KiRA – Scalable Zero-Touch Routing for Autonomous Control Planes

Roland Bless
Institute of Telematics, KIT
KIRA – Motivation

- NMRG context: Topic 1) self-driving/-managing networks
- KIRA provides an important foundation for that:
  - resilient control plane connectivity
    - e.g., for SDN, NFV, VIM, AI-based Control, Intent-based NM, OAM, …
  - avoiding circular dependencies
  - support for inband, out-of-band, hybrid management/control
  - controllability of every networked device (even virtual ones)
- Existing solutions not scalable, zero-touch, or topology specific
- KIRA could be an alternative routing protocol for ANIMA’s ACP (Autonomous Control Plane)
  - Offering advantages over RPL-ACP, e.g., built-in DHT
- Could be base for 6G Core infrastructure [link](https://ieeexplore.ieee.org/document/10175535)
KIRA – Features

- **Scalable**: connect 100,000s of nodes
  - ID-based, flat (i.e., no hierarchy or aggregation), no locators (no mapping!)
  - Trade-off: stretch (some routes longer than shortest path), tunable
    - Shortest paths to contacts in routing table
- **Zero-touch**: no configuration, self-organizing
  - Self-assigned addresses, no dependencies
  - Resilient control plane connectivity (IPv6)
    - Loop-free even during convergence
- Works well in and across various topologies (sparse and “dense”)
- Path-based forwarding (e.g., supports multi-path routing)
KIRA – Status

- **First Internet-Draft**
  - Update will follow

- **Running Code** (going to be released soon)
  - Large Scale Simulations
  - SDN-based Application for Ryu SDN Controller (Python)
    - Forwarding Tier uses OpenvSwitch
  - Native Routing Daemon Linux (Rust)
    - Forwarding Tier uses nftables

https://s.kit.edu/KIRA
Architecture

Routing Tier
(R²/Kad)

Forwarding Tier
PathID-based Forwarding

Control Plane Connectivity

Control Apps
(e.g., SDN/NFV Controller)

Transport over IPv6

Control Plane „Data“

IPv6 Packets
Fast Path
IPv6 Packets
Fast Path

R²/Kad Messages
IPv6 Packets
**Architecture**

- **Routing Tier** (R²/Kad)
  - Supports Service Placement, Network Management, ...
  - Supports Name/Service Registration & Lookup, ...
  - Control Plane Connectivity

- **Forwarding Tier**
  - PathID-based Forwarding
  - IPv6 Packets
  - Fast Path
  - IPv6 Packets

- **Distributed Hash Table** (Key/Value Store)
- **Topology Discovery (KeLLy)**
- **Control Apps** (e.g., SDN/NFV Controller)

- **Control Plane „Data“**
  - Transport over IPv6

- **Control Plane Connectivity**
KIRA – Further Features

- Domain Scopes
  - Global, Organizational, Topological
  - KIRA nodes keep their NodeID!
- End-system mode
- Multi-path routing
- Ongoing: Security
Why am I here?

- Make you aware of the approach/solution
- Get feedback
- Get support
- Get more ideas for...
  - use cases
    - e.g., telemetry data for AI, AI data transport
  - and supporting services
    - Multi-path, Multicast, QoS Support

that KIRA could support