
ForCES Interoperability test report

IETF – 75 Stockholm

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Summary

- Location
 - Tested material
 - Topology
 - Local
 - Distributed
 - Scenario Tested
 - Results
 - Issues Found.
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Location

- University of Patras – Rio – Greece
- Department of Electrical & Computer Engineering.
- 15-16/07/2009



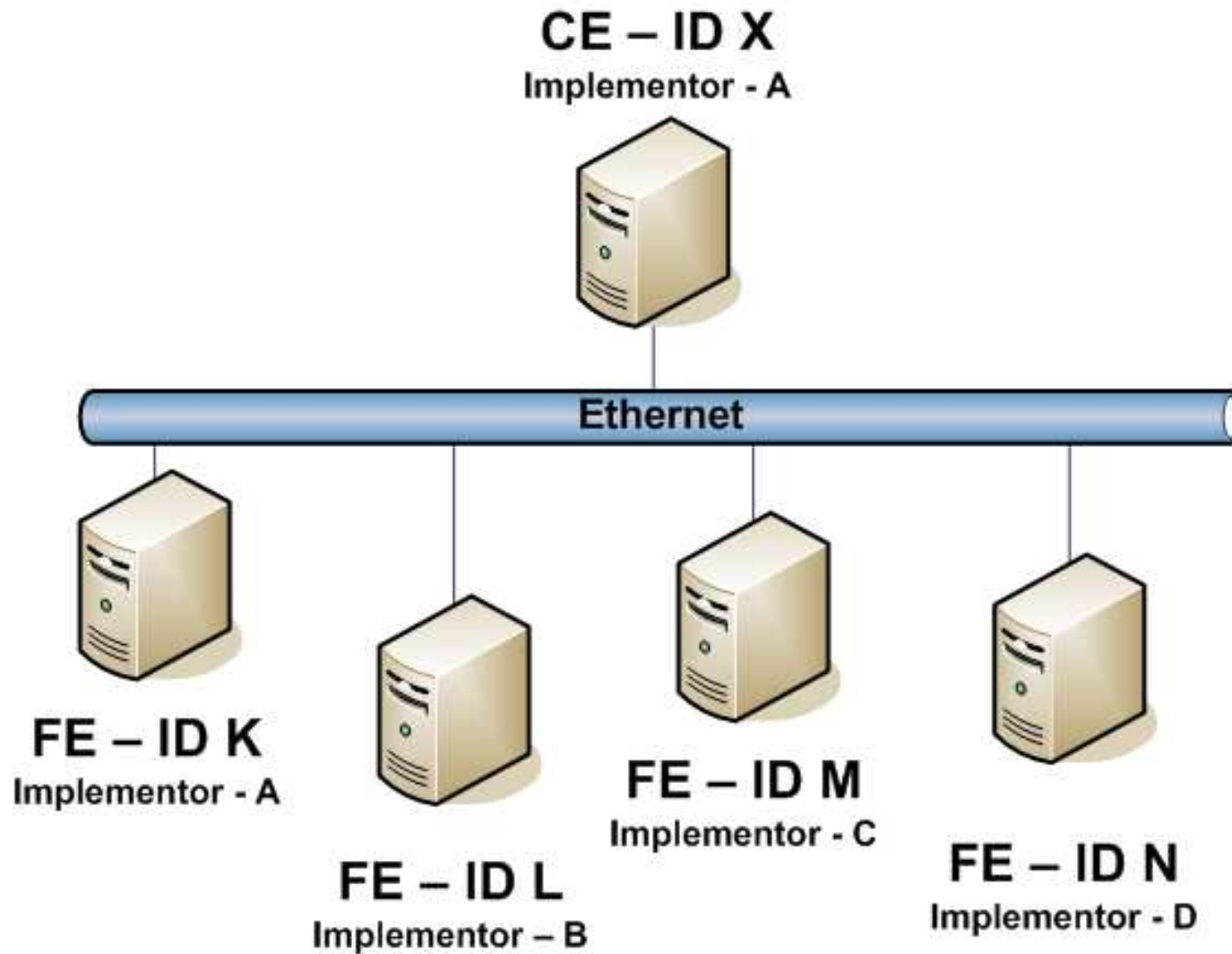
Testing material

- Model draft-16
 - Protocol draft-22
 - SCTP-TML draft-04
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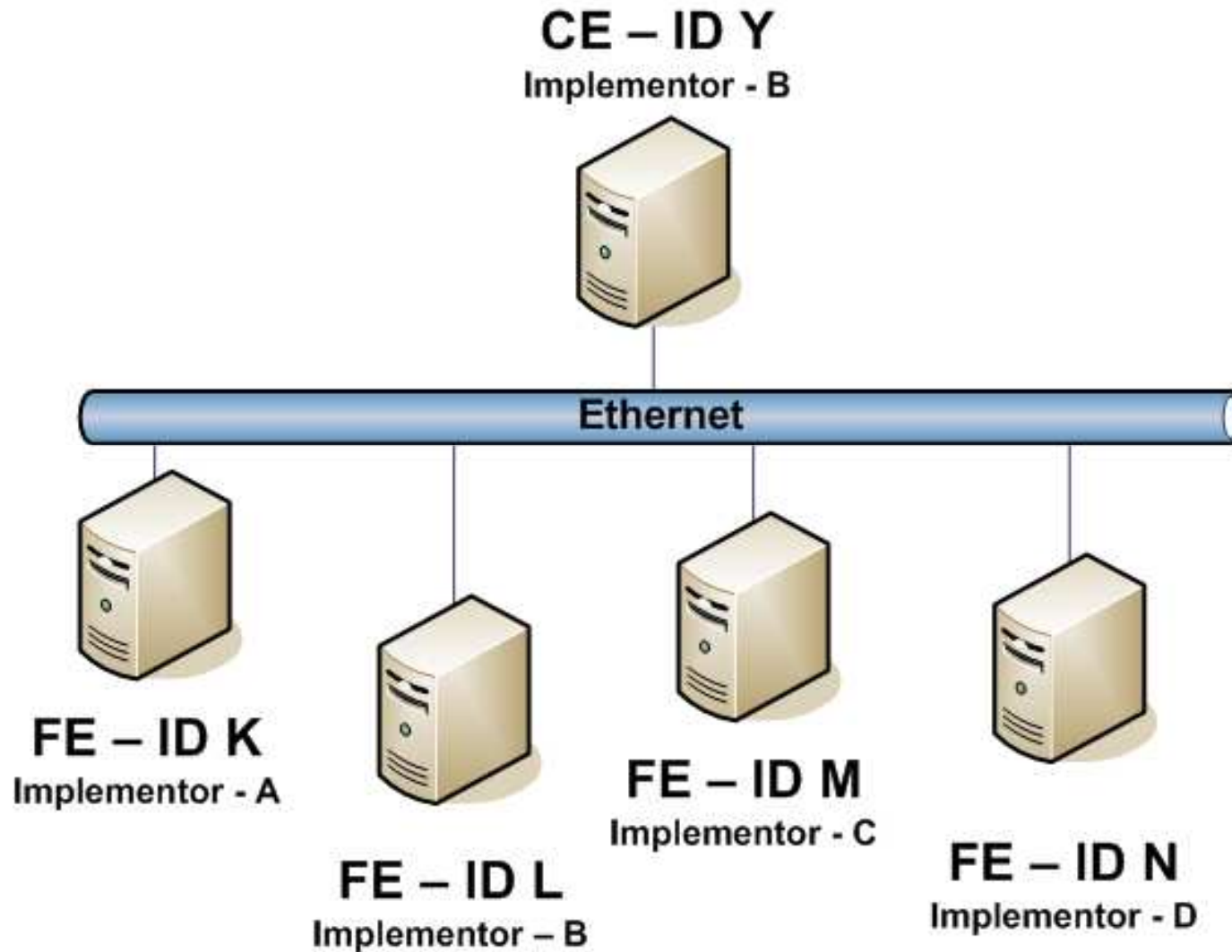
Scenarios Overview

- The scenarios covered the basic ForCES functionality.
 - In all scenarios, NEs were comprised of one CE and one/multiple FEs from different implementers.
 - All scenarios were tested more than once with permutations of CEs and FEs from different implementers.
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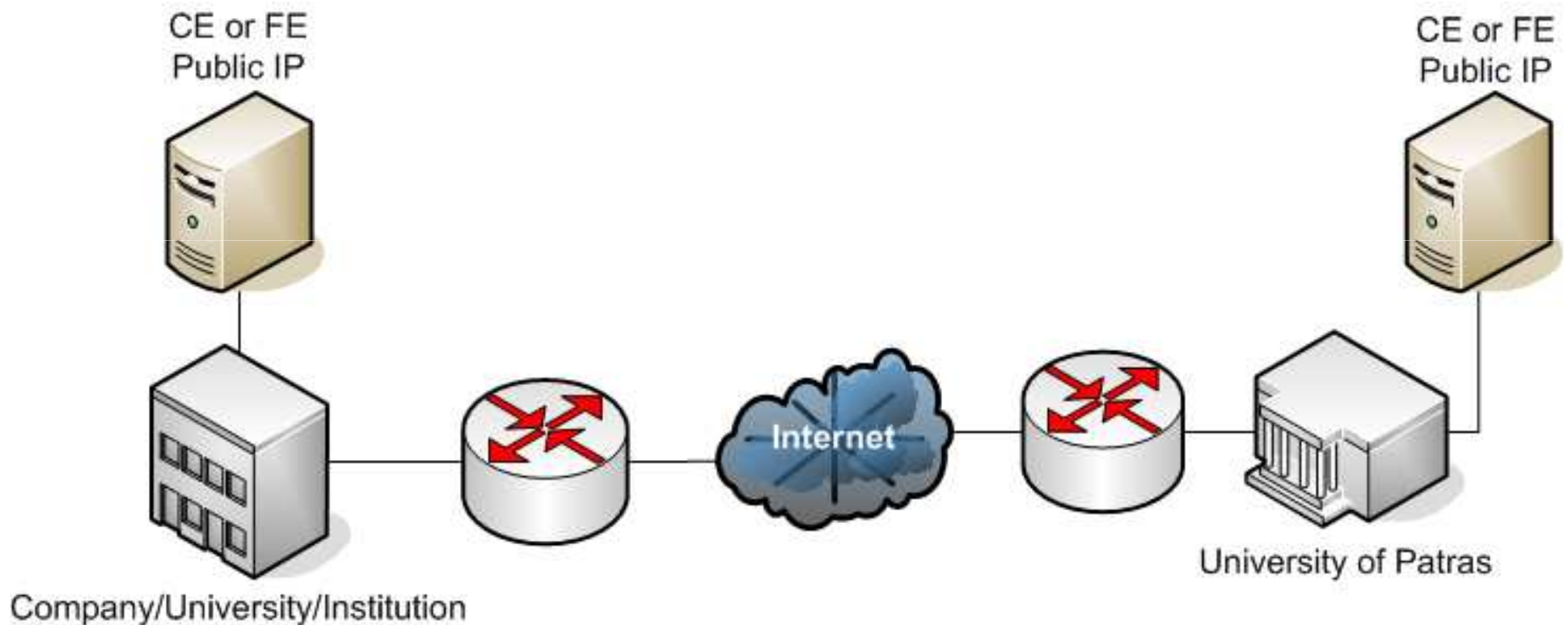
Local Configuration



Local Configuration (cont.)



Distributed Configuration



Scenario 1 - Pre-association Setup

- Configuration of CEs and FEs.
 - Implementation specific.
 - Need to setup:
 - FE/CE id to associate with.
 - IP of FE/CE to associate with.
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Scenario 2 – SCTP - TML setup

- Open a TML SCTP connection between FE-CE
 - Establish 3 SCTP priority channels
 - High priority – Port number: 6700
 - Medium priority - Port number: 6701
 - Lower priority - Port number: 6702
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Scenario 3 - Association Setup - Association Complete

- Association for each CE-FE pair
 - Messages Tested:
 - Association Setup Message
 - Association Setup Response Message
-

Scenario 4 - CE query

- Simple Query CE → FE
 - Example SHOULD be:
 - FE protocol LFB → HeartBeat Timer (FEHI)
 - FE object LFB → FE State (FEState)
 - Messages Tested:
 - Query Message
 - Query Response Message
-

Scenario 5 – Heartbeat monitoring

- CE → FE HeartBeat with ACK flag set to AlwaysACK.
 - Messages Tested:
 - Heartbeat Message
-

Scenario 6 – Simple Config Command

- Two parts:
 - ❑ A. Change FEHBPolicy to 1.
 - ❑ B. Change FEHI to another value.
 - Messages tested:
 - ❑ Config Message.
 - ❑ Config Response Message.
-

Scenario 7 – Association Teardown

- Normal:
 - Shutting down or rebooting CE/FE.
- Forced:
 - Loss of connection
 - Manual stopping of heartbeats.
 - Disconnect network cable.



Features Tested.

■ ForCES Protocol Features:

Feature	Tested
Execution Mode	No
Transaction	No
Batching	Yes
Command Pipelining	No
HeartBeats	Yes

TLV	Tested
Redirect TLV	No
Association Setup Result TLV	Yes
Association TearDown Reason TLV	Yes
LFBSector TLV	Yes
Operation TLV	Yes
PathData TLV	Yes
KeyInfo TLV	No
FullData TLV	Yes
SparseData TLV	No
ILV	No
Metadata TLV	No
Result TLV	Yes
Redirect Data TLV	No

Protocol Message	Tested
Association Setup	Yes
Association Setup Response	Yes
Association TearDown	Yes
Configuration	Yes
Configuration Response	Yes
Query	Yes
Query Response	Yes
Event Notification	No
Packet Redirect	No
HeartBeat	Yes

Header Field	Tested
Correlator	Yes
Acknowledge Flag	Yes
Priority Flag	Yes
Execution Mode Flag	No
Atomic Flag	No
Transaction Flag	No

Operation	Tested
Set	Yes
Set Prop	No
Set Response	Yes
Set Prop Response	No
Del	No
Del Response	No
Get	Yes
Get Prop	No
Get Response	Yes
Get Prop Response	No
Report	Yes
Commit	No
Commit Response	No
TRComp	No

Features Tested (con).

■ ForCES Model Features:

Atomic Type	Tested
char	No
uchar	Yes
int16	No
uint16	No
int32	No
uint32	Yes
int64	No
uint64	No
boolean	No
string[N]	No
string	No
byte[N]	No
octetstring[N]	No
float16	No
float32	No
float64	No

Compound Type	Tested
structs	Yes
arrays	Yes

FE Protocol LFB Events	Tested
PrimaryCEDown	Yes

FE Protocol LFB DataTypes	Tested
CEHBPoly	Yes
FEHBPoly	Yes
FERestarPolicy	No
CEFailoverPolicy	No
FEHACapab	No

FE Protocol LFB Components	Tested
CurrentRunningVersion	No
FEID	Yes
MulticastFEIDs	No
CEHBPoly	Yes
CEHDI	Yes
FEHBPoly	Yes
FEHI	Yes
CEID	Yes
BackupCEs	No
CEFailoverPolicy	No
CEFTI	No
FERestartPolicy	No
LastCEID	No

FE Protocol LFB Capabilities	Tested
SupportableVersions	No
HACapabilities	No

FE Object LFB DataTypes	Tested
LFBAgencyLimit	No
PortGroupLimitType	No
SupportedLFBType	No
FESateValues	Yes
FEConfiguredeighborType	No
FEConfiguredeighborType	No
LFBSelectorType	Yes
LFBLinkType	No

FE Object LFB Components	Tested
LFBTopology	No
LFBSelectors	Yes
FEName	No
FEID	No
FEVendor	No
FEModel	No
FESate	Yes
FENeighbors	No

FE Object LFB Capabilities	Tested
ModifiableLFBTopology	No
SupportedLFBs	No

Features Tested (con).

■ ForCES SCTP Features:

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

ForCES Message Handling on HP Port	Tested
Association Setup	Yes
Association Setup Response	Yes
Association Teardown	Yes
Config	Yes
Config Response	Yes
Query	Yes
Query Response	Yes

ForCES Message Handling on MP Port	Tested
Event Notification	No

ForCES Message Handling on LP Port	Tested
Packet Redirect	No
Heartbeats	Yes

Security Feature	Tested
IPSec	No

Results:



SUCCESS



Results (con.)

- Five different implementation organizations:
 - NTT Japan (CE & FE) (local).
 - Zhejiang Gongshang University (CE & FE) (remote).
 - University of Patras (CE & FE) (host - local).
 - National Digital Switching Center (NDSC) - Extended Ethereal dissector (local).
 - Mojatatu Networks - Extended Tcpdump dissector (local).
 - Local CEs/FEs in a hub.
 - Global IPs for remote connections.
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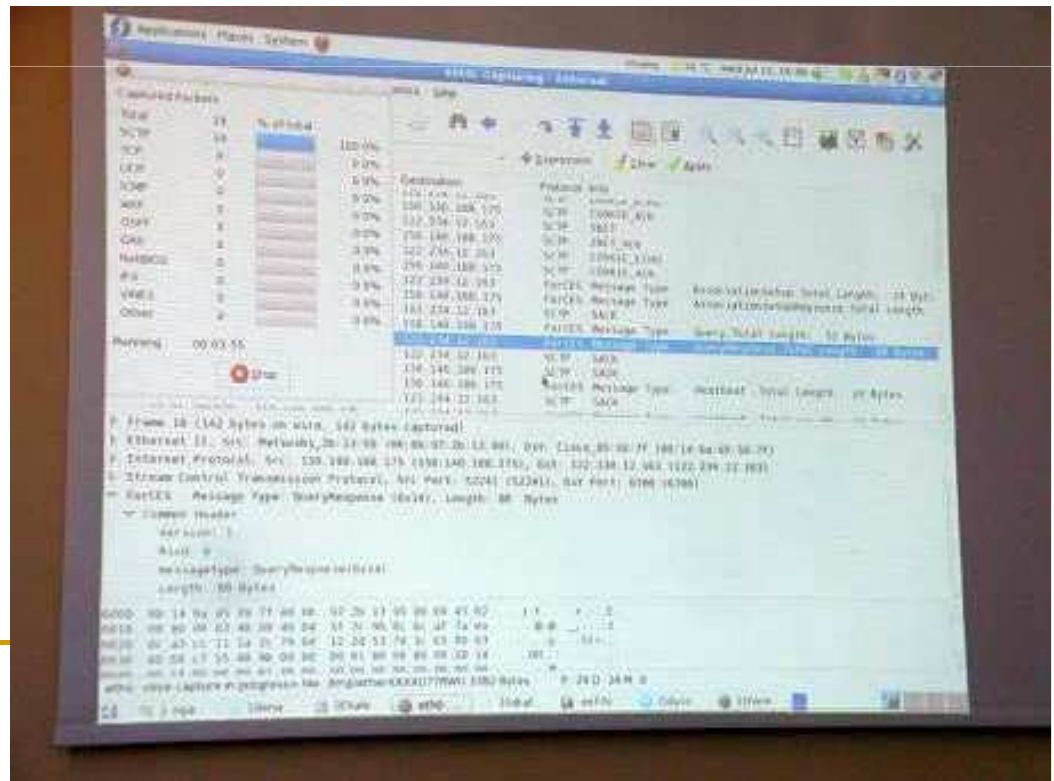
Results (con.)

- Run 29 Tests.
 - 25 tests one CE with one FE.
 - 3 tests with one CE and multiple FEs.
 - 1 extended test with batching configuration and query messages.

 - Success in all tests after resolving code issues.
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Results (con.)

- Results were verified by:
- Extended Tcpdump.
- Extended Ethereal.
- Outputs from code.



Results (con.)

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 retransmission
8	Zhejiang Gongshang University	University of Patras	Teardown from CE	Success	Problems with retransmission
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 retransmission
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 retransmission
17	University of Patras	Zhejiang Gongshang University	Loss of CE Heartbeats	Success	FE didn't send Teardown and closed connection
18	Zhejiang Gongshang University	NTT & University of Patrasx2	Teardown from CE	Success	
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

Issues

1. Some implementations sent messages on the wrong priority channel.

What should the recipient do?

1. Respond on the same channel?
2. Respond on the correct channel?
3. Discard the message?

Result: A necessary fix for the SCTP-TML draft occurred that specified the correct way to address this issue.

Issues (con.)

2. Teardown Deadlock.

- ❑ A CE sent a Teardown.
- ❑ The FE got the Teardown.
- ❑ The CE waited for the FE to drop the connection.
- ❑ The FE waited for the CE to drop the connection.

Result: Code bug. The sender of the Teardown **MUST** also drop the connection, since it does not expect a response. Fixed.

Issues (con.)

3. Data Encoding.

- An implementation in the TLVs, in the length included the padding.

Result: Code bug. Fixed.

4. EM Flag.

- A CE sent config with EM flag to reserved value.
- The FE sent config response: error-unspecified.

Result: Code bug. Fixed.

Issues (con.)

5. FEHBPolicy.

- ❑ The CE sent config FEHBPolicy to 1.
- ❑ The FE didn't respond with Heartbeats.

Result: Code bug. Fixed.

6. Heartbeats.

- ❑ The FE sent HeartBeats with ACK flag set for response.
- ❑ The CE responded to the ACK flag.

Result: Code bug. Fixed.

Issues (con.)

7. LFBSelectors.

- A CE wasn't able to continue after receiving unknown (to the CE) LFBSelectors.

Result: Code bug. Fixed.

Issues (con.)

8. Cable disconnect.

- ❑ All implementations failed to see the cable disconnection.
- ❑ SCTP inherently does not drop sockets immediately upon cable disconnection.
- ❑ All implementations saw loss of heartbeats and dropped connections instead.

Result: SCTP configuration issue.

Issues (con.)

9. Retransmissions.

- ❑ High latency and lossy link between China and Greece
- ❑ A lot of retransmissions.
- ❑ Retransmission should not happen for MP and LP

Result: Implementation issue. SCTP-PR needed to be used. Did not fix.

Issues (con.) – Retransmission-Test19

```
17:16:08.579328 00:14:6a:d5:59:7f > 00:0b:97:2b:13:99, ethertype IPv4 (0x0800),
122.234.155.8.32812 > 150.140.188.175.6702: sctp[ForCES LP]
  1) [SACK] [cum ack 3406933825] [a_rwnd 55784] [#gap acks 0] [#dup tsns 0]
  2) [DATA] (B)(E) [TSN: 2492300772] [SID: 0] [SSEQ 10] [PPID 0x0]
ForCES HeartBeat
ForCES Version 1 len 24B flags 0xc0000000
SrcID 0x3(FE) DstID 0x40000001(CE) Correlator 0x3
ForCES flags:
  AlwaysACK(0x3), prio=0, EMReserved(0x0),
  Standalone(0x0), StartofTransaction(0x0)
  Extra flags: rsv(b5-7) 0x0 rsv(b13-15) 0x0 rsv(b16-31) 0x0

  3) [DATA] (B)(E) [TSN: 2492300773] [SID: 0] [SSEQ 11] [PPID 0x0]
ForCES HeartBeat
ForCES Version 1 len 24B flags 0x00000000
SrcID 0x3(FE) DstID 0x40000001(CE) Correlator 0x35
ForCES flags:
  NoACK(0x0), prio=0, EMReserved(0x0),
  Standalone(0x0), StartofTransaction(0x0)
  Extra flags: rsv(b5-7) 0x0 rsv(b13-15) 0x0 rsv(b16-31) 0x0

  4) [DATA] (B)(E) [TSN: 2492300774] [SID: 0] [SSEQ 12] [PPID 0x0]
ForCES HeartBeat
ForCES Version 1 len 24B flags 0xc0000000
SrcID 0x3(FE) DstID 0x40000001(CE) Correlator 0x4
ForCES flags:
  AlwaysACK(0x3), prio=0, EMReserved(0x0),
  Standalone(0x0), StartofTransaction(0x0)
  Extra flags: rsv(b5-7) 0x0 rsv(b13-15) 0x0 rsv(b16-31) 0x0
```

Acknowledgments

- Many thanks to all involved parties.
 - Many thanks to the remote connected party.
(Wouldn't have caught some issues).
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Acknowledgments (con.)

- Many thanks to
 - Professor Odysseas Koufopavlou
 - Professor Spyros Denazis
 - Department of Electrical and Computer Engineering
 - And the University of Patras
 - For hosting the event.
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What's next?

- If someone has an implementation, please ask to fill the implementation report questionnaire for the formal implementation report for the IESG.
 - A second interoperability test is in order to test more advanced features.
 - Perhaps in a year's time?
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