

AMIsim: Application-layer AMI Simulation Framework

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Motivation

- Compare the performance of application-layer Advanced Metering Infrastructure (AMI) protocols
- Protocols are used for
 - Aggregation
 - Confidentiality/integrity protection
 - Privacy-preservation

Performance Metrics

- Computational performance
 - Encryption/decryption/aggregation time taken by a smart meter
- Communication performance
 - Total packet size that the smart meter transmits
 - Congestion analysis based on the number of packets in the sending queue at the smart meter

Simulation Network Specification

- OMNeT++
 - C++
 - NED
- ZigBee
 - Data rate: ~163kpbs
 - Packet error rate: 0.1
 - Delay: 100ms
- Pecan Street dataset (one of the largest energy/water datasets)

Case Study

Laptop (Intel Core i7-3610QM 2.3 GHz processor)

VS

Smart Meter (120 MHz, 32-bit ARM Cortex-M4)

- Cortex-M4 is ~100 times slower in performing FLOPS in comparison with Intel Core i7-3610QM

Demo

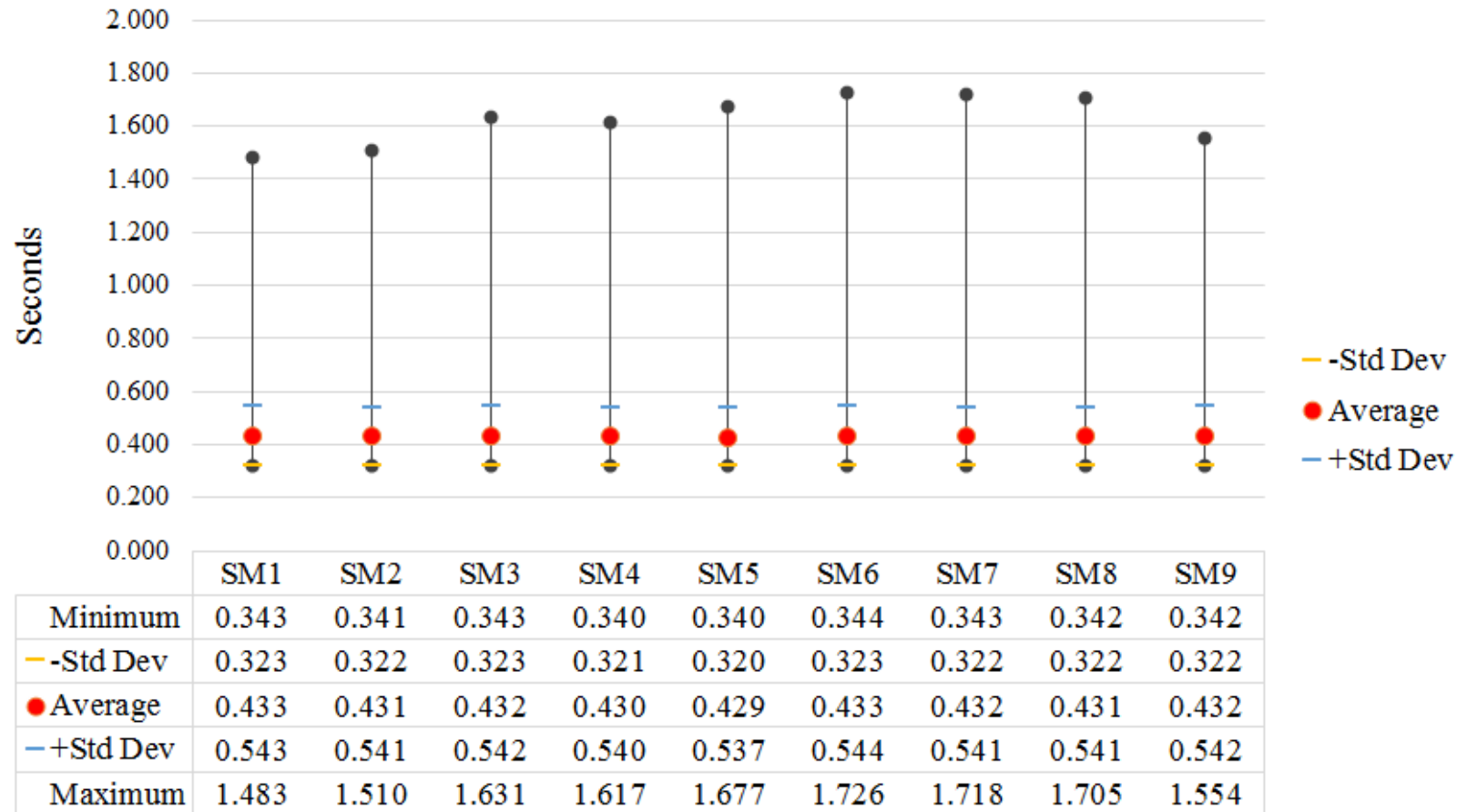
- Documentation
 - doxygen

The screenshot displays the OMNeT++ simulation environment. At the top, the menu bar includes 'File', 'Simulate', 'Inspect', 'View', and 'Help'. The status bar shows '#1006' and '58.127s'. A toolbar contains various simulation controls, with a red box labeled '5' highlighting the 'Next' button. The main window is divided into two panes. The top pane, labeled 'AMI', shows a network diagram with nodes 'sms[0]' through 'sms[9]' and 'uc'. A red box labeled '1' highlights a central node. The bottom pane shows a log window with a red box labeled '4' highlighting a specific event. The log contains the following text:

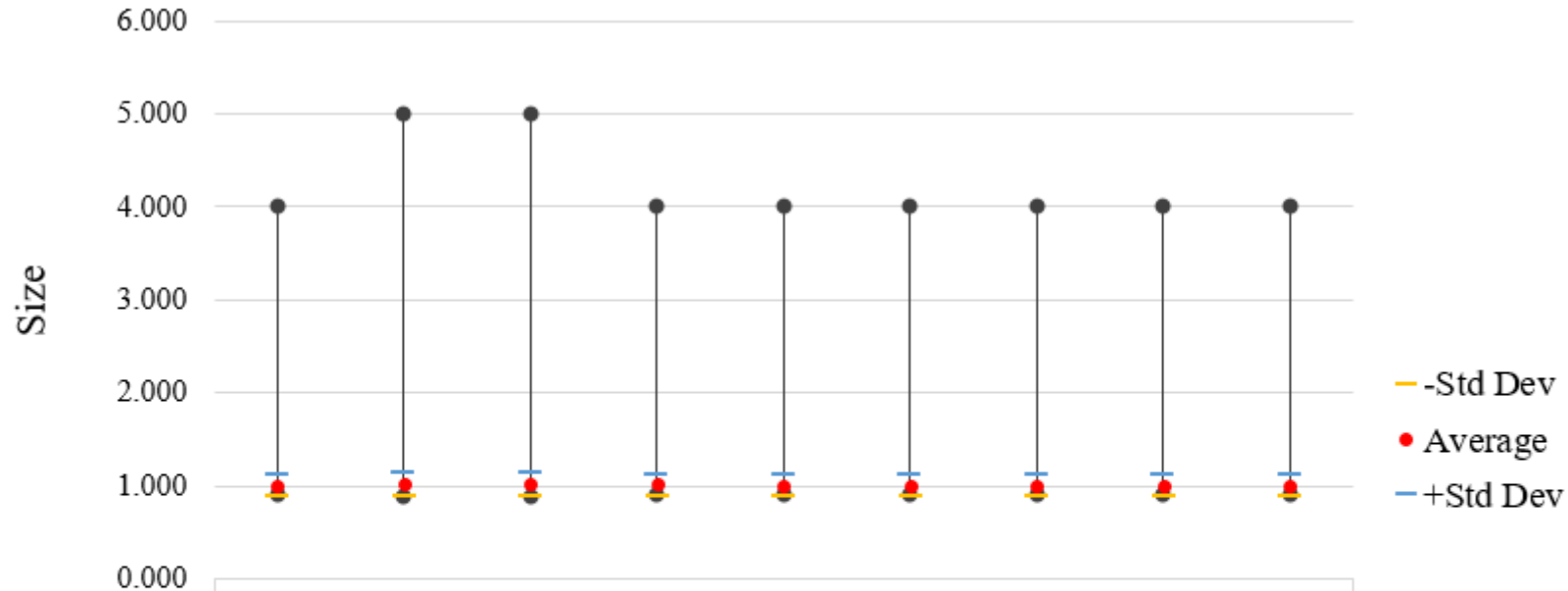
```
** Event #986 t=56.219 AMI.sms[6] (SmartMeter, id=8) on selfmsg startSendingEnergyData (omnetpp::cMessage, id=20)
** Event #987 t=56.239 AMI.sms[9] (SmartMeter, id=11) on selfmsg startSendingEnergyData (omnetpp::cMessage, id=23)
** Event #988 t=56.278 AMI.sms[5] (SmartMeter, id=7) on selfmsg startSendingEnergyData (omnetpp::cMessage, id=19)
** Event #989 t=56.295 AMI.sms[0] (SmartMeter, id=2) on selfmsg startSendingEnergyData (omnetpp::cMessage, id=14)
** Event #990 t=56.354 AMI.sms[7] (SmartMeter, id=9) on selfmsg startSendingEnergyData (omnetpp::cMessage, id=21)
** Event #991 t=56.392 AMI.sms[3] (SmartMeter, id=5) on selfmsg startSendingEnergyData (omnetpp::cMessage, id=17)
** Event #992 t=56.414 AMI.sms[2] (SmartMeter, id=4) on selfmsg startSendingEnergyData (omnetpp::cMessage, id=16)
** Event #993 t=56.431 AMI.sms[4] (SmartMeter, id=6) on selfmsg startSendingEnergyData (omnetpp::cMessage, id=18)
** Event #994 t=56.437 AMI.sms[1] (SmartMeter, id=3) on selfmsg startSendingEnergyData (omnetpp::cMessage, id=15)
** Event #995 t=56.489 AMI.sms[8] (SmartMeter, id=10) on selfmsg startSendingEnergyData (omnetpp::cMessage, id=22)
** Event #996 t=57.219 AMI.sms[6] (SmartMeter, id=8) on selfmsg startSendingEnergyData (omnetpp::cMessage, id=20)
** Event #997 t=57.239 AMI.sms[9] (SmartMeter, id=11) on selfmsg startSendingEnergyData (omnetpp::cMessage, id=23)
** Event #998 t=57.278 AMI.sms[5] (SmartMeter, id=7) on selfmsg startSendingEnergyData (omnetpp::cMessage, id=19)
** Event #999 t=57.295 AMI.sms[0] (SmartMeter, id=2) on selfmsg startSendingEnergyData (omnetpp::cMessage, id=14)
** Event #1000 t=57.354 AMI.sms[7] (SmartMeter, id=9) on selfmsg startSendingEnergyData (omnetpp::cMessage, id=21)
** Event #1001 t=57.392 AMI.sms[3] (SmartMeter, id=5) on selfmsg startSendingEnergyData (omnetpp::cMessage, id=17)
** Event #1002 t=57.414 AMI.sms[2] (SmartMeter, id=4) on selfmsg startSendingEnergyData (omnetpp::cMessage, id=16)
** Event #1003 t=57.431 AMI.sms[4] (SmartMeter, id=6) on selfmsg startSendingEnergyData (omnetpp::cMessage, id=18)
** Event #1004 t=57.437 AMI.sms[1] (SmartMeter, id=3) on selfmsg startSendingEnergyData (omnetpp::cMessage, id=15)
** Event #1005 t=57.489 AMI.sms[8] (SmartMeter, id=10) on selfmsg startSendingEnergyData (omnetpp::cMessage, id=22)
** Event #1006 t=58.127 AMI.gen (DataGenerator, id=16) on selfmsg timer (omnetpp::cMessage, id=26)
```

At the bottom of the log window, it says 'General #0: AMI' and 'Msg stats: 10 scheduled / 842 existing / 1752 created'. A red box labeled '2' is also present in the top right area of the simulation window.

Computation Overhead



Packet Queue Size



	SM1	SM2	SM3	SM4	SM5	SM6	SM7	SM8	SM9
Minimum	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
— -Std Dev	0.899	0.888	0.894	0.897	0.897	0.902	0.904	0.897	0.903
● Average	1.010	1.012	1.012	1.012	1.010	1.010	1.009	1.010	1.009
— +Std Dev	1.121	1.137	1.130	1.126	1.124	1.117	1.115	1.124	1.116
Maximum	4.000	5.000	5.000	4.000	4.000	4.000	4.000	4.000	4.000

Questions?

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