DEVELOPMENT OF A WIRELESS AD-HOC ROUTER

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Agenda

- Introduction
- Objective & proposed solution
- Wireless ad-hoc router
- Result
- Conclusion and future work
- QA

Introduction - Wireless Ad-hoc network

- A sub-type of wireless network without a backbone infrastructure (centralized).
- Characteristic:
  - Host movement frequently.
  - Topology change frequently.
  - No infrastructure. Multi-hop wireless links.
  - Data must be routed via intermediate hosts.

(In this thesis, I focus on routing feature for Mobile Ad-hoc network - MANET)

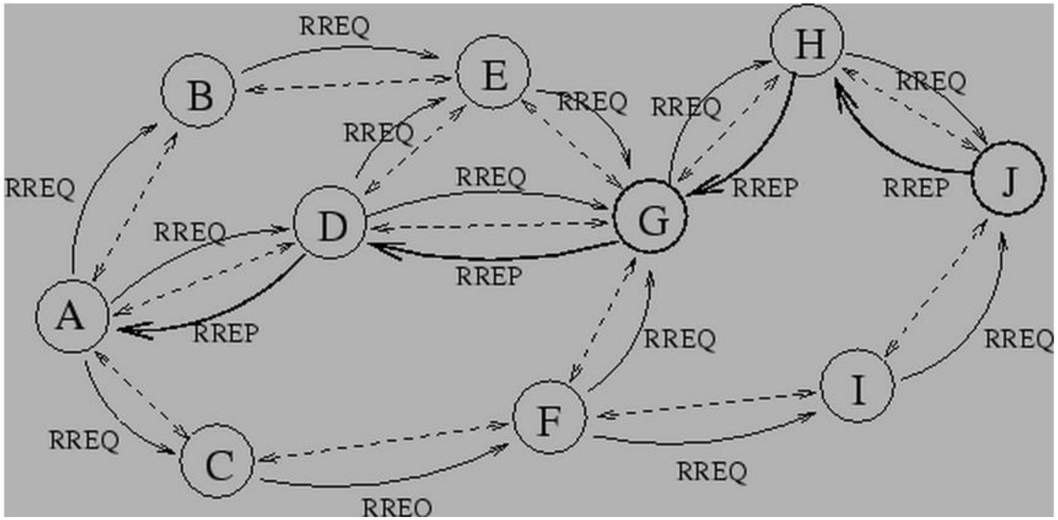
Introduction - MANET routing protocols

- IETF MANET Working Group develops two main types of routing protocol for MANET.

  (http://datatracker.ietf.org/wg/manet/charter/)
- Reactive MANET Protocol (On-demand)
  - Route finding on-demand (triggered when there is no available path to destination node)
  - Protocols: **AODV**, DSR, etc...
- Proactive MANET Protocol (Table driven)
  - Nodes maintain routes to other nodes in the network and periodically exchange it's routing table with others
  - Protocols: **OLSR**, DSDV, OSPF-MANET, etc...

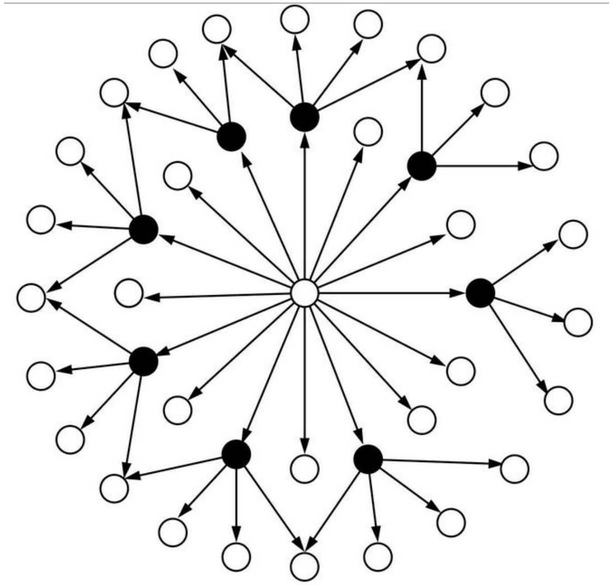
Introduction - AODV

- On-demand routing. Route request (RREQ) flooded to limited way to other nodes.
- Use message sequence number to prevent loop.
- Simple implementation, used in Zigbee.



Introduction OLSR

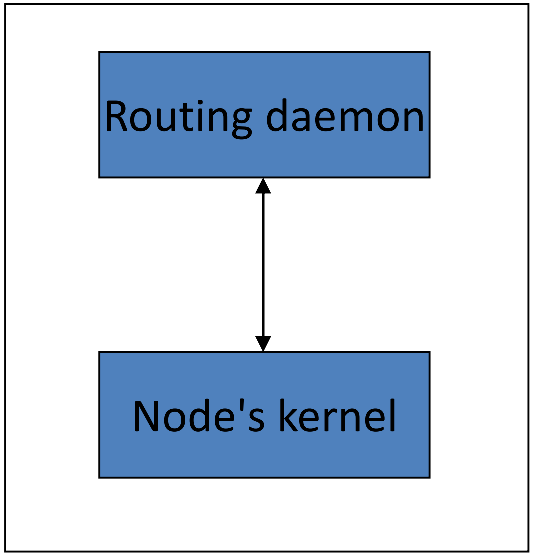
- Table driven routing. Nodes exchange topology information periodically.
- Using MultiPoint Relay mechanism to optimize flooding process.



MRP nodes (black) are selected to perform flooding

Traditional MANET routing build

- Contain a routing daemon works and updates kernel routing.
- Lack of router features: Static routing, access control list, route map, etc…



Objective and proposed solution

- Objective: build a software router supports
  - MANET routing (AODV & OLSR).
  - Additional features : static routing, access control list, route map, etc...
- Proposed solution:
  - Integrate AODV-UU (0.9.6), OLSRdq (0.1.18) to Quagga routing suite (0.99.22.1)

Wireless Ad-hoc router

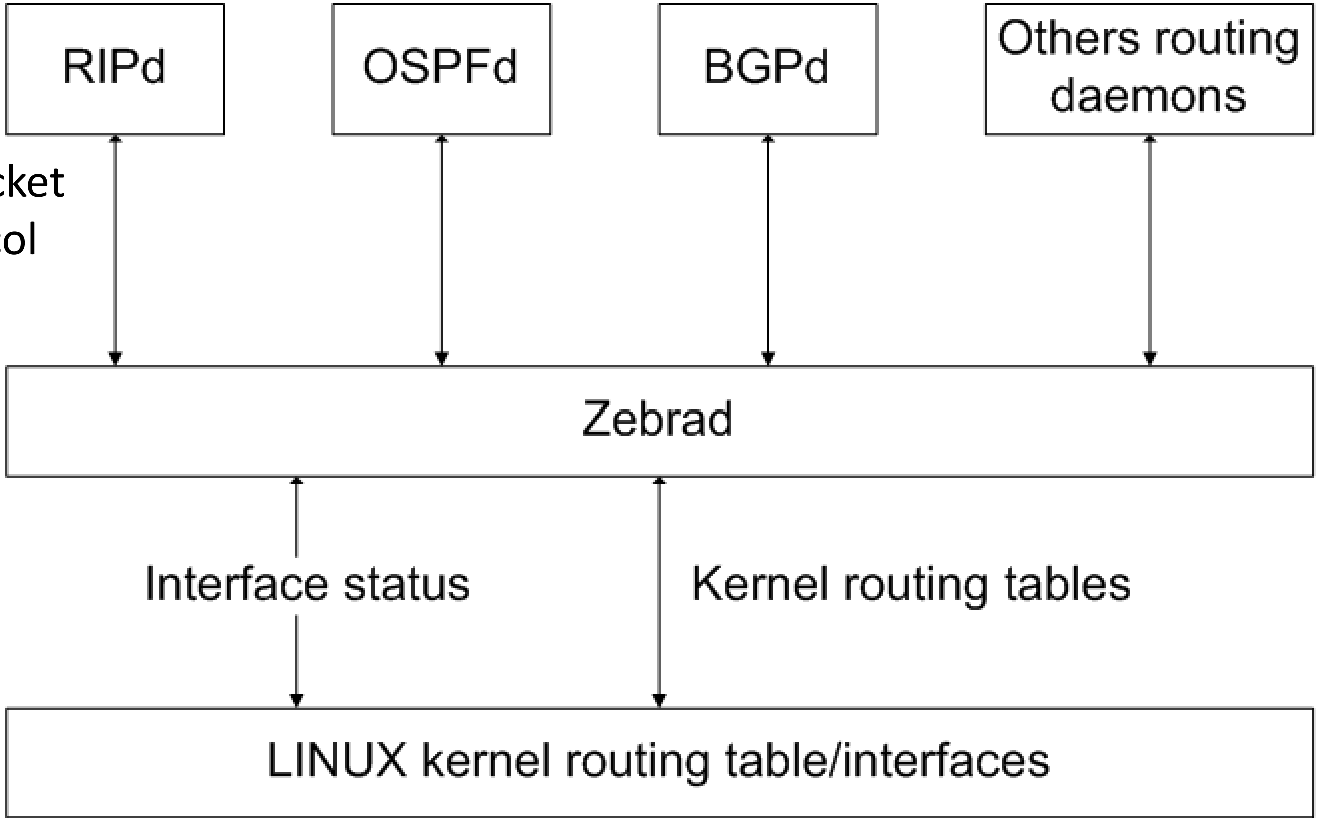
- Why choose Quagga:

	Quagga	XORP	OpenWRT
Type	Opensource	Opensource	Opensource
OS	Linux, BSD	Linux, BSD	Embedded devices
Features	Static routing, RIP, OSPF, BGP, Telnet server, Access list, route map, CLI, SNMP	Static routing, RIP, OSPF, BGP, CLI, SNMP	OLSR, BABEL, B.A.T.M.A.N
Usage	Used in Vyatta (replace XORP), OpenSolaris, Amazon VPC		In linux embedded devices

Wireless Ad-hoc router (cont.)

- Quagga module:
  - Kernel routing table update.
  - Static routing, RIP, RIPv2, OSPF, BGP.
  - Access list, route map, route redistribution.
  - Telnet server, CLI, SNMP, ping, traceroute, etc...
- AODV module: handle AODV routing
- OSLR module: handle OLSR routing

Wireless ad-hoc router (cont.)

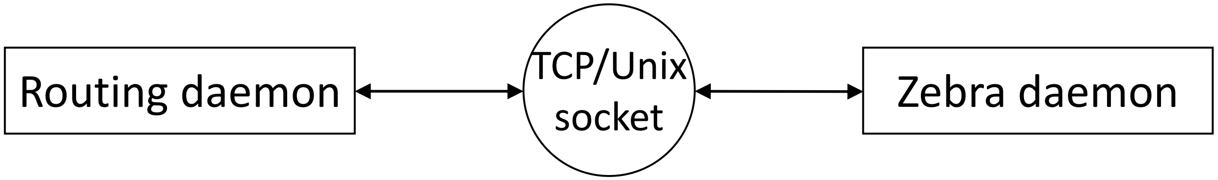


- TCP/Unix socket
- Zebra protocol messages

Quagga architecture (quagga.net)

Wireless ad-hoc router (cont.)

- Routing daemon connects zebra daemon via TCP/Unix socket.



Routing daemon

TCP/Unix socket

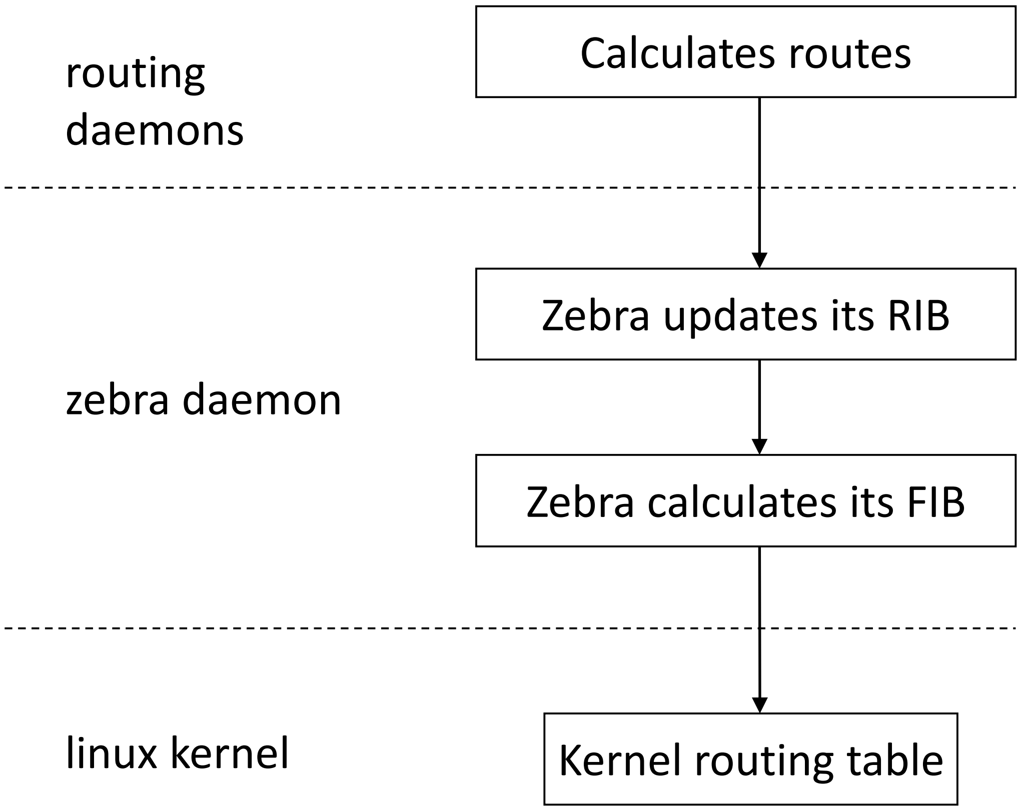
Zebra daemon

- Communication is done using Zebra protocol

```
0                   1                   2                   3
0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-------------------------------+---------------+-------------+
|           Length (2)          |   Marker (1)  | Version (1) |
+-------------------------------+---------------+-------------+
|          Command (2)          |
+-------------------------------+
```

- Message types (command field):
  - Interface add/delete/down/up/address change.
  - Route add/delete (IPv4 / IPv6), nexthop lookup
  - Redistribution add/delete.

Wireless ad-hoc router (cont.)



routing daemons

Calculates routes

zebra daemon

Zebra updates its RIB

Zebra calculates its FIB

linux kernel

Kernel routing table

Kernel routing table update flow

Integrate routing daemon to Quagga

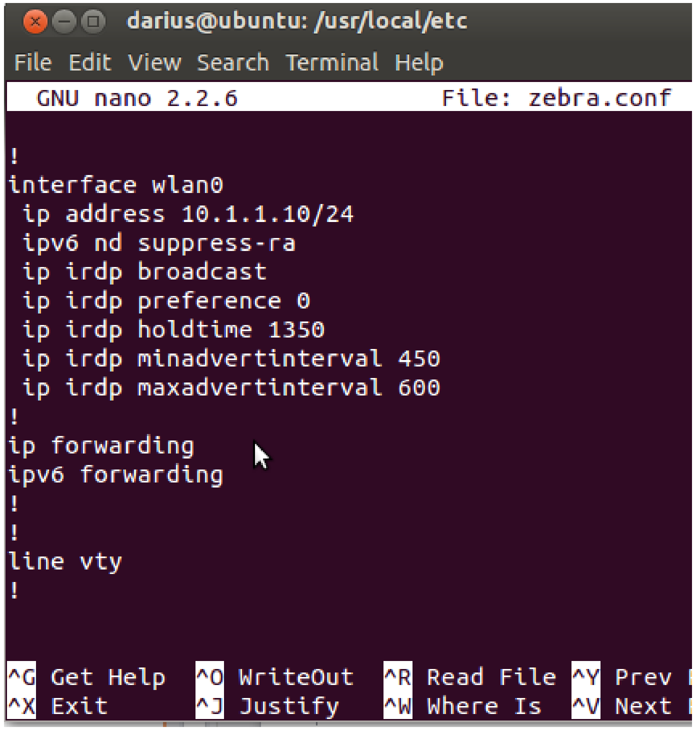
- Define new routing daemons (AODV, OLSR) parameters in Zebra library.
- Zebra socket functions: create, read, write data for new routing daemons.
- Zebra messages functions: interface message, route add/delete/update.
- Stream functions: to create , parse protocol control messages.
- Functions to support CLI, telnet, read/write config file, “show” commands and others.

Result

- AODV and OLSR daemons run and communicate with Zebrad
- Routing functions work and support AODV and OLSR.

Result (cont.)

- Support configuration via config_file and a command line interface (telnet)

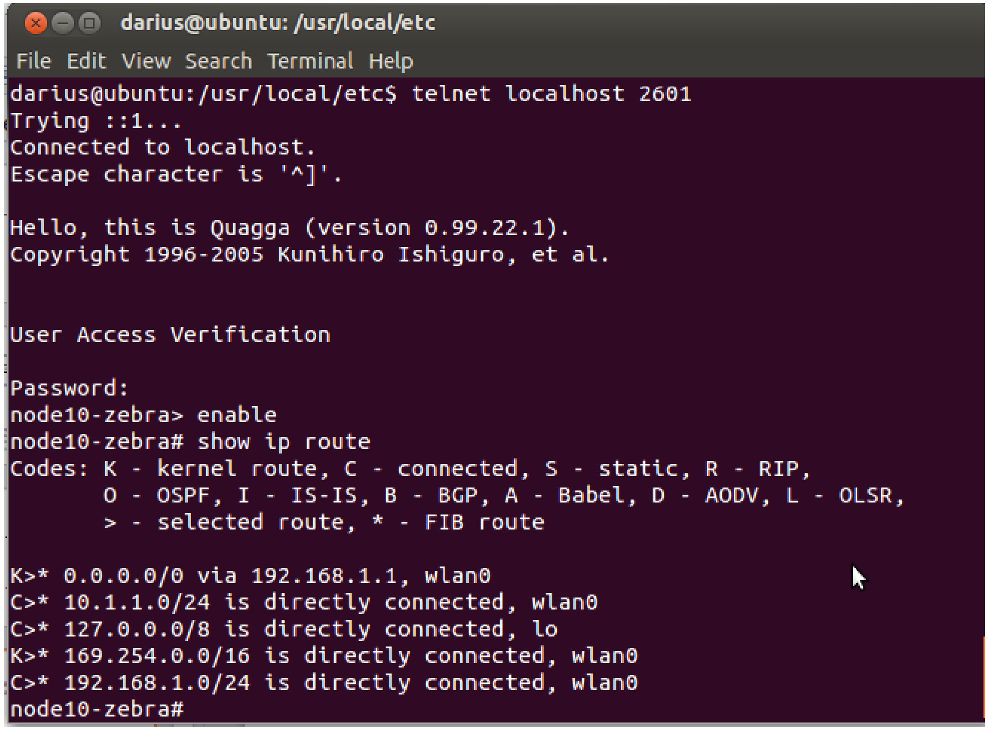


darius@ubuntu: /usr/local/etc
File Edit View Search Terminal Help

```
  GNU nano 2.2.6              File: zebra.conf

!
interface wlan0
 ip address 10.1.1.10/24
 ipv6 nd suppress-ra
 ip irdp broadcast
 ip irdp preference 0
 ip irdp holdtime 1350
 ip irdp minadvertinterval 450
 ip irdp maxadvertinterval 600
!
ip forwarding
ipv6 forwarding
!
!
line vty
!

^G Get Help  ^O WriteOut  ^R Read File ^Y Prev
^X Exit      ^J Justify   ^W Where Is  ^V Next
```



darius@ubuntu: /usr/local/etc
File Edit View Search Terminal Help

```
darius@ubuntu:/usr/local/etc$ telnet localhost 2601
Trying ::1...
Connected to localhost.
Escape character is '^]'.

Hello, this is Quagga (version 0.99.22.1).
Copyright 1996-2005 Kunihiro Ishiguro, et al.


User Access Verification

Password:
node10-zebra> enable
node10-zebra# show ip route
Codes: K - kernel route, C - connected, S - static, R - RIP,
       O - OSPF, I - IS-IS, B - BGP, A - Babel, D - AODV, L - OLSR,
       > - selected route, * - FIB route

K>* 0.0.0.0/0 via 192.168.1.1, wlan0
C>* 10.1.1.0/24 is directly connected, wlan0
C>* 127.0.0.0/8 is directly connected, lo
K>* 169.254.0.0/16 is directly connected, wlan0
C>* 192.168.1.0/24 is directly connected, wlan0
node10-zebra#
```

Result (cont.)

- Support a list of command (input in CLI or config_file).
- "Interface" commands: configure physical interface (on/off), update IP address, and other parameters.
- "Show" commands: show the router information
- "Router" commands: enable routing protocols and routing parameters.

Conclusion & future work

- The prototype works and supports
  - AODV and OSLR routing
  - Multi-hop routing with node movement test (with 3 & 4 nodes).
  - Internet sharing (2 node) in ad-hoc mode with NAT (linux).
- Pending:
  - Performance test: convergence, throughput, etc...
  - IPv6 for AODV and OLSR routing.

Demo & QA

- Test-case: multi-hop routing with node movement. Check connectivity with ping
- Purpose: view routing operation (route add/delete…)