

# **A Testbed for GRMP Protocol**

**(draft-wang-forces-grmp-01.txt)**

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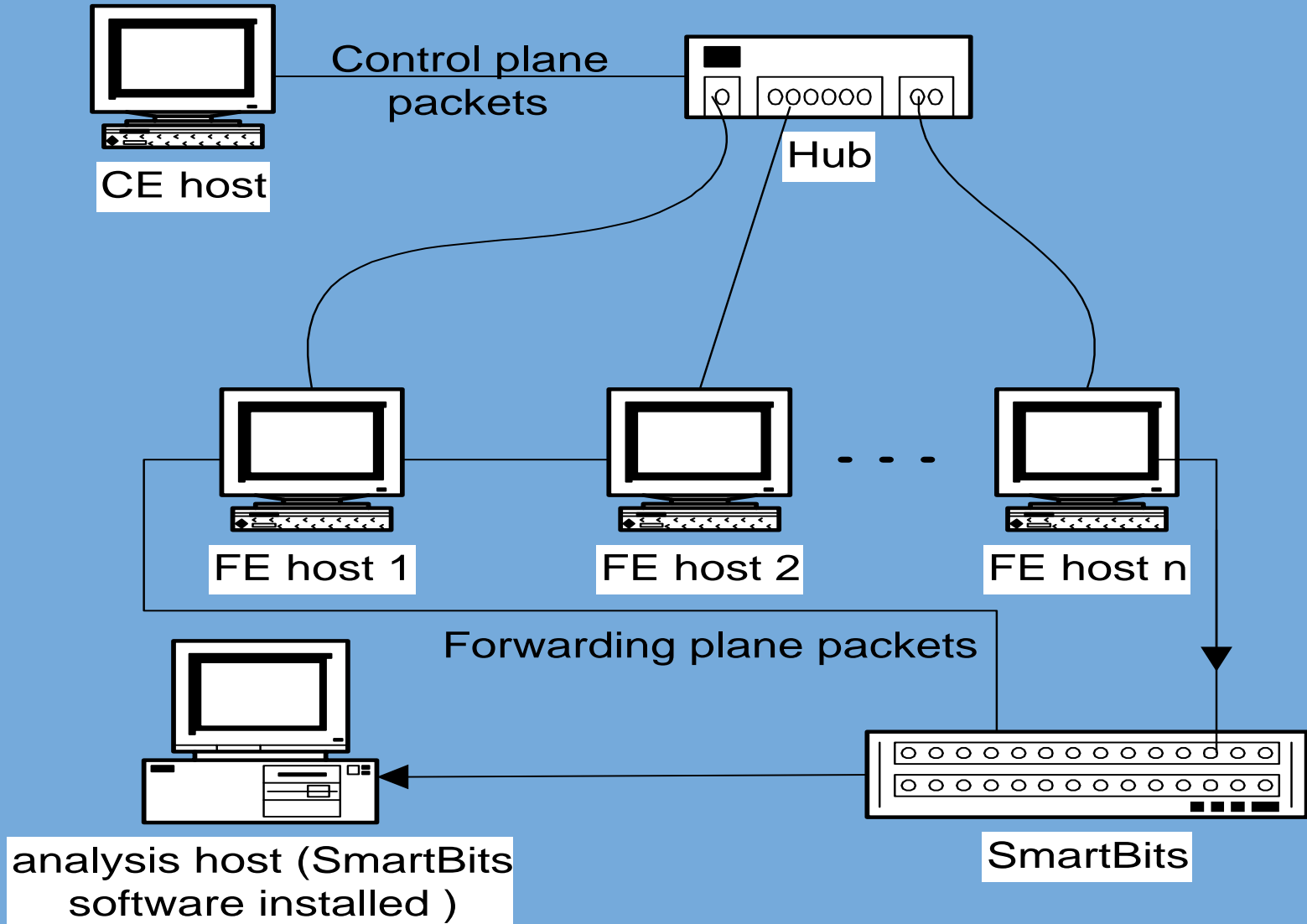
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- Introduction to Testbed
- Experiments on Testbed



# Introduction to Testbed – Deployment



# Introduction to Testbed – CE and FE

- The CE located in the CE host takes the responsibility to **control** FEs.
- The **messaging** system between the CE and the FEs follows **GRMP**
- **Control plane packets** can be sent between CE and FEs via TCP, UDP, or IP **socket** connection.

# Introduction to Testbed - CE

- The CE is realized using a **VC++** software that runs in **Windows OS**. (software)
- The CE can **send** various kinds of messages, whose parameters can be **specified via dialog boxes**.

# Introduction to Testbed – CE software

The screenshot displays the GRMP TEST PLATFORM software interface. The title bar reads "GRMP TEST PLATFORM" and the menu bar includes "File", "Pre-Association", "FE Management", "LFB Management", "Datapath Management", "Slave Test", and "Demo".

The "FE Management" menu is open, showing a hierarchy: "FE Management" > "Attribute Manipulate" > "GRMP Class" > "Dos Protection Policy". Other options in the "FE Management" menu include "Topology Query", "Capability Query", "Action Manipulate", "Attribute Query", "FE Model Class", and "Vendor Class".

The main window area is titled "Slave" and contains several panels:

- Control Message Sending Rates:** A panel with a "Control Message Sending Num:" label.
- Control Message Send Statistic:** A panel with two rows of data:
  - CE Control Message Send TCP Packet Events: 0 Packet Length:35
  - CE Control Message Send TCP Packet Rates: 0 per second
- Control Message Recv Statistic:** A panel with two rows of data:
  - CE Control Message Recv TCP Packet Events: 0 Loss Rates:
  - CE Control Message Recv TCP Packet Rates: 0 per second
- Redirection Packet Recv Statistic:** A panel with two rows of data:
  - Redirection Packet Recv Tcp Packet Events: 0 Loss Rates:
  - Redirection Packet Recv Tcp Packet Rates: 0 per second
- Time of Completing Sending&Receiving:** A panel showing 0 second.

At the bottom of the window, there are three buttons: "Send", "Stop Sending", and "Stop All".

The Windows taskbar at the bottom shows the "start" button, open applications including "Microsoft PowerPoint ..." and "GRMP TEST PLATFORM", and the system tray with the time "16:51".

# Introduction to Testbed – FE

- The FE is realized using an **adapted Linux kernel**, which can **forward** packets and **communicate** with the CE.

# Introduction to Testbed – Smartbits

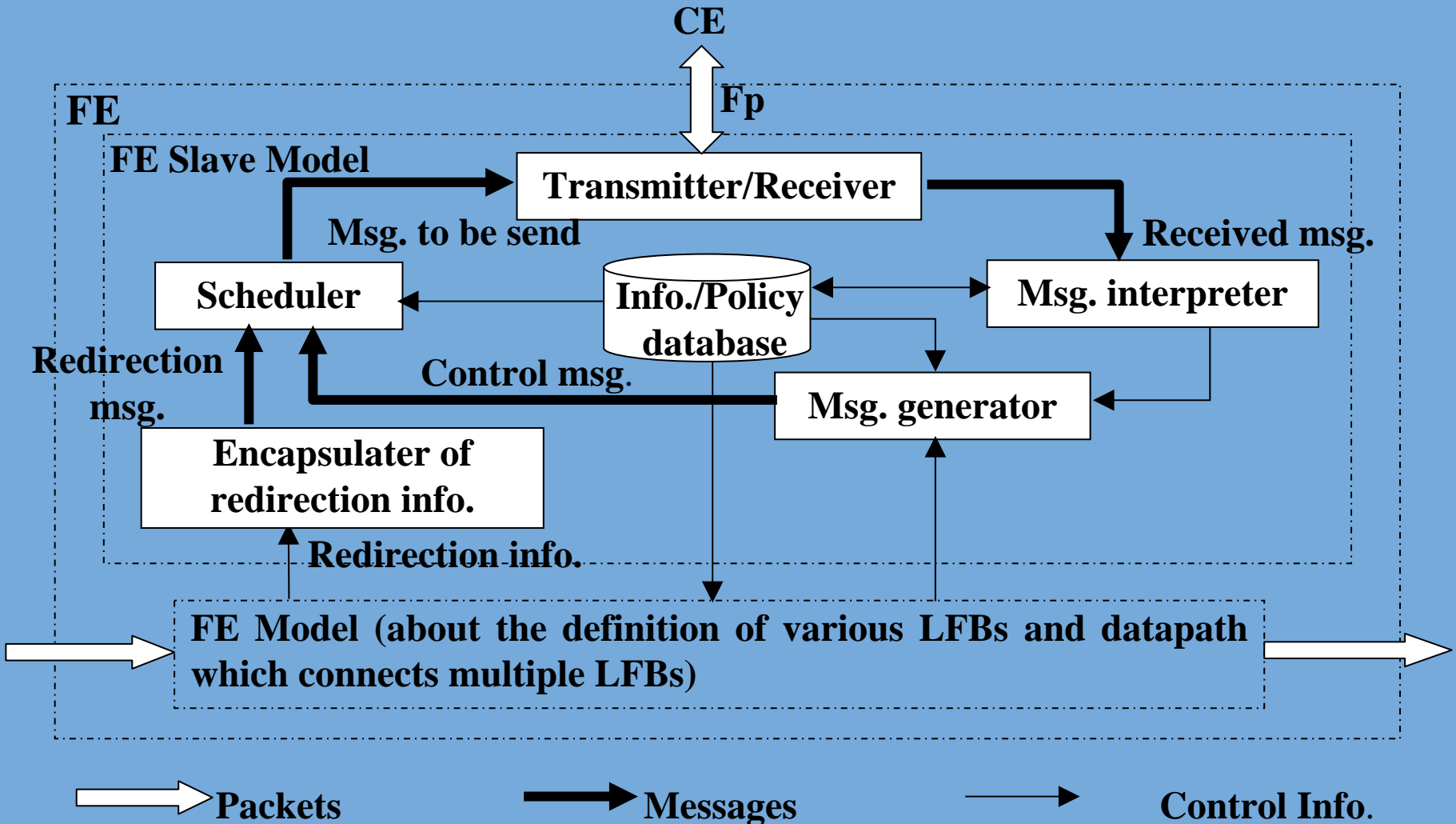
- The smartbits is used to **generate** various rates of packets and **measure** the rates of **received** packets.



# Experiments on Testbed - Purpose

- Check the implementation **feasibility** of GRMP
- Currently testify the **strategies** for DoS attack protection policy

# GRMP: FE architecture



# Experiments on Testbed - Setting

- The **smartbits** generates and sends **common data packets** and **redirection data packets** to FEs.
- The **CE** generates and sends **pseudo** control packets to FEs.
  - As the **rate** of **pseudo** control packets can be **controlled**, we use pseudo control packets instead of **"real"** control packets for performance comparison.

# Experiments on Testbed – Setting (cont.)

- When the **FE** receives packets from the **CE**, the FE sends back **reply packets** according to the test demand.
- When the **FE** receives packets from the **smartbits**, the FE **forwards or redirects** received packets to the smartbits or CE respectively according to the setting status of the classifier LFB.

# Experiments on Testbed – Experiment I

- **Content**

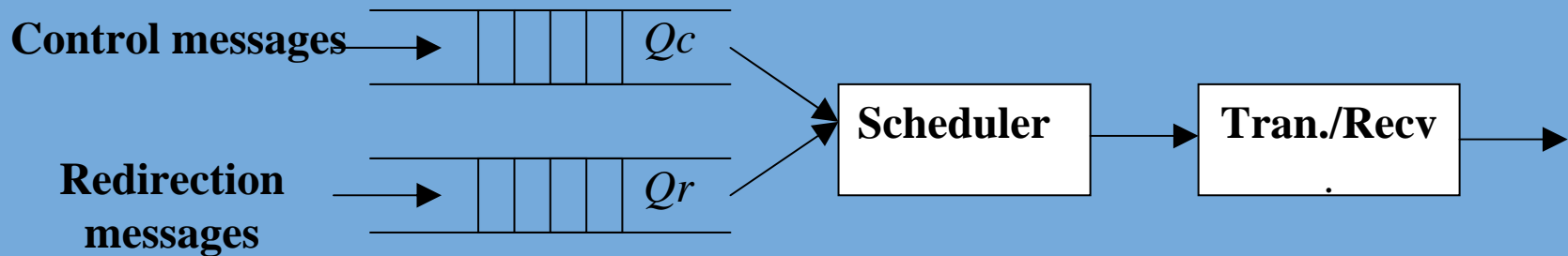
- **Before uploading a classifier LFB, All** the packets sent by the **smartbits** are received by smartbits. (screen record)
- The CE sends control messages to the FE and inform a FE host to **upload the classifier LFB**. (screen record)
- **After uploading**, the **redirection** data packets are received by the **CE** while the **common** data packets are still received by the **smartbits**. (screen record)

- **Result**

- It testifies that we implemented the **messaging system** and **dynamic loading** of the classifier LFB.

# Experiments on Testbed – Experiment II

- Content



- We change the **scheduling strategy** (for DoS Protection Policy) in the FE in terms of the control from the CE according to GRMP

- FCFS strategy
- Priority-Based strategy
- Rate-Based strategy

# Experiments on Testbed - Metrics

- DoS attack from the redirection packets may **congest** the communication channel
- Currently used performance metric: the **loss rate** of packets.
  - Packets may be **lost in the waiting queues** when congestion happens. The more the packets lost, the more serious the congestion is.

# Experiments on Testbed – Experiment II

- Table 1: Loss rate of Control and Redirection packets in the case of one TCP (when the rate of redirection packets varies)

| Packet Rates<br>(% of 10Mbs) |                               | $r_c=50\%$<br>$r_r=20\%$ | $r_c=50\%$<br>$r_r=50\%$ | $r_c=50\%$<br>$r_r=80\%$ | $r_c=50\%$<br>$r_r=150\%$ |
|------------------------------|-------------------------------|--------------------------|--------------------------|--------------------------|---------------------------|
| FCFS                         | control                       | 0.3%                     | 0.3%                     | 21%                      | 49%                       |
|                              | redirect.                     | 0.3%                     | 0.3%                     | 21%                      | 49%                       |
| Priority-Based               | control (H)                   | 0.3%                     | 0.4%                     | 21%                      | 21%                       |
|                              | redirect. (L)                 | 0.2%                     | 0.4%                     | 22%                      | 67%                       |
| Rate-Based<br>(with RR)      | Control<br>(no rate limit)    | 0.3%                     | 0.2%                     | 0.1%                     | 0.1%                      |
|                              | redirect.<br>(50% rate limit) | 0.3%                     | 0.2%                     | 38%                      | 67%                       |



# Experiments on Testbed – Experiment II

- **Analysis of Table 1:**
  - FCFS scheduling strategy cannot prevent the DoS attack
  - Priority-Based strategy can prevent the DoS to some extent.
  - Rate-Based (with Round Robin) strategy can prevent the DoS attack quite well.

# Experiments on Testbed – Experiment II

- **Table 2: Loss rate of Control/Redirection packets in the case of one TCP (when the rate of control packets varies)**

| Packet Rates<br>(percentage of 10Mbps) |           | $r_c=20\%$<br>$r_r=50\%$ | $r_c=50\%$<br>$r_r=50\%$ | $r_c=80\%$<br>$r_r=50\%$ | $r_c=150\%$<br>$r_r=50\%$ |
|--|-----------|--------------------------|--------------------------|--------------------------|---------------------------|
| Priority-Based                         | control   | 0.2%                     | 0.4%                     | 13%                      | 32%                       |
|  | redirect. | 0.2%                     | 0.4%                     | 52%                      | 100%                      |

It shows that the control packet may congest the redirection packet too. In particular when we use priority-based strategy, it is possible that all of redirection packets can be congested.

# Experiments on Testbed – Experiment II

- Table 3: Loss rate of C and R packets in the case of TCP channel for C packets and UDP channel for R packets

| Packet Rates<br>(percentage of 10Mbs)          |                            | $r_c=50\%$<br>$r_r=20\%$ | $r_c=50\%$<br>$r_r=50\%$ | $r_c=50\%$<br>$r_r=80\%$ | $r_c=50\%$<br>$r_r=150\%$ |
|--|----------------------------|--------------------------|--------------------------|--------------------------|---------------------------|
| Scheduling<br>strategy<br>from Linux<br>kernel | Control<br>(TCP channel)   | 0.3%                     | 2.4%                     | 67%                      | 76%                       |
|  | Redirect.<br>(UDP channel) | 0.2%                     | 0.3%                     | 0.3%                     | 44%                       |

It shows that control packets in the TCP channel will **be affected** by redirection packets in the UDP channel,  
- meaning a DoS attack cannot be prevented purely by such separation.

# Experiments on Testbed - Conclusion

- Current experiments testify the following facts
  - GRMP is feasible for implementation of
    - messaging, LFB uploading, ...
  - **Scheduling at the ForCES protocol level is effective for DoS attack protection.**
    - Moreover, in this case, the scheduling strategies can be flexibly selected.
  - **DoS attack cannot be avoided ONLY by separating Control packets and Redirection packets to different channels.**
  - It is possible that Control packets may congest Redirection packets in some cases.

**The End**

