



Artur Scussel, Christoph Brandauer, Georg Panholzer, Ferdinand von Tüllenburg

## Improvements in OMNeT++/INET Real-Time Scheduler for Emulation Mode

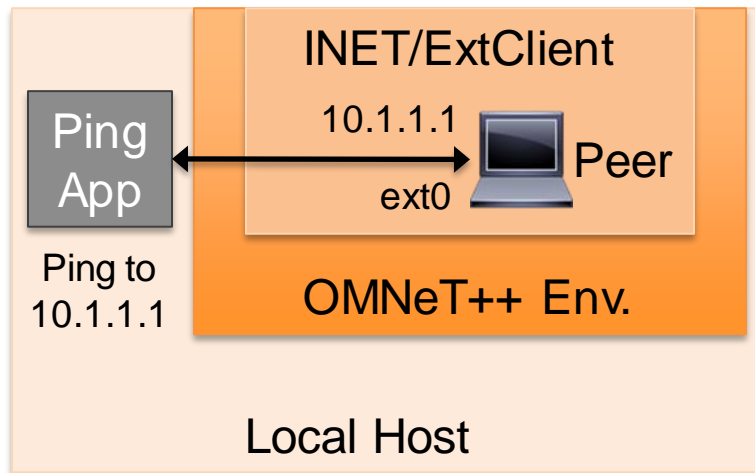
2nd OMNeT++ Community Summit 2015, 03. – 04.09.2015, IBM Research - Zurich, Switzerland



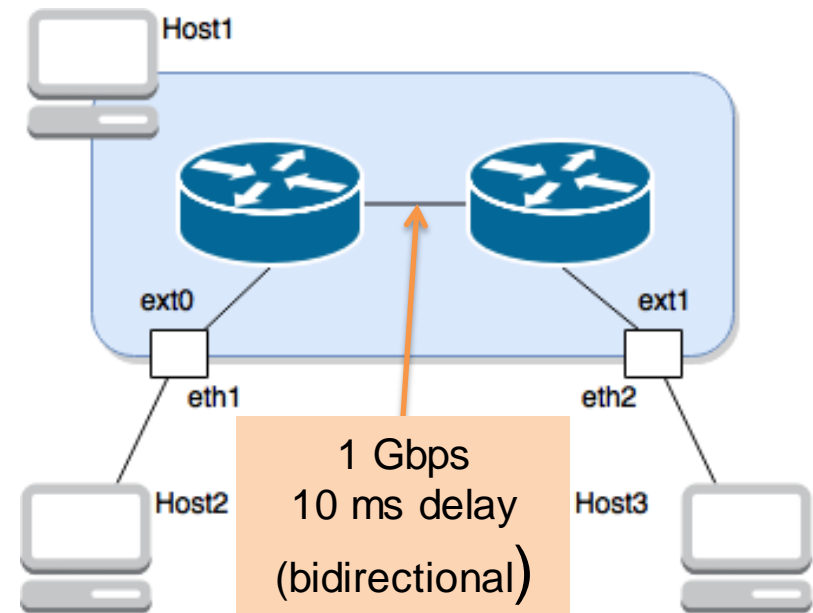
# Performance Evaluation

- Question:
  - How precise is communication quality emulation (part. delay)?

## Test 1: Ping to local Standard Host

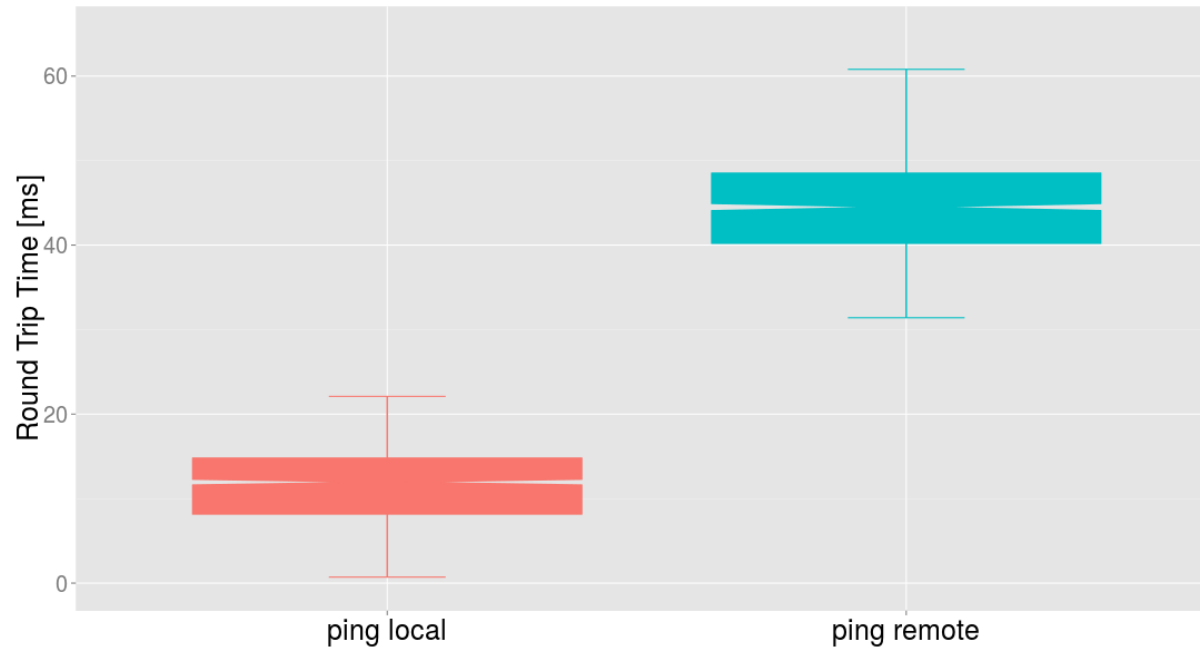


## Test 2: Ping over emulated Link





# Problem Evaluation - Results



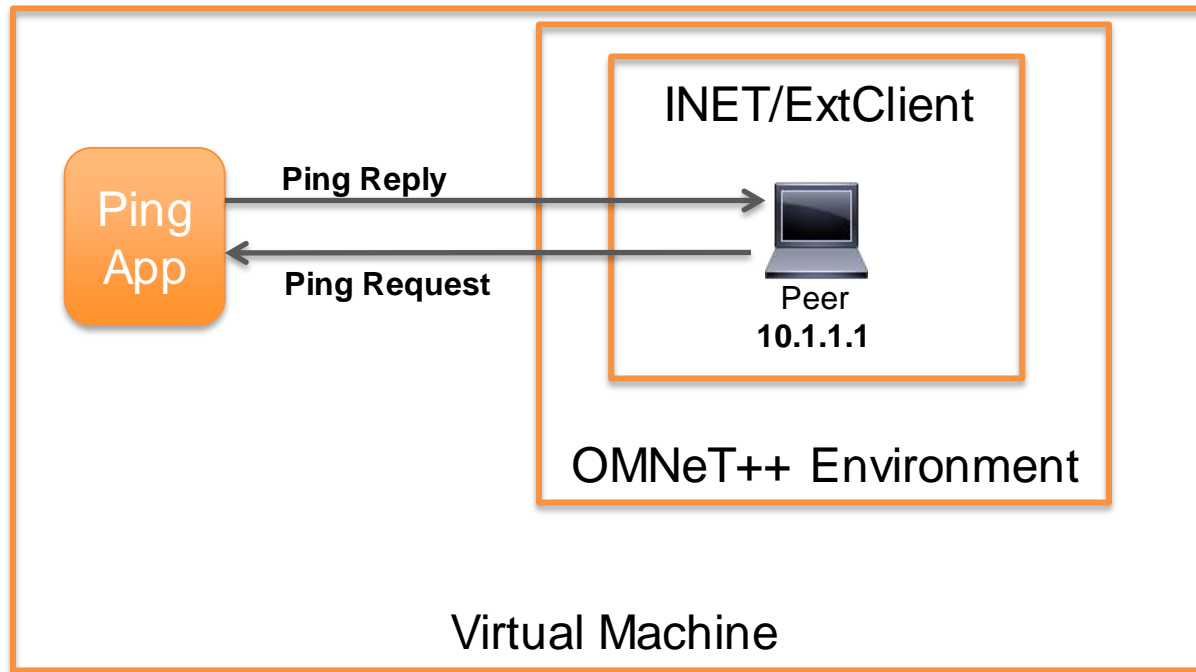
## Ping local (Test 1)

- Ping local test:
  - RTT range: [0.7,22.1] ms
  - Average (Mean): ~11 ms
- Test w/o emulation:
  - Ping to eth1 (Host1)
  - RTT < 1 ms (all time)

## Ping remote (Test 2)

- Ping remote test:
  - RTT range: [31.4, 60.8] ms
  - Average (Mean): ~44 ms
  - Expected RTT (Mean) : ~21 ms
- Test w/o emulation:
  - Ping to Host 3 w/o emulation.
  - RTT < 1 ms (all time)

# Demo I – Unmodified Version



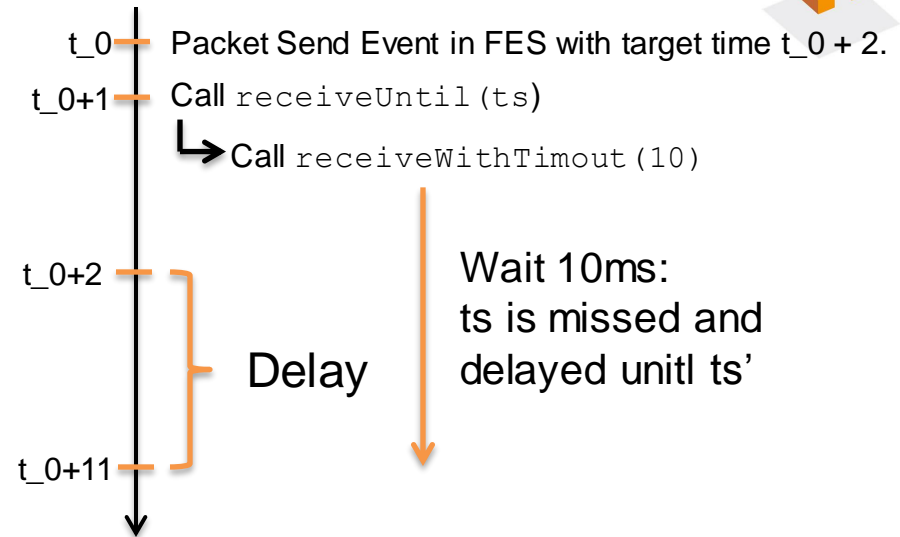
## ExtClient Example without Modification



# Problem Analysis & First Enhancements

## 1. Issue: Incorrect Timeout Computation

- RT Scheduler synchronizes event processing with wall-clock
- Incoming / Outgoing Packets are induced in FES
- Timeout Computation corrected and code optimized by A. Vargas and R. Hornig (by themselves)

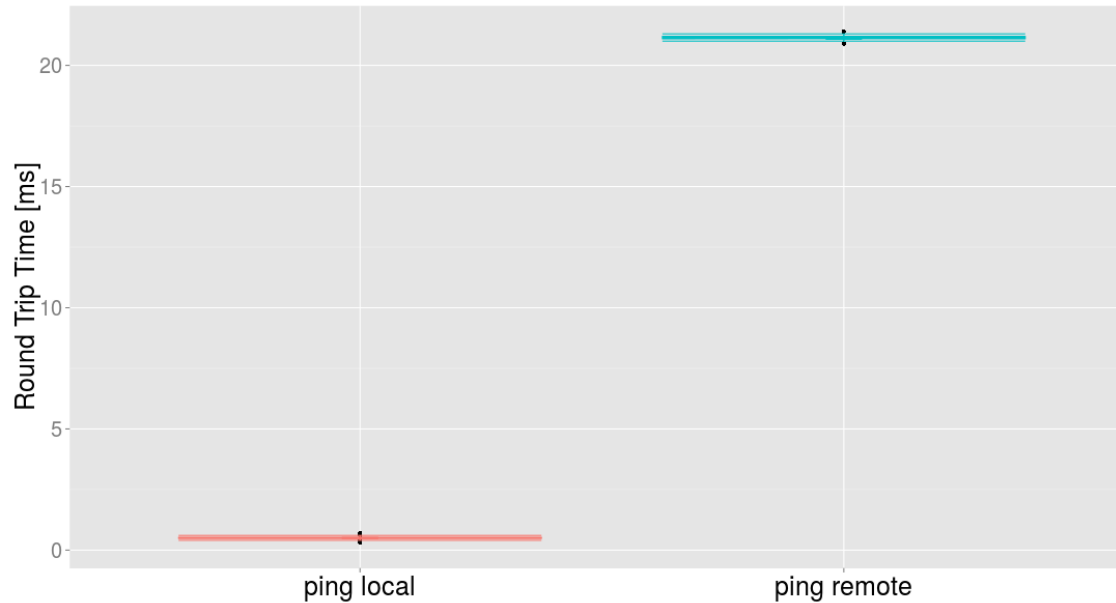


## 2. Issue: Kernel pcap Buffering

- Pcap Default:
  - Kernel buffers packets before passing to OMNeT++
- Work around:
  - pcap immediate mode
  - Risk of increased packet loss

**Enhancements were integrated in  
INET 3.0  
(actually INET 2.99.1)**

# Results



**Ping local (Test 1)**

**Ping remote (Test 2)**

- Ping local test:

- RTT range [0.8,1.3] ms
- Average (Mean): ~1ms

- Ping remote test:

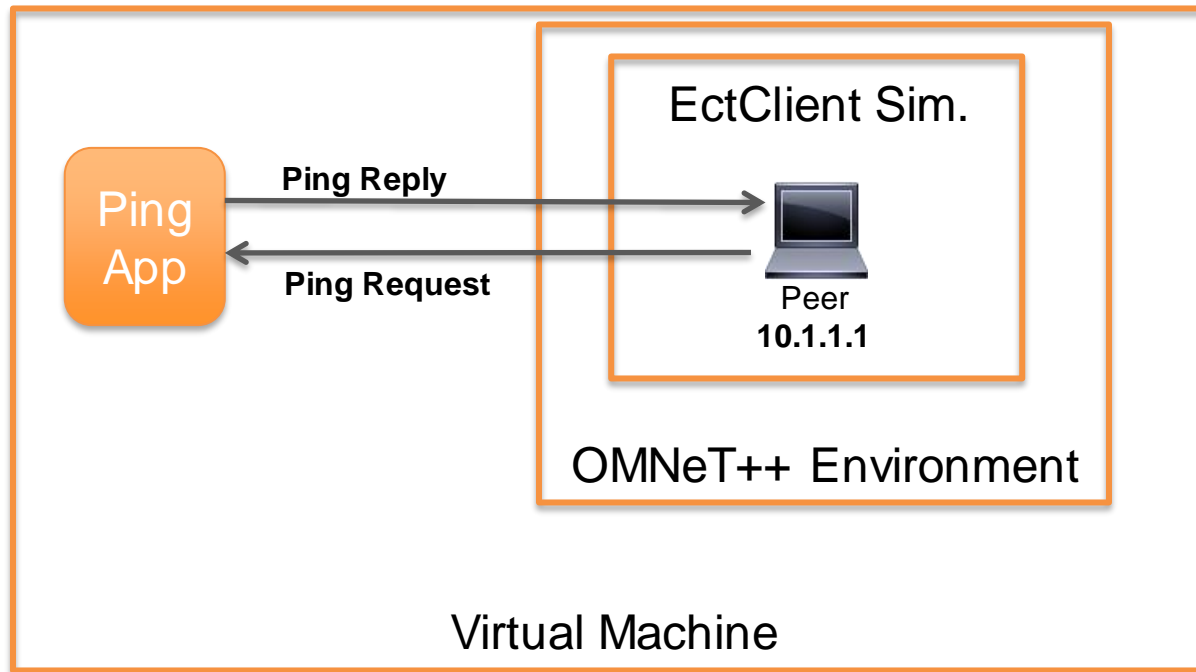
- RTT range [21.1, 22.2] ms
- Average (Mean): ~21ms

- **But Packet Loss increases**

- Test: 10Mbit/s; packet size 100 Bytes (125 packets/s)
  - With immediate mode: 3.4% loss
  - Without immediate mode 1.6%

**Further studies  
needed**

# Demo 2

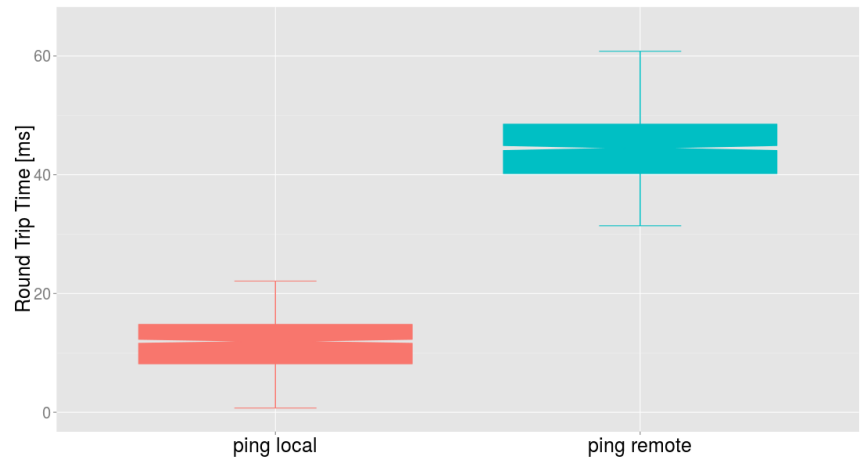


## ExtClient Example with Modification

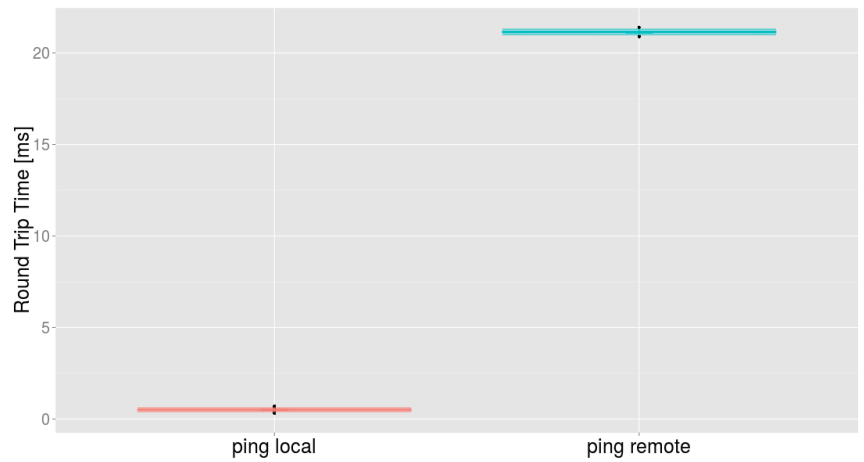
# Summary & Future Work



- Starting Situation exhibits
  - High Delays,
  - High Delay Variation
- Issues found
  - Incorrect Timeout Computation
  - Bugs in RTScheduler
  - Kernel pcap Buffering
- Correcting these issues
  - Enhances delay precision, responsiveness +
  - Increases packet loss -
- Future Work
  - Investigation of packet loss issue
  - Check other packet capturing mechanisms (e. g., PF\_RING)
  - Multi-threading



**Starting Situation**



**Current Situation**