Monitoring and Measurement Cluster – 001990

D13 - MOME Interoperability Testing Event

Abstract

This document presents the results of the MOME Interoperability Event, which has been organized in Paris, France, on July 28-30, 2005. Implementations of IPFIX, NSIS, and NETCONF protocols were tested during this three-day event.

Keywords

MOME, Deliverable D13, Interoperability Event, Interoperability Testing,
IPFIX, OWAMP, NETCONF, NSIS, IST Projects, Implementation

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List of Acronyms

CAIDA	The Cooperative Association for Internet Data Analysis
CLI	Command Line Interface
ETSI	European Telecommunications Standards Institute
IETF	Internet Engineering Task Force
IPFIX	Internet Protocol Flow Information Export
IPPM	Internet Protocol Performance Metric
IPv4	Internet Protocol version 4
IPv6	Internet Protocol version 6
IST	Information Society Technologies
ITU	International Telecommunication Union
QoS	Quality of Service
OWAMP	One-Way Active Measurement Protocol
NETCONF	Network Configuration
NSIS	Next Steps in Signaling
NTLP	NSIS Transport Layer Protocol (NTLP) Functionality
PSAMP	Packet Sampling

Executive Summary

This document describes the Interoperability Event organized by the MOME project in cooperation with the IST Eurolabs project and the ETSI plug tests.

The interoperability tests covered monitoring and measurement protocols such as IPFIX, NSIS, and NETCONF. During this event face-to-face tests from different implementers were organized. Remote tests for OWAMP are scheduled a few weeks after the 63rd IETF.

Forty four (44) engineers representing eighteen (18) companies with fourteen (14) implementations attended the event. Tests were performed in protocol specific groups with four to six implementations per group.

This event brings together developers to remove ambiguities and misinterpretations in the protocol standard, as well as in their implementations. This interoperability event also provided feedback into the IETF's working groups and thereby into the ongoing standardization process, and at improving interoperability between the different implementations.

This deliverable is structured into the following chapters:

Chapter 1 presents the event itself. It details the event objectives, the overall organization, the agenda and the attendees.

Chapter 2 provides specific information regarding each protocol tested. It describes the tests and their results such as discovered issues and expected impact.

Appendix A lists the references.

Appendix B shows the MOME Interoperability Event agenda.

Appendix C provides the Non-Disclosure-Agreement (NDA) signed by all participants.

Appendix D lists related material for the IPFIX protocol.

Appendix E lists related material for the NETCONF protocol.

Appendix F lists related material for the NSIS protocol.

Appendix G presents IPFIX test specifications in more detail.

Appendix H shows the common XML data model test schema used for the NETCONF tests

1 Interoperability Event

1.1 Goals

The goals of the MOME Interoperability Event are:

- To evaluate how mature existing implementations of monitoring-related protocols such as IPFIX, OWAMP, NETCONF, NSIS, and NETFLOWv9 are.
- To find out what open questions exist on the current protocol specification drafts of these protocols, i.e., check that there are no holes in the protocol standard and that everyone interprets the standard the same way.
- To prepare these questions (and possible answers) and incorporate them into the standardization process of the respective working groups.
- To make sure that protocol implementations of different companies interoperate.

1.2 Motivation

The motivation behind this approach is powered by the observation that actually bringing different implementations to work together often reveals critical shortcomings on the implementations and on the protocol itself much more easily than testing only at home with one's own software. Also the live meetings and discussions enable more direct communication than e.g., mailing list discussions and let people interact more spontaneously, thus covering a broad number of protocol-related aspects during their ad-hoc discussions.

1.3 Overview

This deliverable (D13) presents the MOME Interoperability Event which took place in Paris, France, before the 63rd IETF meeting at Le Palais des Congrès de Paris. The event took place from July, 28 to July, 30 2005 from 9am to 6pm.

The event attracted a total of forty four participants from eighteen different universities, research institutes and companies. They performed interoperability tests for the IPFIX, NETCONF, and NSIS protocols. Interoperability tests organized by MOME for the OWAMP protocol will be performed after the 63rd IETF from partners' remote locations.

A lot of experience has been gained by all partners during the three days of discussions, testing, and improvement. Numerous enhancements have been incorporated into the different software implementations. In addition, feedback and questions for clarification have been collected and documented. These were presented during the IETF's working group's meetings in the week from August 1st to August 5th, 2005.

All interoperability test groups have organized for continued contact and knowledge exchange after the event. Some are already planning for further remotely performed tests or another interoperability event within their group.

1.4 Event Program

The MOME Interoperability Event took place from July 28th to July 30th 2005 in Paris, France, at Le Palais des Congrès De Paris, address - 2, Place de la Porte Maillot, 75017 Paris Cedex 17 France in room 332M/333M.

The agenda of the MOME interoperability event can be found in appendix A.

The non-disclosure agreement which all attending partners had to sign in order to protect their intellectual property rights on their test results can be found in appendix B.

1.5 Attendees

Overall forty four (44) people from eighteen (18) companies coming from nine (9) Countries (BE, CH, DE, FR, IN, KR, PT, UK, US,) have attended the event.

The companies have been:

Organization	**Protocol(s)**
Cisco Systems	IPFIX, NetflowV9
Folly Consulting	NSIS
France Telecom	IPFIX, NetflowV9
Fraunhofer Institute Fokus	IPFIX, *Organizer*
Hitachi Europe	*Observer*
IBM Zurich Research	IPFIX
Keimyung University	NETCONF
Loria	NETCONF
NEC Europe	IPFIX, NSIS, NETCONF, *Organizer*
Nokia	*Observer*
Postech	NETCONF
Siemens	NSIS
Switch	*Observer*
Université Libre de Bruxelles	*Organizer*
University of Coimbra	NSIS
University of Erlangen	IPFIX
University of Göttingen	NSIS
University of Tübingen	IPFIX
Wipro Technologies	NETCONF

Table 1: List of Companies and what Protocol(s) they tested at the event

2 Protocols

2.1 IPFIX

The IPFIX protocol has been developed for the purpose of exporting IP packet flow information from IP devices such as routers or measurement stations to mediation, accounting, and network management systems. This export includes (a) attributes derived from the IP packet headers and (b) attributes known only to the exporter (e.g., ingress and egress ports, network prefix). It is intended for the purposes of Internet research, measurement, attack and intrusion detection, accounting, and billing.

2.1.1 Attendees

The IPFIX testing group brought along six implementations of the IPFIX protocol at various stages of development.

Eight organizations participated with a total of fifteen participants.

Fraunhofer FOKUS acted as test provider for the event, assisted by the other participants.

In addition to scheduled IPFIX tests, some Netflow Version 9 features were tested.

Organization	Country
Cisco Systems	United Kingdom
France Telecom	France
FHG	Germany
Hitachi Europe	France
IBM Zurich Research Laboratory	Switzerland
NEC Europe Ltd.	Germany
University of Erlangen	Germany
University of Tübingen	Germany

Table 2: Companies performing IPFIX Software Interoperability Tests

2.1.2 Tests Goal

The main goal of these tests among participants bringing their own implementations of IPFIX exporter and collector software is to check, improve, and potentially prove interoperability among different exporter and collector implementations. Implementations should be based on the respective RFCs and drafts mentioned in Appendix D.

If an implementation does not support the latest draft specification or lacks some features (e.g., support for transport protocol) or even requirements, this was stated clearly before the tests to adopt or maybe cancel affected tests for this one implementation.

The on-site testing during the MOME Interoperability event was based on predefined scenarios with fixed specification of execution parameters plus ad-hoc tests among attendees from different organizations.

2.1.3 Tests Environment

The IPFIX protocol defines the data mapping, a way to specify templates for data record definition and a transport mapping to export flow information records across the network from an IPFIX exporter to an IPFIX collector.

In the different test scenarios we have sent predefined sets of data records using different data templates (simple and complex) from one machine to a different machine connected to the same network segment.

A collecting (one or multiple) process was started before each test was executed to eliminate potential side-effects due to the state a collector might be in from the previous test. Only in some selected test cases (in the final round) a group of different data sets shall be collected in one run.

A new exporter was started for each test to eliminate side-effects due to previous tests.

After each test the results have been compared with the expected results (behavior and data), and documented into prepared IPFIX test results forms.

2.1.4 Test Scenarios

The following tests can be performed using an IPFIX exporting process on one host and an IPFIX collecting process on a different host. In our tests exporter and collector will originate from different companies.

Connectivity Tests

- support of IPv4 and IPv6 network layer protocol
- transport layer connectivity for TCP, UDP and STCP
- different combination of exporter and collector implementations

Error Case Tests

- temporary network disconnect (probably not useful for UDP)
- exporter restart during data transmission (simulates software crash + restart)
- collector restart during data transmission (simulates software crash + restart)

Data and (Option) Template Transmission Tests

- check correct transmission of control information (template definition records)
- export of different templates and data (single and multiple elements in one template)
- test transmission of all IPFIX data types
- test transmission of combination of data types (multiple elements)
- test big templates with huge number of elements (memory stress test))
- test big number of records for one template
- test malicious (defective) template and/or data records
- check correct transmission of standard option templates
- check specific well-defined templates, e.g., accounting records
- Test protocol extensions like IPFIX aggregation (probably not test this in detail this time because feature is not yet supported; can check robustness of collector though)
- stress test with multiple exporters active in parallel sending to one collector

The detailed list of tests which have been derived from these scenarios and which have been performed during the MOME Interoperability event in Paris can be found in Appendix G.

2.1.5 Test Results

Each partner could check his or her own implementation against the others during the event and noted their results. Often improvements and/or bug-fixes have been incorporated and rechecked already during the event.

The results per partner and the features which each implementation does support cannot be listed here in order to protect the attendees' privacy. See also the NDA in Appendix C.

The following results could be observed in general:

- IPv4 connectivity between all partners was successful on TCP and SCTP (as applicable per partner).
- IPv6 connectivity tests have not been performed because this would mainly test the operating system and not the protocol implementations.
- Transmission of templates (also with many (20) fields) worked well.
- Transmission of template with variable length elements worked well.
- Export from on exporter to multiple collectors worked well on those implementations which support it.
- Collection of data from different exporters at one collector at the same time worked for all collectors.
- The behavior in case of network disconnect (when using TCP or SCTP) depends on the network card, operating system, driver software, and the IPFIX protocol implementation. Up to a certain (OS specific) timeout the data is buffered by the OS and transmitted later after reconnect. This is not a guaranteed behavior.
- Some tests with Netflow v9 over SCTP have been performed successfully.
- Export of non-matching template and data records lead to discarding of the data records (either silently or with issuing warning) by all implementations.
- Overloading a collecting host by sending data records with a huge rate lead to loss of records (either silently or plus a warning message) but no software crashes.
- Sending thousands of different template definition records in a short period of time lead to a higher memory usage (as expected) but was performed well by all implementations.
- Using one field identifier multiple times in one template was accepted by all collectors. It needs yet to be defined if this is allowed (consensus was: yes) and which semantic is used to interpret that data. Suggestion was to use the first value for that field type when only one value is expected. The collector may also use/store al values for that field.
- Use of incorrect/unsupported set IDs (type=4) was correctly ignored by implementations which did not support these set IDs.
- use of information elements as scope was handled well by all implementations
- Padding, enterprise-specific IEs and reduced size encoding was supported correctly by all implementations (partially after some fixes on-site).
- Template withdrawal and option templates worked well for all implementations.

The tests and their results stirred a number of discussions and requests for clarification. These are documented in the next section.

2.1.6 Open Issues on the Protocol

During the tests, several open issues in the protocol definition have been identified. These issues have been notified to the protocol and information model draft authors during the IPFIX WG meeting. All the issues presented, and listed in this section have been addressed in the appropriate documents.

The open issues identified during the interoperability tests are:

1. Padding: it has been proposed to change the field PaddingOneOctet into PaddingOctects, in which the length can be specified. The need comes from very small records (e.g., TOS is one octet) used with padding. Exporting TOS with padding would need three PaddingOneOctet Fields. The IE has been modified and the abstract data type has been changed from octet to octet array.
2. Template or Option Template Withdraw Messages: the protocol draft should explicitly specify (and it now does) that a set cannot contain template withdraws and new definitions at the same time. Also, the collecting process should interpret a withdraw message for a template it has not received as an error and close the TCP connection or SCTP association.
3. A UDP template refresh should be considered as an error if the received and stored templates differ. The collector should issue a warning.
4. Templates or fields of zero size must be considered as errors and the connection should be closed. The protocol draft now specifies this. The only exception is variable size fields; in that case zero length is allowed.
5. Sets with reserved or unknown set IDs should be ignored.
6. Multiple information elements of the same field type should be allowed. Currently this is possible in the scope field, but it should be made possible in the protocol specification. Examples have been identified where this would be a limitation.
7. For UDP there is a need for a configurable refresh time (related to template timeouts) so that we can make sure that "correctly configured" exporters and collectors always interoperate. One option would be the following. Each exporter should send an option containing the template refresh time which it's using. The collector would track refresh times individually for each exporter. This would require one or two new IE's: templateRefreshTime and/or templateRefreshPackets. The template scope would be the exportingProcessId. Of course, the collector would still require a default value which it would use until it received refresh information from the exporter.

2.1.7 Input for Implementation Guidelines

The testing itself, the open points found in the protocols specification, a few mistakes (that have been notified and corrected) and most of all the different implementation and mistakes people did have provided valuable input for another Internet-Draft in preparation: the IPFIX Implementation Guidelines draft. These guidelines aim at providing future IPFIX implementers with a set of rules to follow, or points to pay attention to, when implementing IPFIX. The experience of other implementers should serve as a basis for this work.

This Draft has been announced during both the Interoperability event and the IPFIX WG meeting.

2.1.8 Future Interoperability Work Plans

After the testing on the Interoperability Event, participants agreed to organize more tests in a follow-up event. No specific time has been set yet. Discussions about such plans will be brought to a newly founded "ipfix-interop" mailing list.

2.2 NETCONF

The main goal of the NETCONF tests is to prove interoperability among several NETCONF client and server implementations. Implementations should be based on Internet drafts listed in Appendix E.

Four NETCONF implementations were tested in this testing group. Six Organizations participated with a total of fourteen participants. NEC acted as test provider assisted by Loria.

Organization	Country
Keimyung Univ.	Korea

Loria	France
NEC Europe Ltd	Germany
Postech	Korea
SWITCH (observer)	Switzerland
Wipro Technologies Ltd	India

Table 3: Companies performing NETCONF Software Interoperability Tests

2.2.1 Test Environment

The NETCONF protocol defines a simple mechanism through which a network device can be managed, configuration data information can be retrieved, and new configuration data can be uploaded and manipulated.

Partners tested their NETCONF managers and agents using SSH as their transport mechanism. The test cases were specified and defined by NEC and were provided prior to the Interoperability Event on the MOME website. Each partner tested their manager and agent solution with every other partners' solution.

Manager → Agent ↓	LORIA	NEC	POSTECH	WIPRO
LORIA		X	X	X
NEC	X		X	X
POSTECH	X	X		X
WIPRO	X	X	X	

Table 4: Combinations of NETCONF Software Tests performed

The implementations were developed in various programming languages:

- LORIA implementation uses Python for development.
- NEC and POSTECH use C for development.
- WIPRO uses Java for development.

Different test scenarios were tested, having NETCONF clients and multiple servers connected to each other. The NETCONF managers sent configuration data to the servers using different NETCONF functions. The client which is referred as Manager and the server as Agent are located on the network link as shown in the Figure 1 below.

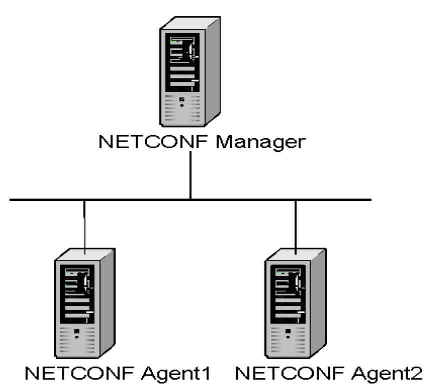

Figure 1: NETCONF Test Scenario

The NETCONF application may configure both devices (Agent1, Agent2 in the Figure 1) using different scenarios of NETCONF protocol.

2.2.2 Common NETCONF model to be used

In order to have a common NETCONF data-model supported by all vendors to be able to use the NETCONF specific protocol operations and simulate different types of errors during the interoperability event, it is assumed that all vendors are supporting the same simple NECTONF data-model defined by the XML schema for network interface data configuration. This data-model is defined by the schema listed in Appendix H.

2.2.3 Basic Test Scenarios

The basic test scenarios consist of:

1. SSH connection setup between the Manager and Agent. (SSH is preferred at this event as an application layer protocol. One can use BEEP or SOAP as well if supported by other vendors).
2. NETCONF capability exchange.
3. Protocol Operations testing using the data-model defined above, the operations to be tested are:
    - <get-config>,
    - <edit-config>,
    - <copy-config> ,
    - <delete-config>,
    - <lock> ,
    - <unlock> ,
    - <get> ,
    - <close-session>
    - <kill-session>
4. Configuration of data stores such as “running”, “startup”, “candidate” upon availability.

2.2.4 Advanced Test Scenarios

The advanced test scenarios include:

Test Scenario 1: Sub tree filtering for the network interface data-model defined above.

Test Scenario 2: Testing the NETCONF rollback capability on error for different types of simulated errors.

Test Scenario 3: This scenario is intended for testing the behavior of a single Agent which is configured by two Managers at the same time with different NETCONF protocol operations.

2.2.5 Open Issues

The four major issues that were identified during the testing are:

- SSH subsystem for NETCONF

There exist different types of SSH subsystems. Some implementations used 1) command subsystem, while others used 2) port forwarding subsystem or 3) custom subsystem (see http://wwww.eldos.com/sbb/articles/1945.php for categorization).
The usage of different subsystems by the different implementations under test has made it difficult to test against each other with respect to NETCONF functionalities.

- Lack of common data model

There were two problems with the common data model. Although a basic data model (related to the interfaces) was specified for the MOME event, some implementations did not properly implement it.

This issue was solved on a case by case basis, i.e., manager applications were customized to fit to a specific agent. The specified common data model was network interface. When an <edit-config> operation was performed on this, the network interface in the device being tested was not accessible any more. Thus, the <edit-config> operation could not be tested.

- Message separator

Messages are separated with a special character string (]]>]]>) in the NETCONF/SSH draft. Some implementations use it, while others do not use the specified separator.

- Different authentication types in SSH

Implementations used different types allowed by SSH (interactive/non-interactive password, public key, etc.) and some offline agreement had to be done. Finally however, these issues were solved.

- Pipelined Requests

An implementation tested allowed multiple requests from a manager. How to process this kind of multiple requests when this is not clearly specified in the draft?

2.2.6 Feedback for the Working Group

The NETCONF Interoperability participants at the MOME event gathered a few suggestions for the NETCONF WG at the IETF, as well as to other developers of NETCONF implementations.

Suggestions for the IETF working group

First to eliminate ambiguities regarding SSH understanding, the group suggested better SSH descriptions and use cases.
A common data model should be proposed.
Finally the team suggested better <edit-config> operation descriptions and use cases.

Suggestions for the developers

A continuous exchange of implementation information between developers will be very useful. The organization of remote testing should be foreseen.

2.2.7 Tests Results

The interoperability testing event was useful to discover who has been implementing the NETCONF draft and to discover areas to be improved in the draft.

The tests results were not too disappointing. All four manager applications succeeded to connect and perform requests on two out of the four tested agents. Two agents could not be connected due to missing SSH support and delimiter problem (mentioned earlier in section 2.2.3. open issues).

Unfortunately, due to different ways of implementing, time has been spent on adjusting implementations to each other, than on really testing NETCONF functions, or performing the test scenarios as specified in the test specifications.

2.2.8 Future Interoperability Work Plans

After these first tests, participants agreed on organizing more tests. No specific time has been set yet. The discussions will be brought to the NETCONF WG mailing list.

2.3 NSIS

This test group was comprised of six Organizations with thirteen participants where five implementations were tested against each other and one organization participated as observer and contributed to the discussion on the interpretations of test results.

Siemens provided the test cases assisted by NEC which acted as the test team leader.

Organization	Country
Folly Consulting	United Kingdom
NEC Europe Ltd.	Germany
Nokia (observer)	England
Siemens AG	Germany
University of Coimbra	Portugal
University of Göttingen	Germany

Table 5: Companies performing NSIS Software Interoperability Tests

During the event the NSIS Transport Layer Protocol (NTLP) Functionality has been tested.

The five independent implementations tested were based on the NTLP draft -06

2.3.1 Test Scenarios

The test cases defined for this NTLP interoperability event were the following:

- All tests done with path-coupled MRM
- NI and NR face to face, no message interception
- Direct D-Mode
- C-Mode setup with forwards-TCP
- C-Mode setup with forwards-TCP/TLS
- Unknown GIMPS version or message types
- MRI “torture” testing (2)
    - Generating faulty MRI and see the result on the other side
- Testing multiple flows in parallel (D mode) (3a)
- Testing multiple flows in parallel (C-mode), with connection re-use (3b)
- State refresh for a single flow with connection re-use (3c)
- As above, where the different flows 'overlap’ (3d)
    - e.g., same MRI but different SID or NSLP, or vice versa
- Multi-profile negotiation (even if only TCP is supported) (5a)
- Testing with unknown stack-configuration data fields (5b)
    - including non-2-byte configuration data fields
- TLS usage (5c)
- Robustness testing (lost handshake messages) (7)
- Test with multiple nodes in a chain and message interception

2.3.2 Found Issues

Only a few issues were discovered during the NTLP interoperability session.

All issues can be found in the NTLP issue tracker:

- http://nsis.srmr.co.uk/cgi-bin/roundup.cgi/nsis-ntlp-issues/

- Issue61: NLI selection (v6 MRI in v4 encapsulation)
- Issue59: Interpretation of D flag in MRI
- Issue58: S flag from end systems
- Issue57: Setting and Interpreting the R-Flag
- Object order
- TCP connections only accepted from peers offered to (clarification)

2.3.3 Future Interoperability Work Plans

The NSIS team is planning for a next interoperability event. The suggested period is around fall 2005. Meanwhile the MOME NSIS Interoperability participants have express their interest for further tests in early September.

The University of Coimbra offered to host the interoperability event in Portugal.

The other possible location of this NSIS interoperability event could be the next IETF meeting in Vancouver, November 6 - 11, 2005.

Further information about the event will be discussed and posted on the NSIS WG mailing list and other relevant mailing lists such as the NSIS implementer's list nsis-imp@ietf.org.

2.4 OWAMP

Three organizations have registered to participate to the OWAMP interop tests. Unfortunately the tests have been postponed due to partners' inability to attend at the event's meeting dates and will be conducted in a remote way a few weeks after end of August 2005.

Salzburg Research will act as the test provider.

2.5 PSAMP

One PSAMP implementation was available at the interop event but due to the lack of tester counterpart, unfortunately it could not be tested.

The MOME interoperability team is investigating for other currently available PSAMP implementations to organize possible tests.

3 Event Results and Conclusion

The results of the MOME Interoperability Event have provided useful feedback to the corresponding IETF WG. Open issues and questions collected and discussed during the Interoperability Event were presented during the IETF's working group's meetings in the week from August 1st to August 5th, 2005. This will help enhance the quality of the IETF deliverables on the specified protocols tested.

In addition to the excellent feedback provided to standardization groups, the event has brought together developers that from now commit to exchange knowledge about their respective protocol implementations. Some remote tests are already planned, not to mention upcoming interoperability events that are planned this year within some groups such as IPFIX.

Appendix A – References

[1] MOME project Deliverable D11: State of Interoperability

[2] MOME project Deliverable D22: The MOME Data analysis workstation

Appendix B – Event Agenda

These three days were organized as follows:

Thursday, July 28th
09:00 - 09:15 Registration on site
09:15 - 10:00 Setup of Test Environment, the testbed (by MOME)
10:00 - 12:00 tests providers and participants set up/installation of test equipment
12:00 - 13:00 Lunch break
13:00 - 13:15 Welcome note and introduction to the MOME project
13:15 - 13:30 Presentation of planned tests (general program)
13:30 - 18:00 Organization of planned tests (per Group)

Execution of first head-to-head tests
Participants feedback: enrollment to next tests

Friday, July 29th
09:00 - 09:15 Registration on site for people attending only from day two on
09:15 - 09:45 Presentation of planned tests (general program /per Group)
09:45 - 12:30 Execution of head-to-head tests
12:30 - 13:30 Lunch break
13:30 - 18:00 Execution of head-to-head tests

Participants feedback: enrollment to next tests

Saturday, July 30th
09:00 - 09:30 Presentation of planned tests (general program /per Group)
09:30 - 12:30 Execution of final head-to-head tests
12:30 - 13:30 Lunch Break
13:30 - 15:00 Summarizing of test results (per Group, or per participant with test provider only)
15:00 - 15:30 Wrap-up and conclusions: Presentation of overall event (by MOME);

Participants' feedback

15:30 - 17:00 Disassembly of equipment, collection of distributed hardware, etc.

Appendix C – Non-Disclosure-Agreement

MOME Interoperability Testing Event

July 28-30, 2005 in Paris, France

Confidentiality Agreement

This Confidentiality Agreement is intended to protect the participants in these tests and to ensure that any information relating to such tests is used solely to further the purpose of interoperability. It must be signed in order for your company to participate in the testing event.

TERMS AND CONDITIONS

As a condition of participating in the MOME Interoperability Testing Event, organized by MOME (http://www.ist-MOME.org/) and EUROLABS (http://www.ist-eurolabs.org/), located at the Le Palais des Congrès de Paris in Paris, France from July 28-30, 2005, the company identified below (“Participant”) agrees that any information about the performance, compatibility or test results relating to the products of any participant (“Information”) is the confidential and proprietary property of the respective owners of such products. In order to protect the confidentiality of the Information, the Participant agrees that it will not disclose any Information or report any problems encountered by any participant during the MOME Interoperability Testing Event to any non-participant of the MOME Interoperability Testing Event. The Participant further agrees not to use the Information for its own benefit or for purposes other than testing of products.

The confidentiality obligations of the Participant herein will not apply beyond one (1) year from the last day of MOME Interoperability Testing Event, nor will such obligations apply to any Information which (a) is now or hereafter becomes generally known or available in the public domain through no fault of the Participant, (b) is knowingly furnished to others by its owner without restrictions on disclosure, (c) is received from a third party not under obligation to treat the Information as confidential, or (d) is independently developed by the Participant.

ACCEPTANCE

The obligation of confidentiality described above is expressly agreed to by the Participant. The individual signing below on behalf of the Participant warrants that he or she has been authorized to execute the Agreement on behalf of his or her company, and that the company agrees to the terms of this Agreement.

The foregoing is agreed to and accepted.

By:

Title:

Company Name:

Date:

Place:

Signature: ____

Appendix D – IPFIX - Related Material

Charter

- http://www.ietf.org/html.charters/ipfix-charter.html

Mailing-List Archive

- http://ipfix.doit.wisc.edu/archive/

RFCs

- RFC 3917: Requirements for IP Flow Information Export
- RFC 3955: Evaluation of Candidate Protocols for IP Flow Information Export (IPFIX)

Drafts

- draft-ietf-ipfix-architecture-08.txt - Architecture for IP Flow Information Export
- draft-ietf-ipfix-info-08.txt - Information Model for IP Flow Information Export
- draft-ietf-ipfix-protocol-16.txt - IPFIX Protocol Specification
- draft-ietf-ipfix-as-06.txt - IPFIX Applicability
- draft-ietf-dressler-ipfix-aggregation-01.txt - IPFIX Aggregation
- draft-boschi-export-perpktinfo-00.txt - export of per packet information with IPFIX

Appendix E – NETCONF - Related Material

Charter

- http://www.ietf.org/html.charters/netconf-charter.html

Mailing-List Archive

- https://ops.ietf.org/lists/netconf

Internet Drafts

- draft-ietf-netconf-prot-06 : NETCONF Configuration Protocol
- draft-ietf-netconf-ssh-04 **:** Using the NETCONF Protocol over Blocks Extensible Exchange Protocol (BEEP)
- draft-ietf-netconf-soap-05.txt : Using the Network Configuration Protocol (NETCONF) Over the Simple Object Access Protocol (SOAP)
- draft-ietf-netconf-ssh-04.txt : Using the NETCONF Configuration Protocol over Secure Shell (SSH)

Appendix F – NSIS - Related Material

Charter

- http://www.ietf.org/html.charters/nsis-charter.html

Mailing-List Archive

- http://www.ietf.org/mail-archive/web/nsis/index.html

RFCs

- Requirements of a Quality of Service (QoS)Solution for Mobile IP (RFC 3583)
- Requirements for Signaling Protocols (RFC 3726)
- Analysis of Existing Quality of Service Signaling Protocols (RFC 4094)
- Next Steps in Signaling (NSIS): Framework (RFC 4080)
- Security Threats for Next Steps in Signaling (NSIS) (RFC 4081)

Appendix G – IPFIX – Detailed Tests Description

#	*Test description*
1	IPv4 - connect between exporter/collector from different companies (TCP, SCTP)
2	IPv6 - connect between exporter/collector from different companies (TCP, SCTP)
3	Transmission of simple template (few fixed size IEs) + data from exporter of one implementer to different collectors via UDP / TCP / SCTP via IPv4 (same via IPv6 if time)
4	Transmission of template (with fixed and variable length IEs) + data from exporter of one implementer to different collectors via UDP / TCP / SCTP via IPv4 (same via IPv6 if time)
5	temporary network disconnect (i.e., unplug network during export) using exporter from one implementer via IPv4/TCP, IPv4/SCTP, IPv6/TCP, IPv6/SCTP
6	exporter kill + restart during data transmission (simulates software crash + restart)
7	collector kill + restart during data transmission (simulates software crash + restart)
8	Transmission of template and data for NetFlow v9 via SCTP via IPv4/6
9	export of non-matching templates and data (wrong number of IEs) (single or multiple elements in one template)
10	big number of records for one template (>64k, >1million)
11	big templates with huge number of elements (memory stress test))
12	stress test with multiple exporters active in parallel sending to one collector
13	Export from on exporter to multiple collectors in parallel (where applicable)
14	multiple use of one field identifier inside one template (successive or with other IEs in between)
15	incorrect set ID's (2 and 3 are valid)
16	using any IE's as scope

17	Using multiple scopes
18	flowsets with padding and without padding, and with illegal padding.
19	paddingOneOctet (IE #210) (a) correctly used, (b) badly extended (length > 1)
20	Enterprise-specific IE's
21	reduced size encoding of IE's.
22	template withdrawal message.
23	MP stats option template
24	MP reliability option template
25	EP reliability option template
26	flow keys option template
27	re-using the same template ID inside the template expiry time (without withdrawing the template) for the same or for different data.
28	re-using the same template ID after the template expiry time without withdrawing the template.

Appendix H – NETCONF – Common XML Test Schema

```
<xs:element name="config">
        <xs:complexType>
            <xs:all>
                <xs:element ref="interfaces" minOccurs="0"/>
            </xs:all>
        </xs:complexType>
 </xs:element>

  <!-- *************INTERFACE CONFIGURATION START************* -->
    <xs:element name="name" type="xs:string"/>
    <xs:element name="address" type="xs:string"/>
    <xs:element name="netmask" type="xs:string"/>
    <xs:element name="mtu" type="xs:string"/>
    <xs:element name="bcast" type="xs:string"/>
    <xs:element name="interfaces">
        <xs:complexType>
            <xs:sequence>
                <xs:element ref="iface" minOccurs="0"
maxOccurs="unbounded"/>
            </xs:sequence>
        </xs:complexType>
    </xs:element>
    <xs:element name="iface">
        <xs:complexType>
            <xs:sequence>
                <xs:element ref="name" minOccurs="1" maxOccurs="1"/>
                <xs:element ref="address" minOccurs="0"
maxOccurs="unbounded"/>
                <xs:element ref="netmask" minOccurs="0" maxOccurs="1"/>
                <xs:element ref="bcast" minOccurs="0" maxOccurs="1"/>
                <xs:element ref="mtu" minOccurs="0" maxOccurs="1"/>
            </xs:sequence>
            <xs:attribute ref="operation"/>
        </xs:complexType>
    </xs:element>
    <!-- INTERFACE CONFIGURATION END -->
```