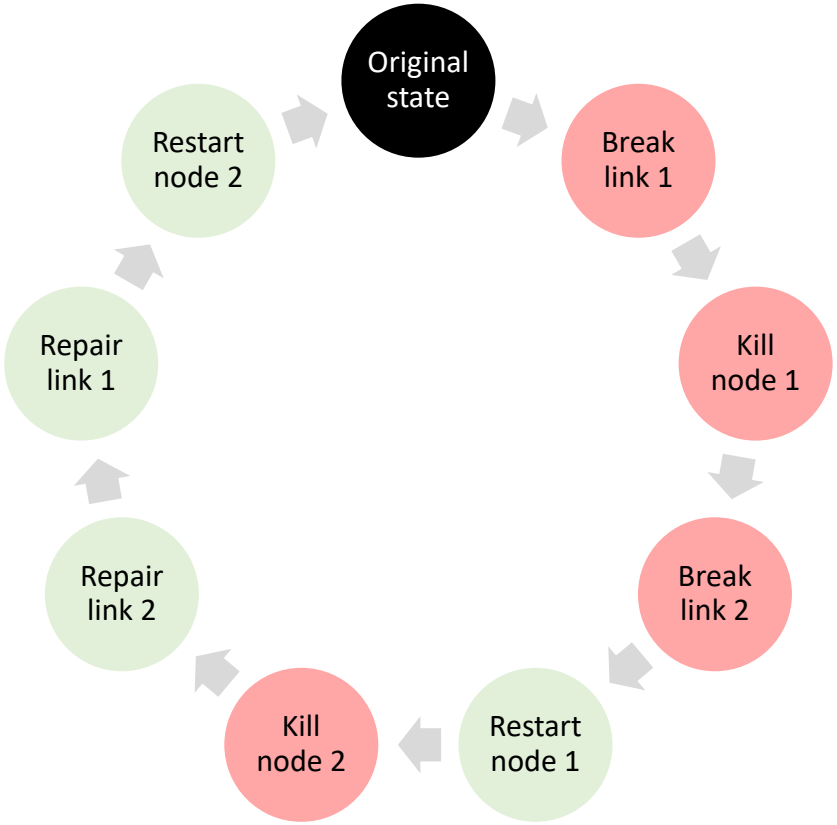
Scripts to test correct convergence



“Chaos monkey” perturbation testing

- Tool generates “chaos script” to randomly break and repair things
- “Chaos script” is topology aware
- Things that are being broken and repaired:
  - Full bi-directional link failures
  - Node failures
  - More things in future: uni-directional link failures, packets drops, packet re-ordering, packet delay, slow CPU, …
- All breakages are repaired at the end of the script
- After chaos script is finished, run check script to check convergence

“Chaos monkey” perturbation testing



Example chaos run

```
root@06786dea16bc:/host# generated/chaos.sh
Break  Link  if-1001a-if-101a (bi-directional failure)
Break  Link  if-2b-if-102d (bi-directional failure)
Fix    Link  if-2b-if-102d
Break  Node  super-1
Break  Link  if-1c-if-103c (bi-directional failure)
Break  Link  if-1002a-if-101b (bi-directional failure)
Fix    Link  if-1001a-if-101a
Break  Link  if-1003a-if-103a (bi-directional failure)
Fix    Link  if-1c-if-103c
Break  Node  spine-2-2
Fix    Node  spine-2-2
Break  Link  if-1001a-if-101a (bi-directional failure)
Fix    Link  if-1001a-if-101a
Fix    Link  if-1003a-if-103a
Fix    Node  super-1
Fix    Link  if-1002a-if-101b
Break  Link  if-1c-if-103c (bi-directional failure)
Break  Link  if-2d-if-104d (bi-directional failure)
Fix    Link  if-1c-if-103c
Break  Node  spine-2-1
Break  Link  if-1c-if-103c (bi-directional failure)
Break  Link  if-1001b-if-102a (bi-directional failure)
```

Automated convergence testing

- Tool generates “check script” to check correct re-convergence
- “Check script” is topology aware
- Things that are tested:
  - Ping from every leaf to every other leaf
  - Each node is up
  - All adjacencies are up (3-way)
  - North-bound default routes are in RIB and FIB and kernel
  - South-bound specific /32 routes are in RIB and FIB and kernel
  - More things in future

Example check convergence run

```
root@06786dea16bc:/host# tools/config_generator.py -n -c meta_topology/clos_2pod_2leaf_2spine_2super.yaml
**** Check node leaf-1-1
OK    Can Telnet to RIFT process
OK    RIFT engine is responsive
OK    Interfaces are up
OK    North-bound default routes are present
OK    South-bound specific routes are present
OK    RIB and FIB are consistent
OK    FIB and Kernel are consistent
**** Check node leaf-1-2
OK    Can Telnet to RIFT process
OK    RIFT engine is responsive
OK    Interfaces are up
OK    North-bound default routes are present
OK    South-bound specific routes are present
OK    RIB and FIB are consistent
OK    FIB and Kernel are consistent
**** Check node spine-1-1
OK    Can Telnet to RIFT process
OK    RIFT engine is responsive
OK    Interfaces are up
OK    North-bound default routes are present
OK    South-bound specific routes are present
```

Protocol visualization tool to help debug issues

Hackathon results and lessons learned

- Implemented framework for:
  - Generate large fat tree topology (config files, scripts, visualization, …)
  - Run topology in virtual machine (AWS instance, using network namespaces)
  - Automated "chaos monkey" perturbation testing
  - Automated testing of correct re-convergence
- Lessons learned
  - We found and fixed several implementation issues using the framework:
  - IPv6 flooding issue (IPv4 in one direction, IPv6 in the other direction)
  - Multiple scenarios where exceptions are not handled in shut-down scenarios
  - Several ideas for new show commands to help debug issues (some implemented)
  - **No new issues in protocol specification found** (only implementation issues)