ANSAINET 3.3.0

Vladimír Veselý,
Ondřej Ryšavý, Marcel Marek, Miroslav Švéda,
Peter Scherfel, Tomáš Suchomel, Martin Danko,
Vladimír Sivák, Martin Tlolka,
Vladimír Kojecký, Zdeněk Kraus, Marek Černý,
Veronika Rybová, Matej Hrnčiřík, Jakub Smejkal, Jakub Mrázek
Tomáš Procházka, Jiří Trhlík, Adam Malik, Petr Vítek,
Jan Bloudíček, Vít Rek, Tomáš Rajca, Jan Holuša, Michal Ruprich

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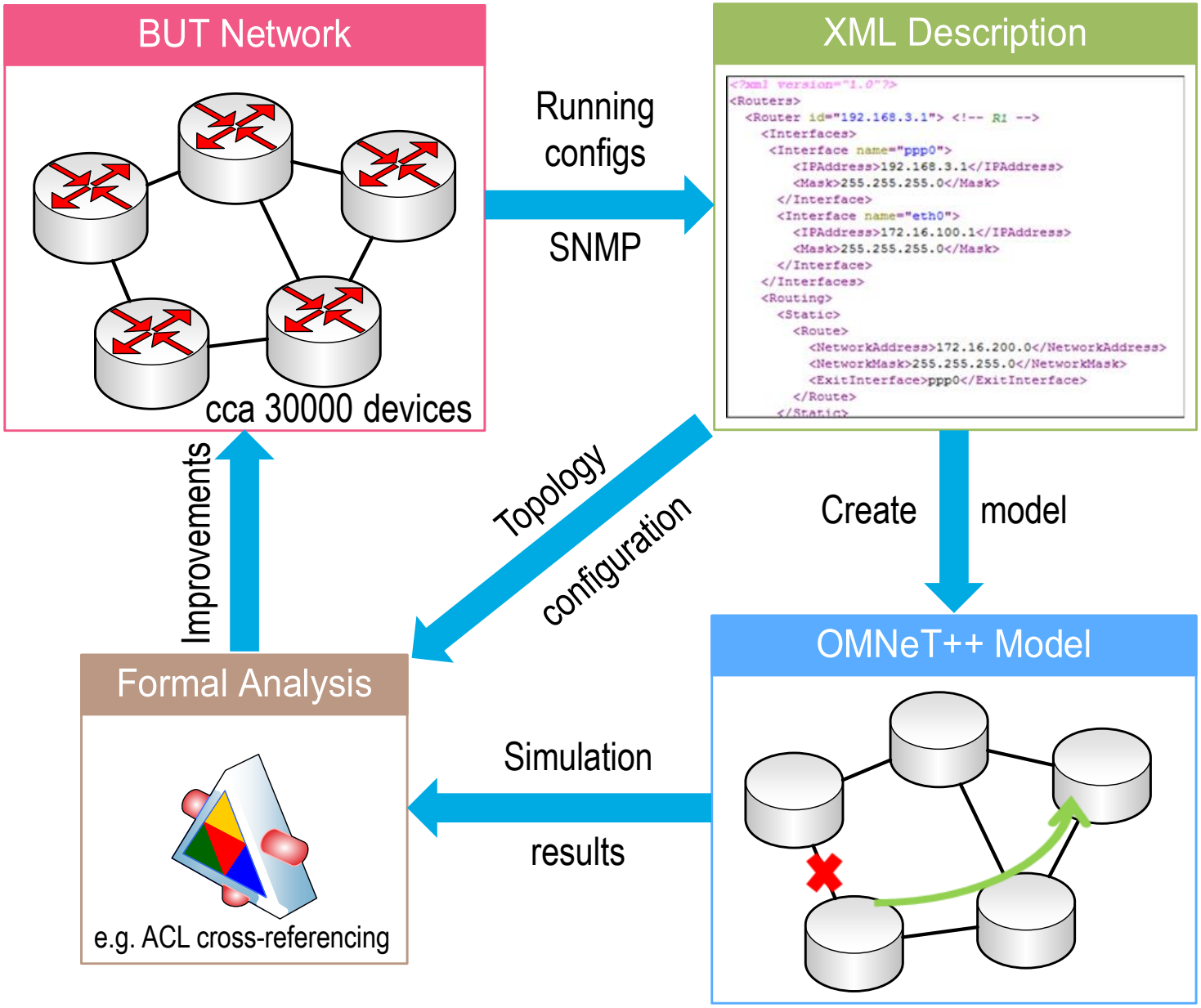
Motivation

- In 2008, FIT-BUT have discovered OMNeT++
- Our research at that time involved
  - Reachibility analysis
  - Network behavior prediction
- However, INET state-of-the-art at that time
  - pure INET version 20061020 for OMNeT++ 3.3
  - INET-MANET version for OMNeT++ 4.0
  - A lot of missing features
    - ACLs
    - traffic generators
    - Cisco-like network packet dispatching behavior
    - Redistribution of routing information
- *We have decided to extend INET for our cause!*

ANSA Project



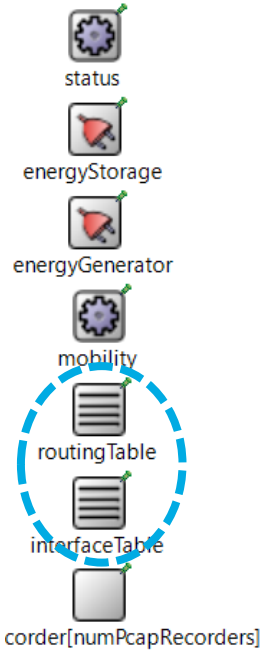
CONTRIBUTIONS

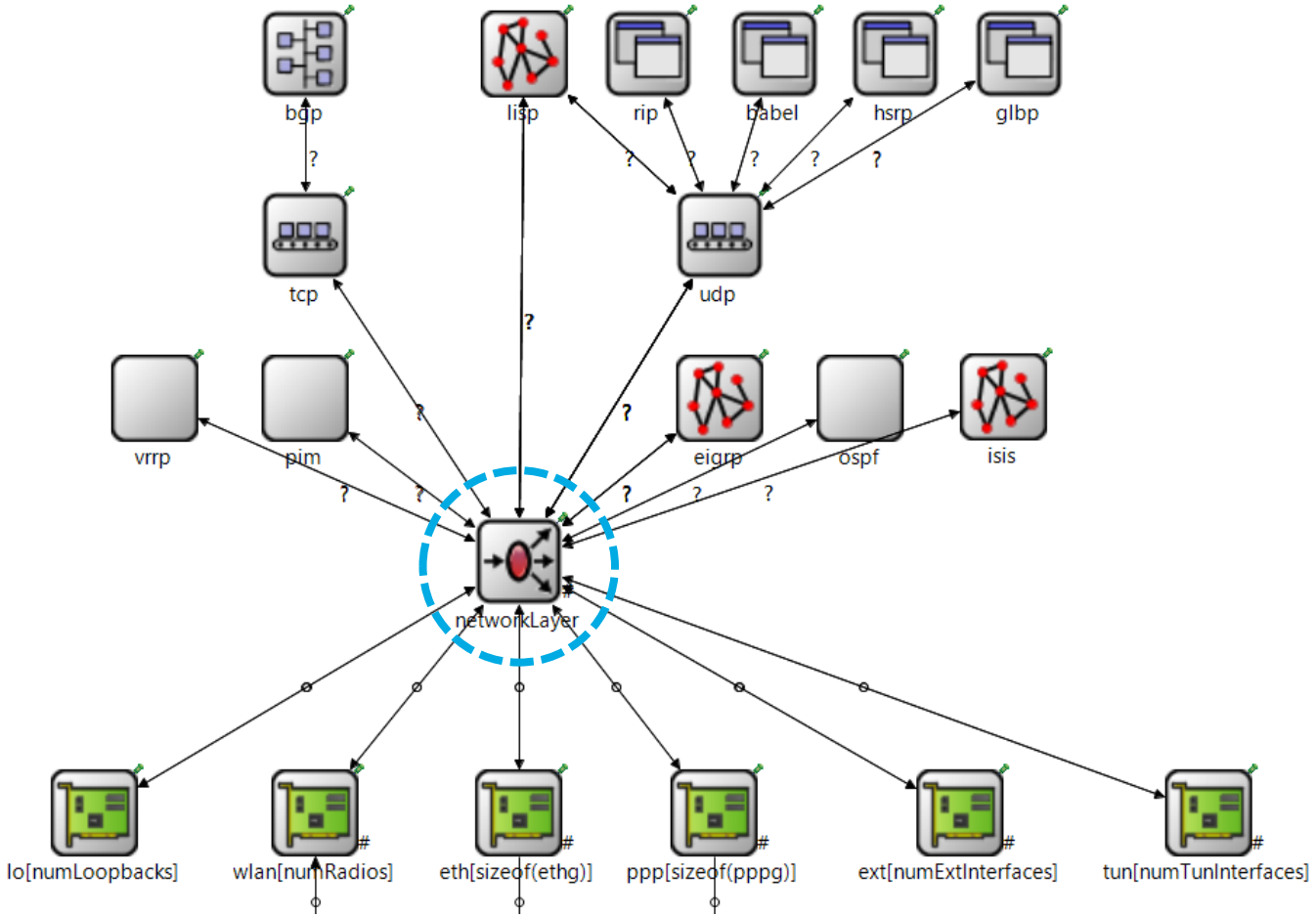
- RYBOVÁ Veronika. *Modelling and Simulation of Network Design Guides for IP Routing*.
- SIVÁK Vladimír. *Modelling Cisco Router in Simulation Tool OMNeT++*.
- SUCHOMEL Tomáš. *OMNeT++ Extension with ACL Filtering Module*.
- DANKO Martin. *Modelling OSPF Routing Protocols Using OMNeT++ Simulator*.
- SCHERFEL Peter. *Simulation of Network Behaviour Based on Analysis of Configuration of Active Network Devices*.
- TLOLKA Martin. *Simulation of EIGRP Protocol Behavior Using OMNeT++*.
- MATELEŠKO Petr. *Multicast Simulation in OMNeT++*.
- DANKO Martin. *Modelling QoS in Computer Networks*.
- ČERNÝ Marek. *IPv6 Modelling in OMNeT++*.
- KRAUS Zdeněk. *Modelling and Reliability Analysis of Campus Network at the BUT*.
- HRNČIŘÍK Matej. *Modelling of L2 Loop-Preventing Protocols*.
- RYBOVÁ Veronika. *Multicast Routing Modelling in OMNeT++*.
- MALIK Adam. *Multicast Distribution Trees Modelling in OMNeT++*.
- MAREK Marcel. *Modelling IS-IS and TRILL*.
- PROCHÁZKA Tomáš. *Modelling PIM-SM in OMNeT++*.
- TRHLÍK Jiří. *Modelling of Distance-Vector Routing Protocols*.
- VÍTEK Petr. *Modelling Gateway Redundancy Protocols*.
- BLOUDÍČEK Jan. *Modelling of EIGRP Routing Protocol*.
- MRÁZEK Jakub. *Modelling of OSPFv3 Link-State Routing Protocol*.
- REK Vít. *Modelling of Babel Routing Protocol*.
- HOLUŠA Jan. *Modelling HSRP and GLBP Gateway Redundancy Protocols*.
- RAJCA Tomáš. *Modelling of L2 Management Protocols*.

Today's metric

25 000 SLOCs

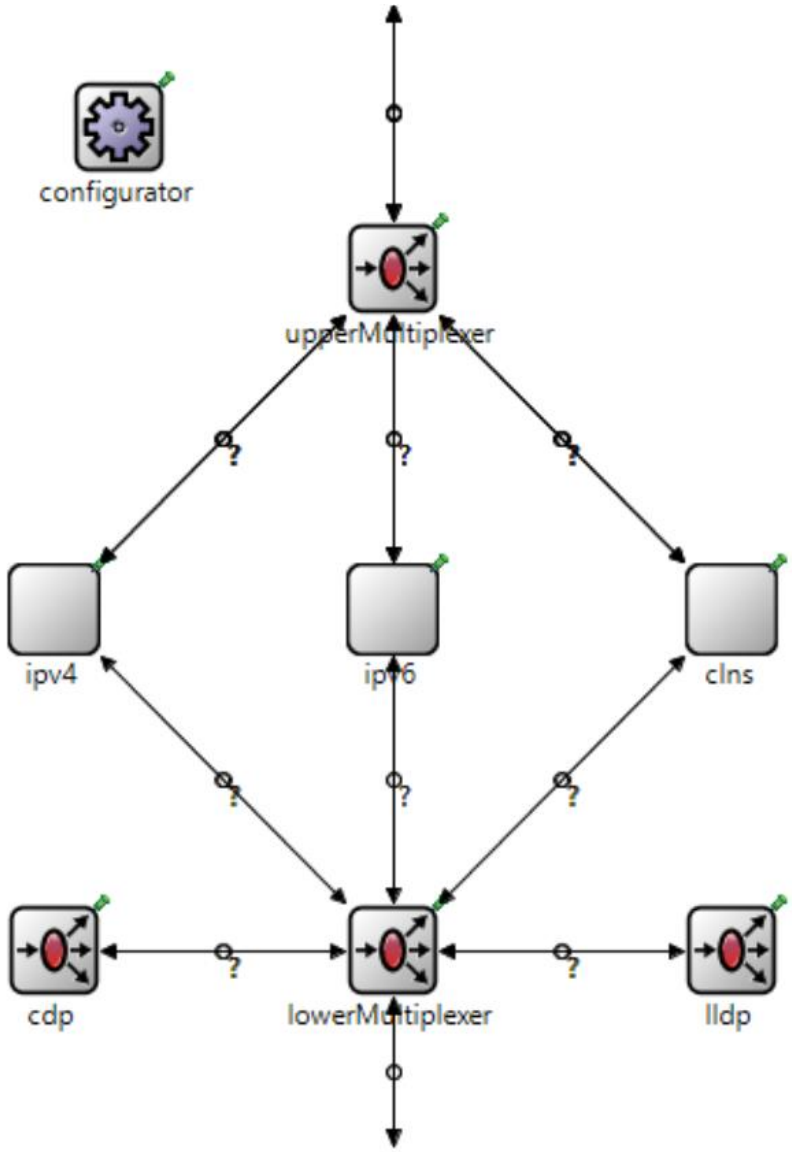
ANSA Router


status
energyStorage
energyGenerator
mobility
routingTable
interfaceTable
corder[numPcapRecorders]


bgp
lisp
rip
babel
hsrp
glbp
tcp
udp
vrrp
pim
eigrp
ospf
isis
networkLayer
lo[numLoopbacks]
wlan[numRadios]
eth[sizeof(ethg)]
ppp[sizeof(pppg)]
ext[numExtInterfaces]
tun[numTunInterfaces]

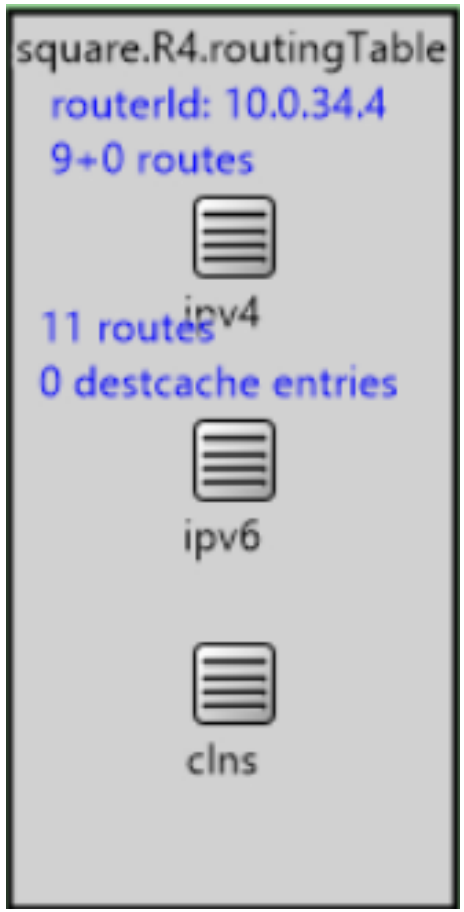
ANSA MULTINETWORKLAYER

- offers up to triple-stack parallel support of IPv4, IPv6 and CLNS
- allows multiplexing for data-link layer protocols
- mimics processing behavior of reference Cisco router



ANSA MULTIROUTINGTABLE

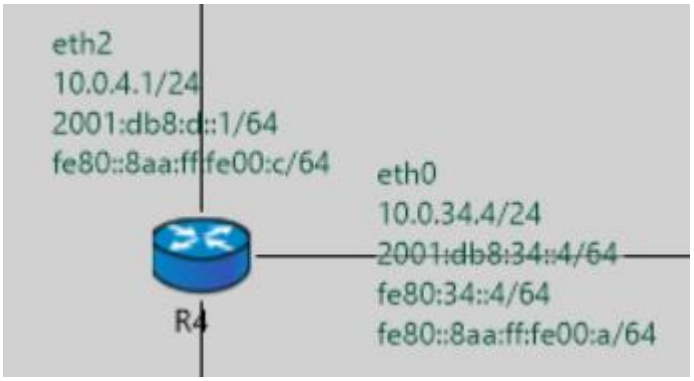
- **ANSA MultiRoutingTable**
  - enhances IPv4/IPv6/CLNS routes
  - employs additional administrative distance constants
  - Cisco-like appearance




```
routes (IPv4Route *>)
  elements[9] (inet::IPv4Route *)
    [0] = ba 10.0.1.0/24 [125/96] via 10.0.14.1, eth1
    [1] = ba 10.0.2.0/24 [125/192] via 10.0.14.1, eth1
    [2] = ba 10.0.3.0/24 [125/96] via 10.0.34.3, eth0
    [3] = C 10.0.4.0/24 is directly connected, eth2
    [4] = ba 10.0.12.0/24 [125/96] via 10.0.14.1, eth1
    [5] = C 10.0.14.0/24 is directly connected, eth1
    [6] = ba 10.0.23.0/24 [125/96] via 10.0.34.3, eth0
    [7] = C 10.0.34.0/24 is directly connected, eth0
    [8] = C 127.0.0.0/8 is directly connected, lo0
```

ANSA InterfaceEntry

- **ANSA InterfaceEntry**
  - registers additional parameters like delay, reliability, virtual forwarder




```
idToInterface (InterfaceEntry *>)
  elements[4] (inet::InterfaceEntry *)
    [0] = lo0 id=100  on:nwLayer.ifOut[3]  MTU:4470 LOOPBACK  macAddr:n/a IPv
    [1] = eth0 id=101  ifOut[0] MTU:1500 BROADCAST MULTICAST
          BW: 100000bit/s, DLY: 100 us, rely:255/255, rload: 1/255, tload:1/255
          MAC:          0A-AA-00-00-00-0A
          IPv4 ucast:   10.0.34.4/24
          IPv4 mcast:   224.0.0.1, 224.0.0.2, 224.0.0.111
          IPv6 ucast:   2001:db8:34::4, fe80:34::4, ff02::1:6, fe80::8aa:ff:fe00:a
          IPv6 mcast:   ff02::1, ff02::2
    [2] = eth1 id=102  ifOut[1] MTU:1500 BROADCAST MULTICAST \ BW: 100000bi
    [3] = eth2 id=103  ifOut[2] MTU:1500 BROADCAST MULTICAST \ BW: 100000bi
```

CONFIGURATION

- Default INET's **NetworkConfigurator** does not suite our needs
- Each simulation module supports initialization from external XML file
- Per-interface config is setup by **MultiNetwork Configurator**

```
<Devices>
    <!-- R1 -->
    <Router id="2001:db8:a::1">
        <Interfaces>
            <Interface name="eth2">
                <IPAddress>10.0.1.1</IPAddress>
                <Mask>255.255.255.0</Mask>
                <IPv6Address>2001:db8:a::1/64</IPv6Address>
                <Babel>
                    <AFDistribute>IPvX</AFDistribute>
                </Babel>
            </Interface>
            <Interface name="eth0">
                <IPAddress>10.0.12.1</IPAddress>
                <Mask>255.255.255.0</Mask>
                <IPv6Address>2001:db8:12::1/64</IPv6Address>
                <IPv6Address>fe80:12::1/10</IPv6Address>
                <Babel>
                    <AFDistribute>IPvX</AFDistribute>
                </Babel>
            </Interface>
            <Interface name="eth1">
                <IPAddress>10.0.14.1</IPAddress>
                <Mask>255.255.255.0</Mask>
                <IPv6Address>2001:db8:14::1/64</IPv6Address>
                <IPv6Address>fe80:14::1/10</IPv6Address>
                <Babel>
                    <AFDistribute>IPvX</AFDistribute>
                </Babel>
            </Interface>
        </Interfaces>

        <Routing>
            <Babel>
                <RouterId>
                    1111:1111:1111:1111
                </RouterId>
            </Babel>
        </Routing>
    </Router>
```

FEATURES

- Currently supported in ansainet-3.3.0 for OMNeT++ 5.0
  - multicast, PIM-DM, PIM-SM
  - RIP, RIPng
  - IS-IS, TRILL
  - EIGRP, Babel
  - LISP
  - CDP, LLDP
  - HSRP, VRRP, GLBP
- Upcoming
  - OSPFv3
  - revisit IPv6
  - revisit DHCP
- Abandoned
  - STP, RSTP
  - ACL
  - QoS (PQ, WFQ, CBWFQ)
  - Traffic Generators

CITED BY

- Gábor Lencse and István Derka, "Experimental Analysis of the Fault Tolerance of the PIM-SM IP Multicast Routing Protocol under GNS3" International Journal of Advanced Computer Science and Applications(IJACSA), 5(5), 2014. http://dx.doi.org/10.14569/IJACSA.2014.050503
- Jozef Papán, “IP Fast Reroute“, dissertation thesis, University of Žilina, 2016. http://acmbulletin.fiit.stuba.sk/abstracts/papan2016.pdf
- LISP simulation modules are recently being used by GMV Innovating solutions

- *Placeholder for your citation of our framework* ☺

REFERENCES

- Project webpage
  - https://nes.fit.vutbr.cz/ansa/

- Project GitHub repository
  - https://github.com/kvetak/ANSA
  - Master branch is ansainet-3.3.0
  - Other supported branches
    - ansainet-3.2.1
    - ansainet-2.2
    - ansainet-2.1
    - ansainet-2.0

- *Thank you for your attention! Questions?*