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Special issue on the INTERMON data base

Introduction to the "common" INTERMON data base for inter-domain QoS, traffic and topology information

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The INTERMON "common" data base for inter-domain QoS, traffic and topology behaviour is designed to integrate the data of different kinds of tools for monitoring, modelling and visualisation of topology, QoS and traffic behaviour in large scale inter-domain environment.

INTERMON tools exchange their results using databases repositories (e.g. tables) included in the data base management system of INTERMON architecture. MySQL is used currently for the implementation of the data bases of INTERMON architecture. The common INTERMON data base management system could be physically considered as integration of multiple physical MySQL tables and data bases.

The main data base repositories of INTERMON architecture are:

- "intermon" database developed for the purpose of inter-domain measurement, modelling and simulation as primary data base including the BGP-4, MRcollector, IPFIX, Pattern and other data bases of integrated INTERMON tools
- "cmbase" intended to store QoS measurements and traceroute topology data obtained by CM Toolset.

The database system of INTERMON could be extended with new databases on demand.

The "common" INTERMON data base design was inspired particularly by AQUILA [AQUILA] architecture, where different tools store their data in a common data base repository. INTERMON common data base design is further step of flexible data repository integration of different tools compared with AQUILA, because INTERMON data base includes more kinds of data and policies for their access and location realised by user interface and global controller.

Further benefit of the INTERMON integrated database concept is the management of related monitoring and modelling tables. The INTERMON tools require their specific data bases, e.g. tables in the "common" data repository to store and/or access monitoring or modelling data, for particular scenario. The relationships between the measurement and modelling data are realised by dependencies of scenarios and users.

The policy based control for INTERMON data base management is required for efficiency and quick data base access. It is provided by global controller and user interfaces There are different observations for such policy based control:

- The common INTERMON data base is very large to be integrated on one location, which is a drawback for efficient operation – it should be partitioned dependent on the usage.
- The optimal location of a data base table should be near the place, where the data is accessed from the users and tools. This is especially required in the cases, in which the particular tool and application of the INTERMON architecture do not work with the whole integrated INTERMON data base, but with one or two concrete data bases (e.g. tables).
- Flexibility – changes of particular tool data base table should consider dependencies with other tools and applications. For instance, the "cmbase" of AQUILA is extended for INTERMON usage. In order to provide particular interoperability with earlier applications the "cmbase" is included as separate MySQL data base in INTERMON data base management system.

The figure 1 shows the INTERMON "common" data base approach with policy control in interaction with integrated tools in the INTERMON architecture, user interface and global controller.

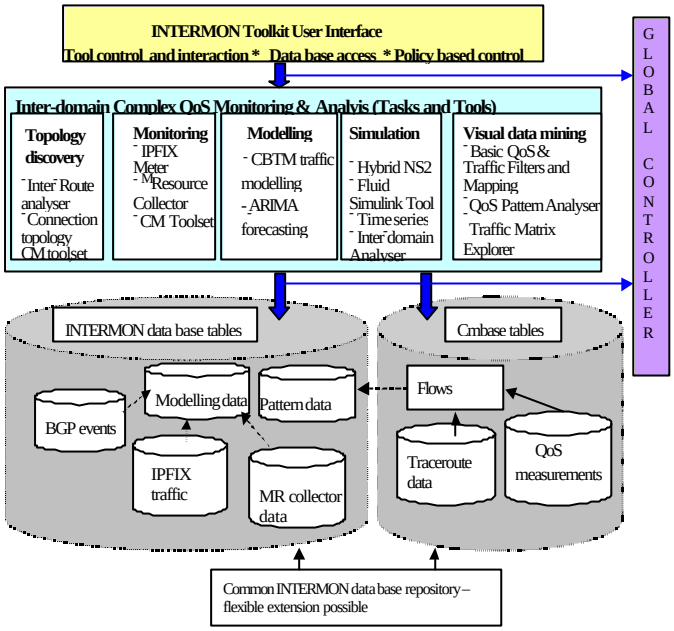

Figure 1: INTERMON integrated data bases and tools

INTERMON integrated data base consisting of different MySQL data bases, e.g. tables intended for particular tool or application is shown in figure 1.
Following tools are developed for the INTERMON architecture and will interact / interwork using the common INTERMON data base:

- InterRoute for Inter-domain topology structure discovery focussing on Exchange Points.
- CM Toolset for QoS Monitoring and Traceroute Topology Discovery of Connections(End-to-end QoS meter of Applications, Event detection for applications, inter-domain performance monitoring).
- QoS Pattern Analysis
- MR Collector
- IPFIX Traffic measurement tools (ISP border router and application traffic measurement).
- Traffic matrix
- Simulation toolkit
- Connection Topology Visualisation.

Policies for data access to the "common" integrated INTERMON data base could consider:

- Configuration of different physical MySQL data bases with tables of the same type (for instance BGP-4, IPFIX, MRCollector table types), which could be located nearby their usage (either considering the remote meters or INTERMON toolkit applications, e.g. VDM, simulation, etc)
- Configuration of integrated INTERMON data base in one location or fully distributed configuration where the particular tables of the data bases of the individual tools are installed at different places.

The selection of policies for efficient operation with the integrated data base will be studied in real world experiments. One approach to increase performance is to locate the data bases near their usage. The global controller could be used to execute the data base access procedures and to "filter" the data to the INTERMON application (e.g. GUI). This will allow for more efficient SQL calls especially in cases where large data selections are to be transferred over the inter-domain environment and only part of the selected data is used.

References

[D10] INTERMON Data base with policy control. INTERMON Consortia, www.ist-intermon.org, Deliverable 10
[AQUILA] EU IST Project AQUILA, A QoS architecture for dynamic resource reservation in Internet, www.ist-aquila.org

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The BGP-4 database in INTERMON

P.A.Aranda Gutiérrez

BGP-4 routing data

BGP-4 routing repositories have been setup by projects like the RIPE-NCC and Oregon Routeviews. The raw data are difficult to manage and process. An interface with a relational database is needed to focus on routing research and not on algorithms to parse the raw routing data.
The data stored in the routing repositories can be categorised using the following criteria:
a) Address family [i.e. IPv4 vs. IPv6]
b) Type of routing record:
- routing table record dump
- advertisement
- withdrawal
- state change for a router

For the INTERMON application, we concentrate on IPv4 routing related records, i.e.
- IPv4 routing table record dump
- IPv4 prefix advertisement
- IPv4 prefix withdrawal

This three routing records share a common structure, which is completed in the case of the advertisements and routing table dumps by additional sets of data, whose structure is shared by both.

Structure of the database

In order to reflect the structure of the updates which are relevant in the INTERMON applications, the database is composed of two tables:

- The update_independant_table and
- the update_dependant_table.

The first table holds a record per significant routing data element in the raw data while the second only holds records for routing table records or routing advertisements. The update_dependent_table is linked to the update_independent_table through an index. Each element in the latter contains a record_id which is identical to the index of the element in the update_independant table it is linked with.

Tools and applications involving the BGP-4 database

The INTERMON has introduced the Quality of Routing concept through the InterRoute application. This application resides in the Visualisation modules of the INTERMON toolkits and implements most tasks which will be used in the context of BGP-4 routing analysis. I.e.

1. Get all prefixes in the routing table, which contain a given IP address. This tasks is used to reduce the volume of data to be processed in a given scenario and still cover all possibilities.
2. Get the most specific prefix for a given IP address. This tasks filters the data which are needed to simulate the behaviour of routers and determine the records which will affect the way packets are treated in the routers.
3. Get all advertisements and withdrawals for a given IP prefix. While the last task can be implemented by a series of SQL statements, the first two calls have to scan through all records in the database because no equivalent SQL statement exists.

The other INTERMON tool which interacts with the BGP-4 database is the BGP-4 Topology probe, which provides the interface between a provider's BGP-4 routing infrastructure and the database. The topology probe listens to BGP-4 routing exchanges and filters routing records (i.e. advertisements and withdrawals) and table dump records. These records are then translated and stored in the BGP-4 database.

Data volume for end to end QoS scenario

Informal measurements conducted on the data use for the end to end QoS scenario in the scope of the INTERMON project, the volume of data generated by a typical BGP-4 repository when loading one routing table and all routing events for one day is in the vicinity of 1.000.000 records. Once reduced to an end to end scenario, with two addresses involved, the data volume is reduced by 4 order of magnitude or more to around 100 records.

Connection topology visualisation using CMToolset traceroute data base

F. Strohmeier ----------

Proactive monitoring of connection topology is useful in different cases:

- To study topology properties of the connection (e.g. number hops, availability of the routers, etc)
- To validate QoS/SLA provision
- To obtain topology changes
- To obtain topology data for understanding QoS behaviour dependent on topology.

In INTERMON, the proactive monitoring of the connection topology is based on a tool for connection topology visualisation using CMToolset traceroute data base.

It allows to obtain the last topology of the connection and to get knowledge on the topology of connection, router availability of the connection and properties of routers and end-systems included in the connection.

The GUI of the tool including a topology obtained for inter-domain connection based on the CM Toolset traceroute data is given in the figure 1:

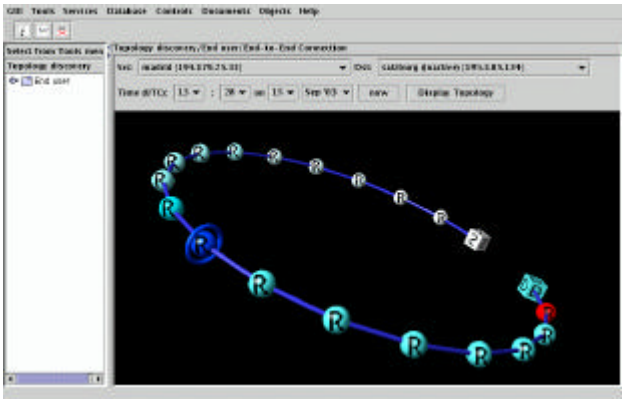

Figure 1: Visualisation of CMToolset connection topology data base

The visualised connection topology is between Madrid and Salzburg. The sender and receiver are differentiated in the visualisation as well as the reachability of the router on the way (red not responding).

The responding routers are distinguished by the brightness of the colour, which is intended to present the

value of RTT time recorded in the traceroute CM Toolset data base, e.g. more brightness means smaller RTT.
Special marked and blue coloured are intermediate routers which have an "outlier" RTT, e.g. intermediate router RTT from source which is bigger than the RTT between source and end system destination.
Information of the router and end systems included in the connection could be obtained by clicking of the corresponding elements.

The tool could be also extended to provide visualisation on connection topology changes which are registered in the CMToolset traceroute data base. The evaluation of the connection topology changes could be used in the measurement based simulation of INTERMON to provide metrics for characterisation of inter-domain paths.

MRcollector database in INTERMON

M. Beoni, R.Antonini ----------

MRcollector, within the INTERMON platform, play the role of a performance and fault management agent. In a real ISP live network environment, Fault and Performance management is the very basic layer that aids the operator to better understand the network behaviour and to perform post analysis like reporting, planning, etc. The operator normally needs two outputs from the proactive analysis of the network:

- Real time network status monitor and alarms
- Report and SLA analysis of a part or the whole network

Therefore the first layer of collected data that can be used for the above purposes must be fine grain and stored with a tuned periodic time, depending on services and typology of the network infrastructure.
In the inter-domain context, operator has to deploy an initial configuration of all monitoring tasks, knowing its own configuration and neighbour interconnection.
This monitoring task is called "measurement campaign" and the above step is called "collection campaign deployment". The campaing is uniquely identified by a number associated to the user who generates the task.
The performance and fault management process can be deployed by an operator within its autonomous system in a special campaign that focuses on a few but important network element and services:

- Extra domain link status, usage and performance
- Intra domain link status, usage and performance
- Border and access router working state
- Intra-domain network delay and VoIP analysis using JITTER evaluation.
- Extra domain HTTP service availability and performance

The database is structured so that different users can deploy, modify and delete multiple campaigns. So users can safely store and retrieve data according with their own authorisation level.
MRcollector data structure within the INTERMON logical database is composed of two main areas explained below.

Configuration Campaign database

Every user configuration task data are stored in two tables that are "net_measurement" that associates user identification with campaign identifier, and "camp_config" where the relationship between network elements and campaign is established. The network element identifier is the one defined in "network_element" general table. These two tables establish the relation between users, campaigns and network elements. This information is stored at user configuration time.

Performance Management database

Collection of performance data is stored in the following tables:

- *interface-variable-collection* table where fault, status and performance interface resource data are collected.
- *saa_variables_collection* table where active SAA measures are collected. The SAA measures involve a source router and a destination router. SAA agent allows user to perform either inter domain measure as HTTP or intra domain delay evaluation using ECHO response as well as VoIP performance emulation traffic between AS router using JITTER. The type of measures that is possible to trigger are
  - *ICMP_ECHO*
  - *HTTP_GET*
  - *HTTP_RAW*
  - *UDP_ECHO*
  - *JITTER*
- *global_meas* table contains router or generic network device behaviour .