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ForTER - A ForCES Router Implementation

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Overview - ForTER Project

- **Goal**

- Completion of the ForCES protocol
- Prototype implementation of a ForCES-inside router

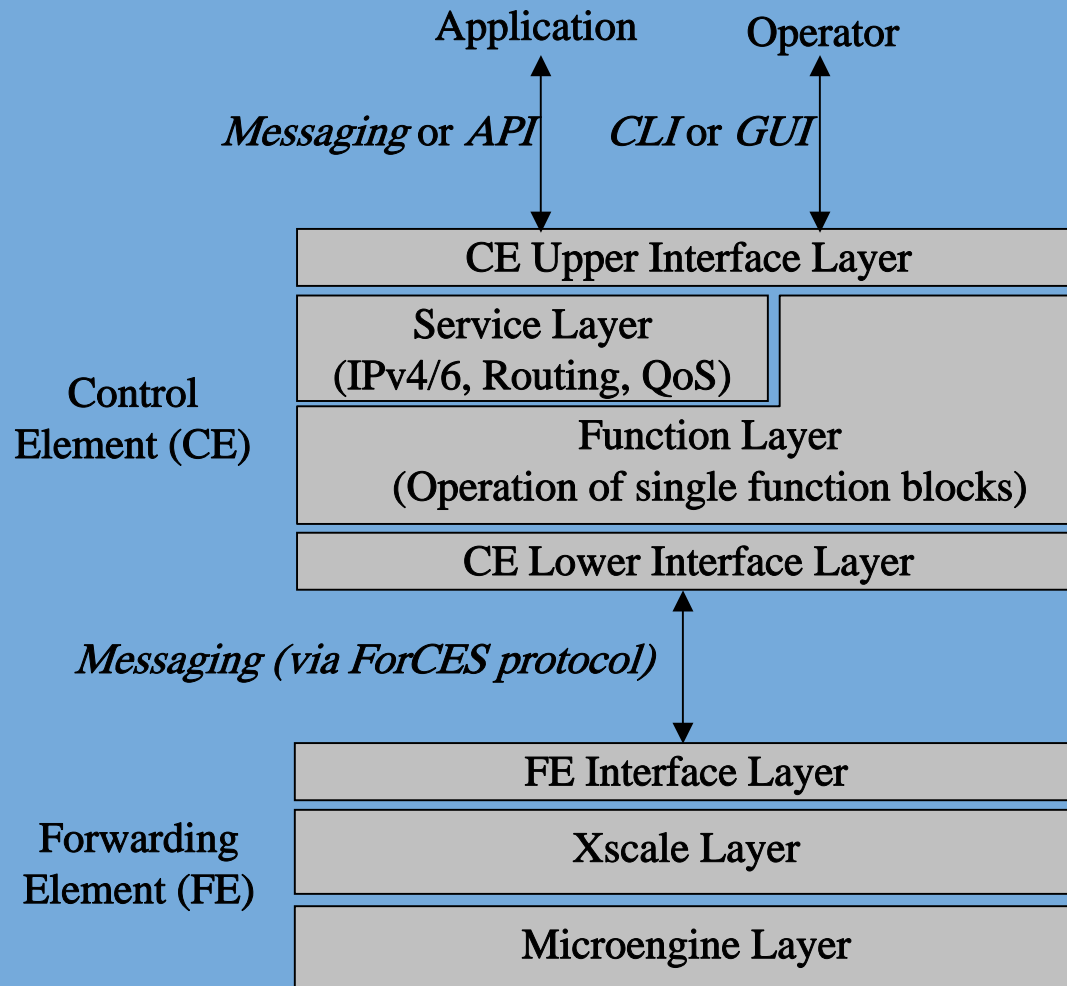
- **Funding**

- NSF China (60273061, 60573116)
- National Hi-Tech R&D Project (2005AA121310)
- ZJ NSF (RC02063), ZJ Sci&Tec Project (2005C21013)

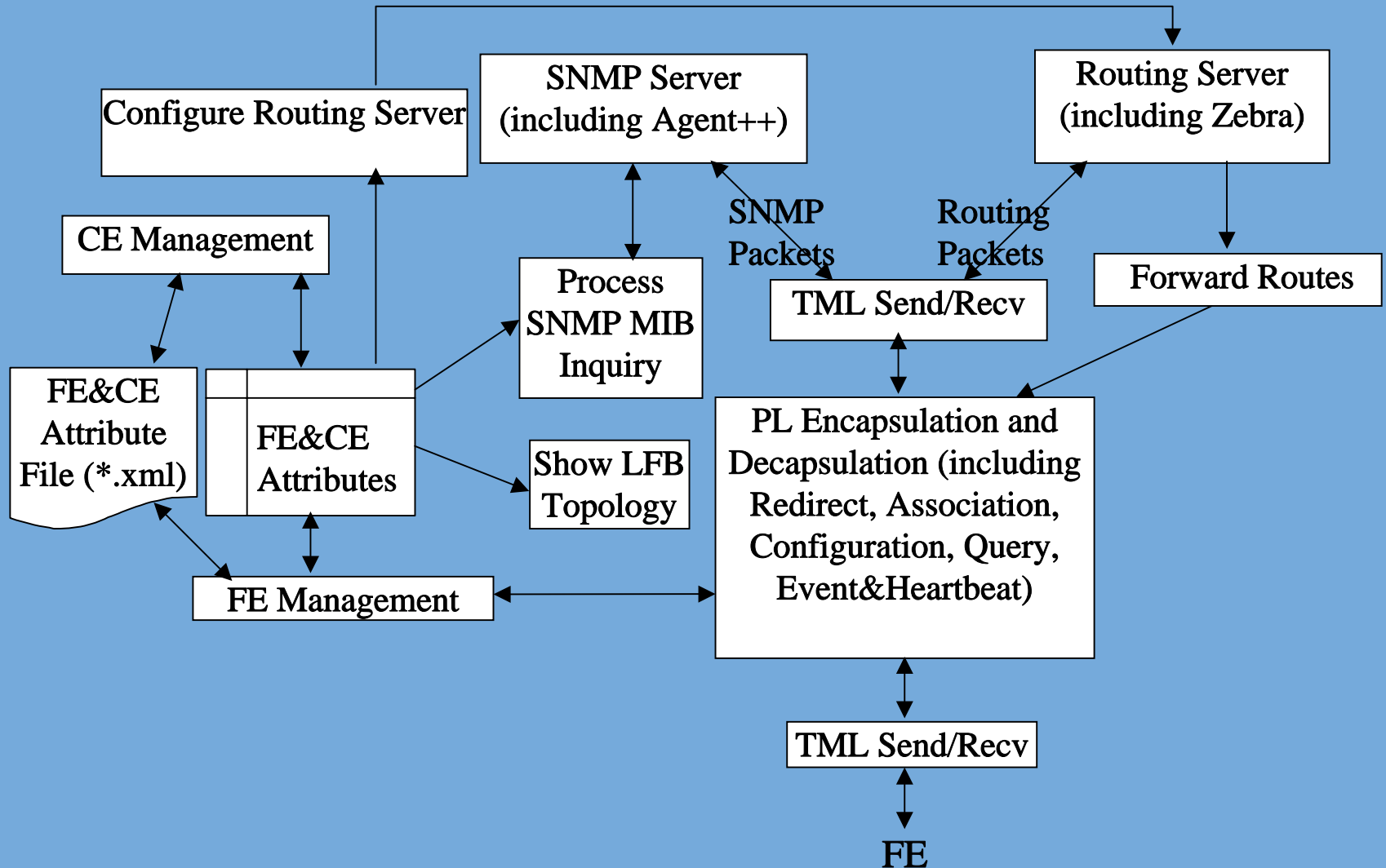
- **Team**

- Weiming Wang, Ligang Dong, Ming Gao, Fenggen Jia, Rong Jin, Gebin Zhu, Guangming Wang, Lei Shi, Ting Yue, Anzhen Zheng, Jin Yu, Shiping You, Xiaochun Wu

Architecture of ForTER



Control Element - Structure



Control Element - Parts

- CE Management and FE Management
- PL
 - Association - Receive Association Setup, Send Association Setup Response and Association Teardown
 - Configuration (including Event Subscription&Unsubscription) - Send Config, Receive Config Response
 - Query - Send Query, Receive Query Response
 - Event (including Heartbeat) - Receive Event and Heartbeat, Send Heartbeat
 - Redirect
- SNMP Server and related Communication (Inquire MIB Info. and Redirect SNMP packets)
- Routing Server and related Communication (Redirect Routing Packet and Forward Routes)
- TML - TMLOpen, TMLClose, TMLRecv, TMLSend, TMLConfig, TMLEvent

Control Element – User Interface

FE
Attribute
Tree

The screenshot displays the 'FE Management CE' application window. On the left, the 'FEs' tree shows two FE instances with their attributes. The right pane shows a network diagram with nodes 1-8 and connections. A legend defines symbols: a red circle for LFB, blue text for PacketFlowID, and a black line for datapath. A status bar at the bottom shows system messages.

FE Attribute Tree (Left Pane):

- FEs
 - FE
 - ID:1
 - IP:10.1.82.11
 - Status
 - Statistics
 - Events
 - Ports
 - LFB
 - LFB
 - LFB
 - LFB
 - LFB
 - LFB
 - LFB
 - LFB
 - FE
 - ID:1
 - IP:10.1.82.53
 - Status
 - Events
 - Event
 - Event
 - Event
 - Ports
 - Port
 - ID:0
 - Type:2
 - Mac:020102030001
 - IP:16.5.0.1
 - Mask:255.255.255.0
 - Speed:2
 - MTU:1500
 - Backplane:0
 - PacketSum:0
 - Activation:0

LFB Topology Graph (Right Pane):

NOTE : ○ : LFB
[num] : PacketFlowID
— : datapath

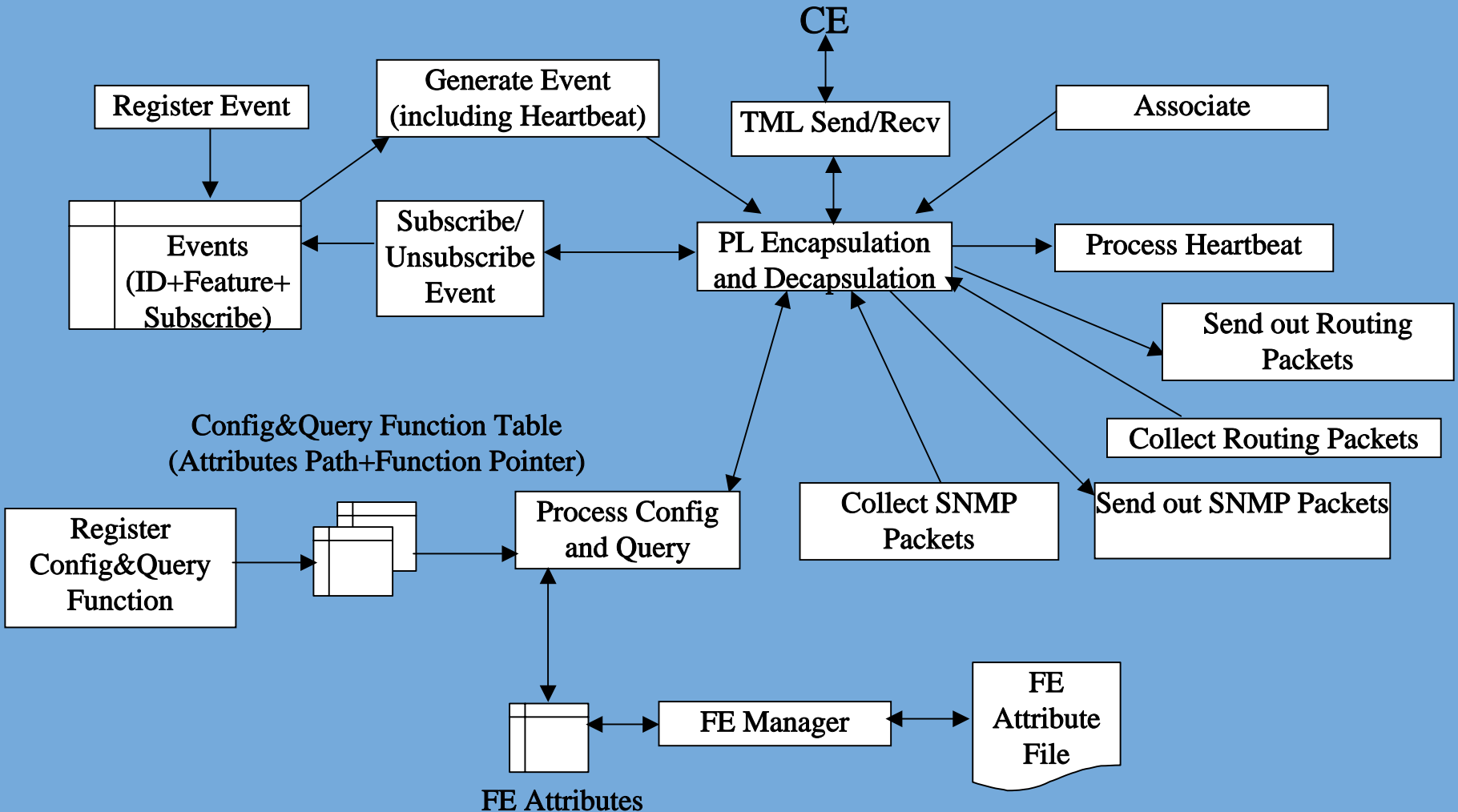
The graph shows two paths:

- Path 1: eth0 → Receiver (1) → Classifier (2) → Scheduler (3) → Sender (4) → eth1. Connections are labeled with PacketFlowIDs: (9) between 1 and 2, (1)[2] between 2 and 3, and (3) between 3 and 4.
- Path 2: eth1 → Receiver (5) → Scheduler (6) → Scheduler (7) → Sender (8) → eth0. Connections are labeled with PacketFlowIDs: (4) between 5 and 6, (8) between 2 and 6, (5)[6] between 6 and 7, and (7) between 7 and 8.

Information
List

Send config message
Send config message
associationSetupResponse send success
associationSetup message from IP 10.1.82.53 arrive Accepted!
now wait for association from FEs

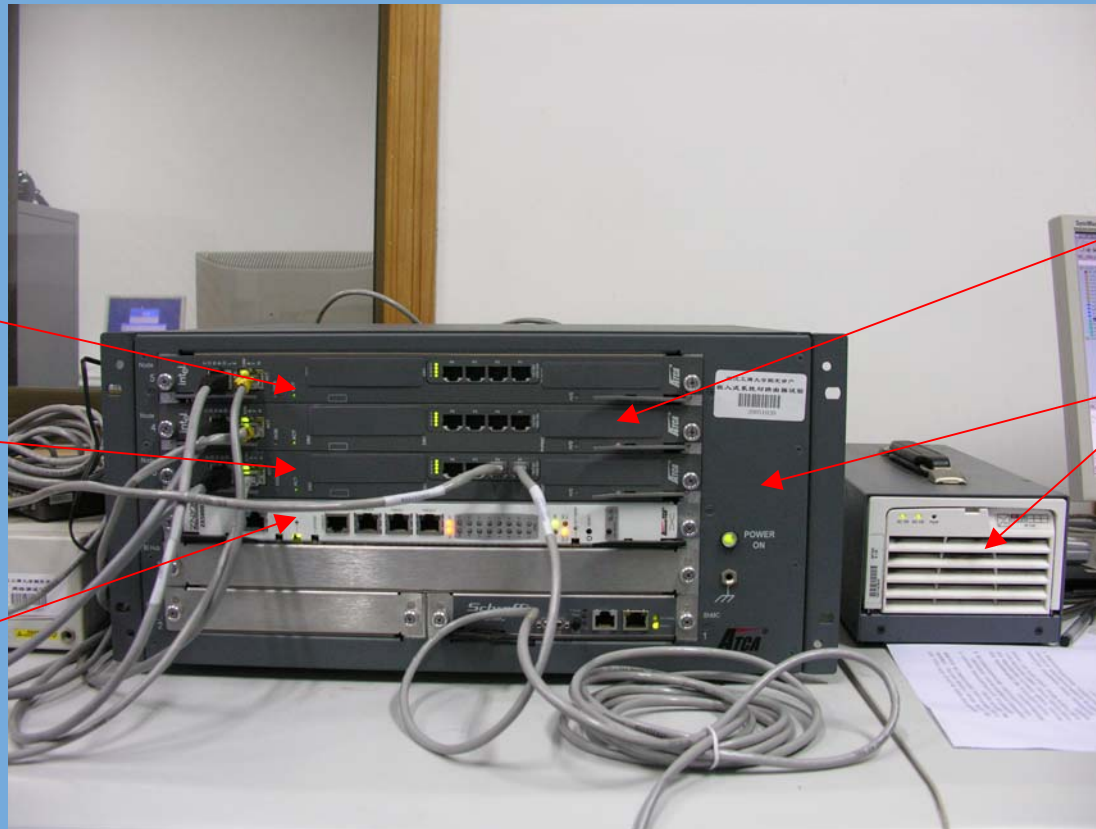
Forwarding Element – Structure



Forwarding Element – Parts

- FE Manager
- PL
 - Association - Send Association Setup, Receive Association Setup Response and Association Teardown
 - Configuration (including Event Subscription&Unsubscription) - Receive Config, Send Config Response
 - Query - Receive Query , Send Query Response
 - Event (including Heartbeat) - Send Event and Heartbeat, Receive Heartbeat
 - Redirect
- TML - TMLOpen, TMLClose, TMLRecv, TMLSend, TMLConfig, TMLEvent
- Callback for Events
- Attributes Path-Function Mapping for Query and Config

Forwarding Element – Surface



**IXMB2401
Single
Network
Processor
Base Card**

**ZX5000 Base
Fabric Switch**

**IXMB2801
Single
Network
Processor
Base Card**

KIXDP2851

Implementation Status

- **ForCES Protocol**

- **Completed:** Association, Configuration, Query, Event, Redirect for Routing
- **In Process:** Hearbeat, Redirect for SNMP

- **FE Model**

- **Primitively Completed:** FE Status, FE Events, FE Statistics, FE Ports, DSCP LFB, Forward LFB, Sender LFB, Receiver LFB, QM LFB
- **Most of works are in Process**

Implementation Status

- **CE**

- **Completed:**

- ForCES Protocol-based Communication with FE
- CE&FE Attributes Management
- Zebra-based Routing ([architecture](#))

- **In Process:**

- Agent++-based SNMP
- More Interfaces with CE
- (Embedded) Linux Version of CE, Multi-CE,...

- **FE** – based on

IXA_SDK_4.1/ipv4_forwarder/quad_gbeth_2401

- **Completed:**

- ForCES Protocol-based Communication with CE

- **In Process:**

- Multi-FE
- On-Line Uploading of LFBs

The End



Routing

