Ongoing Activities on Smart Grid Architecture
(an SGAC-centric view)

SGAC Conceptual Architecture

- Create a Conceptual Architecture with artifacts traceable to National Smart Grid requirements
- Employ an architectural methodology to document these artifacts

EU M.490 – Reference Architecture methodology (RAWG)

- Unification efforts between EU-M490 and SGAC
- Align EU Smart Grid Architecture Methodology (SGAM) with SGAC approach
- Use Conceptual Architecture artifacts where applicable

IEC TC57 WG 19 – Reference Architecture

- Explore potential synergies
- Explore including portions of architectural methodology into reference architecture

Current activities

- Clarify terms – employing ontology
- Identify actors, roles and levels of granularity
- Alignment effort with TC 57 WG19 on architectural approach and methodology reference
- Continuing work with EU M490 RAWG
- Beginning work with TC57 WG19

Next step activities

- Absorb cyber security and communications architectures - currently CSWG & EU M490
- Integrate use case standardization activities (EU M490 sustaining process & IEC TC8 WG5 & 6 use case standardization)
  Assist EU M490 team with next refinement of their reference architecture document
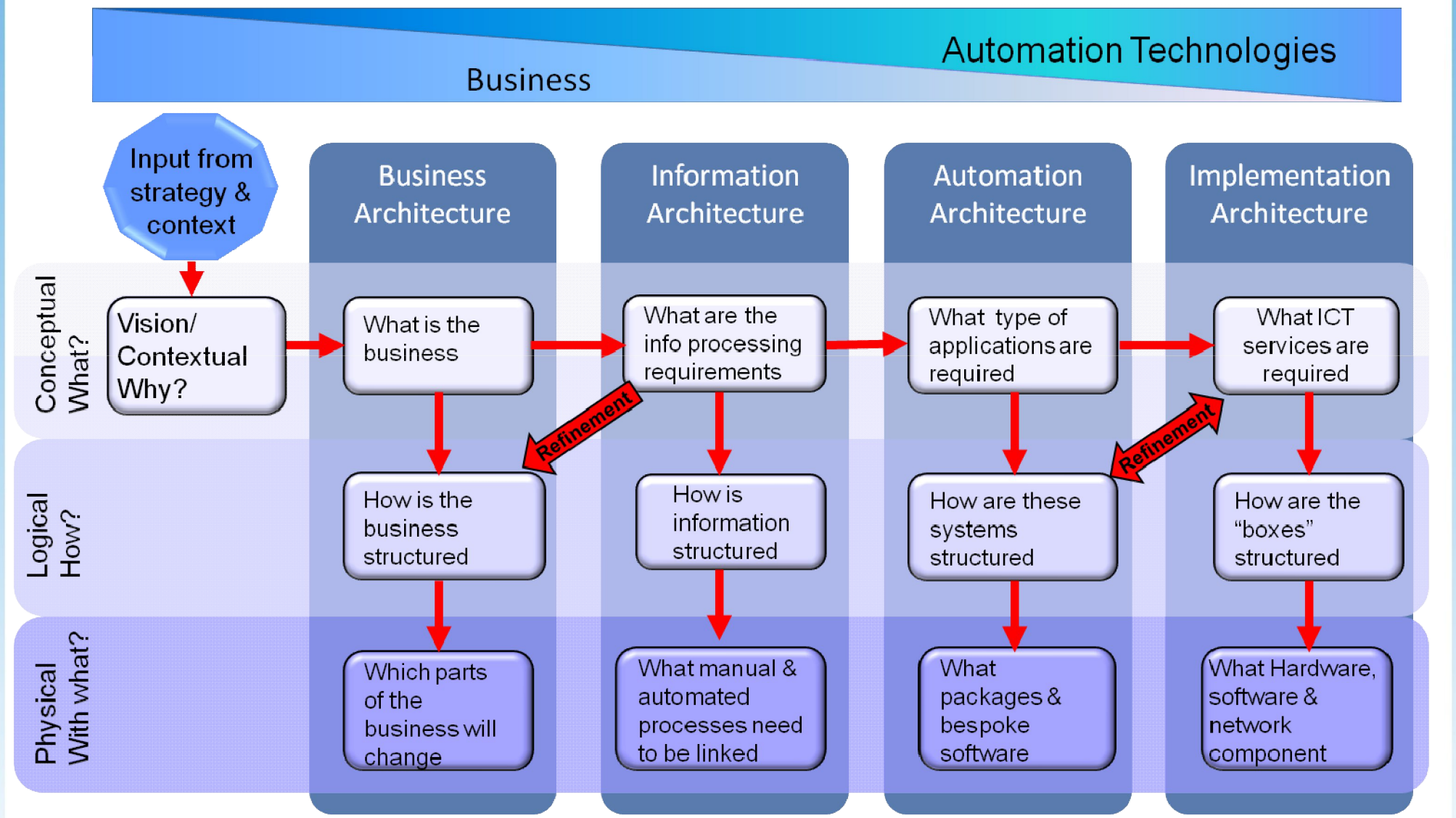- Continuing work with TC57 WG19

Develop a common methodology unifying asynchronous efforts

- Employ TOGAF approach
- Adopt Open Group Service-Orientation and Ontology
- Embed IEC TC8 WG 5 & 6 Use Case Standardization (just being formed)
- Leverage ongoing SGiP and EU Smart-Grid Coordination-Group (SC-CG) activities
- Integrate SGiP-CSWG & EU SC-CG security architecture Points-of-view
- Re-use and integrate standards from other industries as appropriate
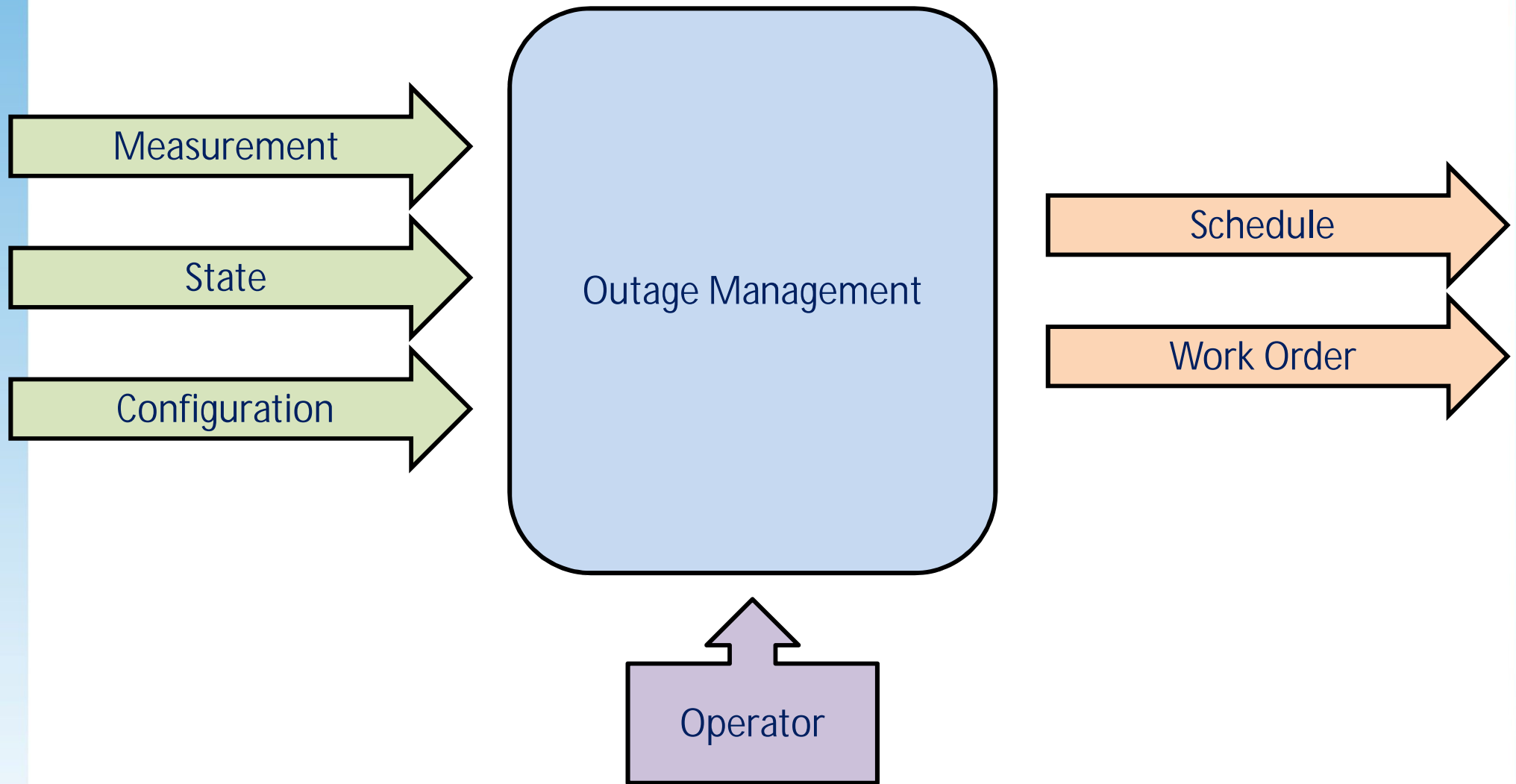
Results

- Mitigate risk
- Accelerated standards development
- Standards derived from business drivers not technologies
- Terminology, semantic crispness and alignment across standards
- Useful Use Case repository -
  (common use case structure and approach mapping to business drivers to services and workflow)
- Holistic approach to solutions development
- Lifecycle maintenance

The Open Group Architecture Forum (TOGAF)

Grid-Interop
Driving to Grid 2020

Business → Automation Technologies

	Business Architecture	Information Architecture	Automation Architecture	Implementation Architecture
Input from strategy & context				
Conceptual What? — Vision/ Contextual Why?	What is the business	What are the info processing requirements	What type of applications are required	What ICT services are required
Logical How?	How is the business structured	How is information structured	How are these systems structured	How are the "boxes" structured
Physical With what?	Which parts of the business will change	What manual & automated processes need to be linked	What packages & bespoke software	What Hardware, software & network component

Refinement

Refinement

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Open Group Service Definition

- Service orientation is a way of thinking in terms of services and service-based development and the outcomes of services.

- A service:
  Is a logical representation of a repeatable business activity that has a specified outcome (e.g., check customer credit; provide weather data, consolidate drilling reports)

  – Is self-contained

  – May be composed of other services

  – Is a "black box" to consumers of the service

  – An architectural style is the combination of distinctive features in which architecture is performed or expressed.

SGAC example: Outage Management

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Driving to Grid 2020

Measurement →

State →

Configuration →

Outage Management

Schedule →

Work Order →

↑ Operator
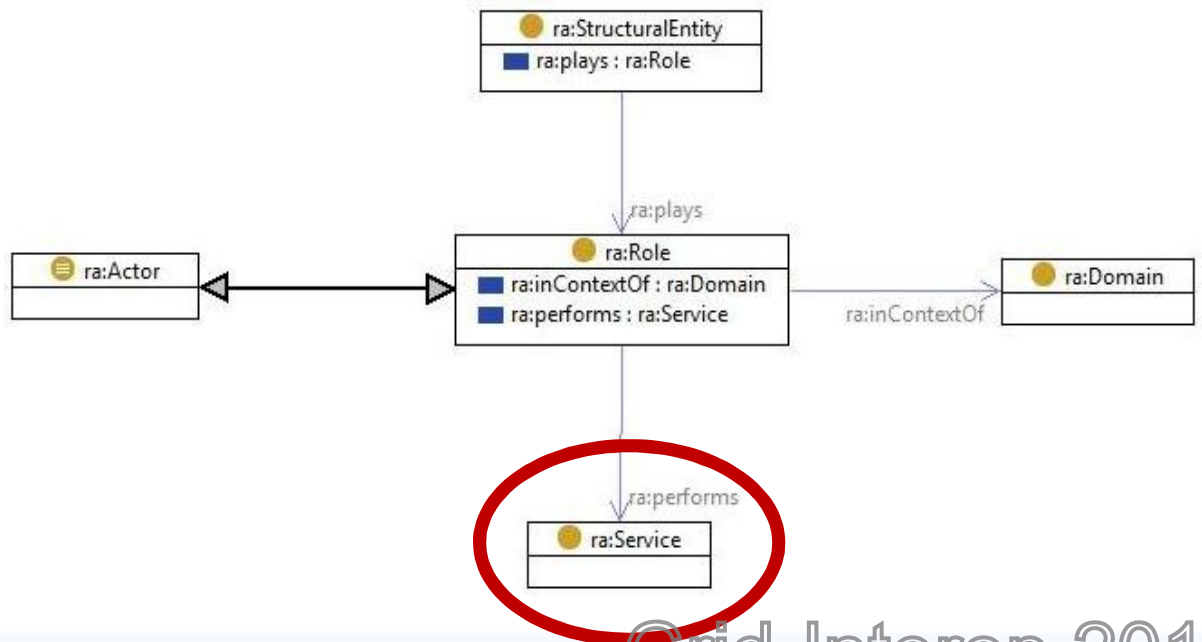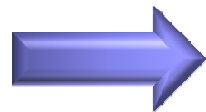
Goal rationalize Actor to roles map to services

Actor is a **physical thing**
- Meter
- Actuator
- Market
- Person
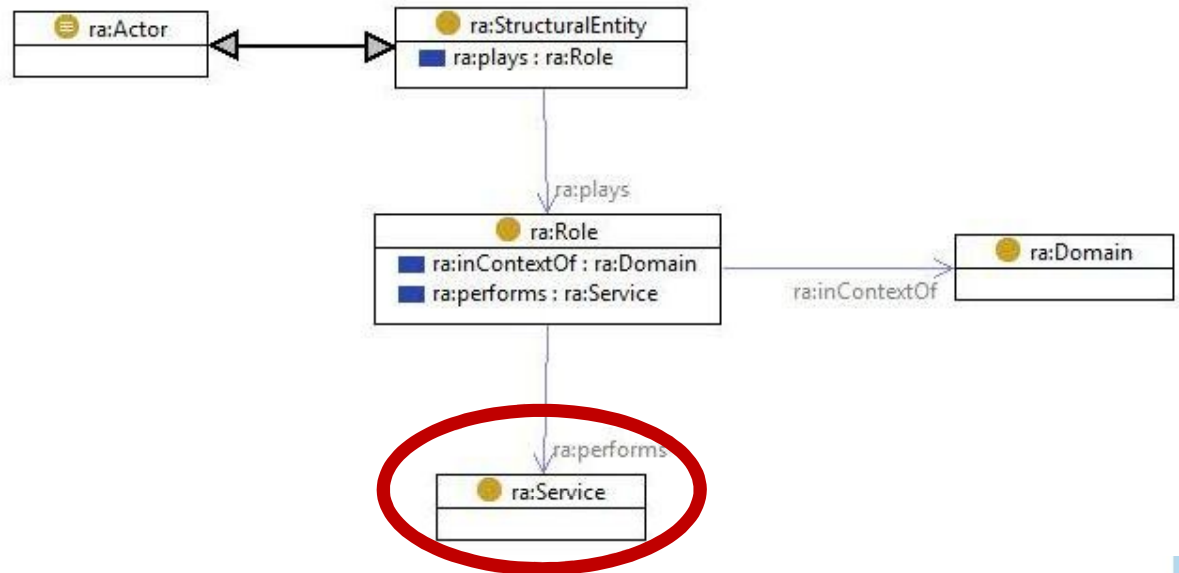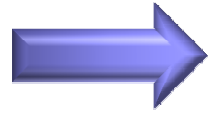
Actor performs roles
- Generation Protection
- Demand Response Management System
- Distribution Stabilize and Optimize

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SGiP-SGAC Actors Effort

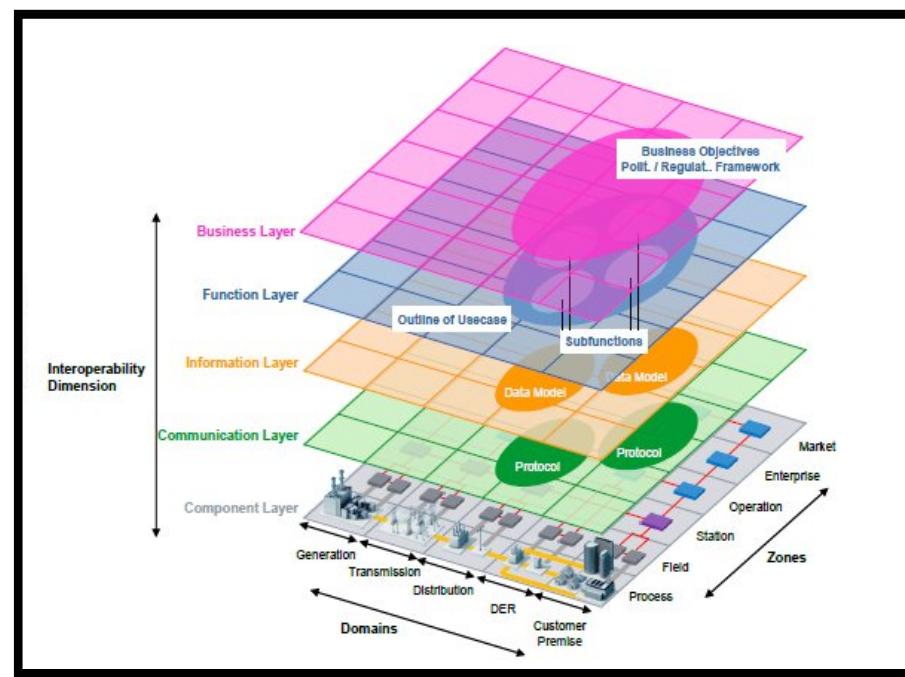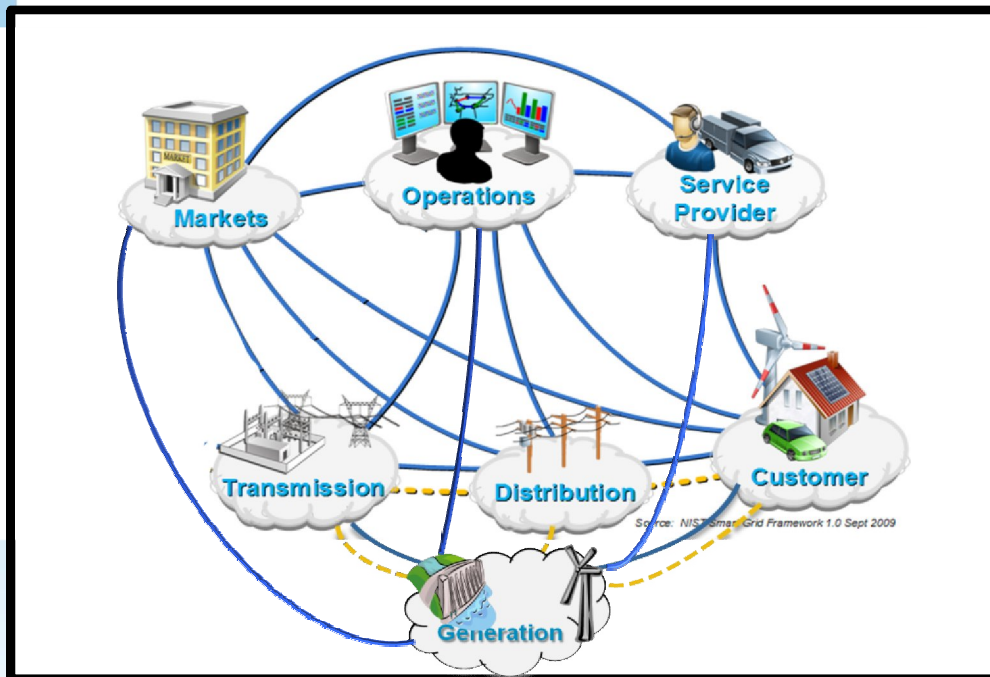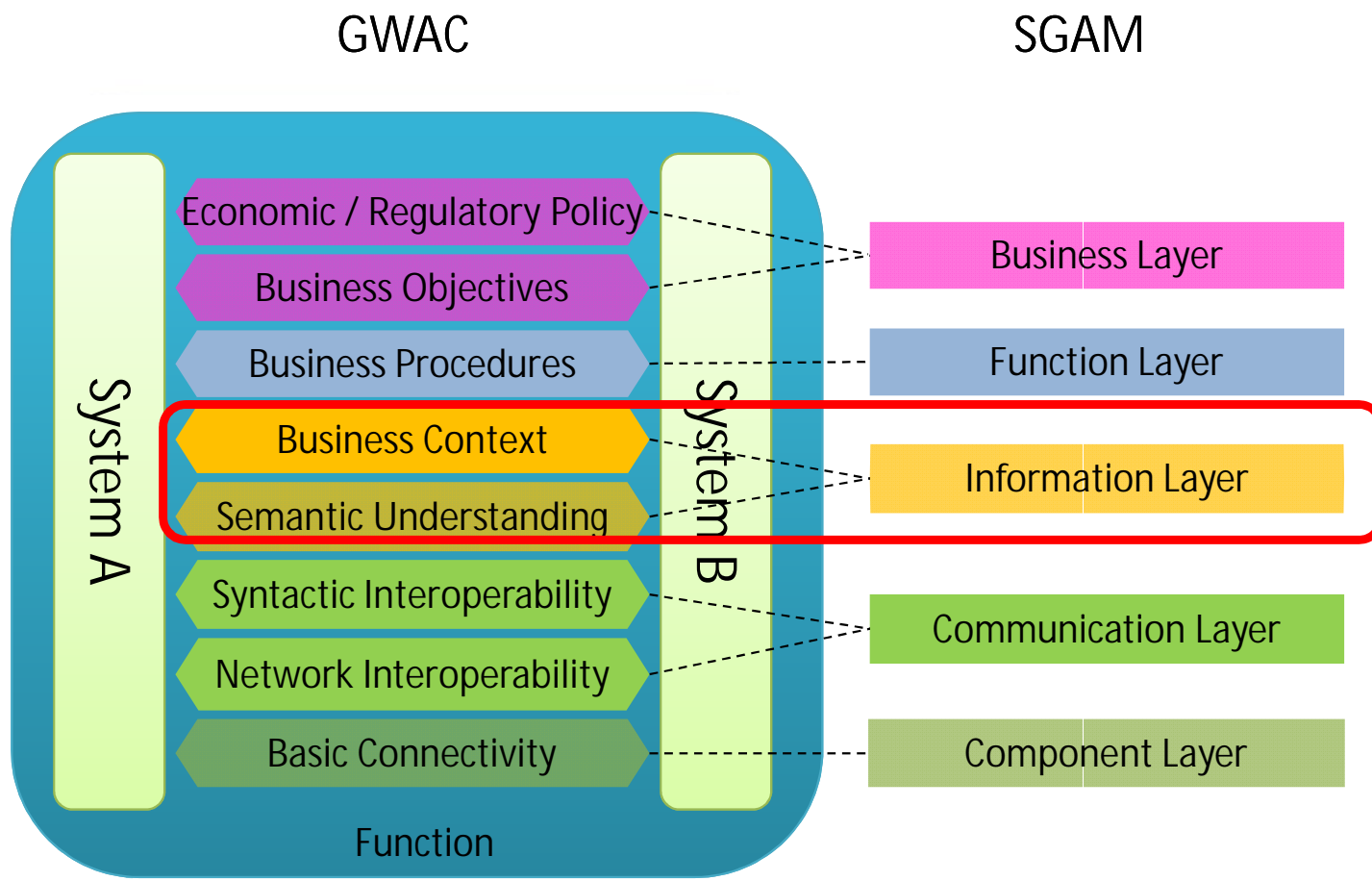| Actor	Original Alternative Actor Name (Including Actors Names with duplicate function)	Actor/Role	Hierarchy Physical/ Logical/ Conceptual	Role (from role tab)	Type	Domain
Access Point (ie. Data Aggregation Point)	IE: Distribution Access Point	Actor	Logical		Device	Distribution
Account Management		Actor or Collection of Roles	Conceptual		Applicatio	Service Provi
Actuator		Actor	Physical		Device	Distribution
Aggregation Resource	N: Resource	Actor	Conceptual		Organizat	Market
Aggregator	RM: Energy Services Company; NR: Aggregator / Retail Energy Provider; EU: Supplier; xx: Energy Services Aggregator	Actor	Conceptual		Organizat	Service Provi

SGAC

- Kept at Conceptual level to avoid being prescriptive
- Organizationally focused
- Bulk Generation and DER merged

EU M490 RAWG

- Logical architecture leveraging NIST Conceptual and GWAC
- Functionally focused
- DER -No interfaces to Transmission or Customer

Defining GWAC stack to SGAM layers

GWAC

SGAM

System A **System B**

Economic / Regulatory Policy

Business Objectives

Business Procedures

Business Context

Semantic Understanding

Syntactic Interoperability

Network Interoperability

Basic Connectivity

Function

Business Layer

Function Layer
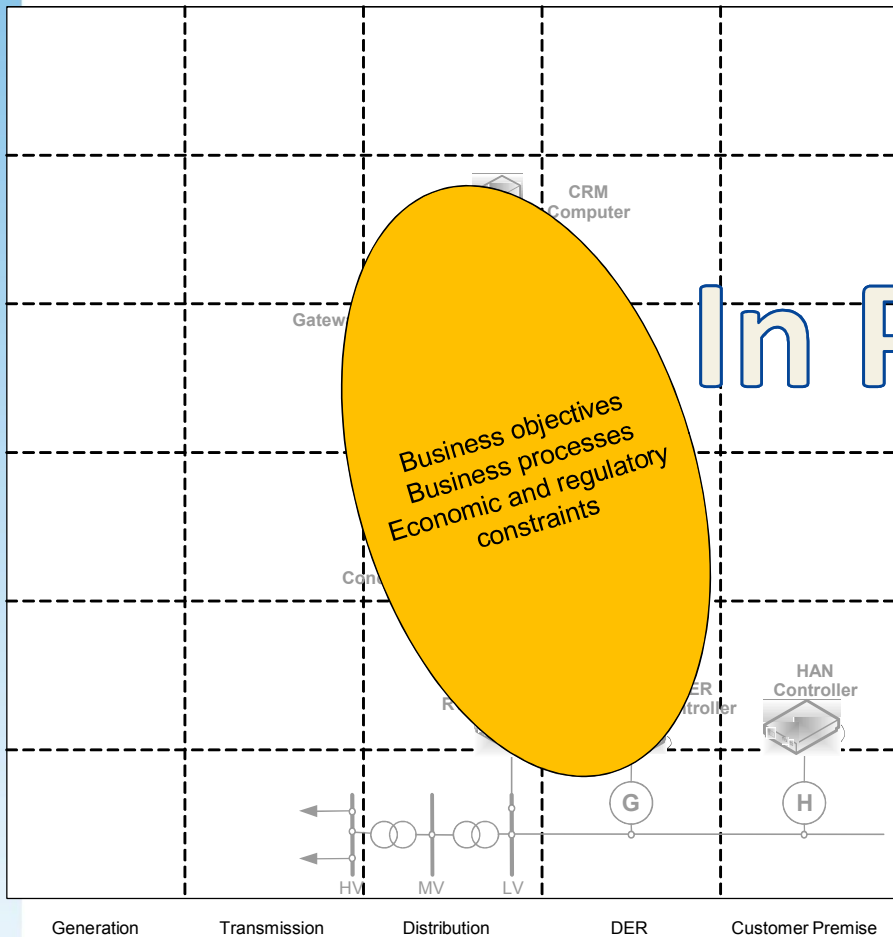
Information Layer

Communication Layer

Component Layer

EU's Smart Grid Architectural Methodology maps to NIST Conceptual Architecture & GWAC Stack

Hierarchy
GWAC
Stack
Based
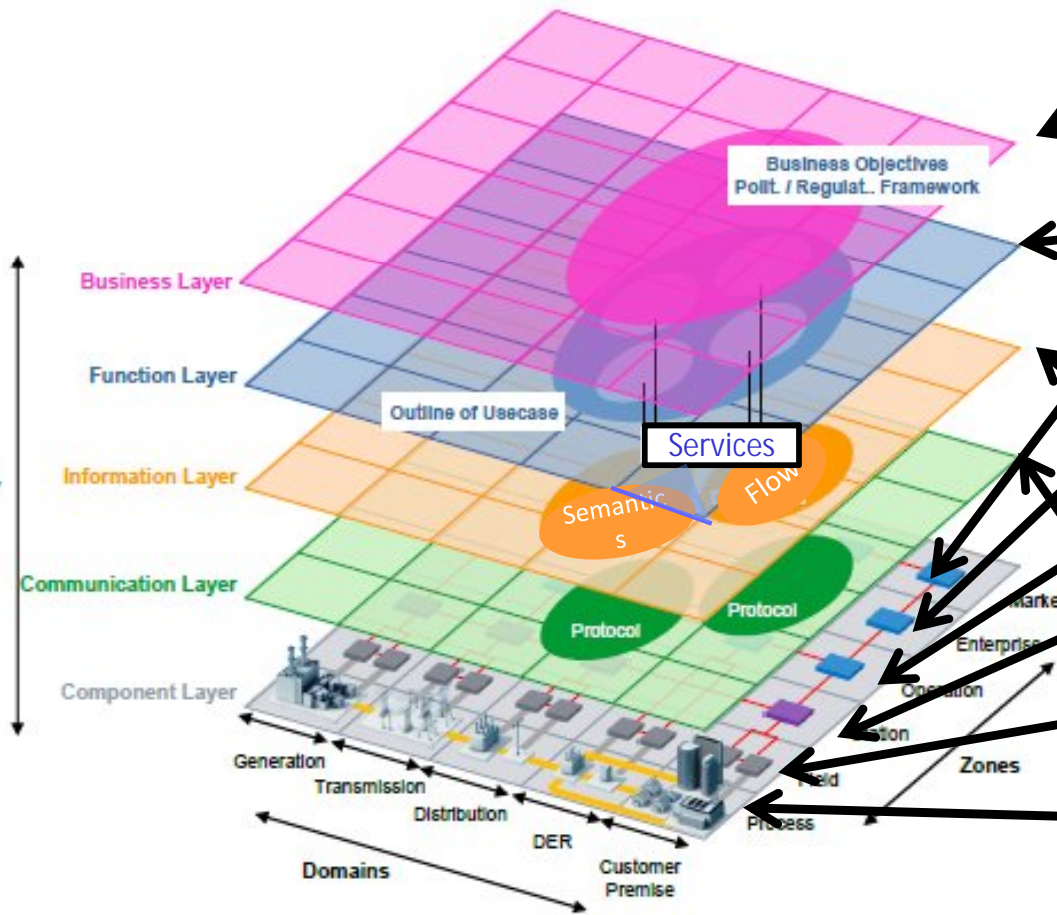
NIST Conceptual Architecture

Zones
Functional` and physical

Business goals & requirements

Market: Org and syst

Use Cases, Business Services, Actors

Enterprise: "back-office" (everything that's not Power ops and Market)

Interactions

Operation: Grid Control (messages),

Automation physical substation

Automation Services

Semantics: CDMs

Semantic

Field: protection and monitoring equipment

Syntax & Communications Standards

Process: Primary power delivery equipment

In Process

Business objectives
Business processes
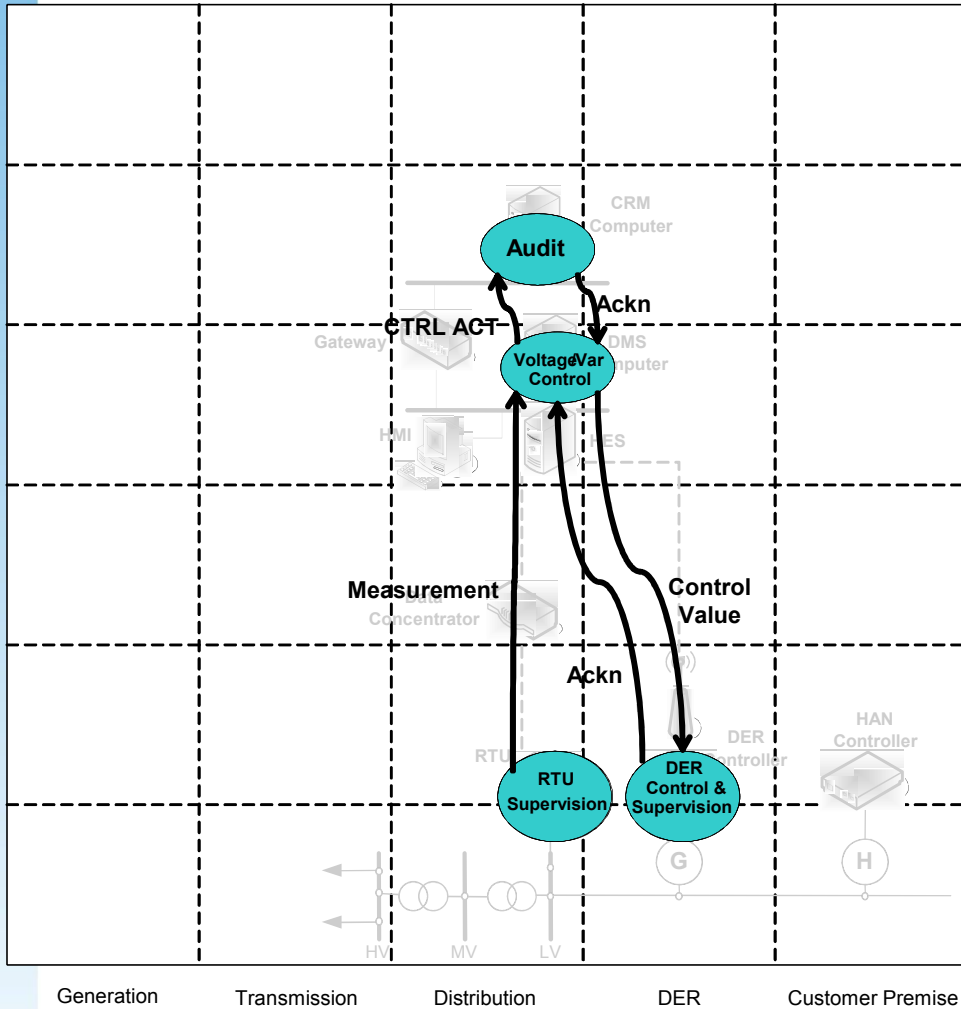Economic and regulatory constraints
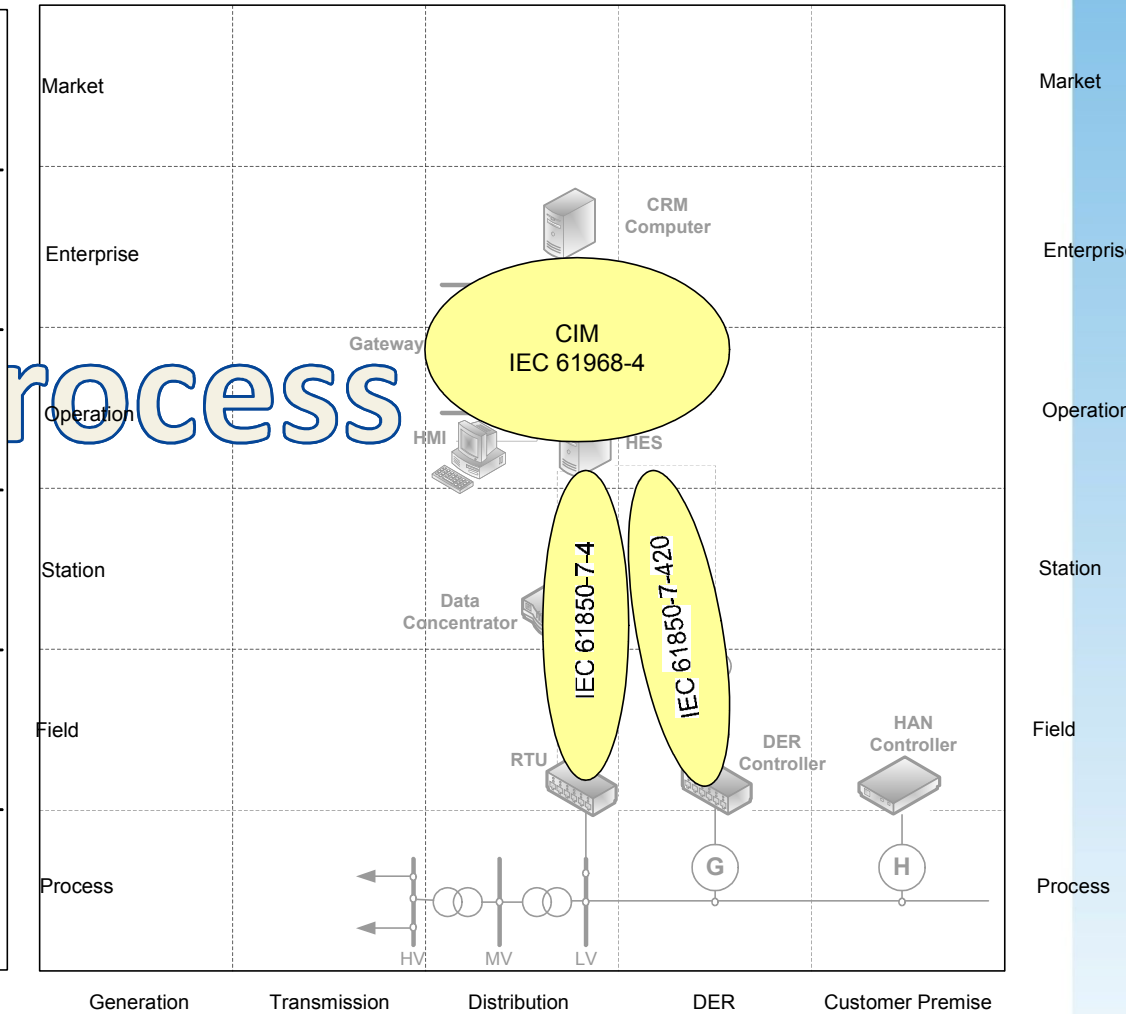
Needs further clarification - Herb and John
Used to show inheritance between layers & layer independence (Service-Oriented and loose-coupling) - Heiko

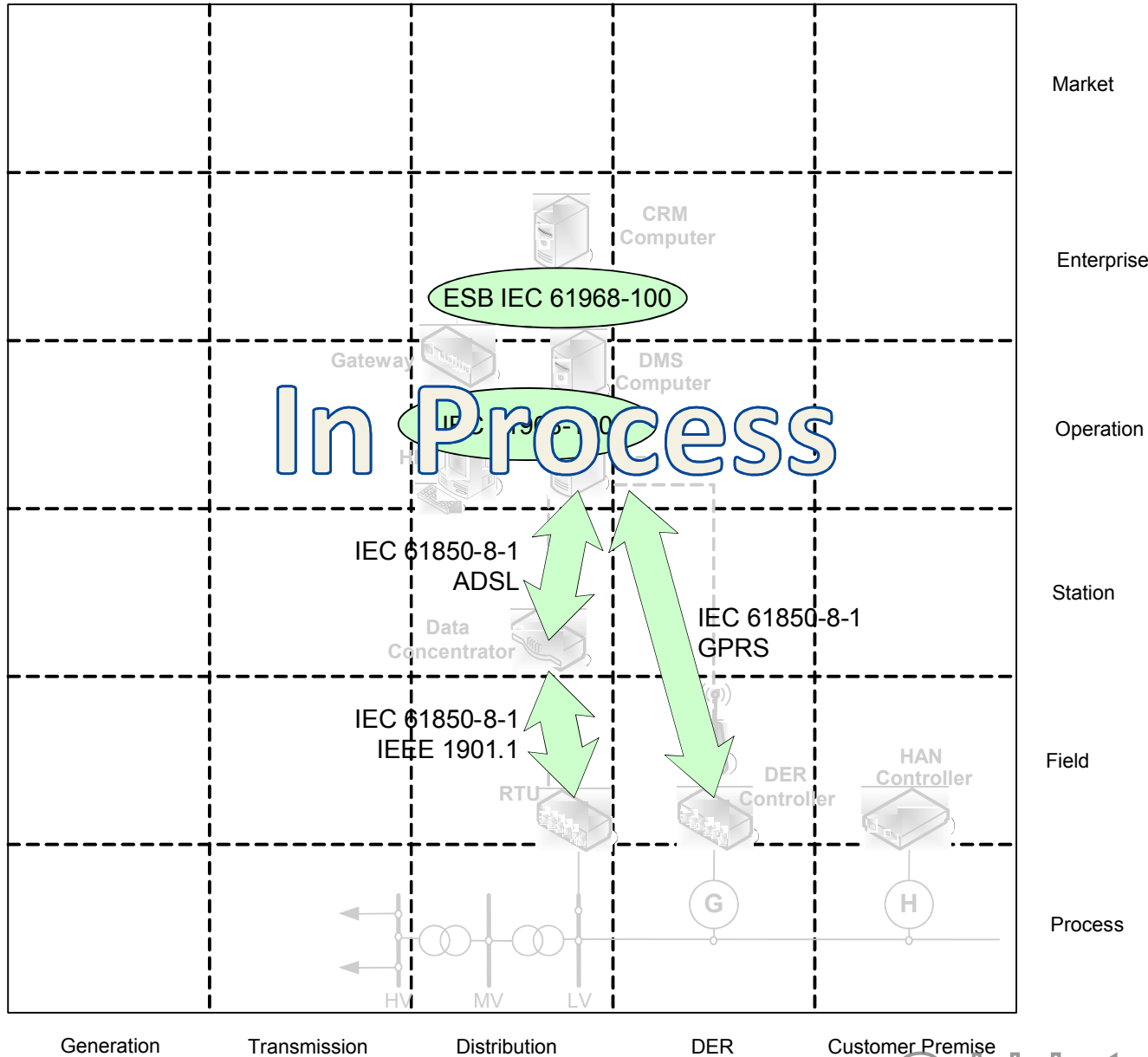Grid-Interop 2012

Information Layer

Business Context (Message) View

Can. Data Model View

Communication Layer

Grid-Interop — Driving to Grid 2020™

Market

CRM Computer

ESB IEC 61968-100

Enterprise

Gateway | DMS Computer

In Process

Operation

IEC 61850-8-1
ADSL

Station

Data Concentrator

IEC 61850-8-1
GPRS

IEC 61850-8-1
IEEE 1901.1

Field

RTU | DER Controller | HAN Controller

Process

G | H

HV | MV | LV

Generation | Transmission | Distribution | DER | Customer Premise

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Component Layer

Market

Service Provider

Operations
OPs & Enteprise)

In Process

Power System
(End devices,
Field Devices)

Generation   Transmission   Distribution   DER   Customer
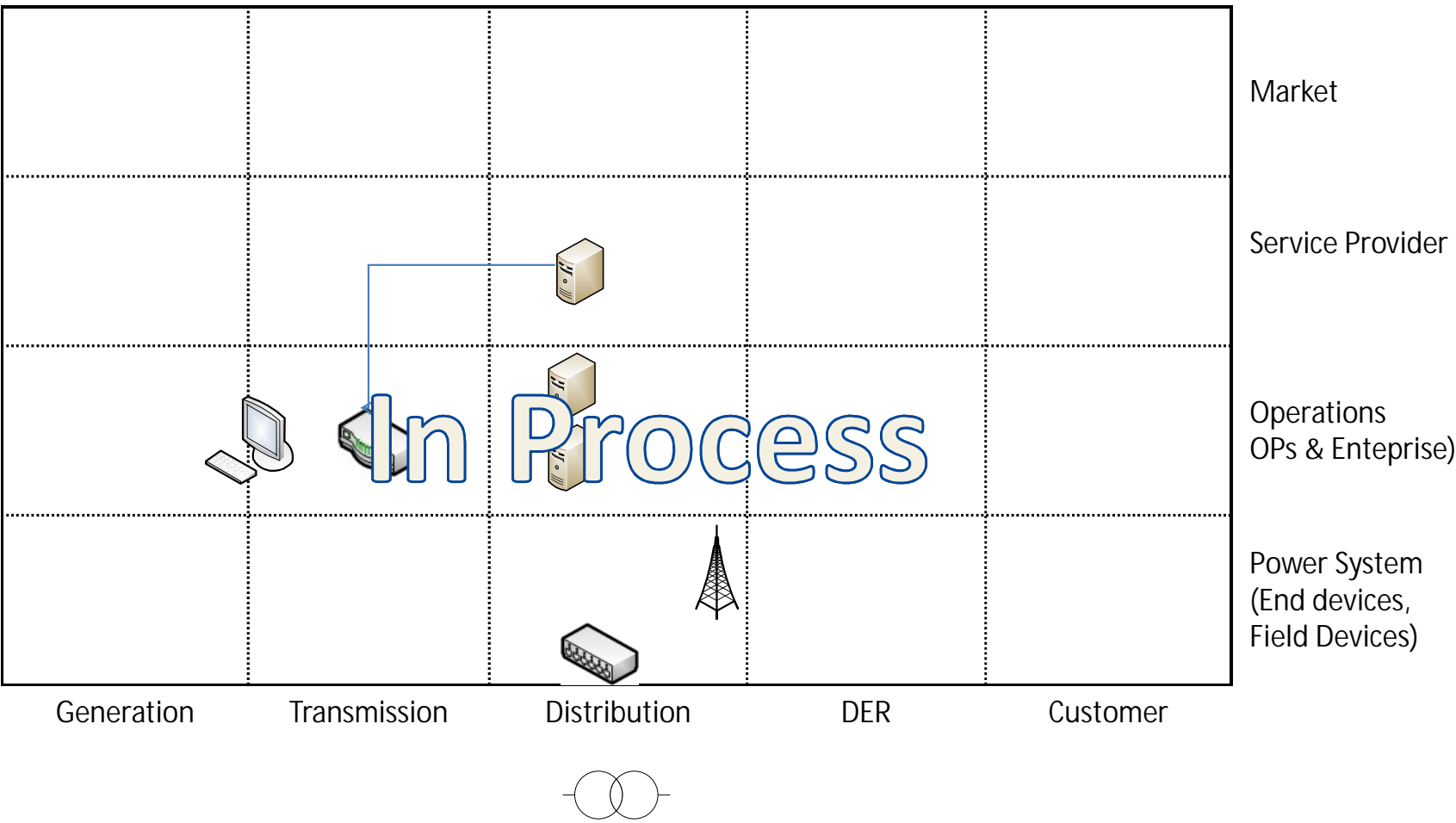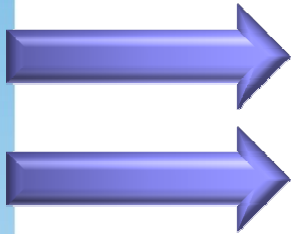
Steps to work out

- Open Group SOA Ontological approach
- Define and agreement on basic terms
- Complete actor to service mapping

We are here

- Create message maps
- Unify "identical" services and messages
- How to identify "Stickybits"
- Work flow notation (BPM, BPEL, other)
- Application Building Block criteria
- Repository for joint work (catalogues, ontologies, etc)
- Others?

Questions ?

How does this work?

SGAC
- Ron Ambrosio - IBM
- Stephan Amsbary - EnerNex
- Jay Britton - Alstom
- Jean Raymond - HydroQuebec
- John Ruiz – Johnson Controls

WG19
- Terry Saxton – Xtensible
- Paul Skare – PNNL

EU M.490 RAWG
- Heiko Englert - Siemens
- Mathias Uslar – Offis
- Peter Hermans - Stedin
- Raymond Forbes – Ericsson
- Jan Bruinenberg – Alliander
- Eric Lambert - EdF

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