The Management Infrastructure of a Network Measurement System for QoS Parameters

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Agenda

- Scenario based on existing tools
- Design of the management infrastructure
- Experimental results
- Conclusions and future work
Existing Tools Scenarios

- Vendor specific applications for specific platforms
- Not all applications are QoS capable
- Some require complex commands, scripts, procedural steps
- Manual measurement control (especially on different tools)
- Additional software and computations to obtain targeted results
Our Software Solution

Network Measurement System

Console
- Straightforward user interface
- User focuses on scenarios, topology, test objectives
- Runtime operations performed by the computer
- Measured QoS parameters available automatically

Infrastructure
- Software module used by both applications
- Measurement information communication
- Accomplishes the task using a management protocol
Infrastructure Design

Structural Logic
- Organizes measurement operations as a set of abstract items
- The user interacts with these items to perform a measurement

Management Messages
- Identification messages relay information about agents’ capabilities
- Task control messages request agents to start a measurement task
- Data messages are used to collect QoS results from a set of agents

Sessions
Groups
Tasks
Working Example

Defining Sessions

Session 1
Agent 1 ➤ Agent 3
Session 2
Agent 2 ➤ Agent 4

Agent (s) involved
Generation / Analysis
Traffic type
Packet distribution
Protocol specific
Desired results

Scheduling and Running Tasks

Task 1
Session 2 @ 1 o’clock
(finished)
Task 2
Session 1 @ 3 o’clock
(pending)

Collecting Results

QoS Parameter vs. Time

Graph showing QoS parameter over time.
Software Architecture

Measurement Services

Management Console

User Interface

- Enables user control through various windows and dialogs
- Allows creation of measurement sessions, groups and tasks

Session Manager

- Management console’s QoS measurement intelligence
- Runs the measurement task; collects and stores results

Communication Services

Management Console

Queuing Service

- Synchronous service for asynchronous messages
- Message retransmissions, duplicates deletion, timeout

SNMP Service

- Encapsulation of messages to SNMP PDUs
- SNMP data verification, buffer overflow checking

Management Service

- A thread for each assigned local network interface
- Socket I/O operations with SNMP data
Management Console

The primary application that enables the users to perform QoS measurements.
Management Service

- Basic networking connectivity using UDP transport
- Interface with SNMP service for message encapsulation
- Interface with queuing service for message distribution
- Security functions (IP-based filtering)
Queuing Service

- Temporary storage for management messages awaiting processing
- 4 inbound and 4 outbound priority based FIFO queues
- Message retransmission
- Duplicate message removal
- Queue recycling
Session Manager

Contains the measurement related intelligence

- Keeps track on measurements to perform
- Generates and listens for related messages
- Discriminates between incoming replies
- Computes final results and presents them to the user
Management Configuration

- The first step after NMS software installation
- The user is notified the configuration is absolutely required (all other features are not available)
- Configuration information: manager identification, networking, SNMP and security

Enables manager recognition in managing topologies
Selection of primary network interface on multihomed hosts
Additional interfaces are selectable later on
SNMP community names and associated permissions
SNMP runs only on selected network interfaces

Internet layer filtering to compensate the lack of security for SNMPv1

Start the Configure Management Wizard using the select in the Wizard Option Box the next menu.
Services Configuration

- Software routines that execute under the same process as the management console
- Some have their own threads, other run under the context of other service threads

Service control: start, stop, pause
Service startup type
Service recovery
Service dependencies
Service parameters
Agents Registration

- Validates an SNMP entity as a NMS measurement agent

**User**

**Background**

- Identification managed objects test the SNMP entity role
- Advanced information on agent station hardware is collected
- Agent information is stored and updated periodically
- The maximum number of agents is 65536
- The maximum number of simultaneous tests per agent from all managers is 256
Performing Measurements

Create a measurement session
Specify session parameters
Session is saved but not executed
Running multiple session at once
Group of independent sessions
Parametric group
Create a new pending task
Session Manager is now in charge
Task may be deleted while pending
Results Inspection

Results

Task Type
- Single
- Group

Session Type
- Generate
- Analyze
- Both

Dependencies
- Average Packet One-Way Delay
- Minimum One-Way Delay
- Maximum One-Way Delay

Time
- Throughput [Kbps]

Data Formatting
- Summary
- Last Data
- Time
- Parametric
- Table
- Plot

At a glance
Experimental Scenario

- Evaluate PC performances for traffic generation at gigabit per second data rates

Objectives
- Throughput
- Packet delay variation
- Packet loss

Parameters
- Traffic type: IEEE 802.3z
- Frame rate: 200 to 100,000 pps
- Frame size: 1500 bytes
- Test duration: 100 seconds
- Packet distribution: periodic and Poisson
Example of Results

- Series of tests vs. packet rate at 1500 byte frames
  - Packet count
  - Throughput
  - Delay variation
  - Packet loss ratio
  - Real-time failure

Overall, 300 packets in 100 seconds test
Comparison of Results

- Throughput (Mbps) vs. desired packet rate obtained for different NICs

**Intel PRO 1000 VE**

Throughput (Mbps)

**SysKonnect SK 9843**

Throughput (Mbps)
Comparison of Results

• Examining the maximum achieved packet rate vs. desired packet rate

Intel PRO 1000 VE

Maximum 60-100 kpps
(depending on packet size)

SysKonnect SK 9843

Maximum 40 kpps
(regardless of packet size)

• Throughput limitation is due to packet rate limitation of traffic generating software

• NIC driver and OS interface play an important role
Software Performance Analysis

• Comparing NMS with MGEN software (Intel NIC)

- Throughput (Mbps) vs. Frames for 256 byte frames
- Throughput (Mbps) vs. Frames for 768 byte frames
- Throughput (Mbps) vs. Frames for 1500 byte frames

• Enhancements needed especially for small packets
Conclusions and Future Work

Advantages

- Faster experiment setup and results processing
- No human attendance during testing required
- Extra features to make network testing easier to perform
- User focuses on experiment target rather than implementation
- Greater availability of data after a test is completed

Drawbacks

- Not portable on all existing platforms
- Not optimized for local resources usage and all measurement procedures
- Does not implement a fine-grained analysis to conserve management bandwidth

Future Work

- Extend support for other management protocols
- Improve communication control procedures between management console and agents
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Thank You