SNMP-based QoS Programming Interface MIB for Routers

(draft-kanada-diffserv-qospifmib-00.txt)

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Active networks

- **What are AN (active networks) ?**
  - Networks that are customized to user needs.
  - Networks that downloads programs to their nodes (i.e., routers, switches, …)
- **The AN view is the programming point of view over networks.**
- **If you are interested in the AN:**
  - See IWAN'99 papers (1st Int'l Working Conference on Active Networks) published as an LNCS by Springer.

Relation between AN and resource allocation / configuration managment

- **Policy-based resource allocation (configuration management) is the first step towards AN.**
  - Customizing resources
  - Downloading policies to network nodes
    - Policies are rule-based programs with limited functionality.
- **Why is the programming point of view is important?**
  - While network nodes could be configured only using parameters (data), the AN concept was not necessary.
  - Now we need programs for configuration, because the function to be configured is so complex.
  - Program semantics must be specified formaly for the network to be interoperable.
    - Standard protocols do not guarantee interoperability any longer.
    - Protocols specify only very limited part of the semantics.

Typical programming interfaces and our practices for resource allocation

- **SNMP & MIB**
  - DiffServ MIB is discussed in IETF DiffServ WG.
  - Kanada et al. (Hitachi) have designed a QoS MIB.
    - Described in draft-kanada-diffserv-qospifmib-00.txt.
    - We have implemented a previous version of the QoS MIB.
- **COPS & PIB**
  - Being standardized by IETF RAP WG.
  - The QoS MIB (PIB) can be used through COPS.
    - We have implemented a previous version of the QoS PIB.
- **API**
  - Being standardized by IEEE P1520 (using CORBA IDL).
  - Yoshizawa et al. (Hitachi Amarica) are proposing drafts to IEEE P1520.
    - They are implementing the API.

Design of the QoS MIB

- **It is a step toward establishing programming methodology for active networks.**
- **Features of the QoS MIB**
  - Modularity of rules
    - Modularity is very important for programming.
    - Each classifier, meter, or action is an if-then rule.
      - This separation has become possible by introducing *"virtual flow labels"*.
    - The order of rules is not significant.
      - The conditions are disjoint (no if-then-*else*).
  - Classification of scheduling algorithms:
    - 1) First-in first-out (FIFO) scheduling, 2) Priority scheduling, 3) Packet-fair scheduling, 4) Byte-fair scheduling, 5) Bounded byte-fair scheduling
  - Classification of dropping algorithms:
    - 1) Dropping all, 2) Tail dropping (non-early dropping), 3) Random early dropping (RED/WRED), 4) Deterministic early dropping (DED/WDED)

Problems in current programming interfaces

- **A problem in MIB (and PIB):**
  Unsuitability for representing program semantics
  - Mismatching of syntactic structures
    - No classification rule nor meter structure in the MIB.
    - This causes difficulty in understanding a MIB.
  - Mismatching of unit of operation
    - Always single get/put on a variable is the unit of operation.
    - This causes diffuculty in MIB/PIB implementation and usage
      - This caused serious bugs in our project.
- **A problem in API:**
  Difficulty in passing optional data
  - Number of parameters is fixed in C/C++-like languages.
    - It is difficult to design APIs that can be used even in exceptional cases.
    - This problem may be solved by using Lisp-like languages.

Possible solutions

- **To design a rule-based programming language for the interface.**
  - A policy is a rule-based program.
  - Program semantics should be expressed by a programming language.
  - This language may be similar to languages for expert systems, such as OPS5.
    - We may have to learn from AI and Knowledge Engineering.

Possible solutions (Cont'd)

- **This language may be implemented using any protocol.**
  - Either SNMP & MIB, COPS & PIB, API (IIOP), or other protocols.
  - If COPS is used, the language semantics must be mapped to the COPS usage formally.
- **Or, the definition of a protocol must embed a language definition.**
  - A new method of specifying protocols is required.