Internet Engineering Task Force	E. Haleplidis	TOC
Internet-Draft	University of Patras	
Intended status: Informational	K. Ogawa	
Expires: February 8, 2010	NTT Corporation	
	X. Wang	
	Huawei Technologies Co., Ltd.	
	C. Li	
	Zhejiang Gongshang University	
	August 07, 2009	

ForCES Interoperability Draft
draft-ietf-forces-interoperability-03

Status of this Memo

Copyright Notice

Abstract

This document describes the details of the interoperability test of the Forward and Control Element Separation (ForCES) protocol that took place in the University of Patras in Rio, Greece, 15 and 16 July 2009. This informational draft provided necessary information, for all parties who wish to participate in the interoperability test.
This update also includes the results of the test.

Table of Contents

1. Terminology and Conventions

TOC

1.1. Requirements Language

TOC

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in [RFC2119] (Bradner, S., “Key words for use in RFCs to Indicate Requirement Levels,” March 1997.).

2. Introduction

TOC

Forwarding and Control Element Separation (ForCES) defines an architectural framework and associated protocols to standardize information exchange between the control plane and the forwarding plane in a ForCES Network Element (ForCES NE). [RFC3654] (Khosravi, H. and T. Anderson, “Requirements for Separation of IP Control and Forwarding,” November 2003.) has defined the ForCES requirements, and [RFC3746] (Yang, L., Dantu, R., Anderson, T., and R. Gopal, “Forwarding and Control Element Separation (ForCES) Framework,” April 2004.) has defined the ForCES framework.

2.1. ForCES Protocol

TOC

The ForCES protocol works in a master-slave mode in which FEs are slaves and CEs are masters. The protocol includes commands for transport of Logical Function Block (LFB) configuration information, association setup, status, and event notifications, etc. The reader is encouraged to read FE-protocol (Dong, L., Doria, A., Gopal, R., HAAS, R., Salim, J., Khosravi, H., and W. Wang, “ForCES Protocol Specification,” March 2009.) [I-D.ietf-forces-protocol] for further information.

2.2. ForCES Model

TOC

The FE-MODEL (Halpern, J. and J. Salim, “ForCES Forwarding Element Model,” October 2008.) [I-D.ietf-forces-model] presents a formal way to define FE Logical Function Blocks (LFBs) using XML. LFB configuration components, capabilities, and associated events are defined when the LFB is formally created. The LFBs within the FE are accordingly controlled in a standardized way by the ForCES protocol.

2.3. Transport mapping layer

TOC

The TML transports the PL messages. The TML is where the issues of how to achieve transport level reliability, congestion control, multicast, ordering, etc. are handled. It is expected that more than one TML will be standardized. The various possible TMLs could vary their implementations based on the capabilities of underlying media and transport. However, since each TML is standardized, interoperability is guaranteed as long as both endpoints support the same TML. All ForCES Protocol Layer implementations MUST be portable across all TMLs. Although more than one TML may be standardized for the ForCES Protocol, for the purposes of the interoperability test, the mandated MUST IMPLEMENT SCTP TML [I-D.ietf-forces-sctptml] (Salim, J. and K. Ogawa, “SCTP based TML (Transport Mapping Layer) for ForCES protocol,” January 2009.) will be used.

3. Definitions

TOC

This document follows the terminology defined by the ForCES Requirements in [RFC3654] (Khosravi, H. and T. Anderson, “Requirements for Separation of IP Control and Forwarding,” November 2003.) and by the ForCES framework in [RFC3746] (Yang, L., Dantu, R., Anderson, T., and R. Gopal, “Forwarding and Control Element Separation (ForCES) Framework,” April 2004.). The definitions below are repeated below for clarity.

*Control Element (CE) - A logical entity that implements the ForCES protocol and uses it to instruct one or more FEs on how to process packets. CEs handle functionality such as the execution of control and signaling protocols.

*CE Manager (CEM) - A logical entity responsible for generic CE management tasks. It is particularly used during the pre-association phase to determine with which FE(s) a CE should communicate. This process is called FE discovery and may involve the CE manager learning the capabilities of available FEs.

*Forwarding Element (FE) - A logical entity that implements the ForCES protocol. FEs use the underlying hardware to provide per-packet processing and handling as directed/controlled by one or more CEs via the ForCES protocol.

*FE Manager (FEM) - A logical entity responsible for generic FE management tasks. It is used during pre-association phase to determine with which CE(s) an FE should communicate. This process is called CE discovery and may involve the FE manager learning the capabilities of available CEs. An FE manager may use anything from a static configuration to a pre-association phase protocol (see below) to determine which CE(s) to use. Being a logical entity, an FE manager might be physically combined with any of the other logical entities such as FEs.

*ForCES Network Element (NE) - An entity composed of one or more CEs and one or more FEs. To entities outside an NE, the NE represents a single point of management. Similarly, an NE usually hides its internal organization from external entities.

*LFB (Logical Function Block) - The basic building block that is operated on by the ForCES protocol. The LFB is a well defined, logically separable functional block that resides in an FE and is controlled by the CE via ForCES protocol. The LFB may reside at the FE's datapath and process packets or may be purely an FE control or configuration entity that is operated on by the CE. Note that the LFB is a functionally accurate abstraction of the FE's processing capabilities, but not a hardware-accurate representation of the FE implementation.

*FE Topology - A representation of how the multiple FEs within a single NE are interconnected. Sometimes this is called inter-FE topology, to be distinguished from intra-FE topology (i.e., LFB topology).

*LFB Class and LFB Instance - LFBs are categorized by LFB Classes. An LFB Instance represents an LFB Class (or Type) existence. There may be multiple instances of the same LFB Class (or Type) in an FE. An LFB Class is represented by an LFB Class ID, and an LFB Instance is represented by an LFB Instance ID. As a result, an LFB Class ID associated with an LFB Instance ID uniquely specifies an LFB existence.

*LFB Metadata - Metadata is used to communicate per-packet state from one LFB to another, but is not sent across the network. The FE model defines how such metadata is identified, produced and consumed by the LFBs. It defines the functionality but not how metadata is encoded within an implementation.

*LFB Component - Operational parameters of the LFBs that must be visible to the CEs are conceptualized in the FE model as the LFB components. The LFB components include, for example, flags, single parameter arguments, complex arguments, and tables that the CE can read and/or write via the ForCES protocol (see below).

*LFB Topology - Representation of how the LFB instances are logically interconnected and placed along the datapath within one FE. Sometimes it is also called intra-FE topology, to be distinguished from inter-FE topology.

*Pre-association Phase - The period of time during which an FE Manager and a CE Manager are determining which FE(s) and CE(s) should be part of the same network element.

*Post-association Phase - The period of time during which an FE knows which CE is to control it and vice versa. This includes the time during which the CE and FE are establishing communication with one another.

*ForCES Protocol - While there may be multiple protocols used within the overall ForCES architecture, the term "ForCES protocol" and "protocol" refer to the Fp reference points in the ForCES Framework in [RFC3746]. This protocol does not apply to CE-to-CE communication, FE-to-FE communication, or to communication between FE and CE managers. Basically, the ForCES protocol works in a master- slave mode in which FEs are slaves and CEs are masters. This document defines the specifications for this ForCES protocol.

*ForCES Protocol Transport Mapping Layer (ForCES TML) - A layer in ForCES protocol architecture that uses the capabilities of existing transport protocols to specifically address protocol message transportation issues, such as how the protocol messages are mapped to different transport media (like TCP, IP, ATM, Ethernet, etc), and how to achieve and implement reliability, multicast, ordering, etc. The ForCES TML specifications are detailed in separate ForCES documents, one for each TML.

4. Date, Location and Access

TOC

4.1. Date

TOC

The date that the Interoperability test took place was 15-16/07/2009, one and a half week before IETF 75, in Stockholm.

4.2. Location

TOC

Patras is a major harbor of Greece connecting it with Italy.
The University of Patras is located in Rio, 10km east out of Patras.
The following coordinates mark the Electrical and Computer Engineering building in the University.

*North: 38o17'15.99"

*East: 21o47'19.28"

4.3. Access

TOC

The best way to come to Greece is by plane to the Athens International Airport.
From there there are three ways to arrive in the University of Patras.

1. Renting a car and driving to the University. It is a maximum 2:30 hours drive from the aiport.

2. Via coach station. Get from the airport to the coach station via X93 bus towards the Kifissos Coach Station. At the Coach Station there are buses to Patras every 30 minutes. The Bus to Patras may take about 2:30 - 3:00 hours, and the ride of the X93 bus may take about 30 mins - 1hour depending on the traffic, so it's about 3:30 - 4:30 hours away with the wait at the Coach Station.

3. Via Train. It is recommended you already have booked your ticket beforehand as there are not many trains going to Patras, and mostly are booked in advanced. It is not recommended that you take the train to Patras, as you have to change at least 2 trains. In order to reach Patras from the Athens International Airport you need to take the Suburban Rail to Kiato. From Kiato you can catch a train to Patras. It will take you at least 5 hours to reach Patras.

---

5. Testbed architecture

TOC

Most FEs and CEs were located locally at the University of Patras premises. One party participated connecting over the internet.
The test took place between FEs and CEs of different implementors with different permutations.
All protocol messages of each scenario were monitored using a protocol network analyzer that tested validity. Two tools were used:

*A modified tcpdump [tcpdump] (, “Tcpdump is a linux protocol analyzer. The specific tcpdump that will be used is a modified tcpdump, by Jamal Hadi Salim, that can analyze and decode the ForCES protocol messages.,” .).

*A modified Ethereal [ethereal] (, “Ethereal is a protocol analyzer. The specific ethereal that will be used is an updated Ethereal, by Fenggen Jia, that can analyze and decode the ForCES protocol messages.,” .).

All NE's in all the scenarios were comprised of one CE and one FE from different implementors.

5.1. Local configuration

TOC

Hardware/Software (CEs and FEs) that were located within the University of Patras premises, were connected together using switches.
The scenarios were tested with only one CE associated with one or multiple FEs from different implementors. The CE and the FE(s) were connected in one LAN as shown in the following figure.

```
                              +-----+
                              | CE1 |
                              |Impl1|
                              +-----+
                                 |
                                 |
               +-------------------------------------+
               |                 LAN                 |
               +-------------------------------------+
                  |       |          |          |
                  |       |   ...    |          |
               +-----+ +-----+   +-----+   +---------+
               | FE1 | | FE2 |   | FEn |   |Protocol|
               |Impl1| |Impl2|   |Impln|   |Analyzer|
               +-----+ +-----+   +-----+   +---------+
```

All scenarios were tested more than once with permutation of the CE from different implementors. In the next permutation, the setup were as shown in the following figure.

```
                              +-----+
                              | CE2 |
                              |Impl2|
                              +-----+
                                 |
                                 |
               +-------------------------------------+
               |                 LAN                 |
               +-------------------------------------+
                  |       |          |          |
                  |       |   ...    |          |
               +-----+ +-----+   +-----+   +---------+
               | FE1 | | FE2 |   | FEn |   |Protocol|
               |Impl1| |Impl2|   |Impln|   |Analyzer|
               +-----+ +-----+   +-----+   +---------+
```

5.2. Distributed configuration

TOC

For parties that cannot participate, public IPs can be provided and associations can be achieved over the internet as seen in the following figure.

```
+------+   +------------+   /\/\/\/\/\   +-----------+   +------+
|FE/CE|   |Implementor |   \Internet/   |University|   |FE/CE|
|ImplX|---|   Router    |---/        \---|  Router   |---|ImplY|
+------+   +------------+   \/\/\/\/\/   +-----------+   +------+
```

For interoperability issues, all CEs and FEs MUST implement no security even in the TML. For security, firewalls MUST be used that will allow only the specific IPs and the SCTP ports defined in the SCTP-TML draft (Salim, J. and K. Ogawa, "SCTP based TML (Transport Mapping Layer) for ForCES protocol," January 2009.) [I-D.ietf-forces-sctptml].

---

6. Scenarios

TOC

Since the main goal of this interoperability test is to test the basic protocol functionality, we will limit the test parameters. Therefore:

1. In the Association Setup Message, all report messages will be ignored.

2. In the Association Setup Phase, the messages, FEO OperEnable Event (FE to CE), Config FEO Adminup (CE to FE) and FEO Config-Resp (FE to CE) will be ignored. The CE will assume that the FE is enabled once the LFBSelectors has been queried.

3. Only FullDataTLVs are going to be used and not SparseData TLV's.

4. There will be no transaction operations.

5. Each message shall have only one LFBSelector TLV, one Operation TLV and one PathDataTLV per message when these are used.

6.1. Scenario 1 - Pre-association Setup

TOC

While the Pre-association setup is not in the ForCES current scope it is an essential step before CEs and FEs communicate. As the first part in a successfull CE-FE connection the participating CEs and FEs should be able to be configured.
In the Pre-association Phase the following configuration items MUST be setup regarding the CEs:

*The CE ID.

- *The FE IDs that will be connected to this CE
- *The IP of the FEs that will connect
- *The TML priority ports.

In the Pre-association Phase the following configuration items MUST be setup regarding the FEs:

- *The FE ID.
- *The CE ID that this FE will be connecting to.
- *The IP of the CE that will connect to
- *The TML priority ports.

Once each element is setup and configured, Scenario 1 is successful.

6.2. Scenario 2 - TML priority channels connection

TOC

For the current interoperability test, the SCTP will be used as TML. The TML connection with the associating element is needed for the scenario 2 to be successful.
The SCTP-TML draft (Salim, J. and K. Ogawa, “SCTP based TML (Transport Mapping Layer) for ForCES protocol,” January 2009.) [I-D.ietf-forces-sctptml] defines 3 priority channels, with specific ports:

- *High priority - Port number: 6700
- *Medium priority - Port number: 6701
- *Lower priority - Port number: 6702

Once these channels have been established with each associated element, will the Scenario 2 be successful.

6.3. Scenario 3 - Association Setup - Association Complete

TOC

Once the Pre-association phase has been complete in the previous 2 scenarios, CEs and FEs are ready to communicate using the ForCES protocol, and enter the Association Setup stage. In this stage the FEs attempts to join the NE. The following ForCES protocol messages will be exchanged for each CE-FE pair in the specified order:

*Association Setup Message (from FE to CE)

*Association Setup Response Message (from CE to FE)

*Query Message: FEO LFBSelectors(from CE to FE)

*Query Response: FEO LFBSelectors response (from FE to CE)

Once the associations has been initialized scenario 3 will have been successful.

6.4. Scenario 4 - CE query

TOC

Once the Association Phase stage has been complete, the FEs and CEs will enter the Established stage. In this stage the FE is continuously updated or queried. The CE should query the FE a specific value from the FE Object LFB and from the FE Protocol LFB. An example from the FE Protocol LFB is the HeartBeat Timer (FEHI) and from the FE Object LFB is the State of the LFB (FEState)
The following ForCES protocol messages will be exchanged:

*Query Message

*Query Response Message

6.5. Scenario 5 - Heartbeat monitoring

TOC

The Heartbeat (HB) Message is used for one ForCES element (FE or CE) to asynchronously notify one or more other ForCES elements in the same ForCES NE on its liveness. The default configuration of the Heartbeat Policy of the FE is set to 0 which means, that the FE should not generate any Heartbeat messages. the CE is responsible for checking FE liveness by setting the PL header ACK flag of the message it sends to AlwaysACK. In this Scenario the CE should send a Heartbeat message with the ACK flag set to AlwaysACK and the FE should respond.
The following ForCES protocol messages will be exchanged:

*Heartbeat Message

TOC

6.6. Scenario 6 - Simple Config Command

A config message is sent by the CE to the FE to configure LFB components in the FE. A simple config command easily visible and metered would be to change the Heartbeat configuration. This will be done in two steps:

1. Change the FE Heartbeat Policy (FEHBPolicy) to value 1, to force the FE to send heartbeats.

2. After some heartbeats from the FE, the FE Heartbeat Interval (FEHI) will be changed.

The following ForCES protocol messages will be exchanged:

*Config Message

*Config Response Message

6.7. Scenario 7 - Association Teardown

TOC

In the end, the association must be terminated. There are two scenarios by which the association maybe terminated:

1. Normal tear down by exchanging Association Teardown Message

2. Irregular tear down by stopping heartbeats from a FE or a CE.

3. Irregular tear down by externally shutting down/rebooting a FE or a CE.

All scenarios may be tested in the interoperability test.
The following ForCES protocol messages will be exchanged:

*Association Teardown Message

---

7. Tested Features

TOC

The features that were tested are:

TOC

7.1. ForCES Protocol Features

Feature
Batching
HeartBeats

ForCES Protocol Features

Although Batching was not initially designed to be tested, it was tested during the interoperability test.

7.1.1. Protocol Messages

TOC

Protocol Message
Association Setup
Association Setup Response
Association TearDown
Configuration
Configuration Response
Query
Query Response
HeartBeat

ForCES Protocol Message

7.1.2. MainHeader Handling

TOC

Header Field

Correlator
Acknowledge Flag
Priority Flag

MainHeader Handling

7.1.3. TLV Handling

TOC

TLV
Association Setup Result TLV
Association TearDown Reason TLV
LFBSelector TLV
Operation TLV
PathData TLV
FullData TLV
Result TLV

TLVs Supported

7.1.4. Operation Types Supported

TOC

Operation
Set
Set Response
Get
Get Response
Report

Operation Type Supported

7.2. ForCES Model Features

TOC

7.2.1. Basic Atomic Types Supported

TOC

Atomic Type
uchar
uint32

Basic Atomic Types Supported

7.2.2. Compound Types Supported

TOC

Compound Type
structs
arrays

Compound Types Supported

7.2.3. LFBs Supported

TOC

7.2.3.1. FE Protocol LFB

TOC

Protocol DataTypes
CEHBPolicy
FEHIBPolicy

FE Protocol LFB Datatypes

Protocol Components
FEID
CEHBPolicy
CEHDI
FEHBPolicy
FEHI
CEID

FE Protocol LFB Components

7.2.3.2. FE Object LFB

TOC

Object DataTypes
FEStateValues
LFBSelectorType

FE Object LFB Datatypes

Object Components
LFBSelectors
FEState

FE Object LFB Components

7.3. ForCES SCTP-TML Features

TOC

7.3.1. TML Priority Ports

TOC

Port
High priority (6700)
Medium priority (6701)
Low priority (6702)

Priority Ports

7.3.2. Message Handling at specific priorities

TOC

ForCES Message
Association Setup
Association Setup Response
Association Teardown
Config
Config Response

Query
Query Response

Message Handling at High priority (6700) Port

ForCES Message
Heartbeats

Message Handling at Low priority (6702) Port

8. Test details

TOC

The following tests occured:

Test#	CE	FE(s)	Teardown Option	Result	Comment
1	Zhejiang Gongshang University	NTT	Teardown from FE	Success	
2	Zhejiang Gongshang University	NTT	Teardown from CE	Success	
3	Zhejiang Gongshang University	NTT	Cable disconnect	Success	Nobody saw the loss of cable. Everybody found out from loss of PL-heartbeats
4	Zhejiang Gongshang University	NTT	Loss of CE Heartbeats	Success	FE didn't send Teardown and closed connection
5	Zhejiang Gongshang University	NTT	Loss of FE Heartbeats	Untestable	
6	NTT				

		Zhejiang Gongshang University	Teardown from CE	Initial Failure	CE couldn't handle Query Result for unknown LFBSelects.
7	Zhejiang Gongshang University	University of Patras	Teardown from FE	Success	Problems with retransmittion
8	Zhejiang Gongshang University	University of Patras	Teardown from CE	Success	Problems with retransmittion
9	Zhejiang Gongshang University	University of Patras	Cable disconnect	Success	Nobody saw the loss of cable. Everybody found out from loss of PL-heartbeats
10	Zhejiang Gongshang University	University of Patras	Loss of CE Heartbeats	Success	
11	NTT	Zhejiang Gongshang University	Teardown from CE	Success on Repeat	Test# 6. Problems fixed
12	NTT	Zhejiang Gongshang University	Teardown from FE	Success	
13	NTT	Zhejiang Gongshang University	Cable disconnect	Success	Nobody saw the loss of cable. Everybody found out from loss of PL-heartbeats.
14	NTT	Zhejiang Gongshang University	Loss of CE Heartbeats	Success	Problems with retransmittion
15	University of Patras	Zhejiang Gongshang University	Teardown from FE	Success	CE didn't terminat after sending Teardown. FE did
16	University of Patras	Zhejiang Gongshang University	Teardown from CE	Success	Problems with retransmittion
17	University of Patras	Zhejiang Gongshang University	Loss of CE Heartbeats	Success	FE didn't send Teardown and closed connection
18			Teardown from CE	Success	

	Zhejiang Gongshang University	NTT & University of Patrasx2			
19	NTT	Zhejiang Gongshang University & University of Patrasx2	Teardown from CE	Success	
20	University of Patras	NTT & Zhejiang Gongshang University & University of Patrasx2	Teardown from CE	Success	
21	University of Patras	Zhejiang Gongshang University	Batching Query and Config	Success	
22	University of Patras	NTT	Teardown from FE	Success	
23	University of Patras	NTT	Teardown from CE	Success	
24	University of Patras	NTT	Loss of CE Heartbeats	Success	FE didn't send Teardown and closed connection
25	University of Patras	NTT	Cable disconnect	Success	Nobody saw the loss of cable. Everybody found out from loss of PL-heartbeats
26	NTT	University of Patras	Teardown from FE	Success	
27	NTT	University of Patras	Teardown from CE	Success	
28	NTT	University of Patras	Loss of CE Heartbeats	Success	FE didn't send Teardown and closed connection
29	NTT	University of Patras	Cable disconnect	Success	Nobody saw the loss of cable. Everybody found out from loss of PL-heartbeats

Interoperability Tests

9. Results

TOC

All implementations were found to be interoperable with each other.
All scenarios were tested successfully.
The following issues were found and dealt with.

1. Some messages were sent to the wrong priority channels. There was some ambiguities on the SCTP-TML draft that have been corrected.

2. At some point, a CE sent a TearDown message to the FE. The CE expected the FE to shut down the connection, and the FE waited the CE to shut down the connection and were caught in a deadlock. This was a code bug and was fixed.

3. Sometimes the association setup message, only on the remote connection test, although sent, was not received by the other end and made impossible the association. This was caused by network problems.

4. An implementation did not take into account that the padding in TLVs MUST NOT be included in the lenght of the TLV. This was a code bug and was fixed.

5. EM Flag was set to reserved by a CE and was not ignored by the FE. This was a code bug and was fixed.

6. After the FEHBPolicy was set to 1 the FE didn't send any HeartBeats. This was a code bug and was fixed.

7. Some FE's sent HeartBeats with the ACK flag with a value other than NoACK. The CE responded. This was a code bug and was fixed.

8. When a cable was disconnected, the TML didn't realize that. The association was dropped due to heartbeats, this was a success, but this is an implementation issue implementers should keep in mind. This is a SCTP options issue. Nothing was needed to be done.

9. A CE crashed due to unknown LFBSelector values. This was a code bug and was fixed.

10. With the remote connection there were a lot of forces packet retransmittion. The problem is that packets like Heartbeats

were retransmitted. This is a SCTP issue. Perhaps SCTP-PR is needed to be used.

The implementers went beyond the call of duty. The test was extended with another test for batching messages. This test was also done successfully.

---

10. Acknowledgements

TOC

The authors of this draft would like to acknowledge and thank the chair of the ForCES working group Jamal Hadi Salim.
Also, the authors would like to acknowledge Professors Odysseas Koufopavlou and Spyros Denazis, as well as the Department of Electrical and Computer Engineering of the University of Patras for hosting the event.

---

11. IANA Considerations

TOC

This memo includes no request to IANA.

---

12. Security Considerations

TOC

Section 9 of the FE-protocol (Dong, L., Doria, A., Gopal, R., HAAS, R., Salim, J., Khosravi, H., and W. Wang, “ForCES Protocol Specification,” March 2009.) [I-D.ietf-forces-protocol] specifies security considerations of the ForCES protocol. For this interoperability test, no security MUST be chosen even for the distributed architecture.

---

13. References

TOC

13.1. Normative References

TOC

[I-D.ietf-forces-model]	Halpern, J. and J. Salim, “ForCES Forwarding Element Model,” draft-ietf-forces-model-16 (work in progress), October 2008 (TXT).

[I-D.ietf-forces-protocol]	Dong, L., Doria, A., Gopal, R., HAAS, R., Salim, J., Khosravi, H., and W. Wang, "ForCES Protocol Specification," draft-ietf-forces-protocol-22 (work in progress), March 2009 (TXT).
[I-D.ietf-forces-sctptml]	Salim, J. and K. Ogawa, "SCTP based TML (Transport Mapping Layer) for ForCES protocol," draft-ietf-forces-sctptml-02 (work in progress), January 2009 (TXT).

13.2. Informative References

TOC

[RFC2119]	Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels," BCP 14, RFC 2119, March 1997 (TXT, HTML, XML).
[RFC2629]	Rose, M., "Writing I-Ds and RFCs using XML," RFC 2629, June 1999 (TXT, HTML, XML).
[RFC3552]	Rescorla, E. and B. Korver, "Guidelines for Writing RFC Text on Security Considerations," BCP 72, RFC 3552, July 2003 (TXT).
[RFC3654]	Khosravi, H. and T. Anderson, "Requirements for Separation of IP Control and Forwarding," RFC 3654, November 2003 (TXT).
[RFC3746]	Yang, L., Dantu, R., Anderson, T., and R. Gopal, "Forwarding and Control Element Separation (ForCES) Framework," RFC 3746, April 2004 (TXT).
[RFC5226]	Narten, T. and H. Alvestrand, "Guidelines for Writing an IANA Considerations Section in RFCs," BCP 26, RFC 5226, May 2008 (TXT).
[ethereal]	"Ethereal is a protocol analyzer. The specific ethereal that will be used is an updated Ethereal, by Fenggen Jia, that can analyze and decode the ForCES protocol messages.."
[tcpdump]	"Tcpdump is a linux protocol analyzer. The specific tcpdump that will be used is a modified tcpdump, by Jamal Hadi Salim, that can analyze and decode the ForCES protocol messages.."

Authors' Addresses

TOC

	Evangelos Haleplidis
	University of Patras
	Patras,
	Greece
Email:	ehalep@ece.upatras.gr

	Kentaro Ogawa
	NTT Corporation
	Tokyo,
	Japan
Email:	ogawa.kentaro@lab.ntt.co.jp
	Xin-ping Wang
	Huawei Technologies Co., Ltd.
	China
Email:	carly.wang@huawei.com
	Chuanhuang Li
	Zhejiang Gongshang University
	18, Xuezheng Str., Xiasha University Town
	Hangzhou, 310018
	P.R.China
Phone:	+86-571-28877751
Email:	chuanhuang_li@pop.zjgsu.edu.cn