DISIMAN: A Distributed SImulator for MANet in Software Defined Radio technology

Authors

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University of L'Aquila

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Summary

- Introduction
  - Mobile Ad-hoc Networks
  - SDR Technology
  - SCA
- Open issues in the Software Communication Architecture (SCA)
  - Reconfigurability and Scalability
  - Routing and QoS
- A modelling approach to overcome limitations of the SCA
  - The Use Case of the IEEE 802.15.4 Physical Layer
- Tissue Methodology (TM): A network modelling approach for design, simulation and emulation of a SDR MANET device
- DISIMAN
- Conclusion and future works
- Publications

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Introduction

Mobile Ad-hoc Networks

- MANET are ad-hoc networks where each device works both as a terminal and as a router, without the support of an infrastructure communication network
- Some present and future applications concerning the MANET
  - Tactical Networks

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Mobile Ad-hoc Networks

- Some present and future applications concerning the MANET
  - Tactical Networks
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    - Body area networks (BAN)

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Mobile Ad-hoc Networks

- Some present and future applications concerning the MANET
  - Networked Control Systems
    - HYCON 2: This project aims at stimulating and establishing a long-term integration in the strategic field of control of complex, large-scale, and networked dynamical systems

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SDR Technology

SDR Technology

- The Software Defined Radio, (SDR) is a technology useful to realize devices for MANET. This is because a SDR devices has the following features:
  - The ability to generate a base-band waveform, for different radio bands and different protocols, by a set of algorithms implemented by a programming language on programmable architecture for digital signals processing;
  - The ability to execute signal recognition operations, in order to identify available communication services inside an environment;

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SCA

SCA

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- RPC on the server executes the function with the received parameters and returns the result

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Open issue in the Software Communication Architecture (SCA)

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- Every CORBA server object has a unique object reference. In order to invoke the methods implemented by this server, a client needs to know this reference.

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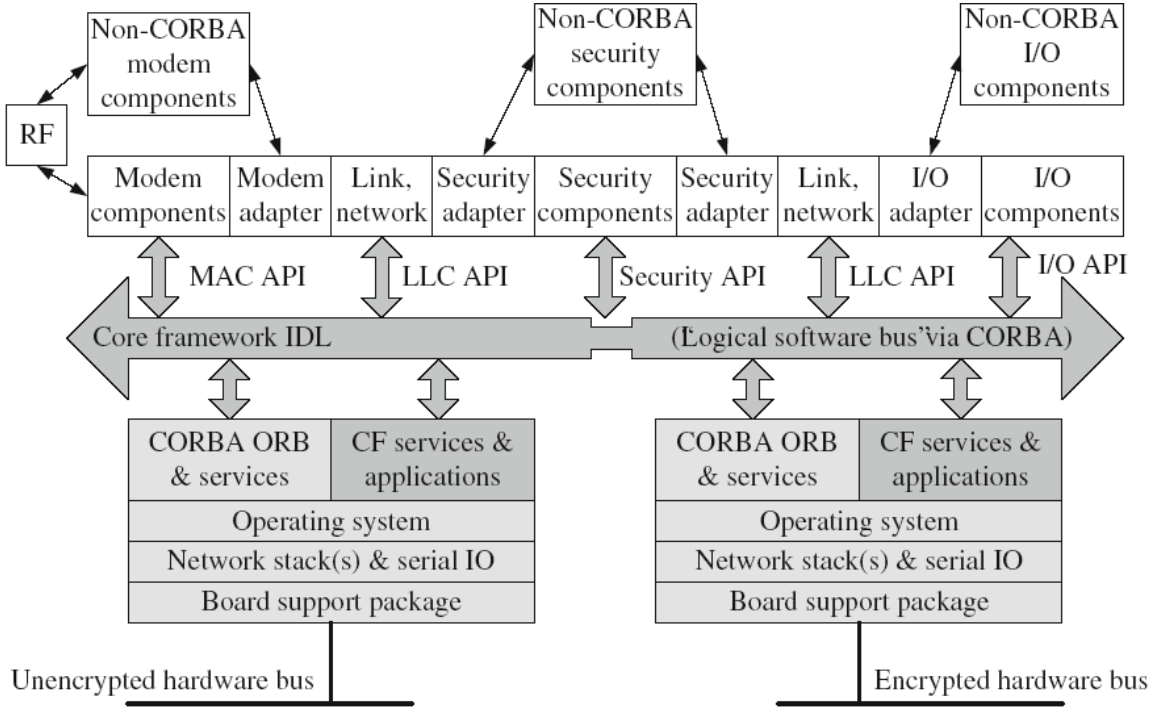
Reconfigurability and Scalability



CORBA

Routing and QoS

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Routing and QoS

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- Physical layer, MAC layer and routing layer together contend for the network resources

Routing and QoS

- In **[CPSP12]** we propose a cross-layer design among physical, MAC and routing layers.

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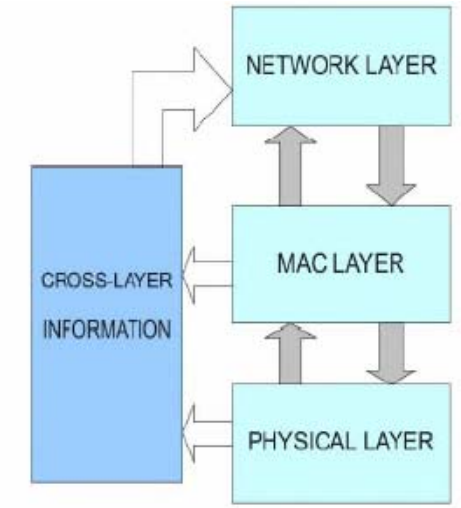
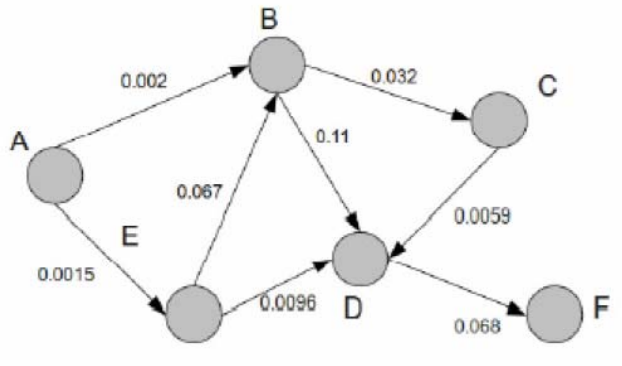
Routing and QoS



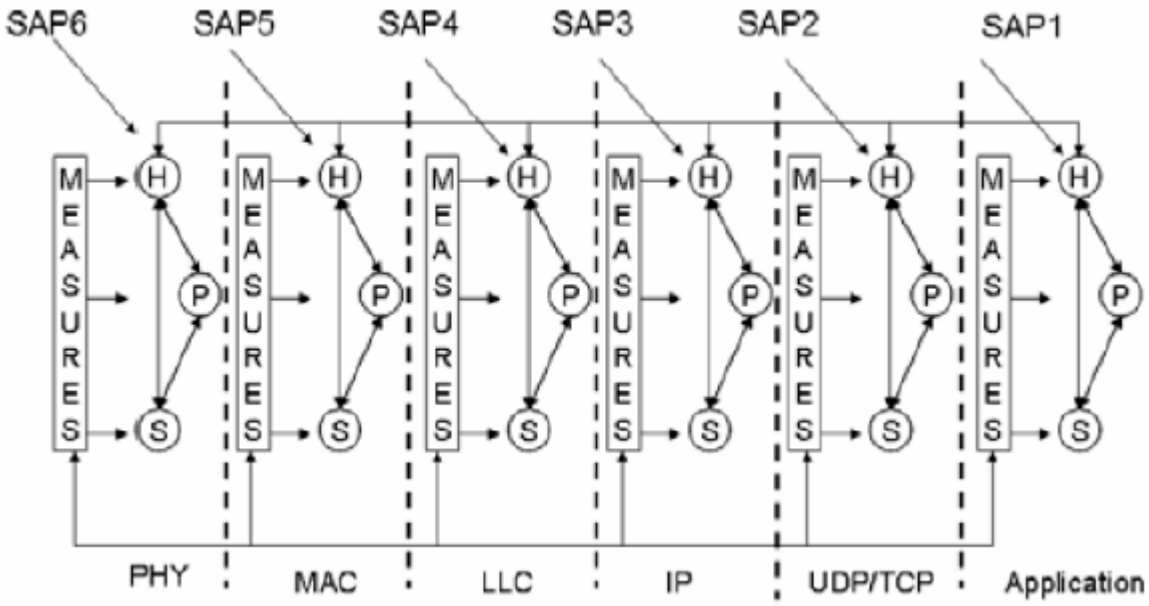
- Number of hosts: 25
- Mobility model: random way-point mobility
- Area: 50 [m] × 50 [m]
- Transmission power: 2 [mW]
- Path-loss factor: 3
- Signal to noise ratio: -110 [dBm]
- Simulation time: 600 [s]

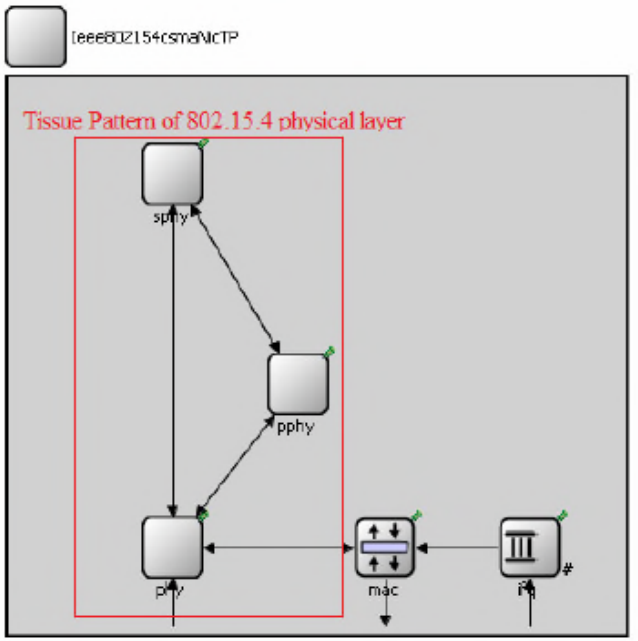


	ETX	PER
Unacked bytes	3760	585
Transmission time	72 [s]	402 [s]
Average congestion window	48473	10905

A modelling approach to overcome the limits of the SCA

The Use Case of the IEEE 802.15.4 Physical Layer





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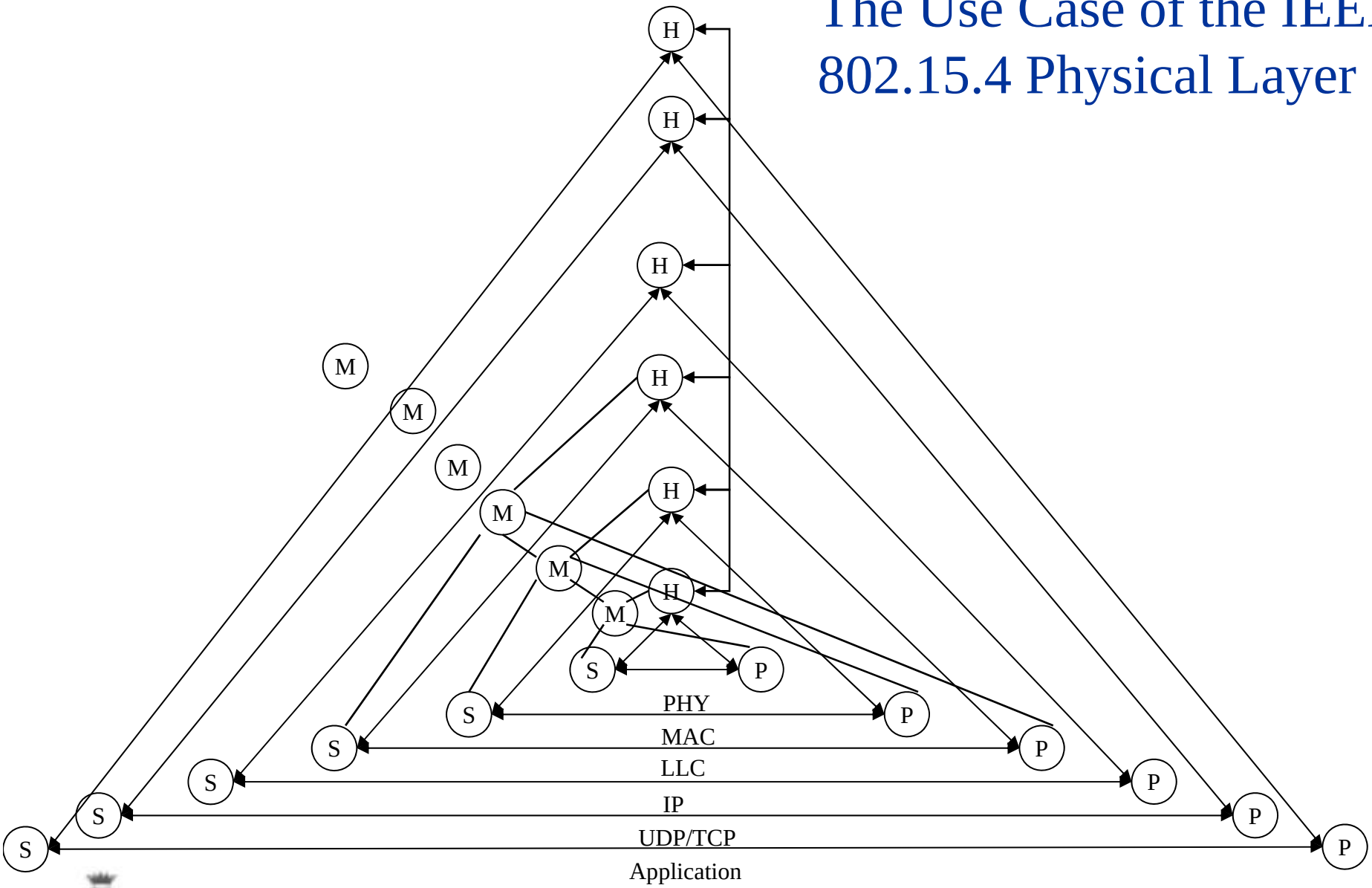

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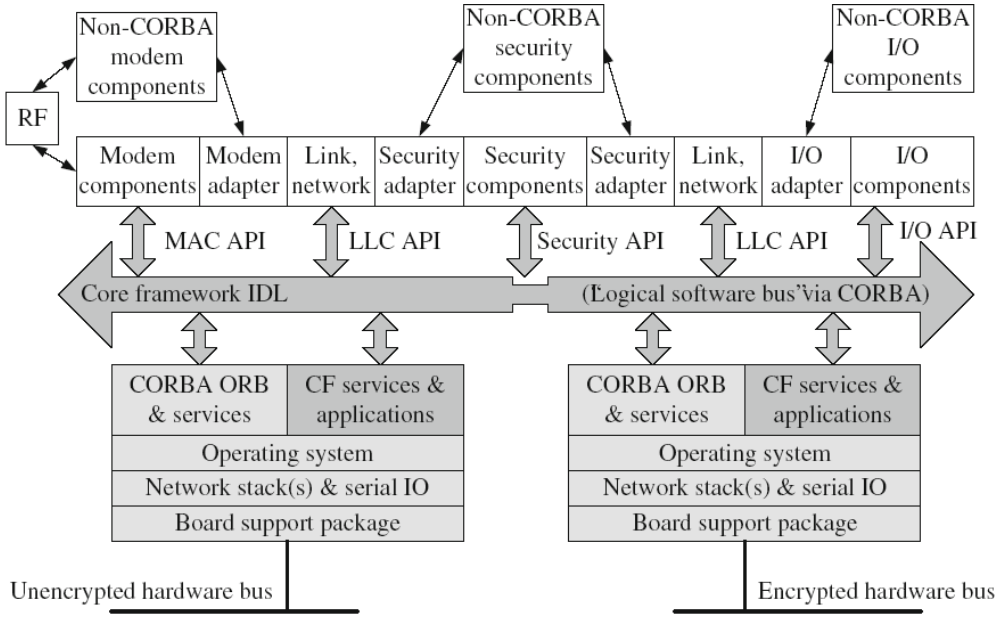

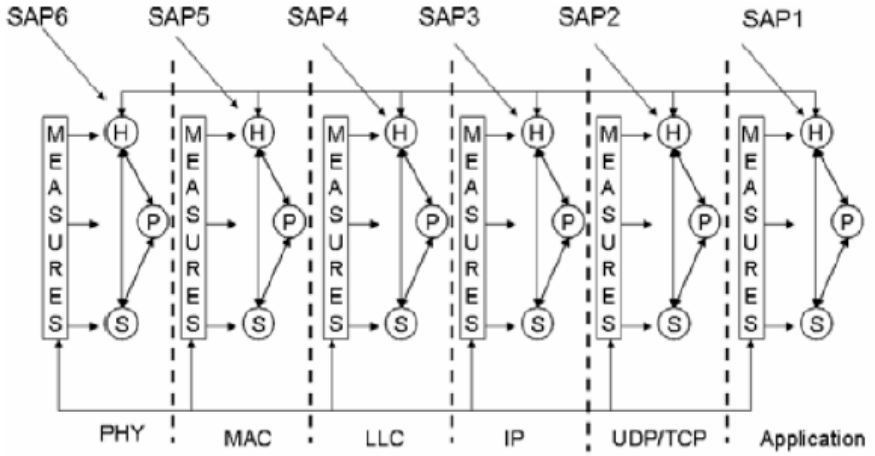

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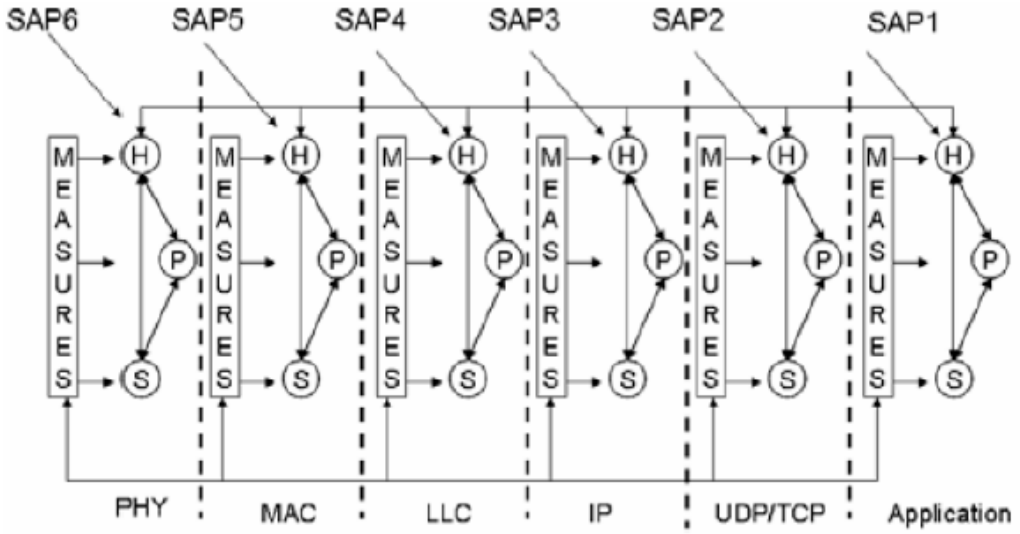
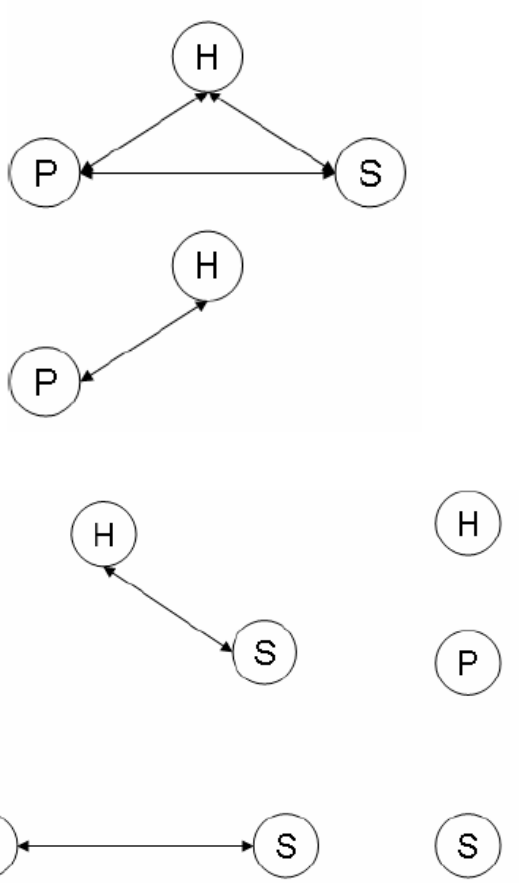
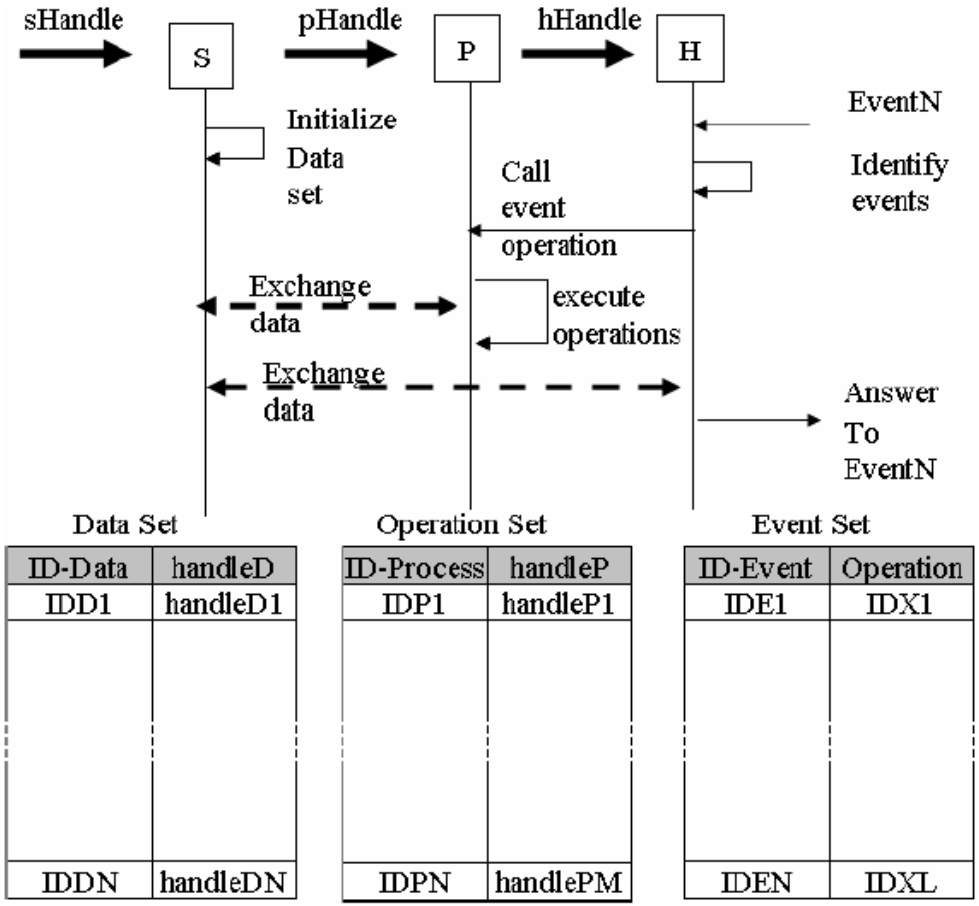


- Architecture proposed in:
  - at *Wireless Innovation Forum European Conference on Communications Technologies (***[CFR12])**
  - *Wireless Telecommunications Symposium (***[CFRS12]**)

Tissue Methodology (TM): A network modelling approach for design, simulation and emulation of a SDR MANET device





Simulation and emulation issue:a solution by using the Tissue Methodology

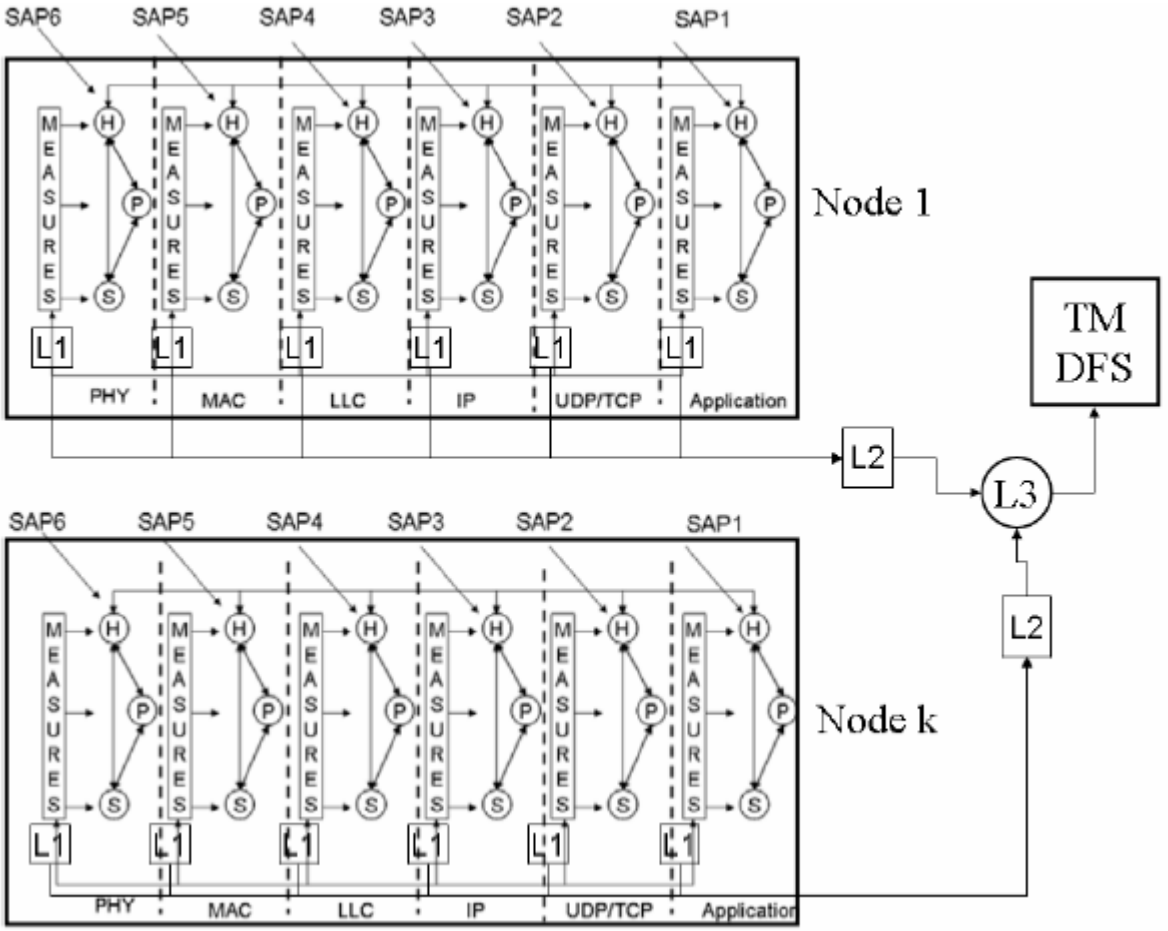
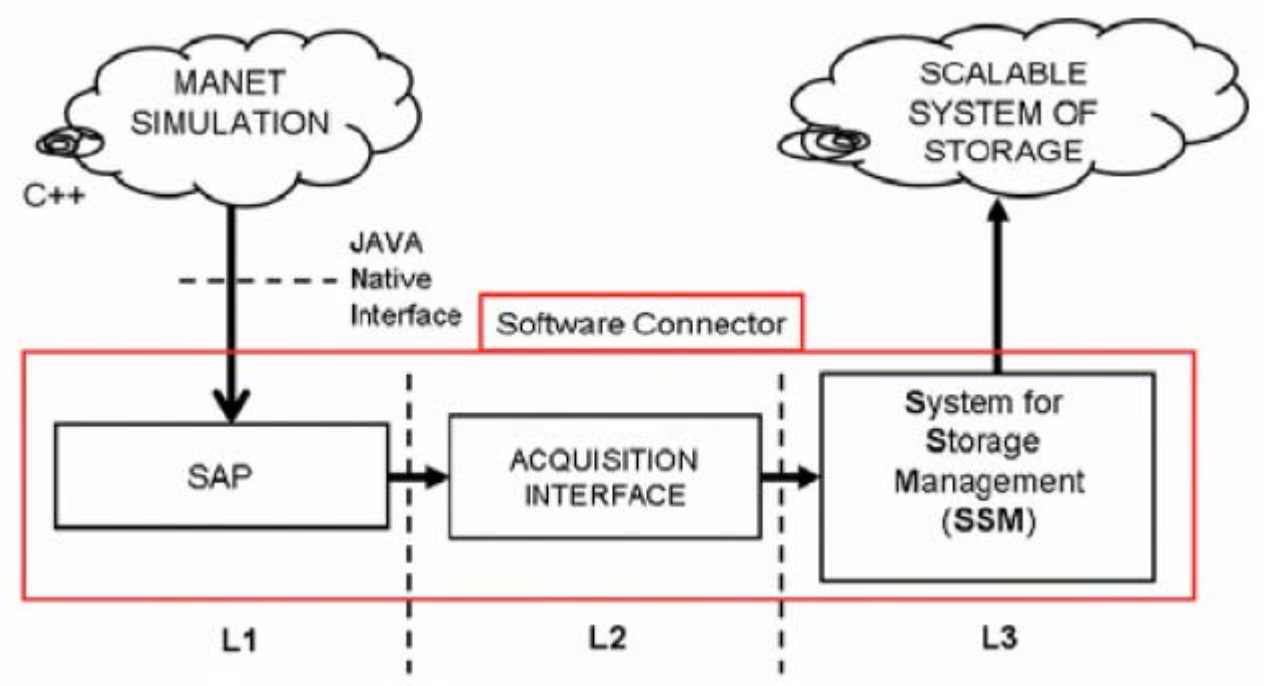


Figure 13: Network Storage.

Simulation and emulation issue:a solution by using the Tissue Methodology



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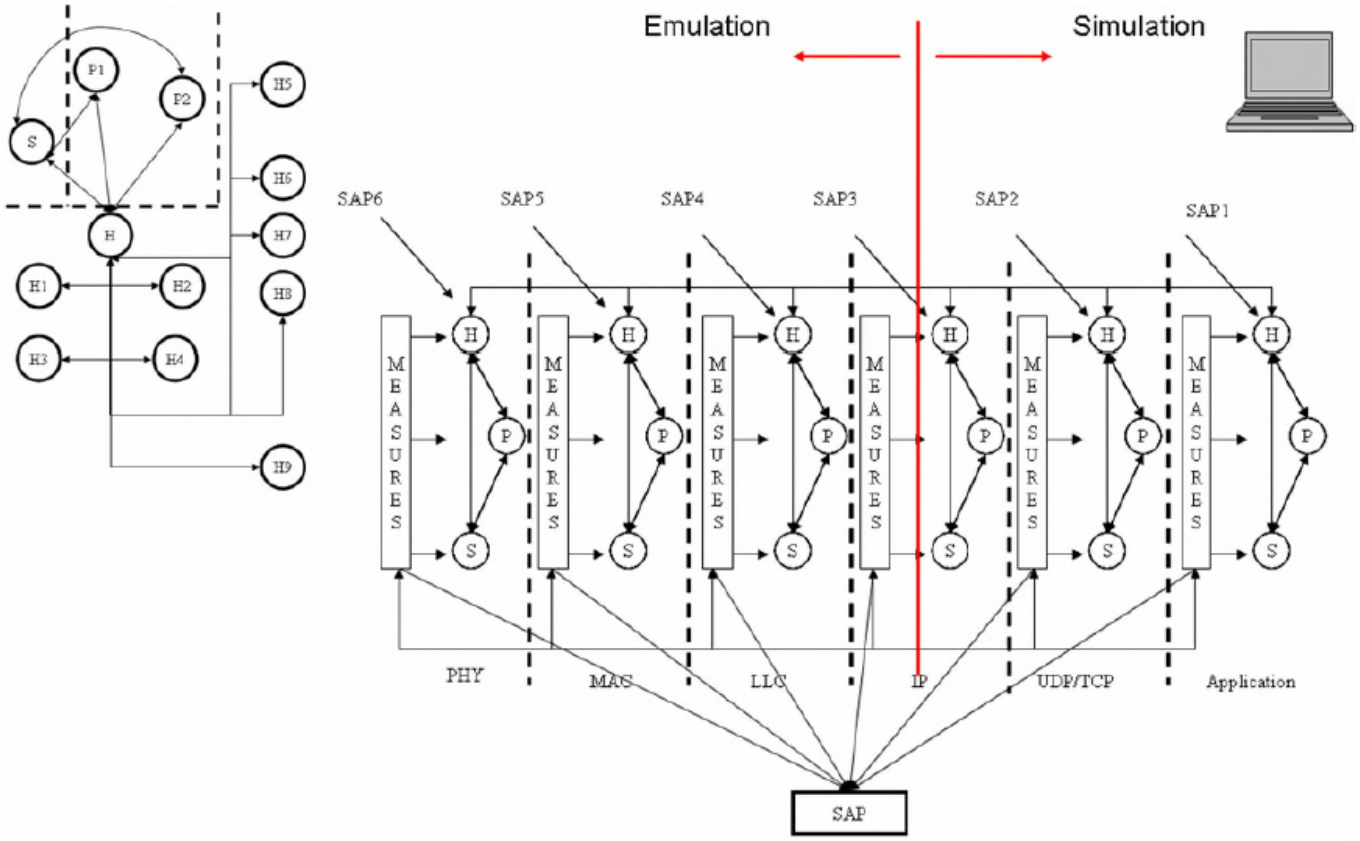
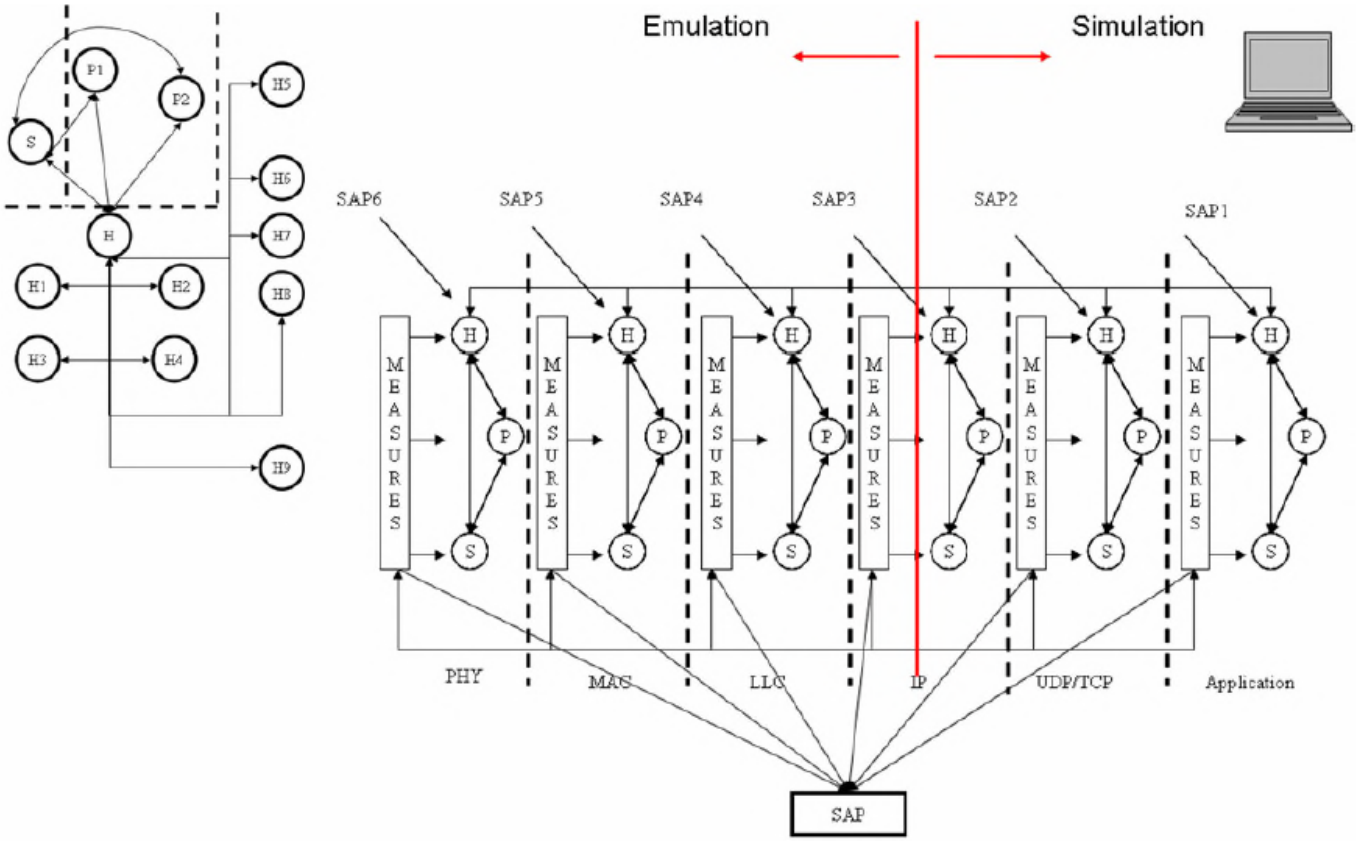


Simulation and emulation issue:a solution by using the Tissue Methodology

EMUTools – 1st Workshop on Emulation Tools, Methodology and Techniques (**[CNPR13]**)



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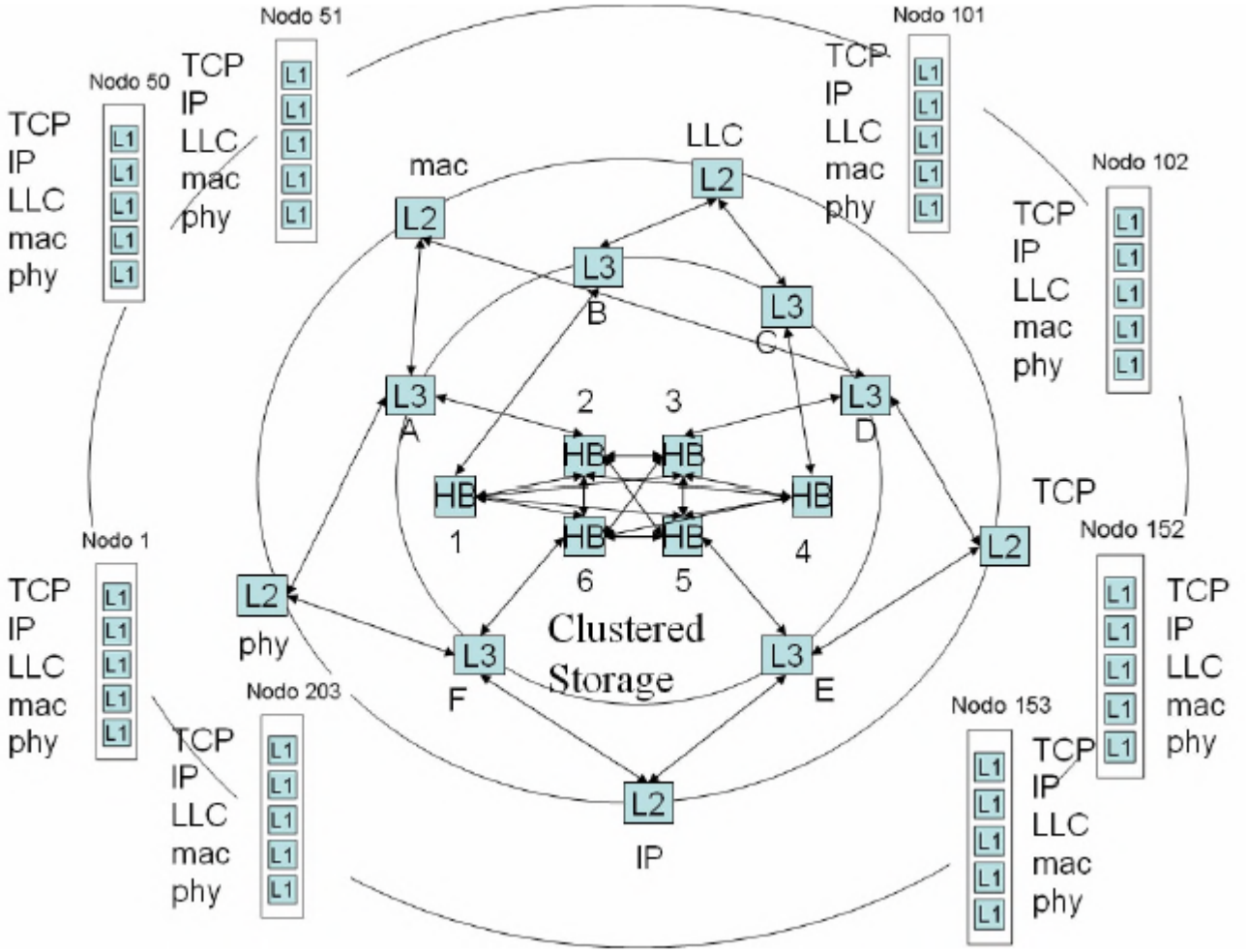
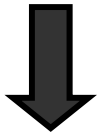

Nodo 51
Nodo 101
Nodo 50
Nodo 102
Nodo 1
Nodo 152
Nodo 203
Nodo 153
TCP
IP
LLC
mac
phy
L1
L2
L3
A
B
C
D
E
F
HB
1
2
3
4
5
6
Clustered
Storage

Conclusion

What's?

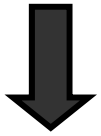


Scalability

Distributed **F**ile **S**ystem	A **D**istributed **F**ile **S**ystem allows to split a file of big size in more files small. These small files may be stored on many remote hosts[Ref.2].
Distributed **C**omputing	**D**istributed **C**omputing is a field of computer science that studies distributed systems. A distributed system is a software system in which components located on networked computers communicate and coordinate their actions by passing messages[Ref.1].

Conclusion

How?



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Distributed **F**ile **S**ystem	**HBASE**
Distributed **C**omputing	**AKKA**

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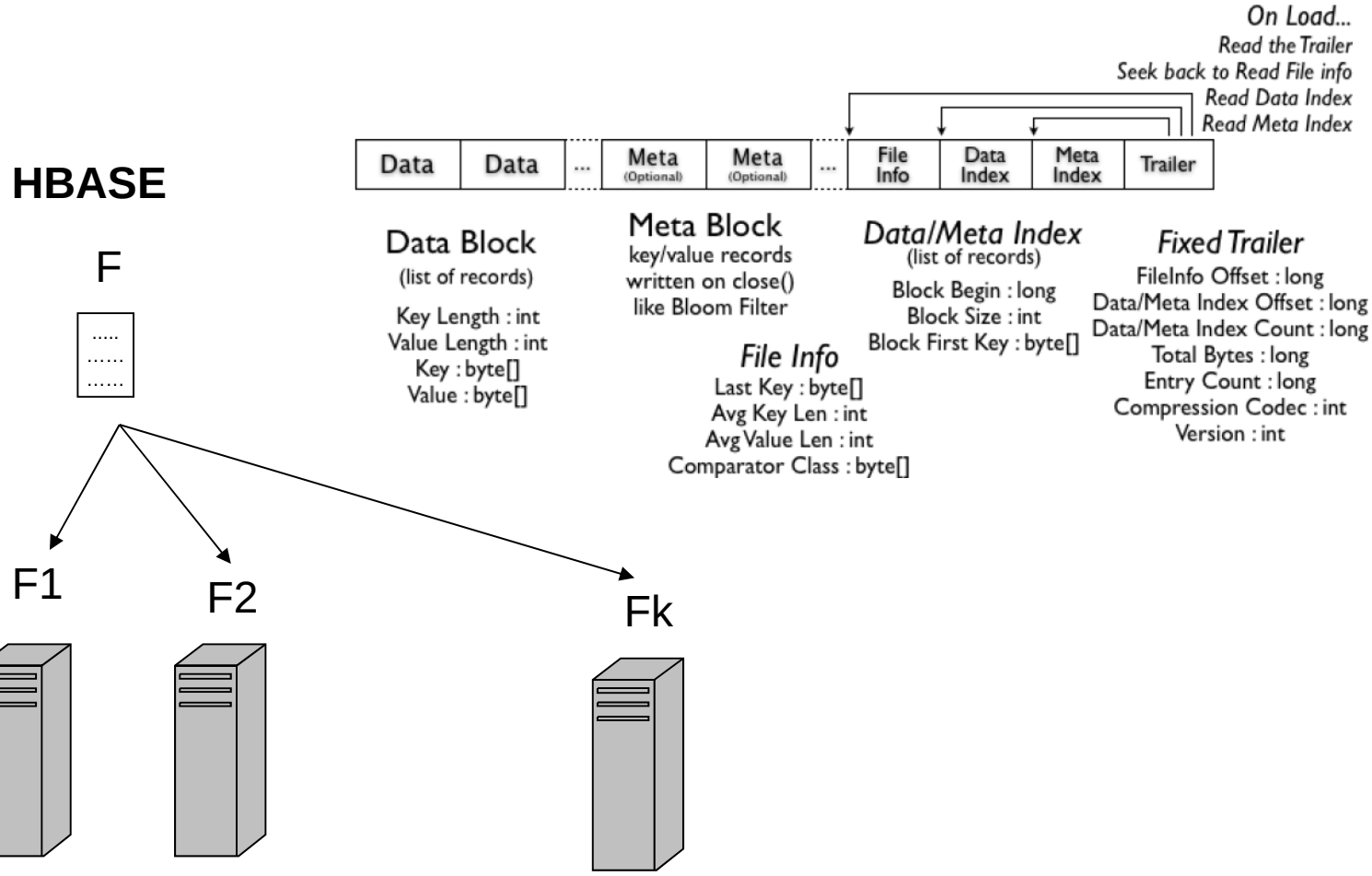
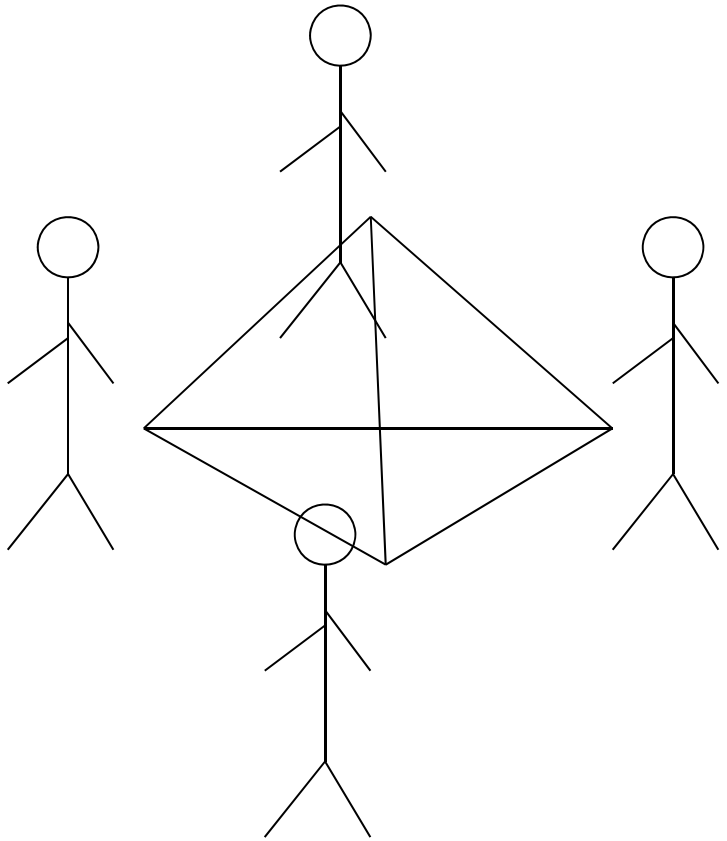

On Load...
Read the Trailer
Seek back to Read File info
Read Data Index
Read Meta Index
Data
Data
...
Meta (Optional)
Meta (Optional)
...
File Info
Data Index
Meta Index
Trailer
HBASE
F
F1
F2
Fk
Data Block
(list of records)
Key Length : int
Value Length : int
Key : byte[]
Value : byte[]
Meta Block
key/value records
written on close()
like Bloom Filter
File Info
Last Key : byte[]
Avg Key Len : int
Avg Value Len : int
Comparator Class : byte[]
Data/Meta Index
(list of records)
Block Begin : long
Block Size : int
Block First Key : byte[]
Fixed Trailer
FileInfo Offset : long
Data/Meta Index Offset : long
Data/Meta Index Count : long
Total Bytes : long
Entry Count : long
Compression Codec : int
Version : int

DISIMAN

AKKA ⇨ **Actor Model**
[Ref.3]



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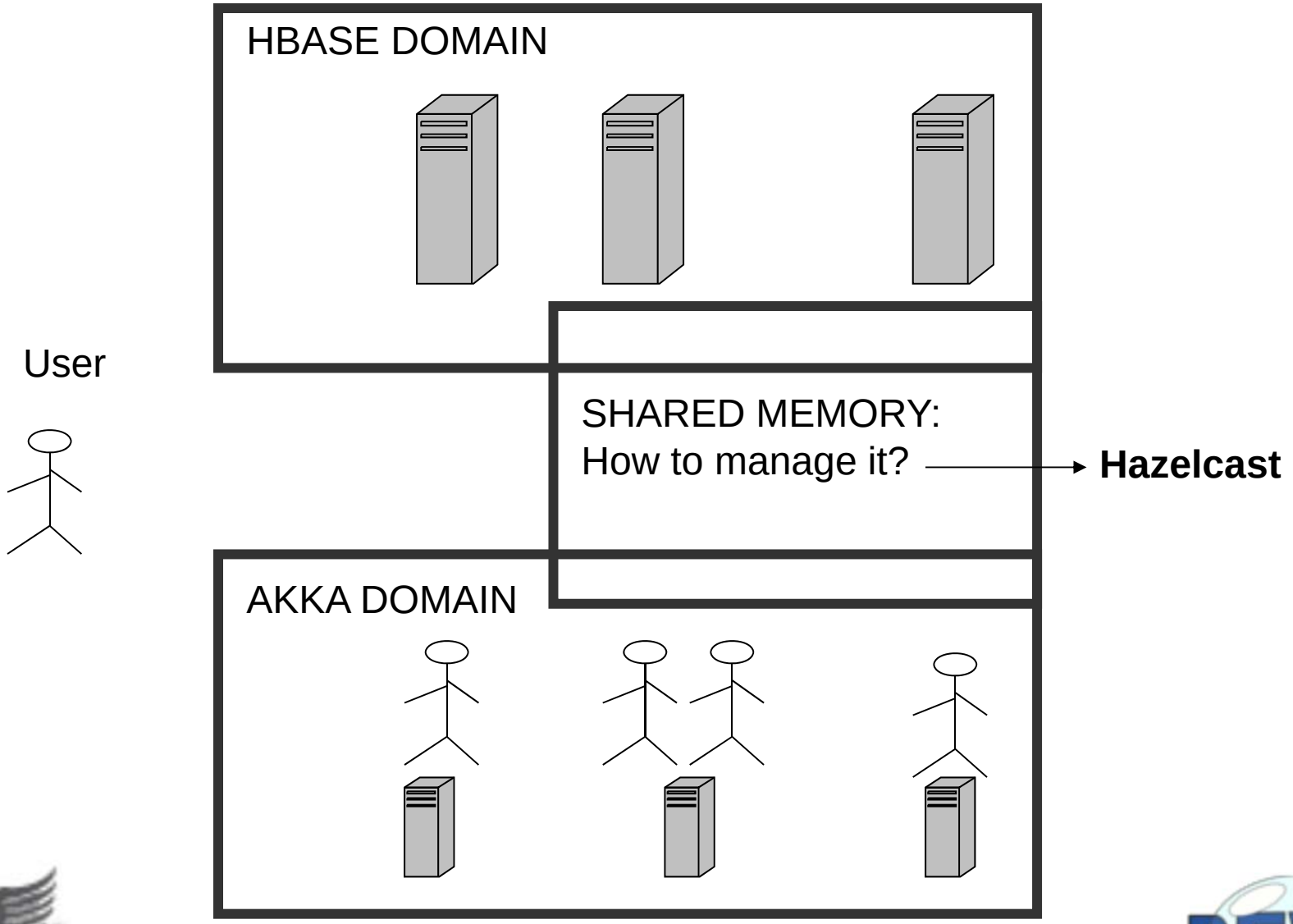
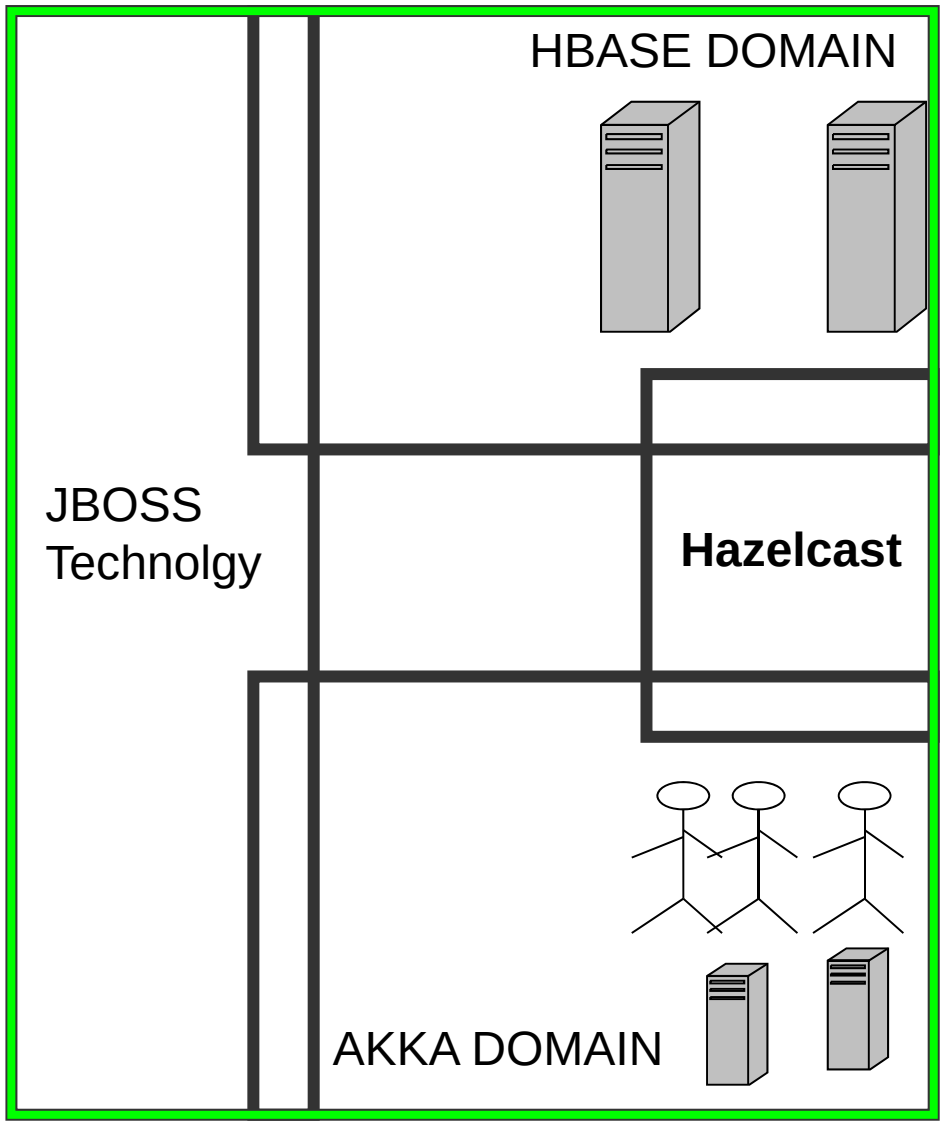

HBASE DOMAIN
User
SHARED MEMORY:
How to manage it?
Hazelcast
AKKA DOMAIN

DISIMAN



User

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Future Works

Study of a Tissue Architecture for Software Defined Networks

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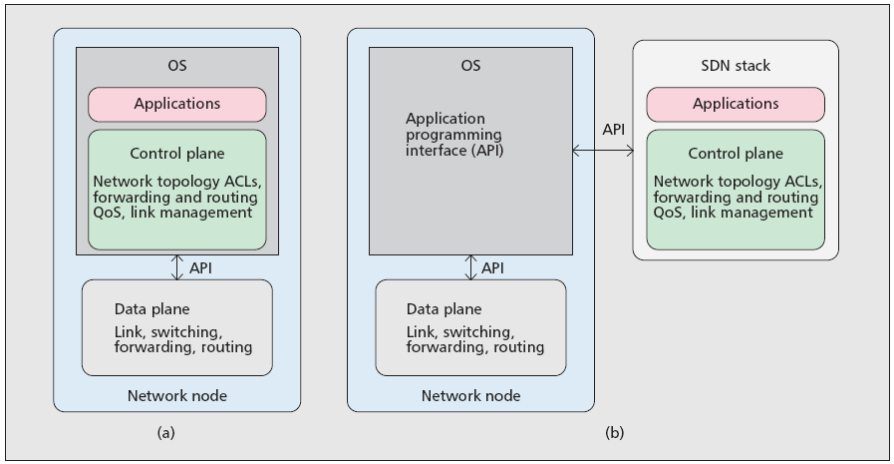
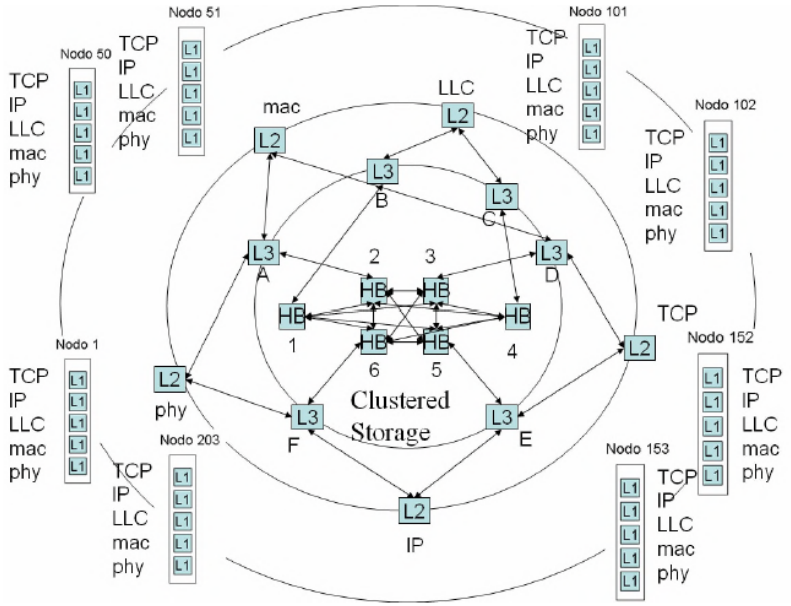
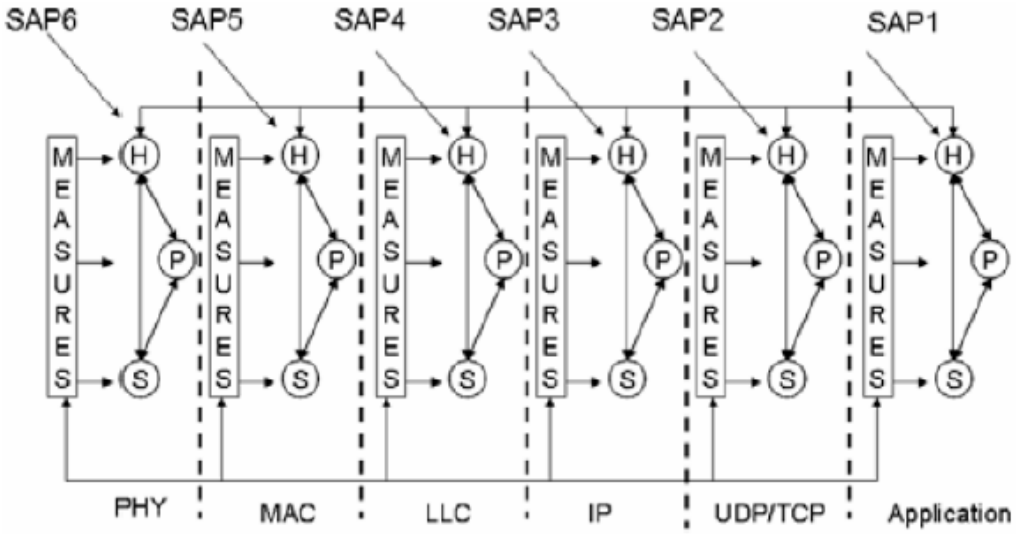
Study of a Tissue Architecture for Software Defined Networks

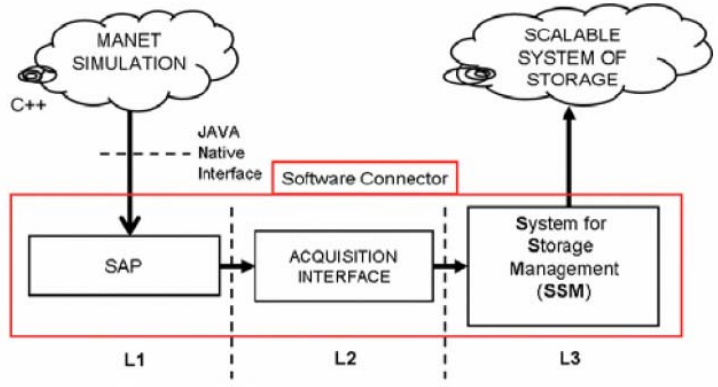
- The Open Networking Foundation (ONF) says:
  - *"In the Software Defined Networks (SDN), the control and data planes are decoupled, network intelligence and state are logically centralized, and the underlying network infrastructure is abstracted from the applications"*
- SDN focuses on four key features:
  - Separation of the control plane from the data plane;
  - A centralized controller and view of the network;
  - Open interfaces between the devices in the control plane (controllers) and those in the data plane
- The architecture requirements to meet operational expectations in carrier grade networks are:
  - scalability
  - reliability,
  - quality of service (QoS),
  - service management

Study of a Tissue Architecture for Software Defined Networks









Publications

- **[CFR12]**M. Colizza, M. Faccio, C. Rinaldi, **A component-based architecture for protocol design and development in SDR frameworks,** *Wireless Innovation Forum European Conference on Communications Technologies, 27-29 June 2012, Brussels, Belgium*
- **[CFRS12]** M. Colizza, M. Faccio, C. Rinaldi, F. Santucci, **A methodology to design an advanced framework for efficient modelling and testing of MANETs**, *Wireless Telecommunications Symposium (WTS), 2012*
- **[CPSP12]** M. Colizza, M. Pratesi, F. Santucci, S. Pollio, G. Rigazzi**, Performance of OLSR in MANETs with Cross-Layer Metrics and TCP/UDP flows**, *WIRELESS COMMUNICATIONS, NETWORKING AND MOBILE COMPUTING, September 21-23, 2012, Shanghai, China*
- **[CRS12]** M. Colizza, C. Rinaldi, I. J. Senese, **A Generalized Waveform Identifier Technique for Software Radio**, *INTERNATIONAL SYMPOSIUM ON COMMUNICATIONS, CONTROL AND SIGNAL PROCESSING, May 2-4, 2012, Rome, Italy*
- **[CFRS13]** M. Colizza, M. Faccio, C. Rinaldi, F. Santucci, **A Methodology for Design of Scalable Architectures in Software Radio Networks: a Unified Device and Network Perspective**, *J Sign Process Syst (2013) 73:315-323*
- **[CNPR13]** M. Colizza, L. De Nardis, M. Patrizi, C. Rinaldi, **A novel architecture for a framework to support the storage of network simulation data into distributed storages for remote access**, *EMUTools – 1st Workshop on Emulation Tools, Methodology and Techniques, Cannes, French Riviera March 5-7, 2013*

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Others References

1. Coulouris, George; Jean Dollimore; Tim Kindberg; Gordon Blair (2011). Distributed Systems: Concepts and Design (5th Edition). Boston: Addison-Wesley. ISBN 0-132-14301-1
2. Silberschatz, Galvin (1994). Operating System concepts, chapter 17 Distributed file systems. Addison-Wesley Publishing Company. ISBN 0-201-59292-4.
3. Carl Hewitt; Peter Bishop; Richard Steiger (1973). A Universal Modular Actor Formalism for Artificial Intelligence. IJCAI.

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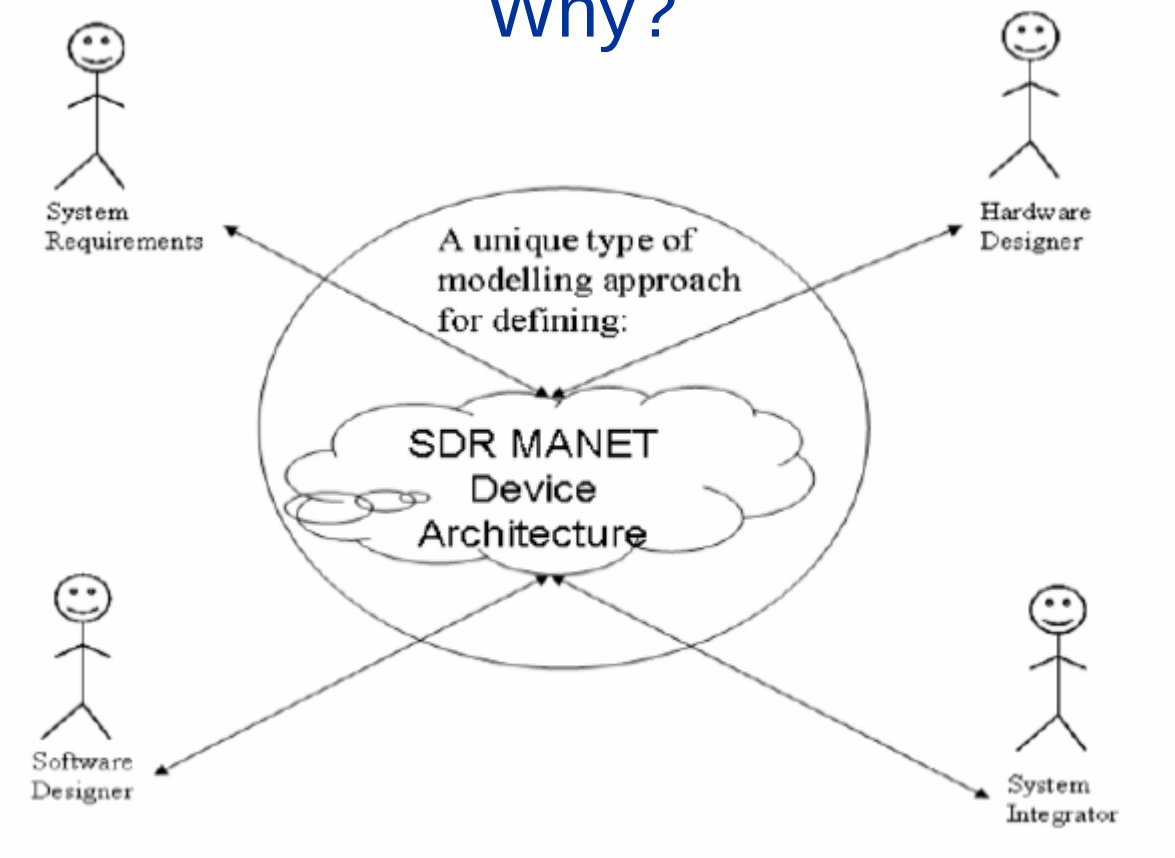
Questions?

Backup

A network oriented approach to design, simulation and emulation of Wireless Embedded Systems

A network oriented approach to design, simulation and emulation of Wireless Embedded Systems

Why?



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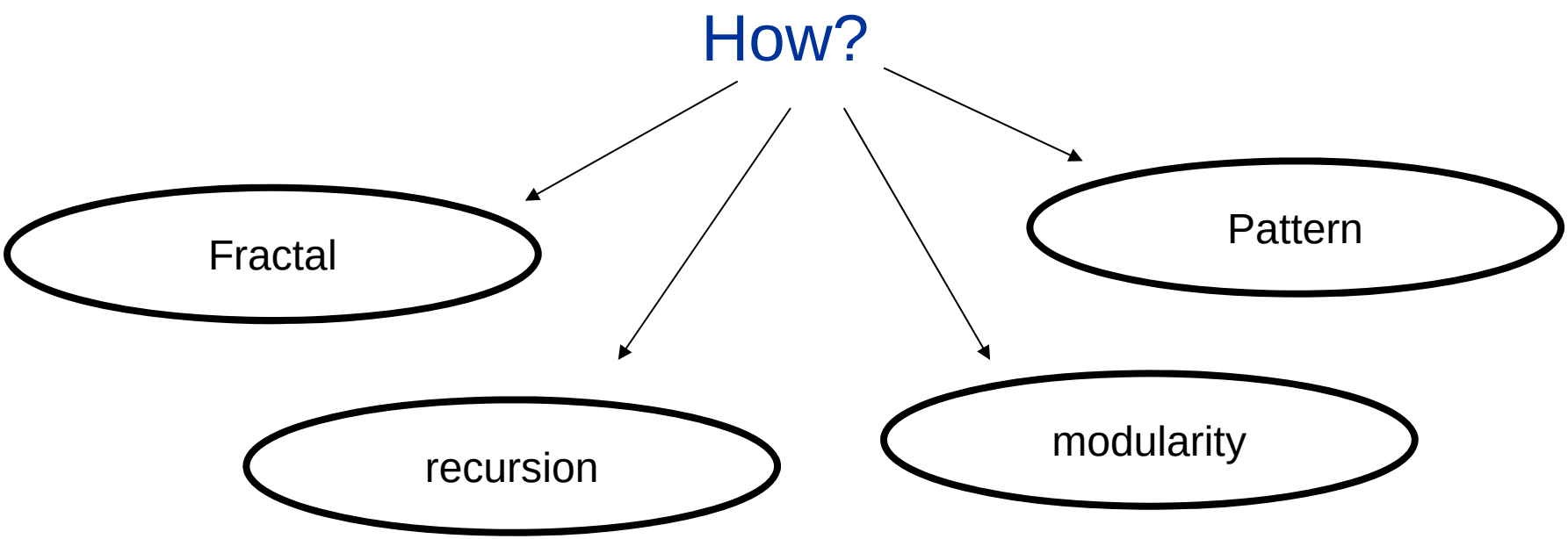

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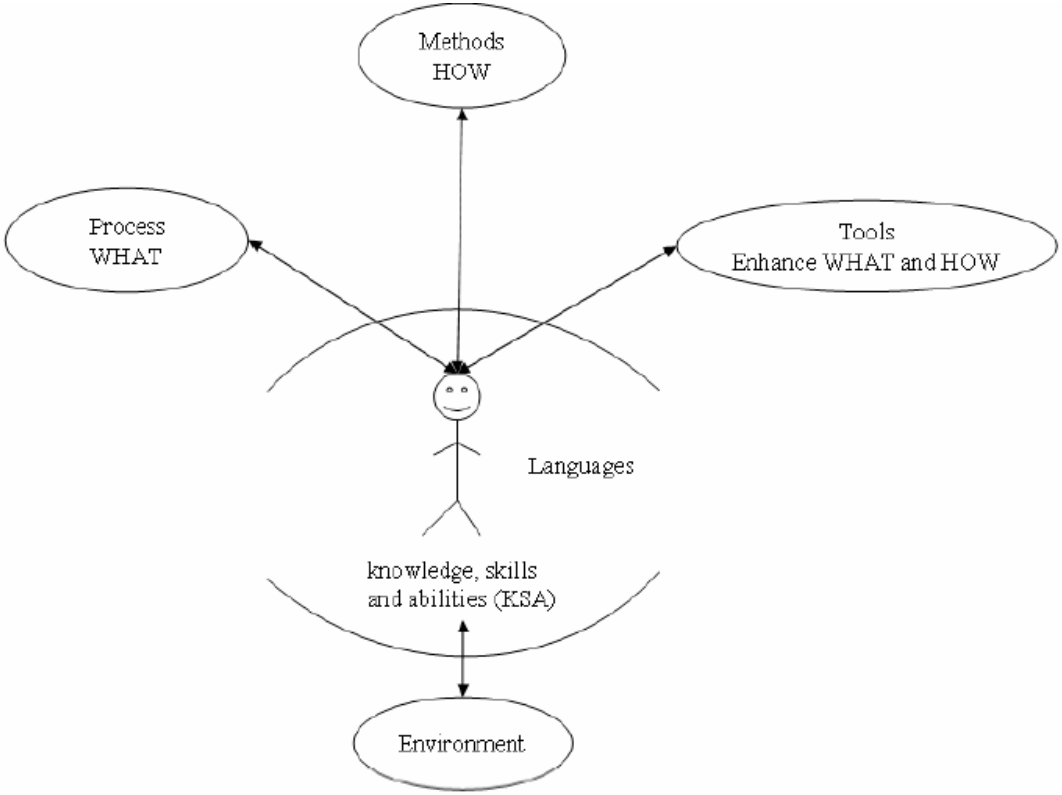
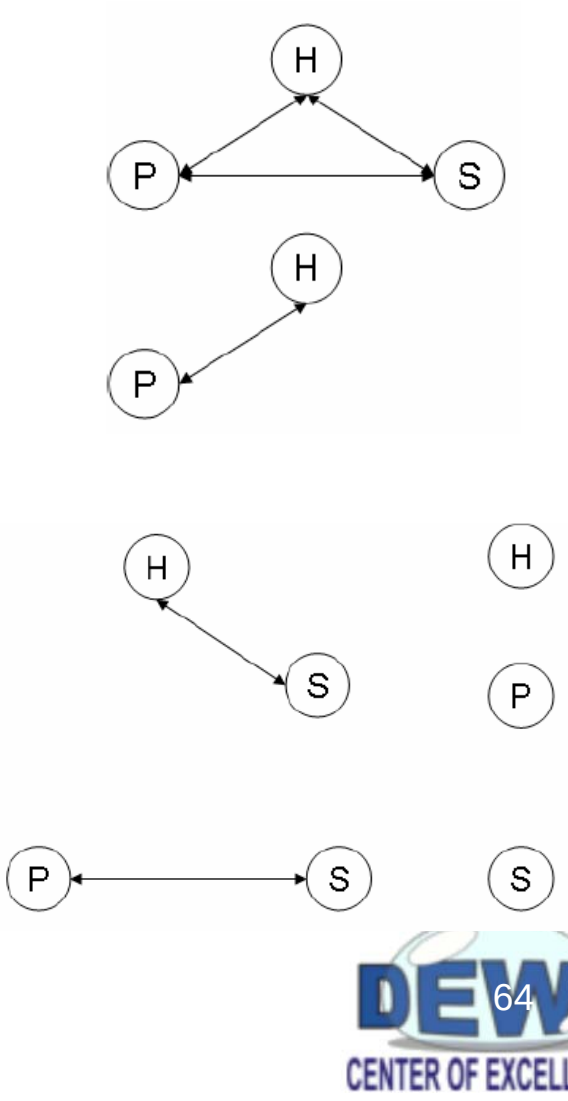
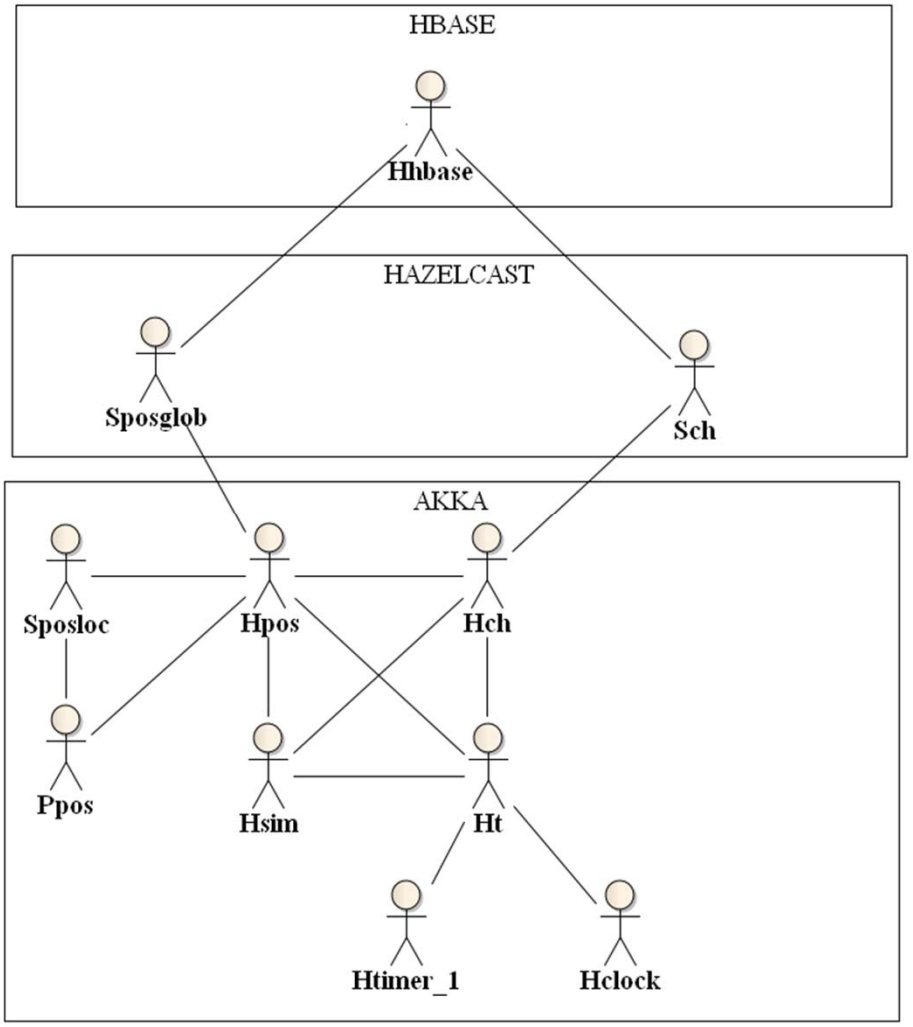
A network oriented approach to design, simulation and emulation of Wireless Embedded Systems





Conclusion and future works

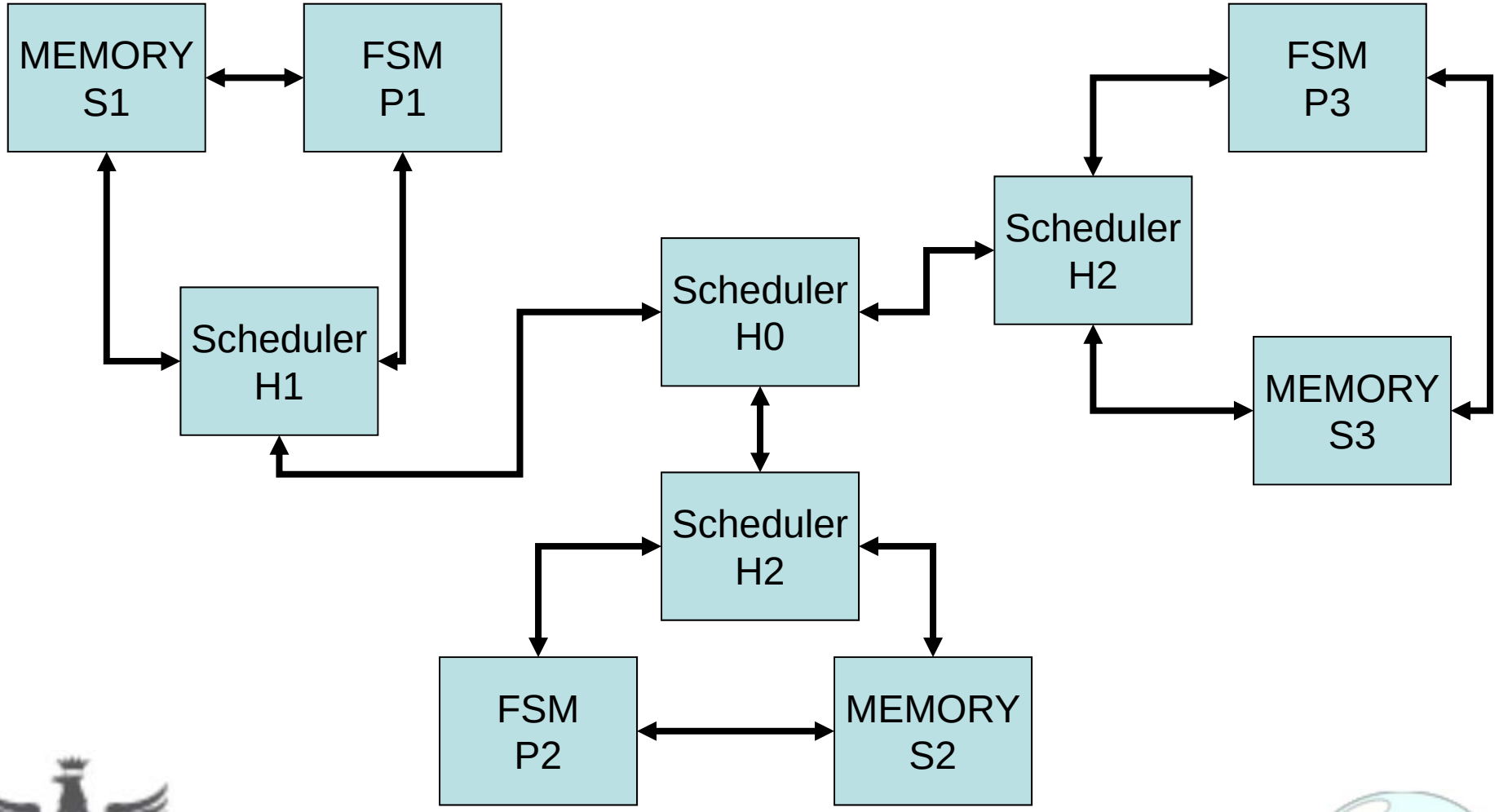


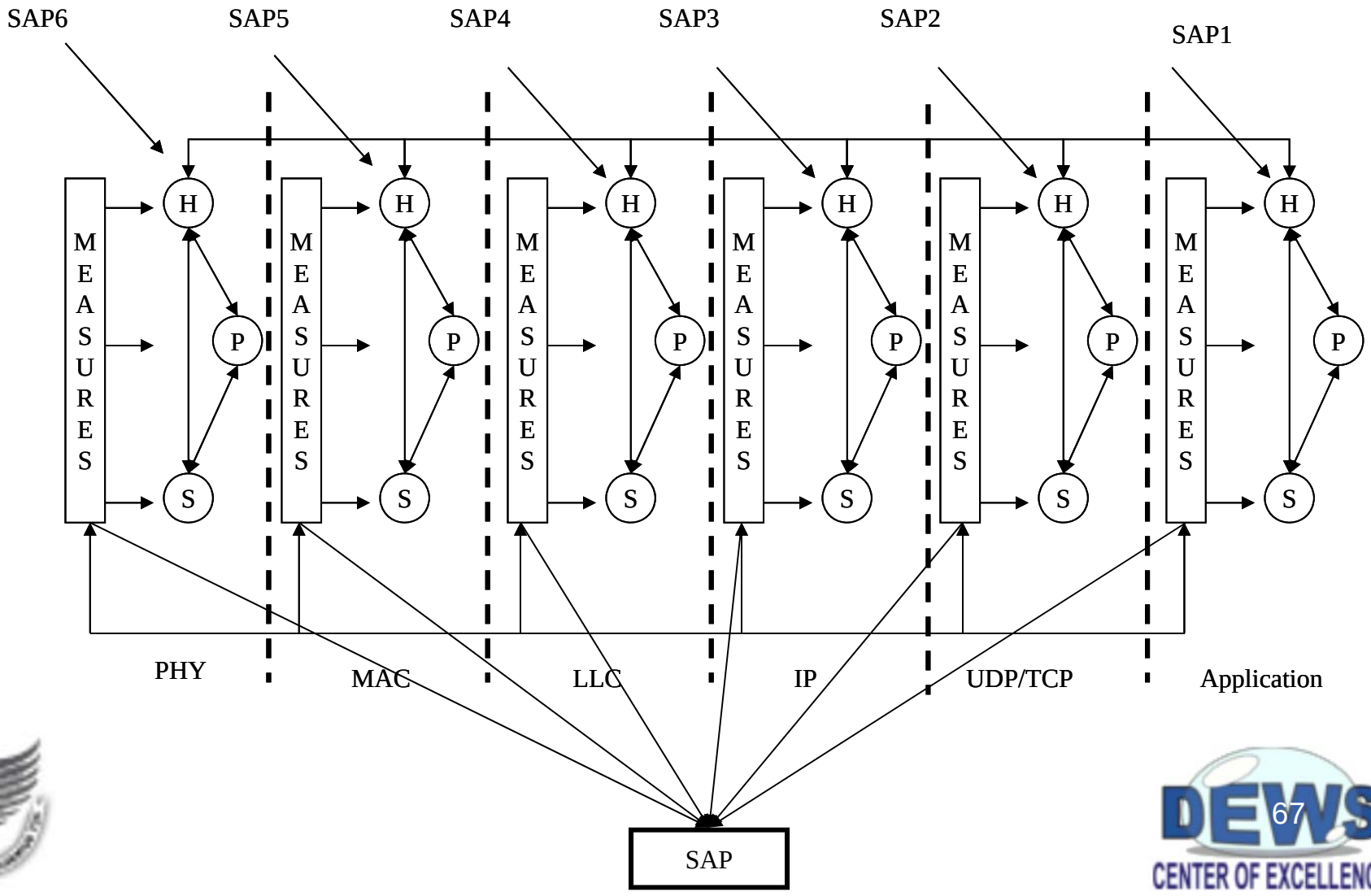
AKKA

HAZELCAST

JBOSS + EJB + JSF

Conclusion and future works




SAP6
SAP5
SAP4
SAP3
SAP2
SAP1
MEASURES
H
P
S
PHY
MAC
LLC
IP
UDP/TCP
Application
SAP

Conclusion

- The objectives of this research activity may be summarized as follows:
  - Identification of a cross-layer approach to improve the throughput of TCP and UDP protocols, inside MANET networks (**[CFRS13]**
  - Identification of an architectural solution able to overcome the scalability and re-configurability issues of the SCA architecture, useful to develop SDR devices for MANET applications (**[CFR12], [CFRS12], [CPSP12]**);
  - Identification of a methodology useful to develop wireless embedded systems; the proposed methodology is named: "Tissue Methodology";
  - The development of simulation/emulation environment for wireless embedded systems (**[CPSP12]** , **[CRS12]**), using the Tissue Methodology.

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