Creating new ICT networks on Smart Grids service

INTEGRIS

(http://www.fp7integris.eu)

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Novel solutions of the information and communication technology as the backbone of Smart Distribution

Darmstadt, 12-14 April 2011

Outline

- The INTEGRIS Project
- Project objectives
- Requirements
- Examples of Smart Grid Use Cases
- ICT Challenges
- Ideas/hints for possible solutions

The INTEGRIS project

Project full title: INTelligent Electrical Grid Sensor communications
Grant agreement no.: 247938
Date of initiation: 1st February, 2010
Duration: 30 months

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Partners:

indra, DS2, LA SALLE Transferència de Tecnologia Universitat Ramon Llull, Tampere University of Technology Department of Electrical Energy Engineering, current, ilight Powerline Communications, a2a Reti Elettriche, Schneider Electric

Coordinator: endesa

The research leading to these results has received funding from the European Union European Atomic Energy Community 7th Framework Programme (FP7/2007-2013 FP7/2007-2011) under grant agreement n° 247938

INTEGRIS Objectives

INTEGRIS is a novel and flexible ICT system, based on the integration of PLC and WSN technologies, able to completely and efficiently fulfill communication requirements for future Smart Grids.

BASIC OBJECTIVE :

- To define and develop an integrated ICT environment able to efficiently encompass the communications requirements that can be foreseen for Smart Grids.

SCIENTIFIC AND TECHNOLOGICAL OBJECTIVES :

- Research on the efficient integration and interoperability of PLC and wireless technologies (WSN, IEEE802.11n, RFID)
- Research and development of an autonomous self-healing ICT system with QoS guarantees for Smart Grids.
- To contribute to the development of IEC 61850 technology within the electrical distribution network

OTHER RESEARCH LINES:

- Multilevel security framework
- Application of Distributed Systems techniques to Smart Grids
- Application of Cognitive techniques to Smart Grids

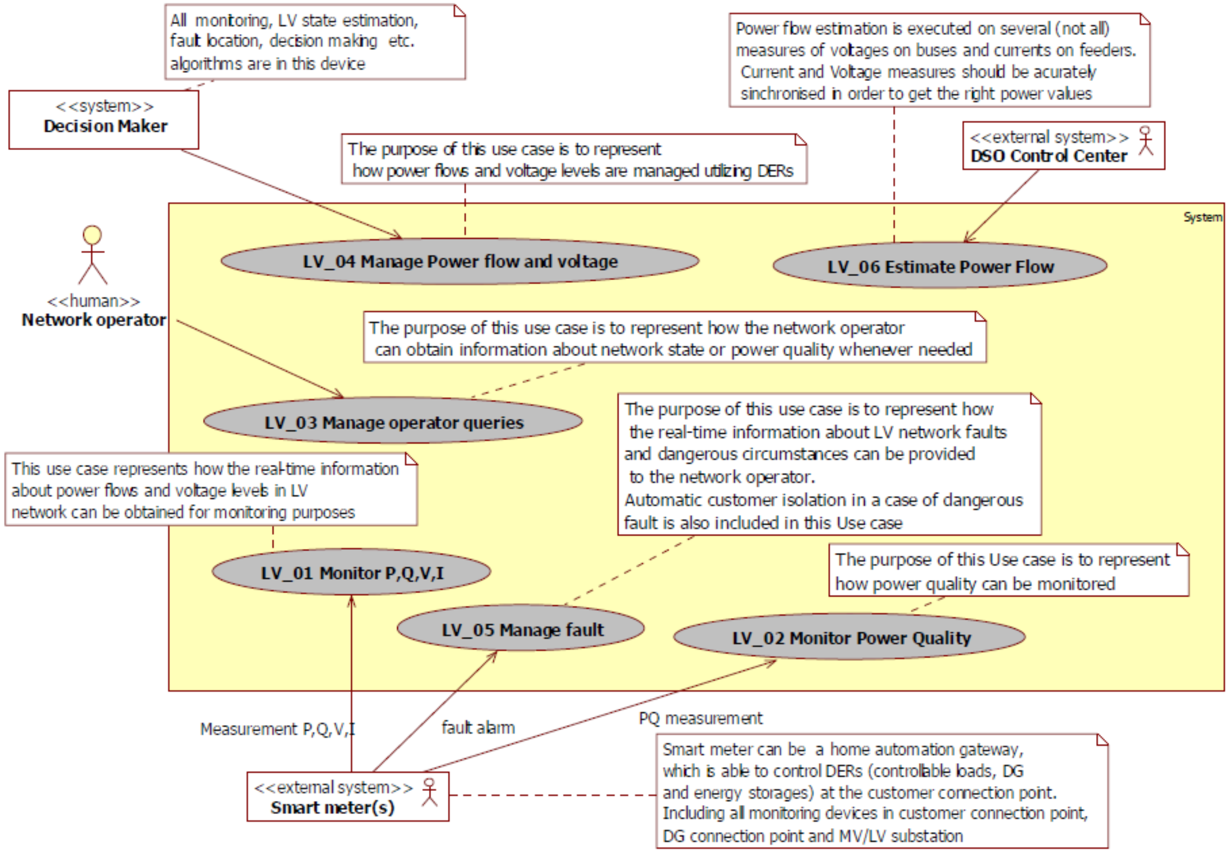
Requirements

A Smart Grid needs a wide communications network, robust and flexible. The requirements of the communications network depend on the applications.

FUNCTION TYPE	FUNCTION CLASS	CLASS MODE	Value/signal	Transfer time (*)	Availability in Grid State	Reliability level
SEN mangement function	Active Protection Functions (@HV/MV-MV/LV level)	APF	Block & trip Signal	<=20ms	Normal Perturbed Crisis	Very High
	Command Control & Regulation	CMD	O/C command Load shedding Peak shaving	<=2s	Normal Perturbed Crisis	High
	Monitoring & Analysis	MON	Analogical & Digital TVPP	>=2s	Normal Perturbed Crisis	High
Advanced meter function	Advanced Meter & Supply Management function (Commercial functionalities	AMS	Energy meas., Supply mngt. Command, Alarm signals	<=5m ---------- <=10s	Normal	Low
Active Demand - DR functions	End to End Information Exchange and Management	IEM	Energy meas., CVPP/Load Other signals	<=5m <=5s	Normal Perturbed	Medium

Smart Grid Use Cases 1/2

INTEGRIS project will design Smart Grid applications for the power distribution network, and will implement some of them in field trials, in order to proof the validity of the developed ICT infrastructure.



Smart Grid Use Cases 2/2

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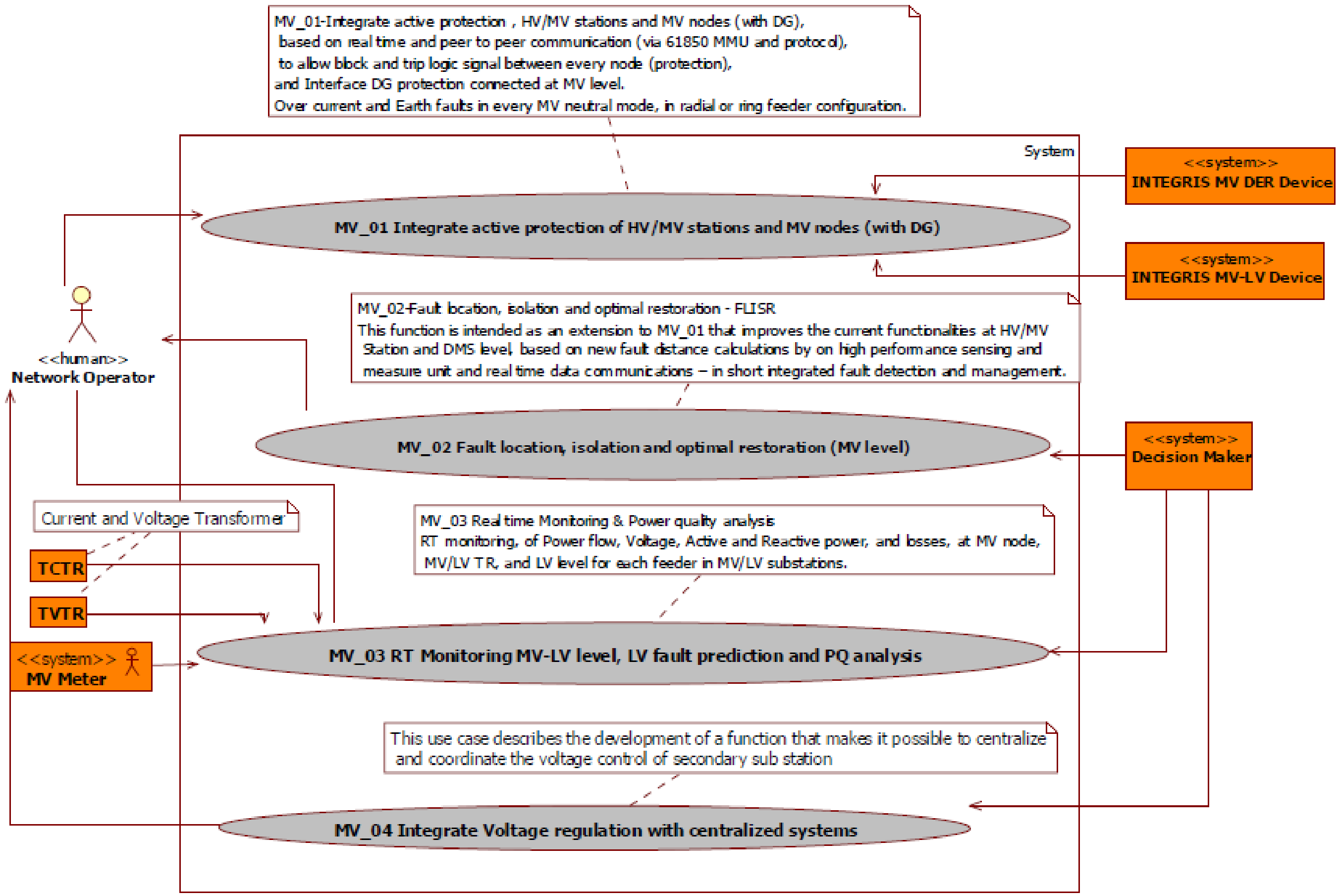


ICT challenges in Smart Grids 1/2

The future of Electric System comes from the construction of an adaptive, optimized, integrated and distributed Intelligent Distribution Network, interactive with consumers and markets

New kind of services:

- Services with very low delay and very high availability at the same time
- Services difficult to be amenable to flows
- Services with no connection establishment (Always connected)
- Wide array of requirements
- Services over L2 (Goose messages)

Extending the concept of Smart Grids to distribution networks:

- Distribution networks are complex, spread over the territory and, in great part, buried or underground.
- The topology of the power network is different in each country.
- Difficulty of designing an ICT infrastructure spreading all over the Power distribution network having the required high availability and low delay.

ICT challenges in Smart Grids 2/2

The future of Electric System comes from the construction of an adaptive, optimized, integrated and distributed Intelligent Distribution Network, interactive with consumers and markets

Networking challenges:

- Self healing,
- QoS for Smart Grids,
- long life-time of electrical infrastructures,
- Heterogeneous communications network with several technologies
- Great number of legacy protocol already deployed and that have to be maintained

Security challenges:

- Secure communications
- Backwards compatible with devices without any provisions for security

Some answers to the challenges 1/2

Smart Grids need a spread communications network, with a low cost of deployment, and a distributed ICT system, capable of dynamically adapting to the medium

High availability:

- Meshing the communications system
- Dual homing
- Locate storage and computing platforms on the distribution network
- Replicating data in different platforms
- Distributing applications

Low delay:

- Networking at MAC layer
- Spreading the MAC layer all over the distribution segment (MV+LV)
- Fast recovery/self healing

Some answers to the challenges 2/2

Smart Grids need a spread communications network, with a low cost of deployment, and a distributed ICT system, capable of dynamically adapting to the medium

Buried or underground infrastructure: PLC/BPL necessary

Services difficult to be amenable to flows: New concepts to control QoS

Always connected services: Need to share the resources fairly

No connections: Planning/dimensioning for some services plus prioritization or class based service for the rest

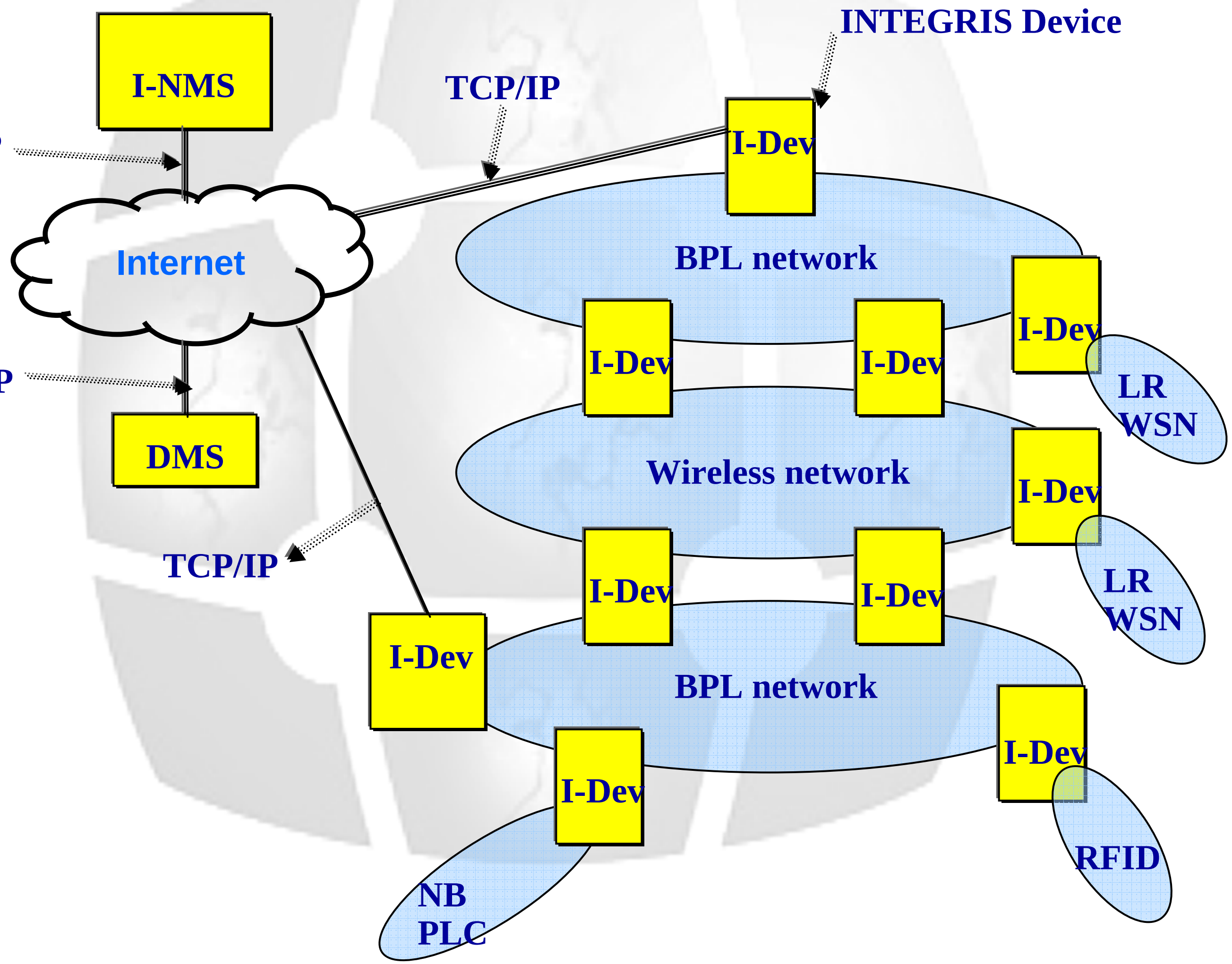
Goose messages: Provide a way to create a L2 network over the distribution segments. Interconnecting different L2 technologies to provide a L2 network capable of spanning the distribution segment under consideration.

Complex networks:

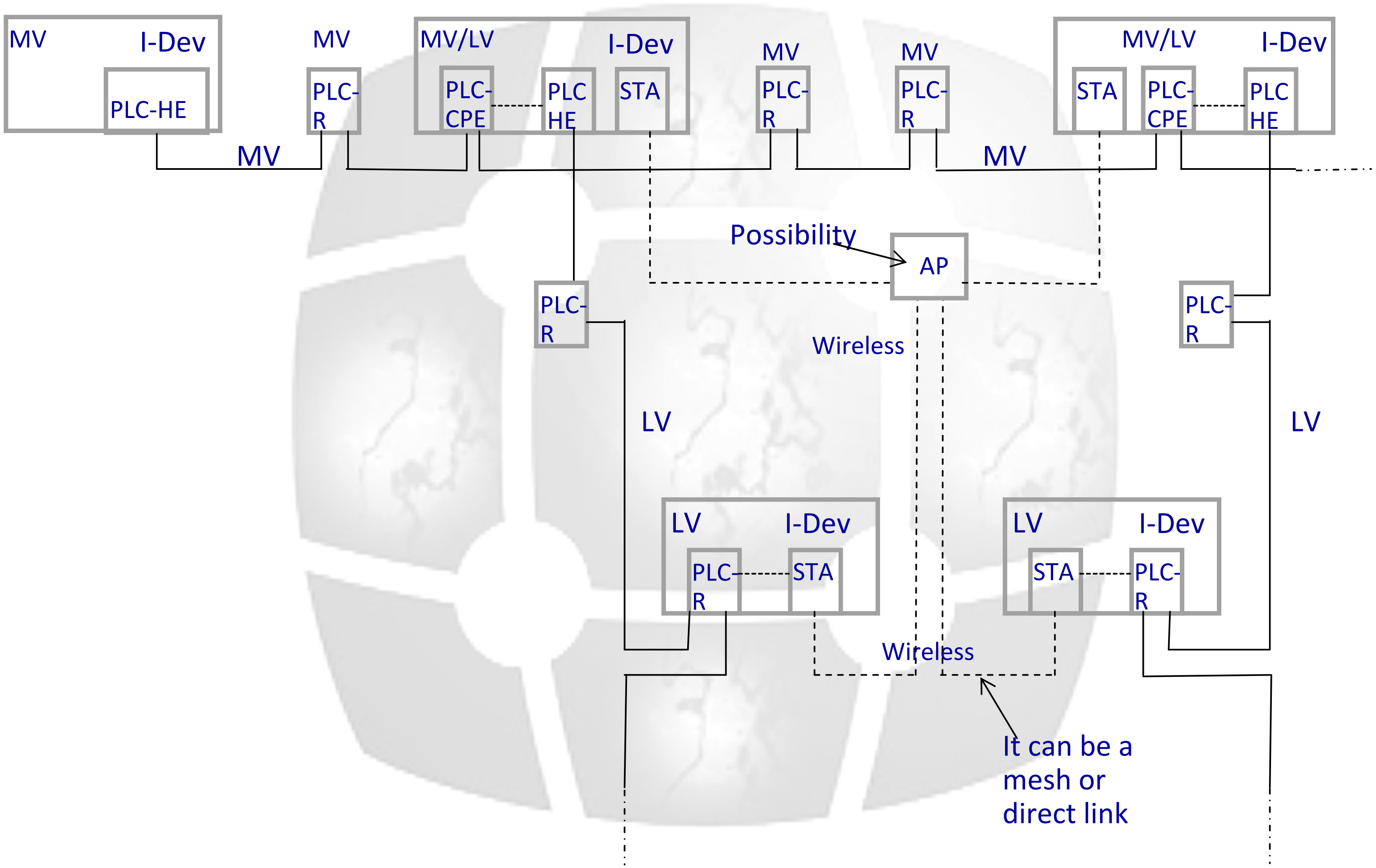
- PLC/BPL (follow closely the electrical infrastructure)
- Different communication technologies (PLC, Wireless, Fiber Optics,..)
- An ICT system covering a distribution segment can be considered a new kind of ITU T NGAN

Networking and QoS

Lines being explored: Forming a super L2 heterogeneous network BPL+Wireless



Example of a network



Security 1/3

Security for standard IEC 61850 is addressed by standard IEC 62351

IEC 62351 mandates the use of TLS to assure end-to-end security

Challenge 1:

- The Smart Grid needs intermediate storage and computing platforms.
- IEC 62351 currently does not offer application layer end-to-end security if multiple transport layer connections are used. Trusted TLS proxies may be a solution for the time-being but not “the solution”. This way may be a weakness.

For some Other challenges in Smart Grid security are:

- NISTIR 7628 Guidelines for Smart Grid Cyber Security (three Volumes)

Finally, it is interesting to realize that currently most electrical devices do not handle any level of security.

Security 2/3

Just a reflection:

	Office	EA-Network
Confidentiality (Data)	High	Low – Medium
Integrity (Data)	Medium	High
Availability / Reliability	Medium	High
Non-Repudiation	Medium	High
Component Lifetime	Short - medium	Long

Figure 2: Comparison Office/Automation security

Security in the Smart Grid is quite different from Office cases

Source: Steffen Fries*, Hans Joachim Hof*, Maik Seewald; „Enhancing IEC 62351 to Improve Security for Energy Automation in Smart Grid Environments", 2010 Fifth International Conference on Internet and Web Applications and Services, Barcelona, Spain

Security 3/3

Lines being explored:

- •Proxies for TLS
- •Combine passwords and certificates
- •Distributed Radius/Diameter servers
- •Cross-layer security issues
- •Trust management

*Due to the low penetration of security components within utilities deployed devices (RTU, Smart Meters, protections and so on), in practice the security in INTEGRIS is focused on assuring a secure networking of the information with the aim of giving the maximum security level also taking into account the security of L2 technologies and its managment.

Distributed System Techniques

Lines being explored:

•Data replication in different platforms to improve data reliability and fault tolerance.

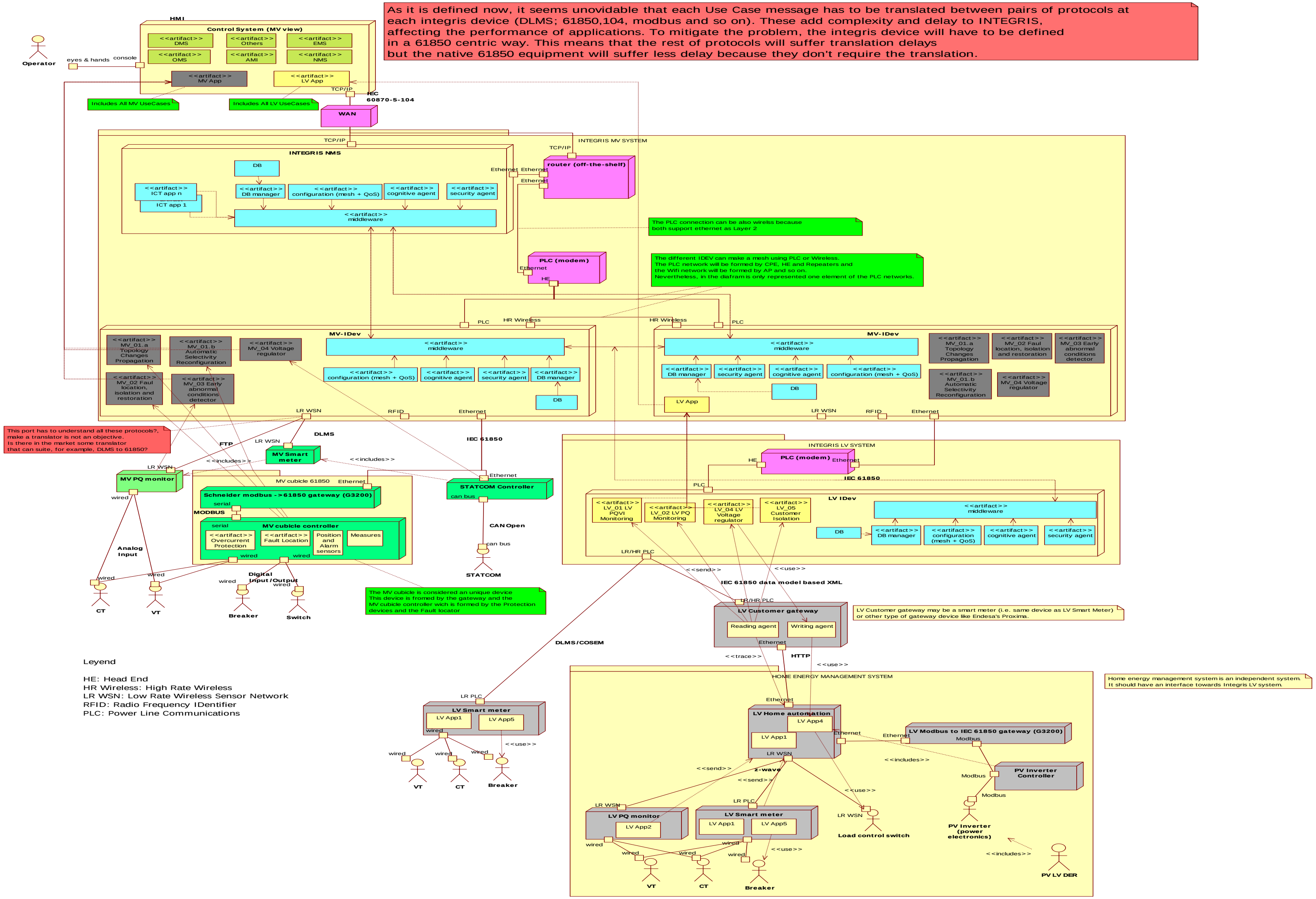
•Replication in circles around the primary repository with decreasing consistency.

•However, replication increases the number of messages transmitted and could reduce the system throughput if not properly engineered.

SEVENTH FRAMEWORK PROGRAMME

Global INTEGRIS architecture

INTEGRIS



Thank you very much