

PRVI DIO:

GLAVNE ZNAČAJKE NORME IEC 61850

Predavač: Stjepan Sučić, mag. ing. el.



S E M I N A R

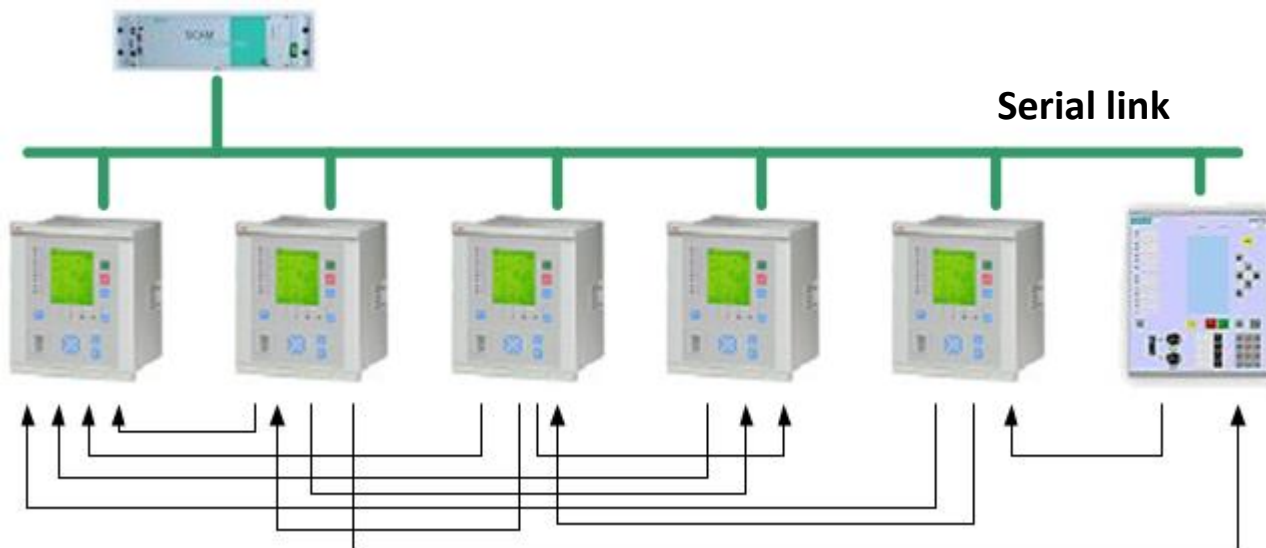
Pregled, praksa i budući razvoj IEC 61850

Zagreb, 29. 03. 2012.

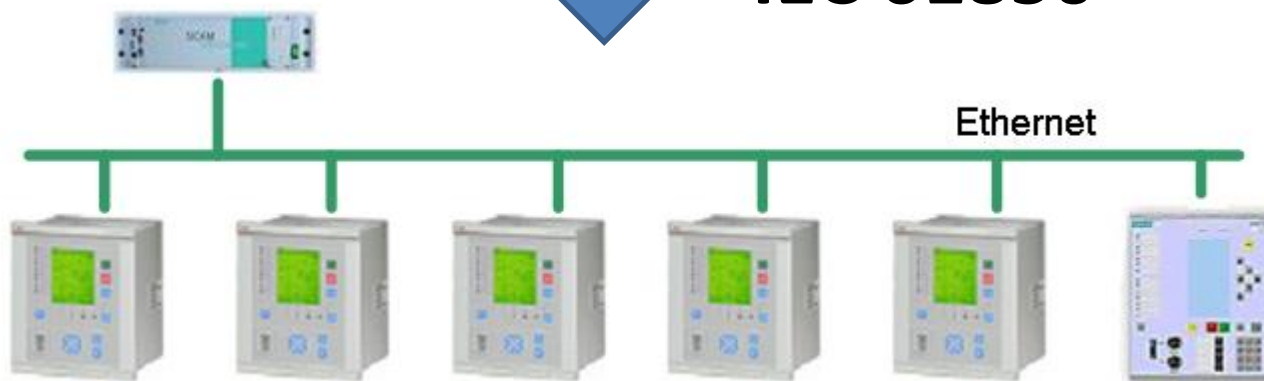
Sadržaj

- 1 • Uvod
- 2 • Arhitektura IEC 61850 sustava
- 3 • Informacijsko modeliranje
- 4 • Komunikacijski servisi
- 5 • Implementacijski zahtjevi
- 6 • Konfiguracija

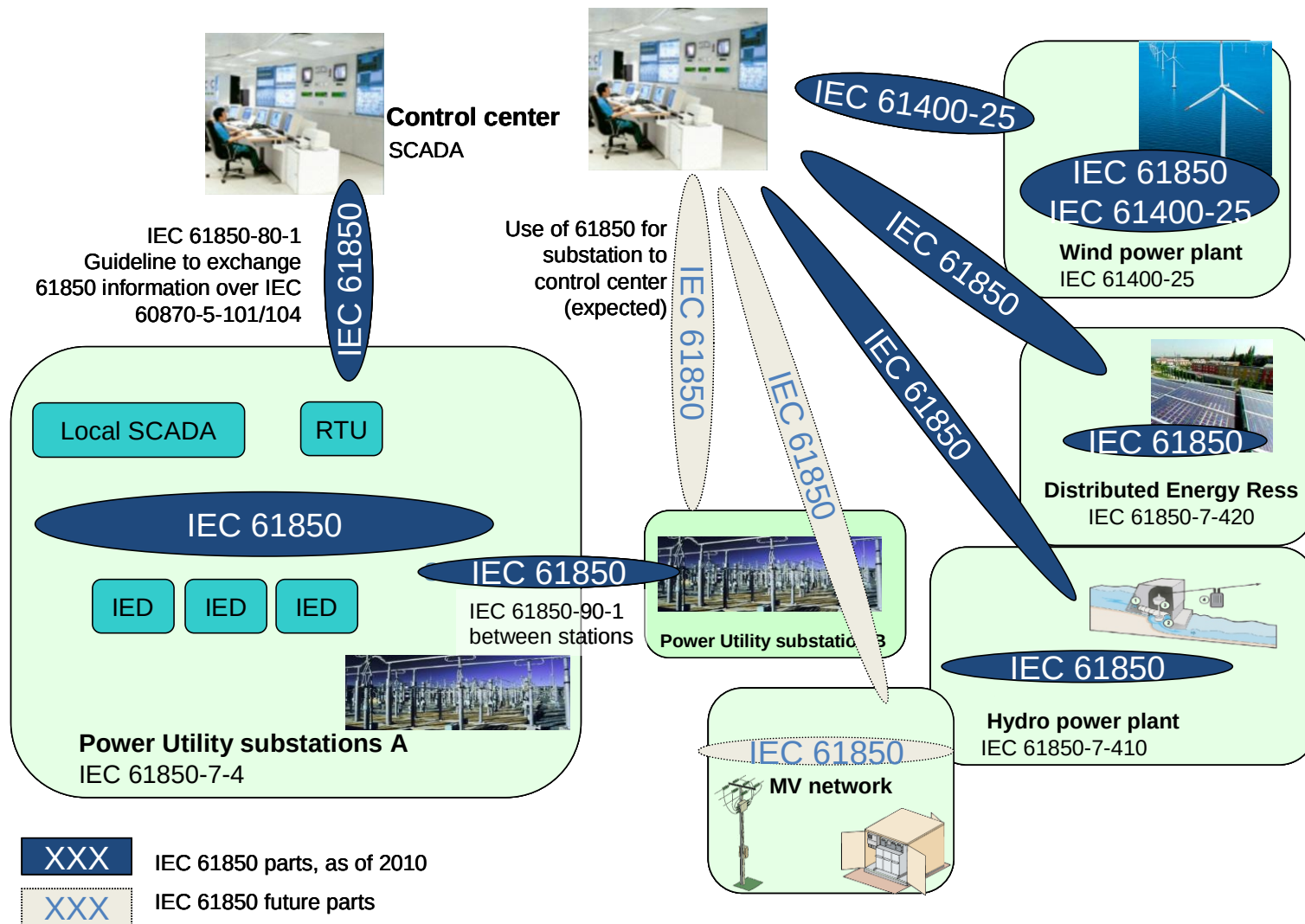
IEC 61850 - Motivacija



IEC 61850



IEC 61850 - Područja primjene danas

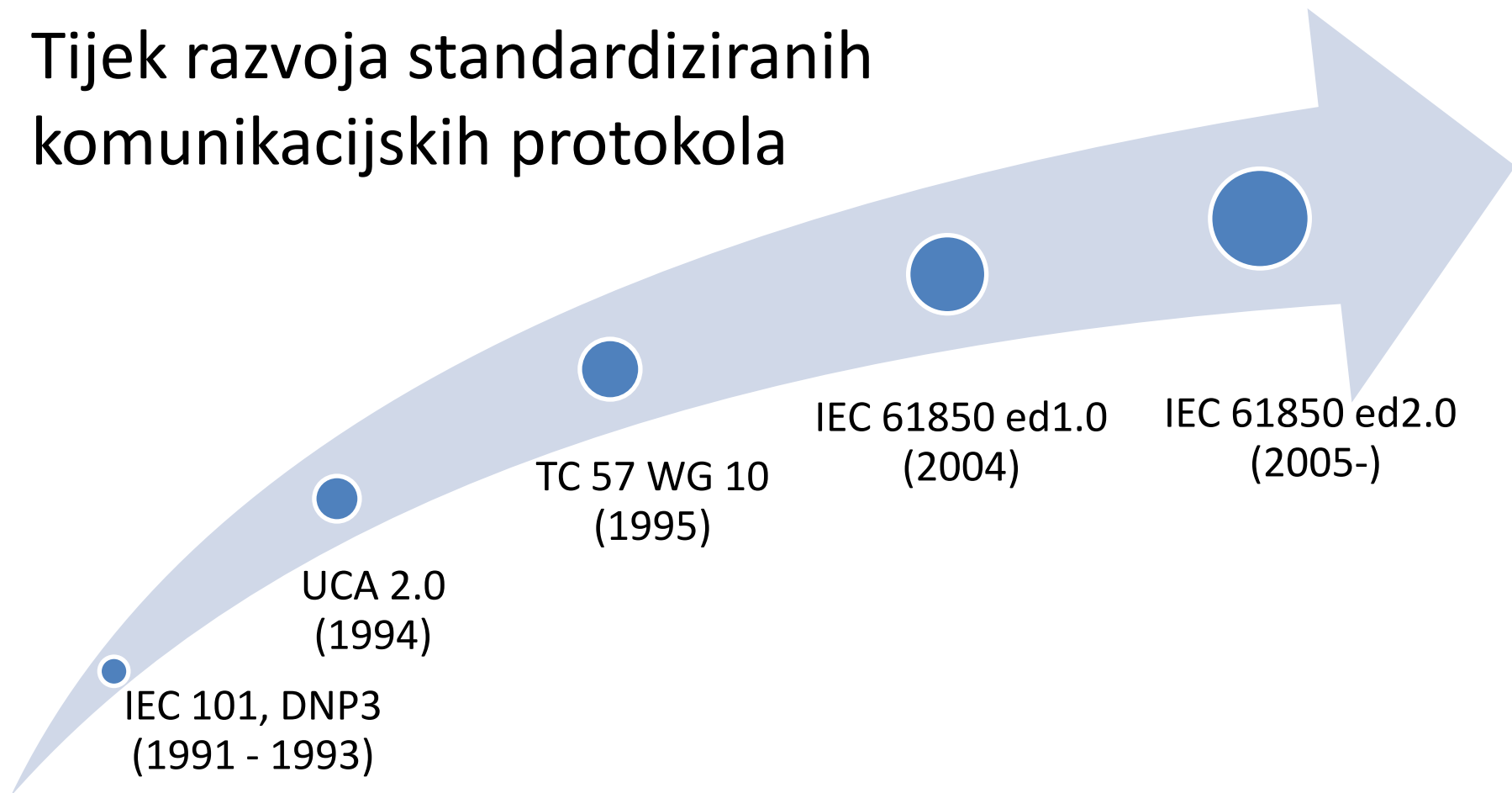


IEC 61850 - Osnove prednosti

- Jedinstveno rješenje za komunikaciju u EES-u
- Interoperabilnost opreme
- Globalna prihvaćenost
- Brža i jeftinija integracija novih sustava
- Jedinstvena semantika procesnih podataka
- Primjena izvan domene trafostanica
- IEC 61850 je arhitektura, a ne tehnologija !

IEC 61850 - Povijesni razvoj

- Tijek razvoja standardiziranih komunikacijskih protokola



IEC 61850 - Odnos prvog i drugog izdanja

IEC 61850 ed1.0

1995.-2004.

3 radne grupe

14 dokumenata

1400 stranica

IEC 61850 ed2.0

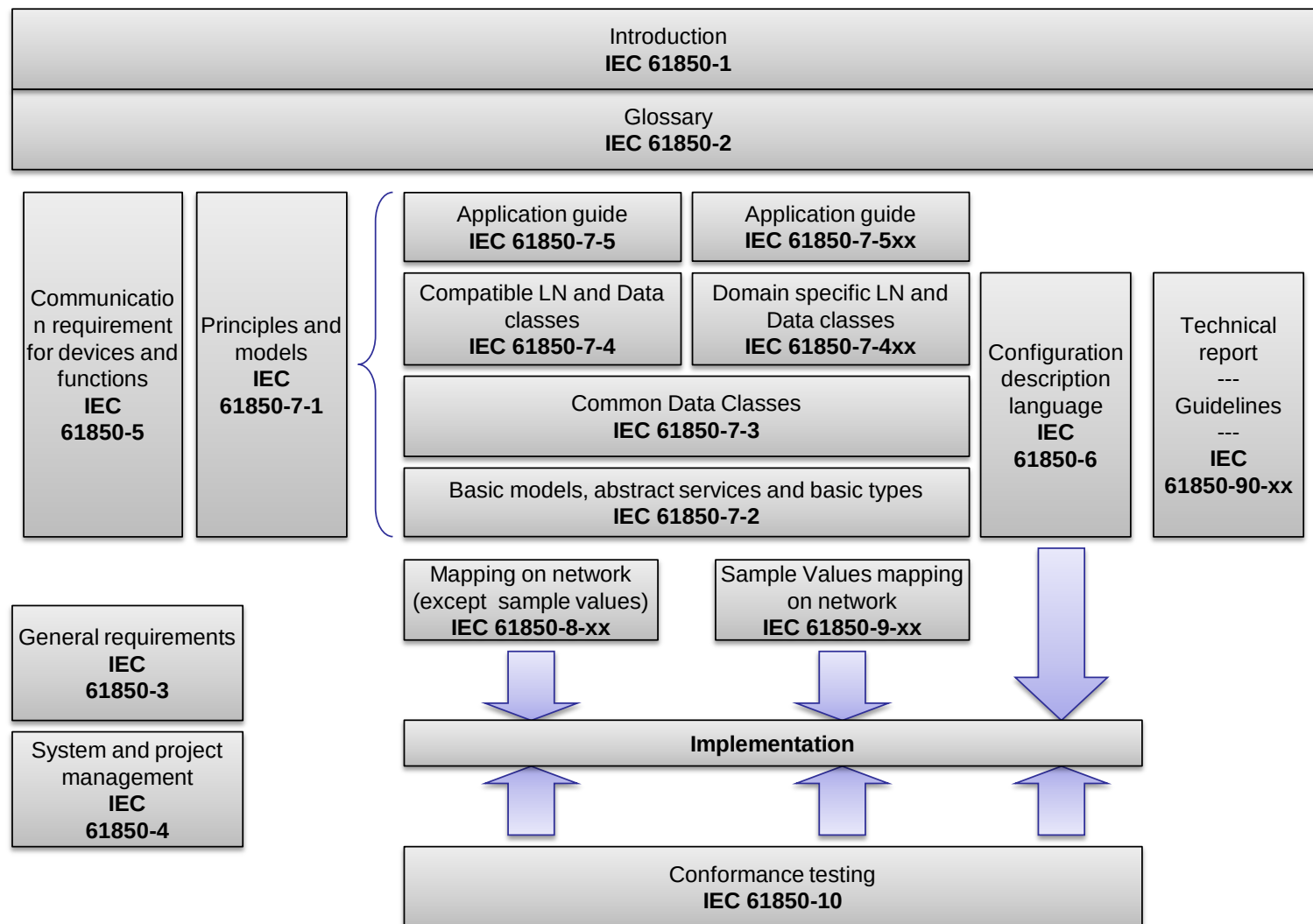
2005-???

5 radnih grupa

27 dokumenata

2400 stranica

IEC 61850 - Odnosi među dokumentima



Sadržaj

1

• Uvod

2

• **Arhitektura IEC 61850 sustava**

3

• Informacijsko modeliranje

4

• Komunikacijski servisi

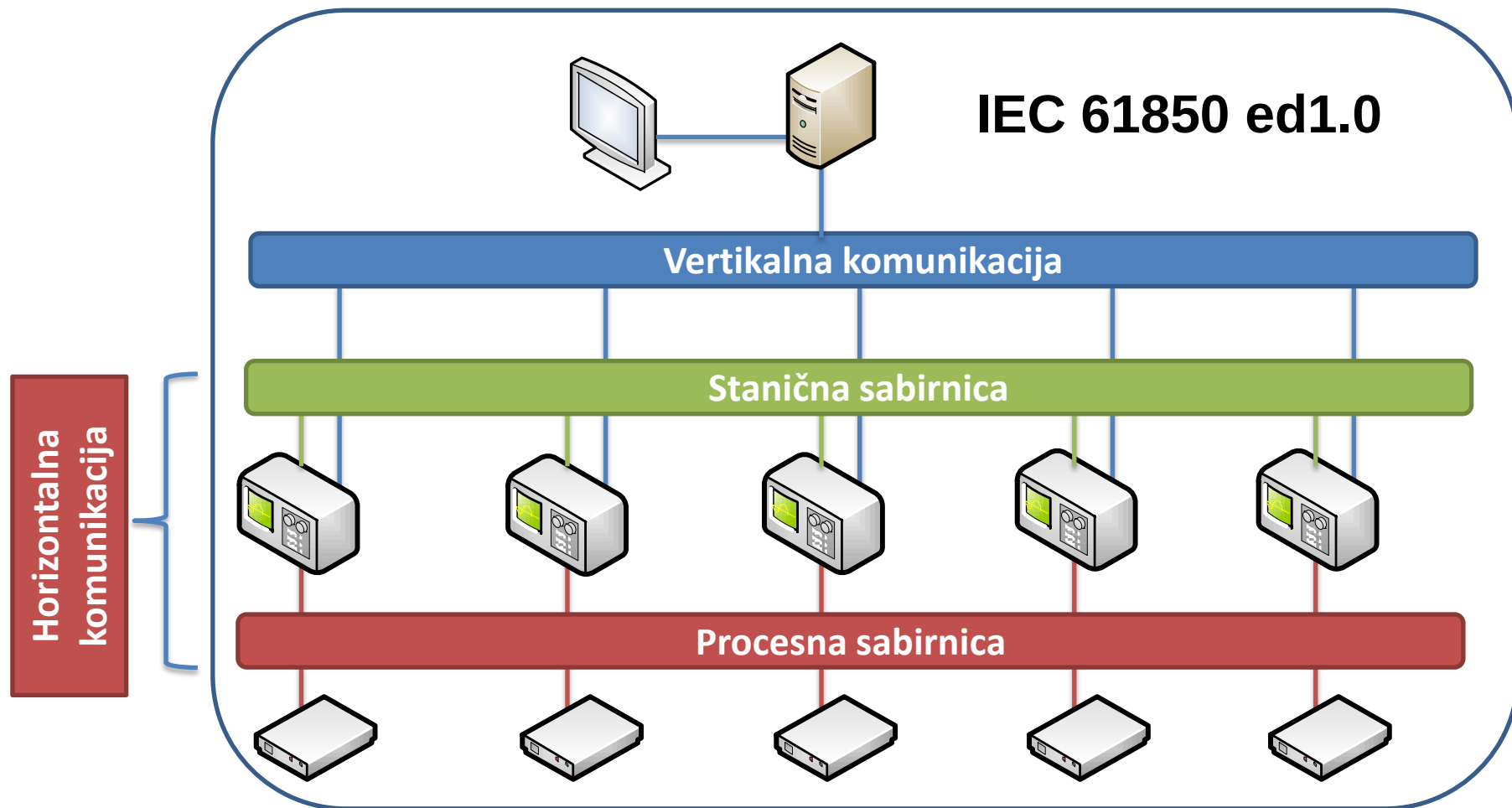
5

• Implementacijski zahtjevi

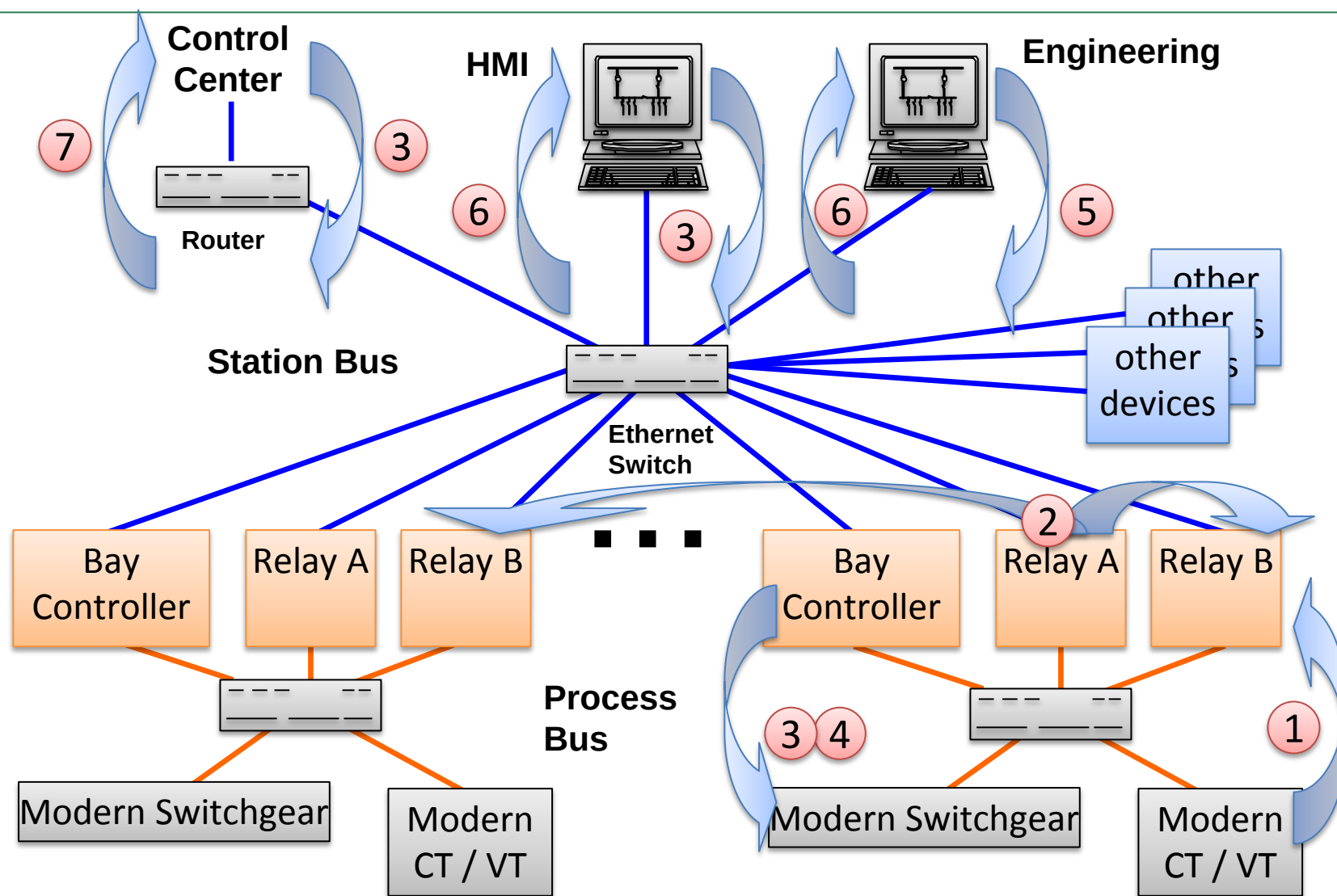
6

• Konfiguracija

IEC 61850 - Osnovna arhitektura sustava



IEC 61850 - Osnovna arhitektura sustava



Sadržaj

1

- Arhitektura

2

- Arhitektura IEC 61850 sustava

3

- **Informacijsko modeliranje**

4

- Komunikacijski servisi

5

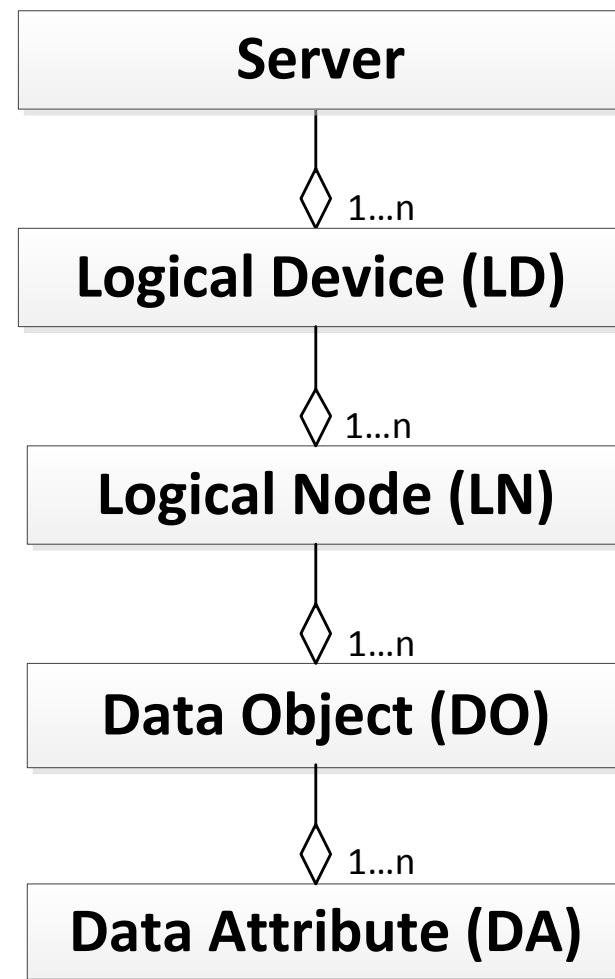
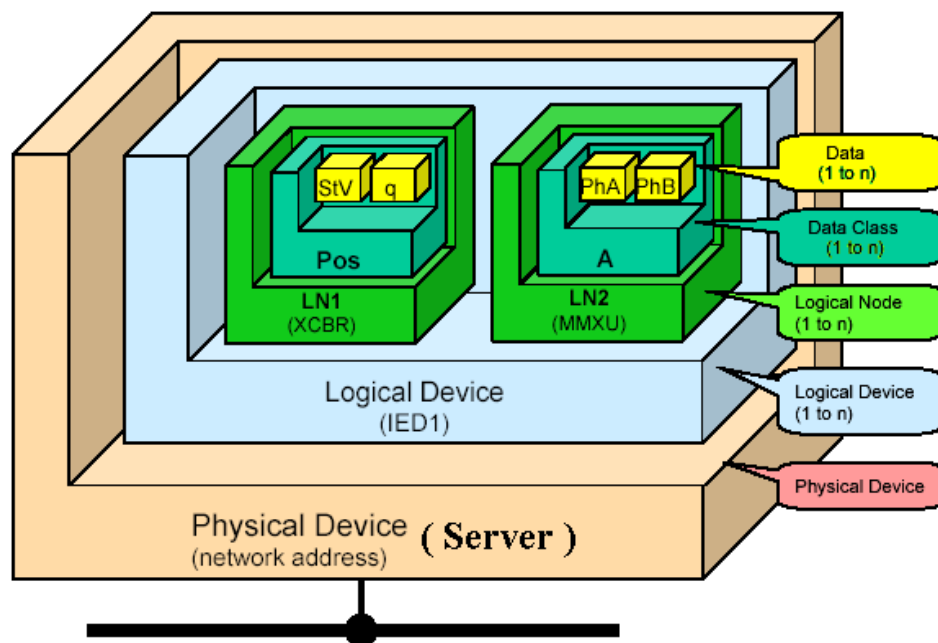
- Implementacijski zahtjevi

6

- Konfiguracija

IEC 61850 – Informacijski model

- IEC 61850-7-2 (Osnovni model)
- IEC 61850-7-3 (Podatkovne klase)
- IEC 61850-7-4 (Trafostanice)

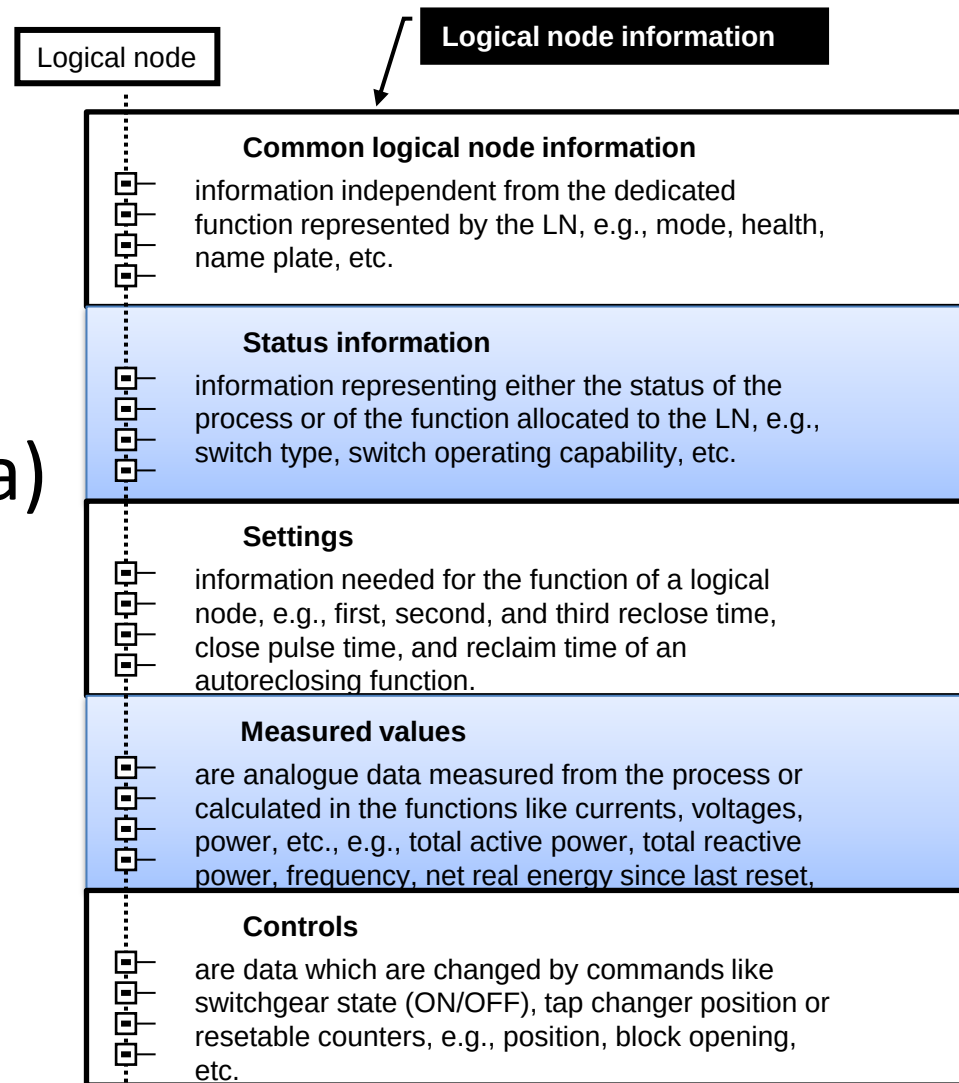


IEC 61850 – Logička čvorišta

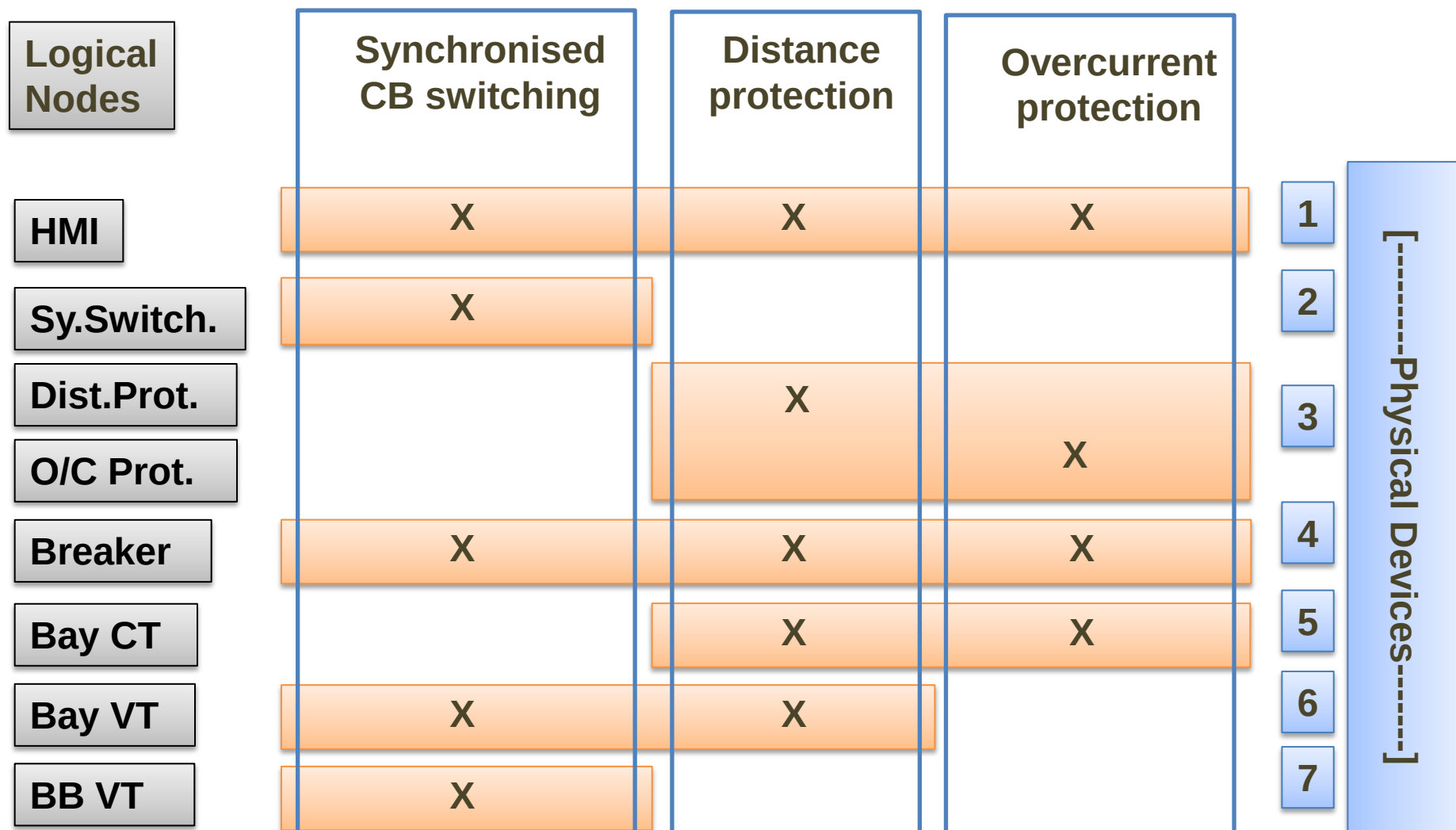
Group indicator	Logical node groups
A	Automatic Control
C	Supervisory control
D	DER
F	Functional blocks
G	Generic Function References
H	Hydro power
I	Interfacing and Archiving
K	Mechanical and non-electrical primary equipment
L	System Logical Nodes
M	Metering and Measurement
P	Protection Functions
Q	Power Quality Events Detection Related
R	Protection Related Functions
S	Supervision and Monitoring
T	Instrument Transformer and Sensors
W	Wind power
X	Switchgear
Y	Power Transformer and Related Functions
Z	Further (power system) Equipment

IEC 61850 – Logička čvorišta

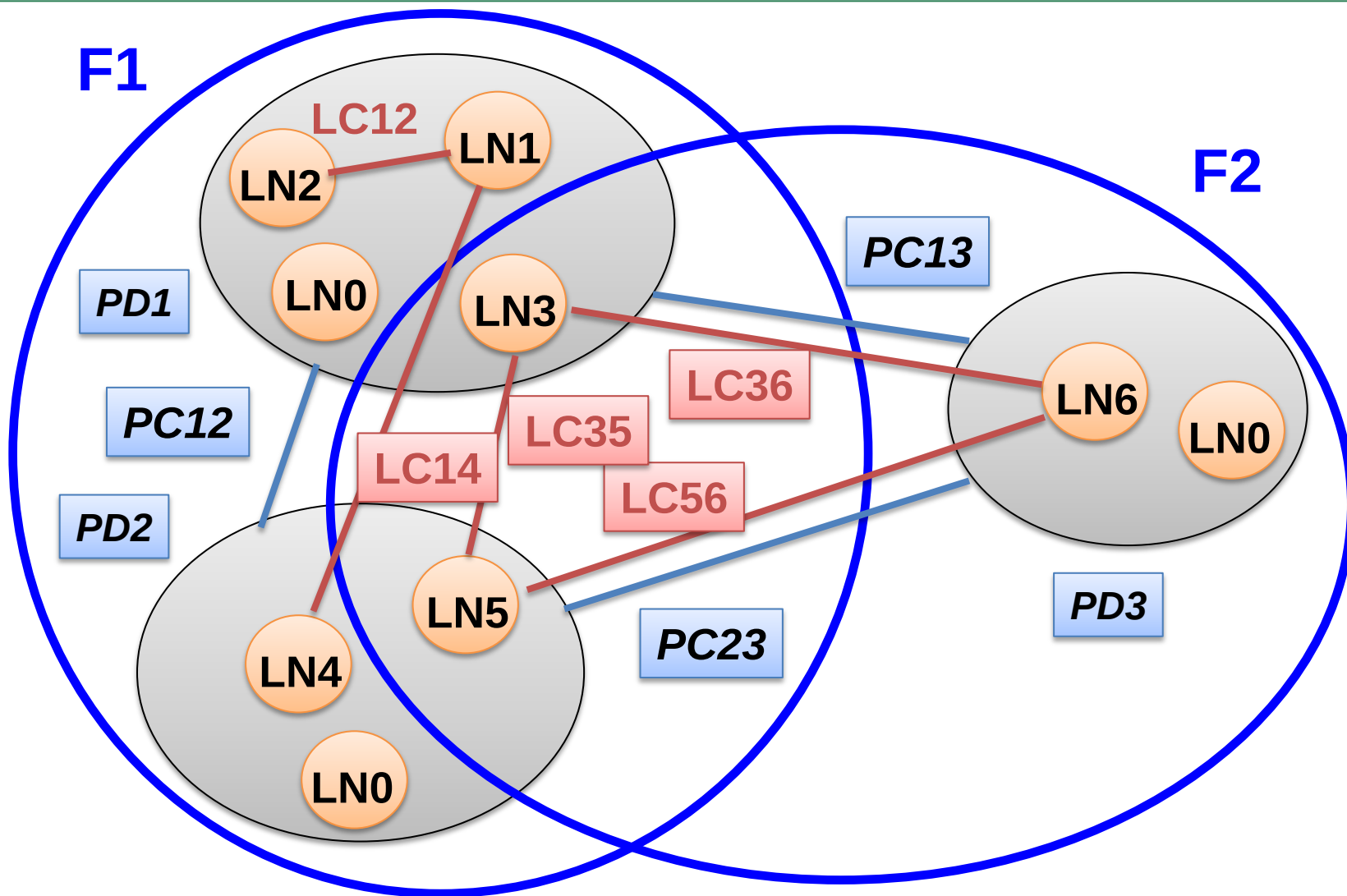
- Semantika procesnih podataka
- X(grupa)+ YYY(funkcija)



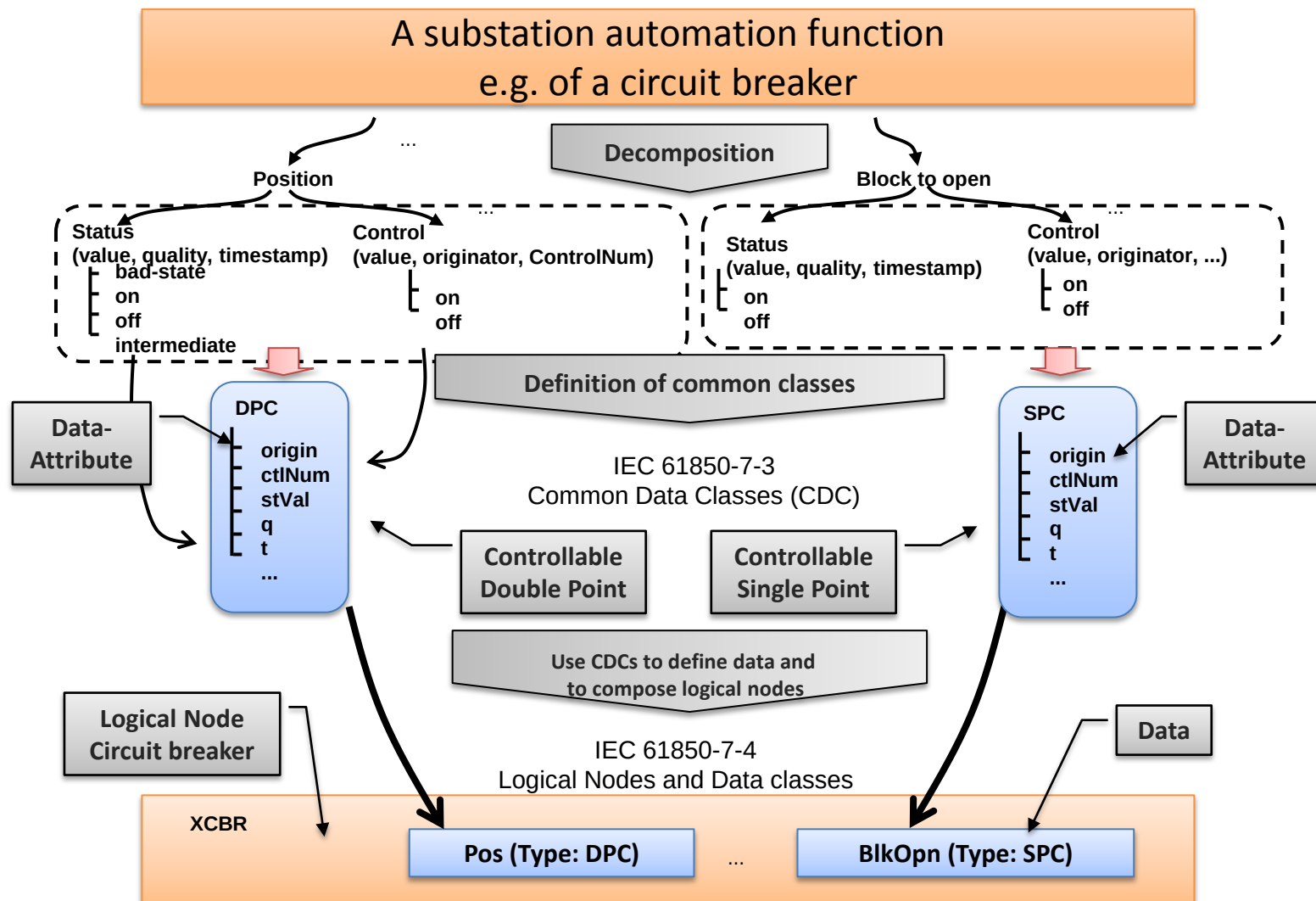
IEC 61850 – Dekompozicija funkcija



IEC 61850 – Dekompozicija funkcija



IEC 61850 - Modeliranje sustava



IEC 61850 – Modeliranje informacija

LD	LN	Data	DAttr.	FC	
E1QA5	/XCBR	.Pos	.stVal	ST	class or instance
E1QA5	/XCBR	.Pos	.q	ST	
E1QA5	/XCBR	.Pos	.t	ST	
E1QA5	/XCBR	.Pos	.ctlModel	CF	
LD5	/YPTR2	.Temp	.mVal.i .mVal.f	MX MX	instance # 2
E1QA5	/XCBR8	.Pos	.stVal	ST	instance # 8
E1QA5	/XCBR8	.Pos	.q	ST	
E1QA5	/XCBR8	.Pos	.t	ST	
E1QA5	/XCBR8	.Pos	.ctlModel	CF	
Object Name		Object Name	Object Name	Object Name	
ObjectReference					

IEC 61850 – Logička čvorišta

Logical Node: Circuit breaker			Name: XCBR
Data-Class	DataName	Common Data Class (CDC)	M/O
Basic Logical Node information			
Mode	Mod	ENC - Controllable Integer Status	O
Behaviour	Beh	ENS - Integer Status	M
Health	Health	ENS - Integer Status	O
Name plate	NamPlt	LPL - Logical node name plate	O
Local control behaviour	Loc	SPS - Single point status	M
External equipment health	EEHealth	ENS - Integer Status	O
External equipment name plate	EENam	DPL - Device name plate	O
Operation counter	OpCnt	INS - Integer Status	M
Controllable Data			
Switch position	Pos	DPC - Controllable Double Point	M
Block opening	BlkOpn	SPC - Controllable Single Point	M
Block closing	BlkCls	SPC - Controllable Single Point	M
Charger motor enabled	ChMotEna	SPC - Controllable Single Point	O

IEC 61850 – Podatkovne klase

DPC class					
Data attribute name	Type	FC	TrgOp	Value/Value range	M/O/C
DataName	Inherited from GenDataObject Class or from GenSubDataObject Class (see IEC 61850-7-2)				
DataAttribute					
status and control mirror					
origin	Originator	ST			AC CO O
ctlNum	INT8U	ST		0..255	AC CO O
stVal	CODED ENUM	ST	dchg	intermediate-state off on bad-state	M
q	Quality	ST	qchg		M
t	TimeStamp	ST			M
stSeld	BOOLEAN	ST	dchg		O
opRcvd	BOOLEAN	OR	dchg		O
opOk	BOOLEAN	OR	dchg		O
tOpOk	TimeStamp	OR			O
substitution and blocked					
subEna	BOOLEAN	SV			PICS SUBST
subVal	CODED ENUM	SV		intermediate-state off on bad-state	PICS SUBST
subQ	Quality	SV			PICS SUBST
subID	VISIBLE STRING64	SV			PICS SUBST
blkEna	BOOLEAN	BL			O
configuration, description and extension					
pulseConfig	PulseConfig	CF	dchg		AC CO O
ctlModel	CtlModels	CF	dchg		M
sboTimeout	INT32U	CF	dchg		AC CO O
sboClass	SboClasses	CF	dchg		AC CO O
operTimeout	INT32U	CF	dchg		AC CO O
d	VISIBLE STRING255	DC		Text	O

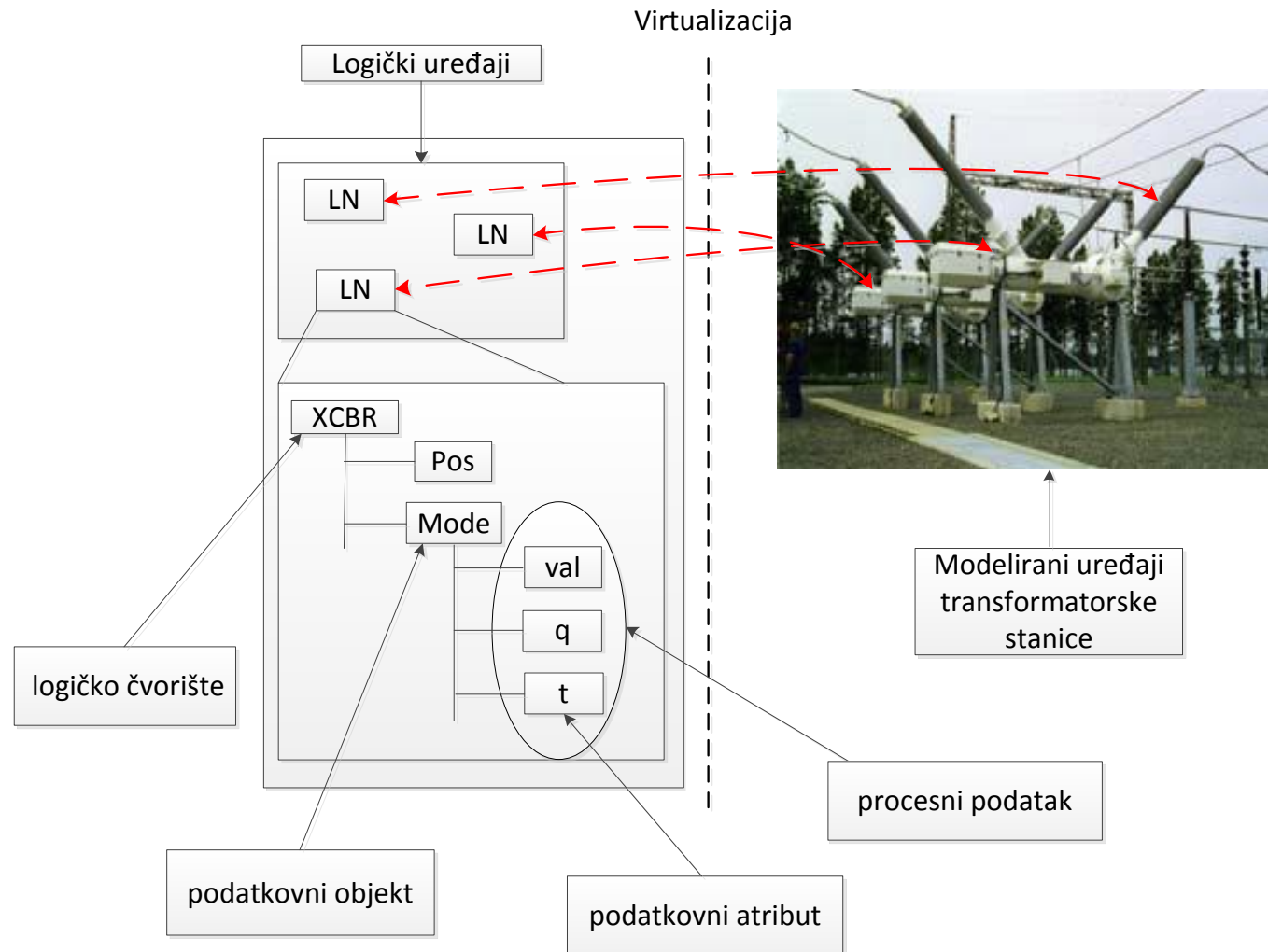
IEC 61850 – Aplikacijski servisi

Services (see IEC 61850-7-2)

The following services are inherited from IEC 61850-7-2. They are specialised by restricting the service to attributes with a functional constraint as specified below.

Service model of IEC 61850-7-2	Service	Service applies to Attr with FC	Remark
GenCommonDataClass model	SetDataValues GetDataValues GetDataDefinition GetDataDirectory	DC, CF, SV, BL ALL ALL ALL	
Data set model	GetDataSetValues SetDataSetValues	ALL DC, CF, SV, BL	
Reporting model GSE model Sampled values model	Report SendGOOSEMessage SendGSSEMessage SendMSVMessage SendUSVMessage	ALL ST, MX ST ST, MX ST, MX	as specified within the data set that is used to define the content of the message
Control model	Select SelectWithValue Cancel Operate CommandTermination TimeActivatedOperate		
<i>parameters for control services</i>			
Service parameter name	Service parameter type	Value/Value range	
ctlVal	BOOLEAN	off (FALSE) on (TRUE)	

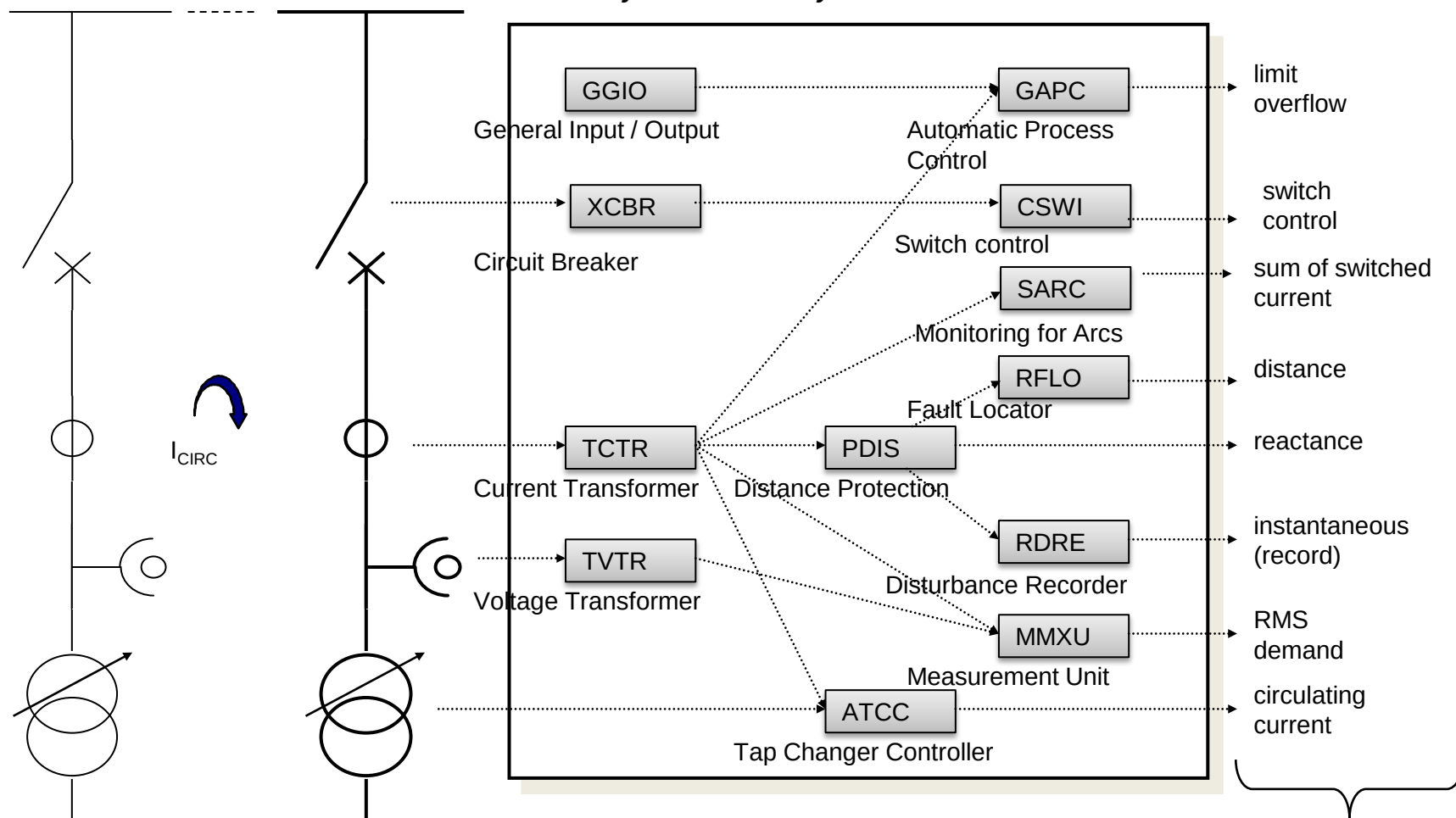
IEC 61850 - Modeliranje sustava



IEC 61850 - Modeliranje sustava

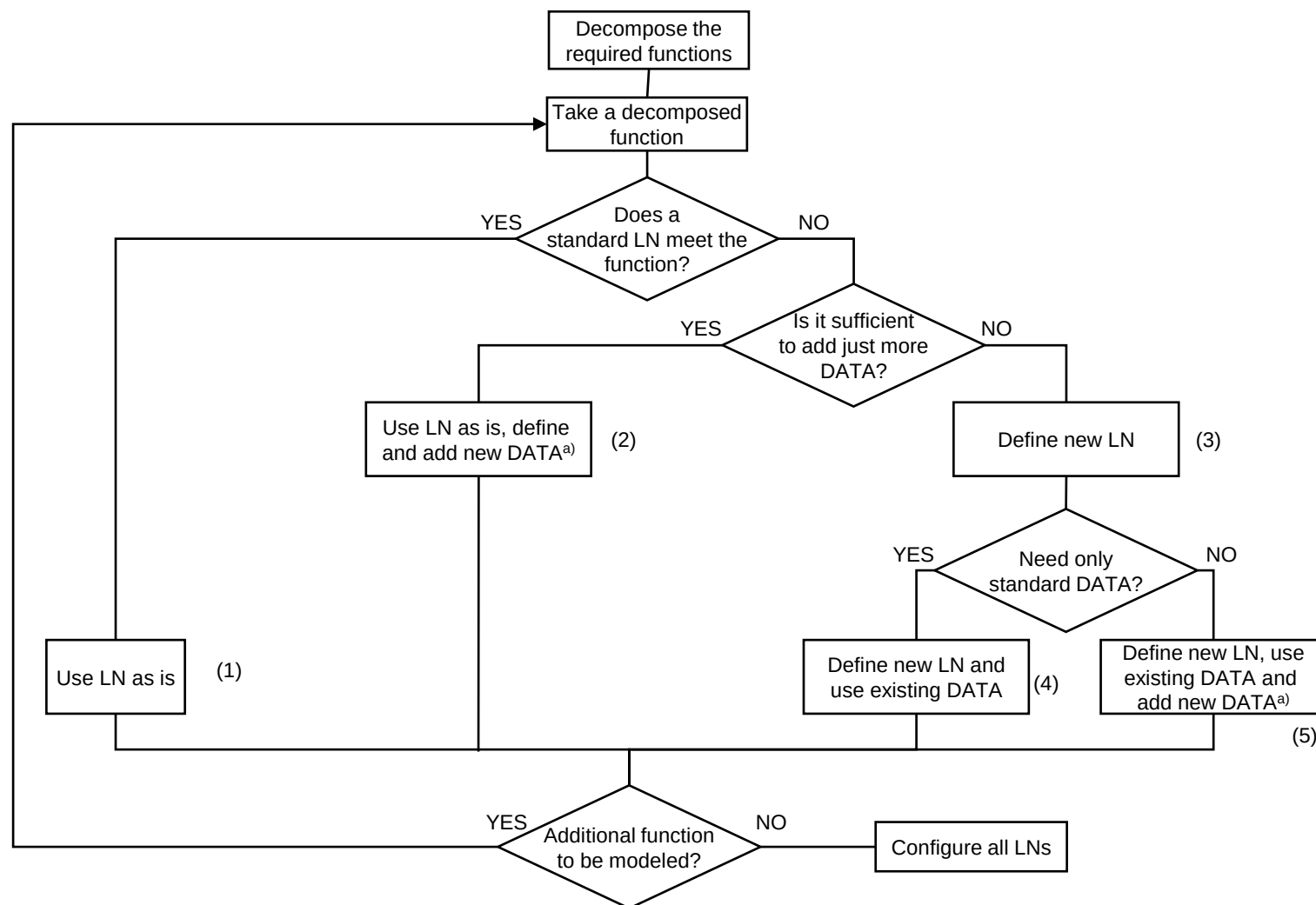
Single Line Diagram

Physical Device Bay Controller



*examples for some current
related data*

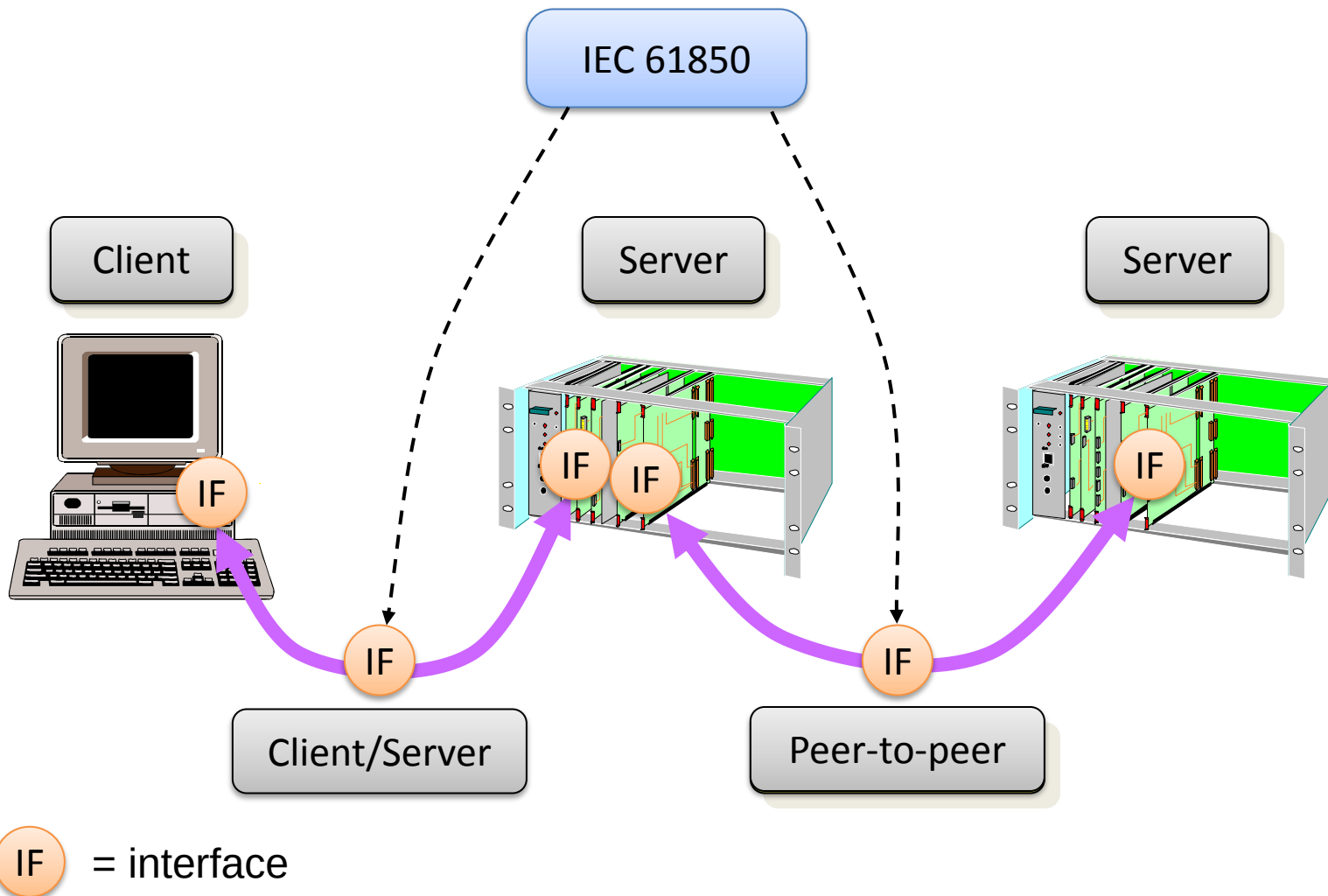
IEC 61850 – Pravila proširenja modela



Sadržaj

- 1 • Arhitektura
- 2 • Arhitektura IEC 61850 sustava
- 3 • Informacijsko modeliranje
- 4 • Komunikacijski servisi**
- 5 • Implementacijski zahtjev
- 6 • Konfiguracija

IEC 61850 – Razmjena informacija



Vertical ACSI

Association

Server/LD/LN/DO/DS

Setting-Group-Control-Block

Control

Report-Control-Block

Log-Control-Block

Horizontal ACSI

GOOSE

Unicast-Sample-Values

Multicast-Sample-Values

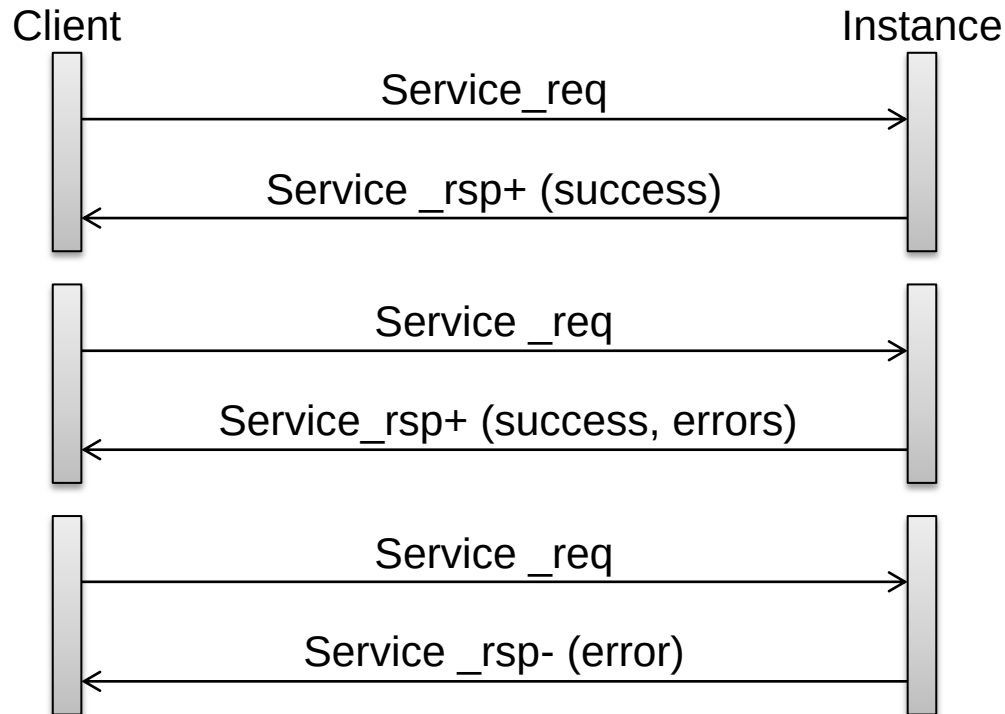
Other ACSI

Time Synchronization

Unicast-Sample-Values

File transfer

IEC 61850 – ACSI definicija



Parameter name

Request

Parameter 1...

Parameter n

Response+

Parameter 1...

Parameter n

Response-

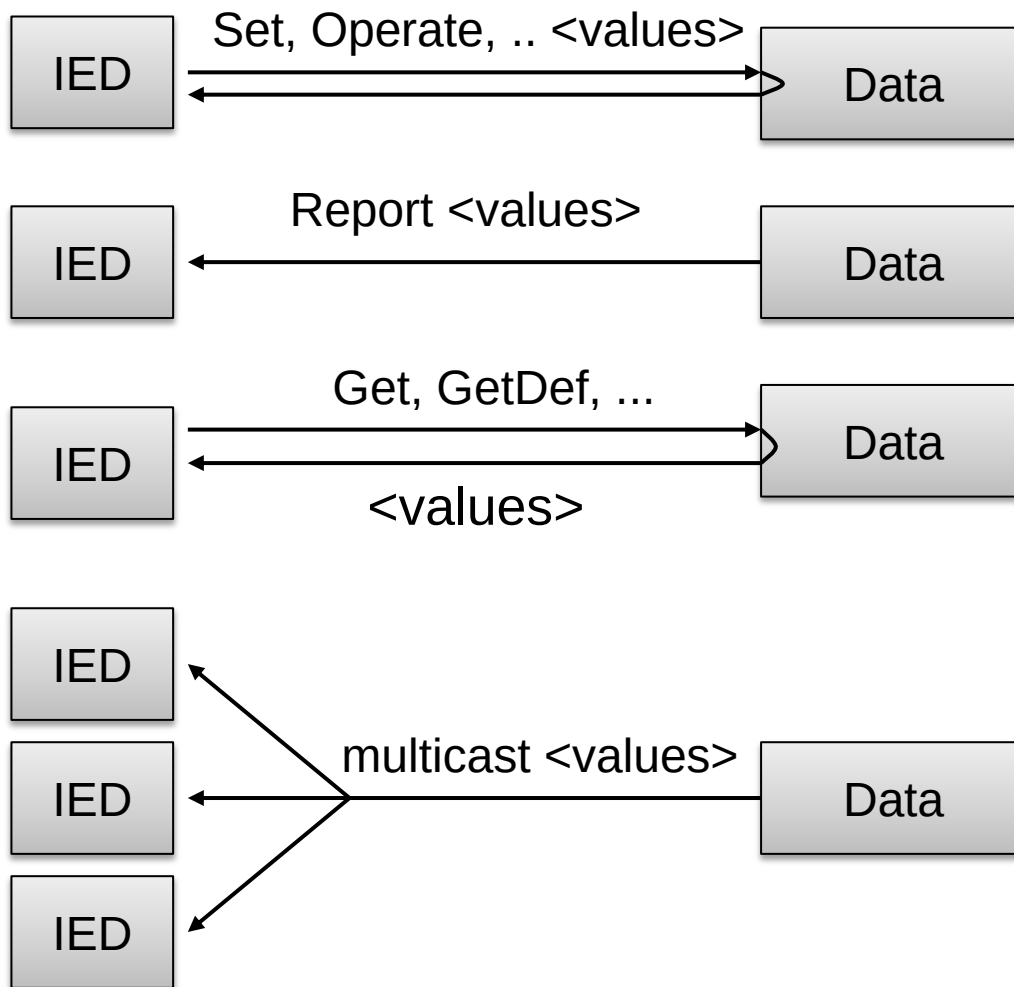
IEC 61850 – Razmjena informacija

Primanje:

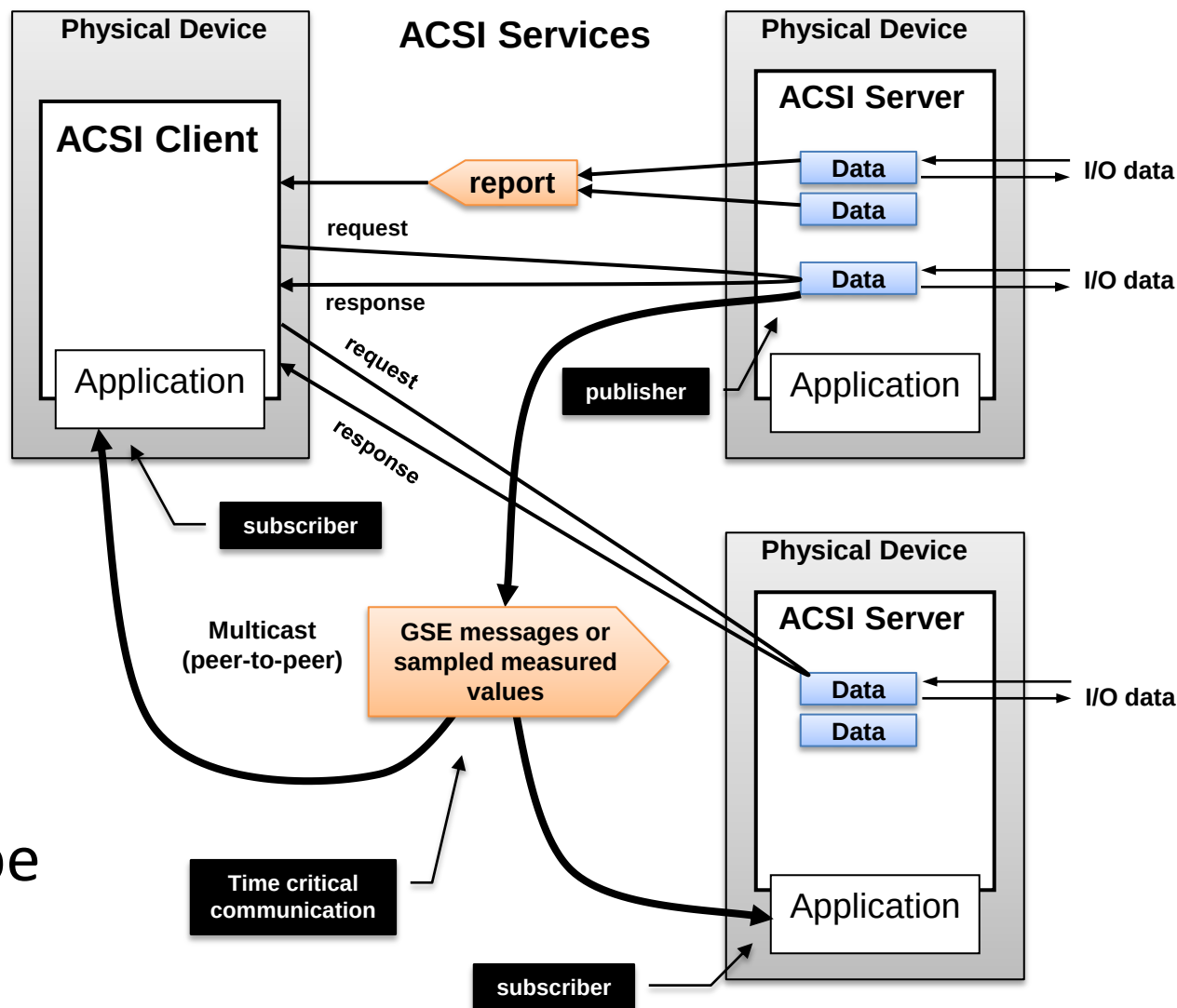
- spontano
- na zahtjev
- na pretplatu

Slanje:

- na zahtjev
- na pretplatu



IEC 61850 – Razmjena informacija



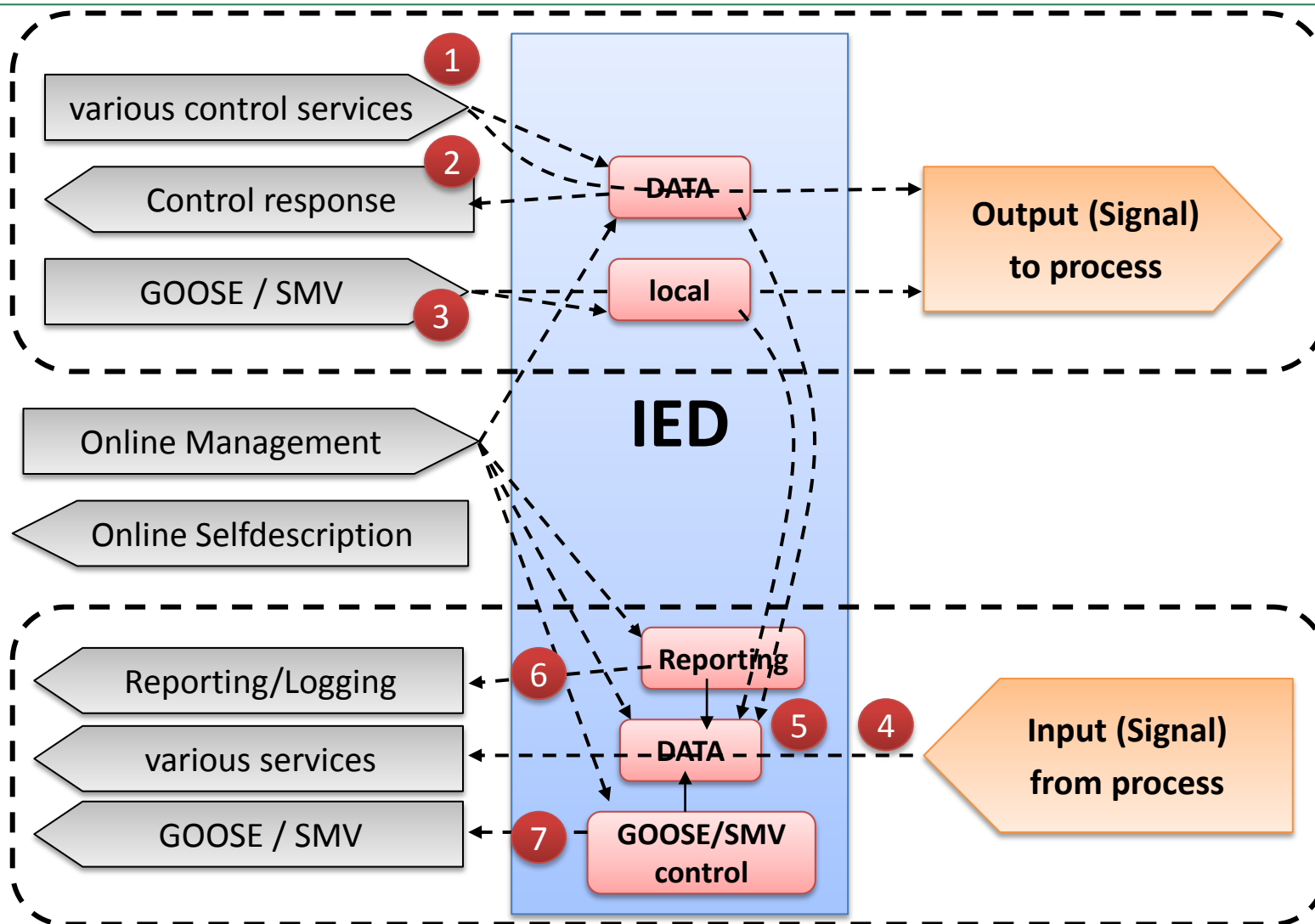
Vertical ACSI:

- clijent/server

Horizontal ACSI:

- publish/subscribe

IEC 61850 – Razmjena informacija



IEC 61850 – Informacijski model + ACSI servisi

Server

Logical Device

nameplate, health

Logical Node

Control

Substitution

Get/Set

Dir/Definition

Data

Data Set

Reporting and Logging

Report

GOOSE/GSSE

GOOSE

GSSE

Sampled measured values

SMV

Activate

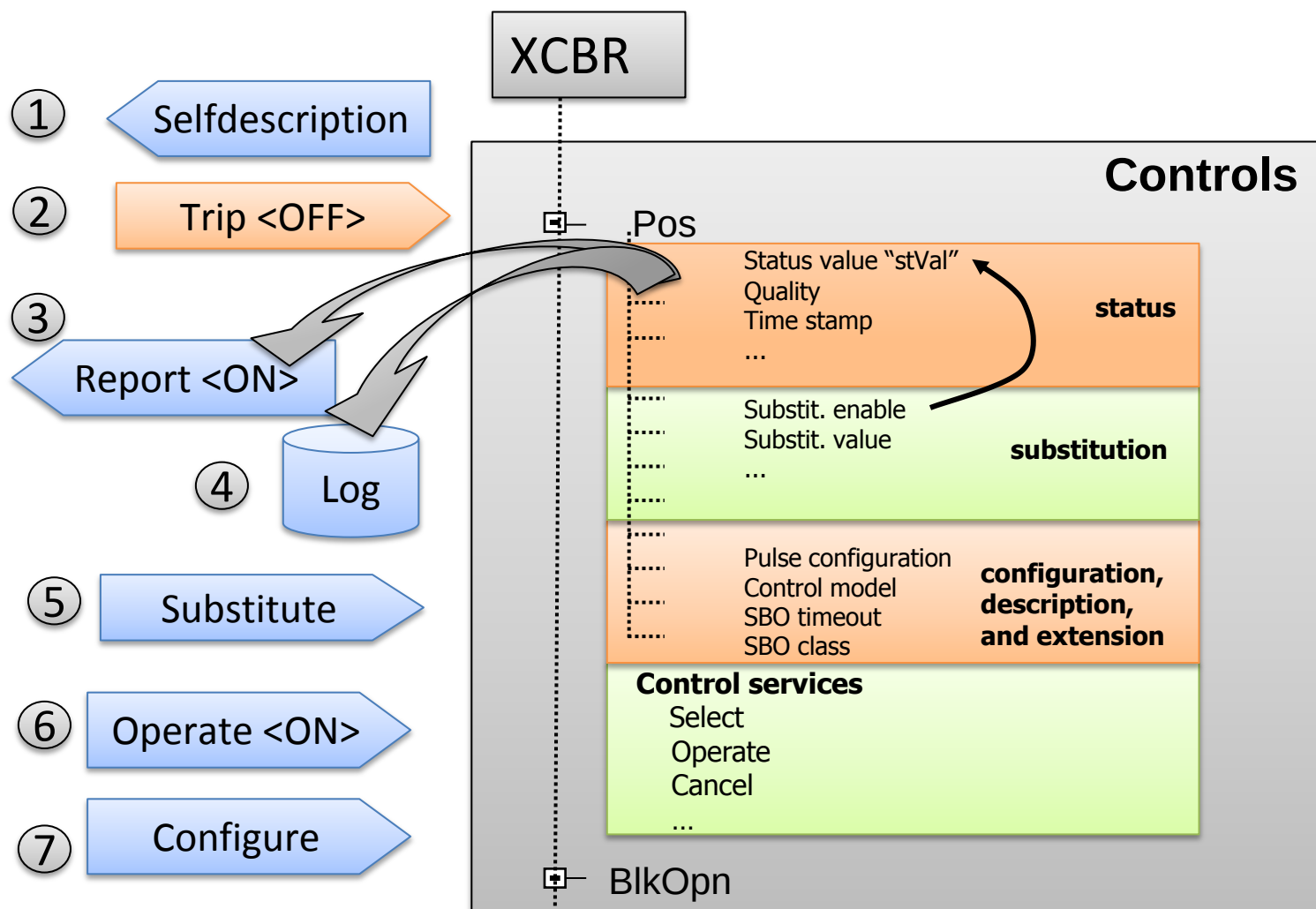
Setting Group

Association

Time Synchronisation

File Transfer

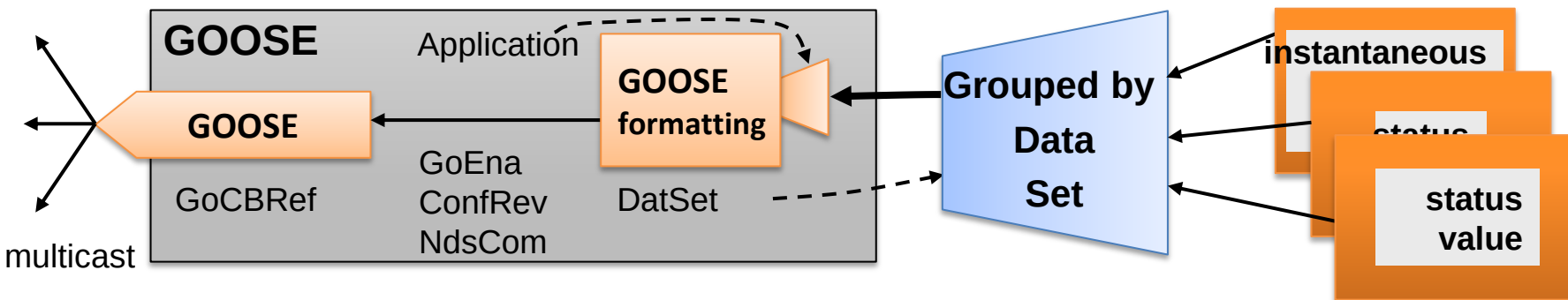
IEC 61850 – Informacijski model + ACSI servisi



IEC 61850 – Horizontalna komunikacija

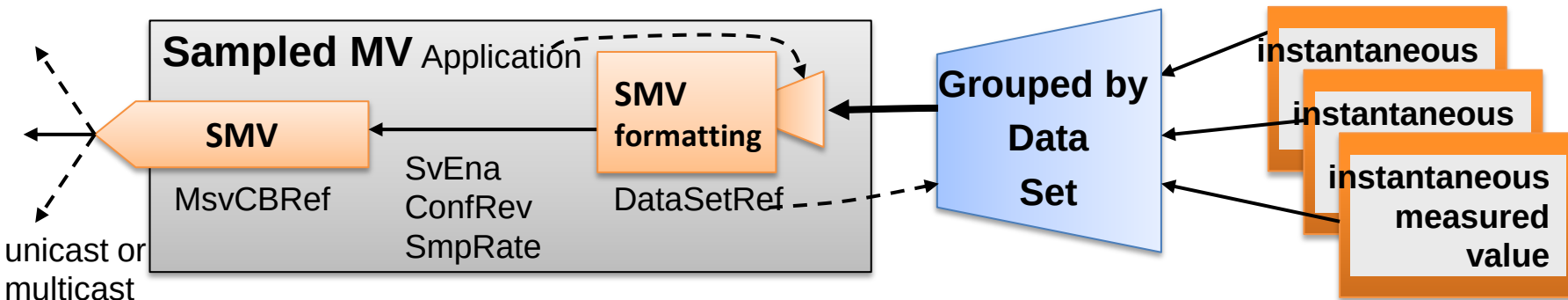
publisher

any data value

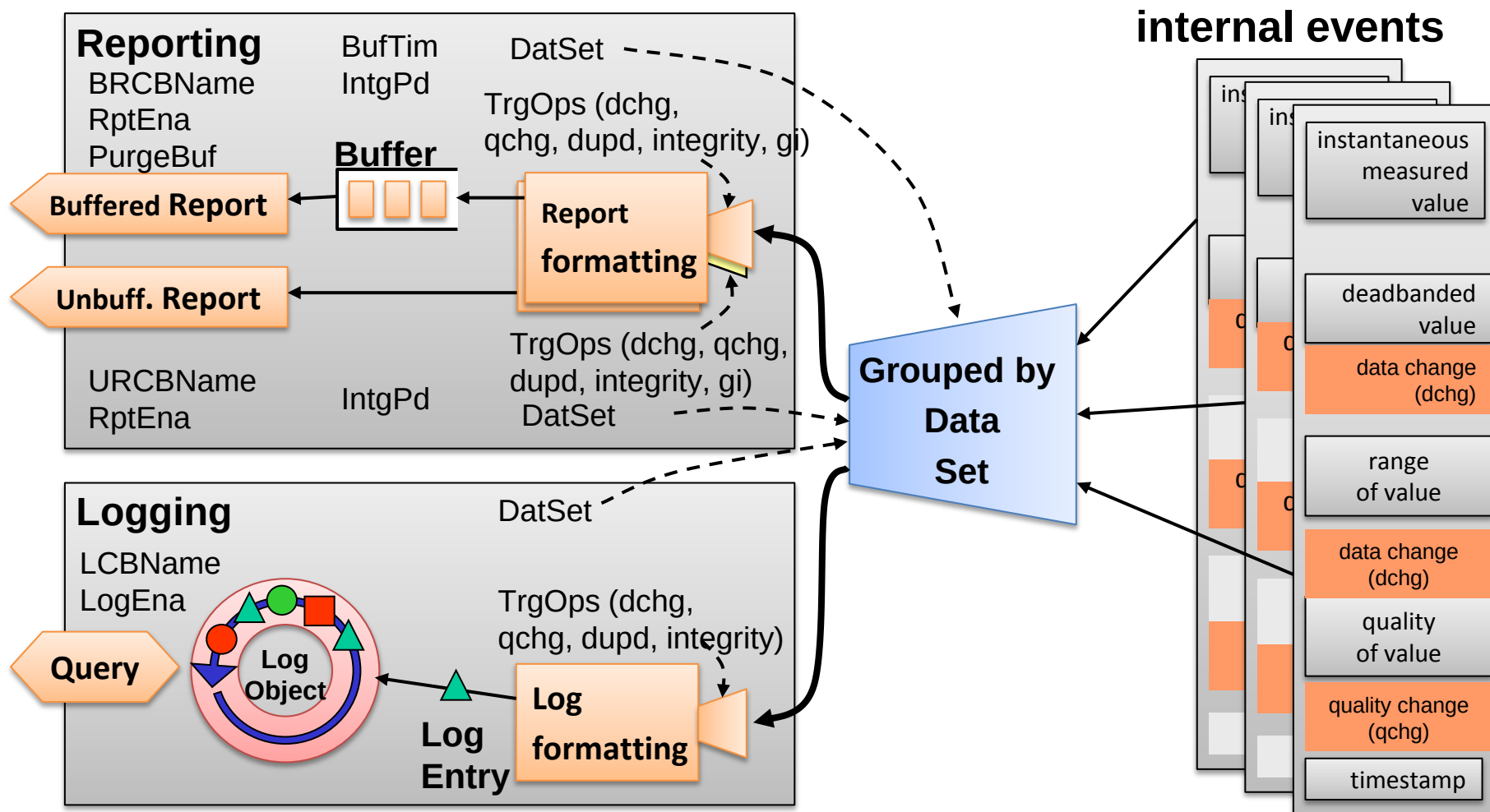


publisher

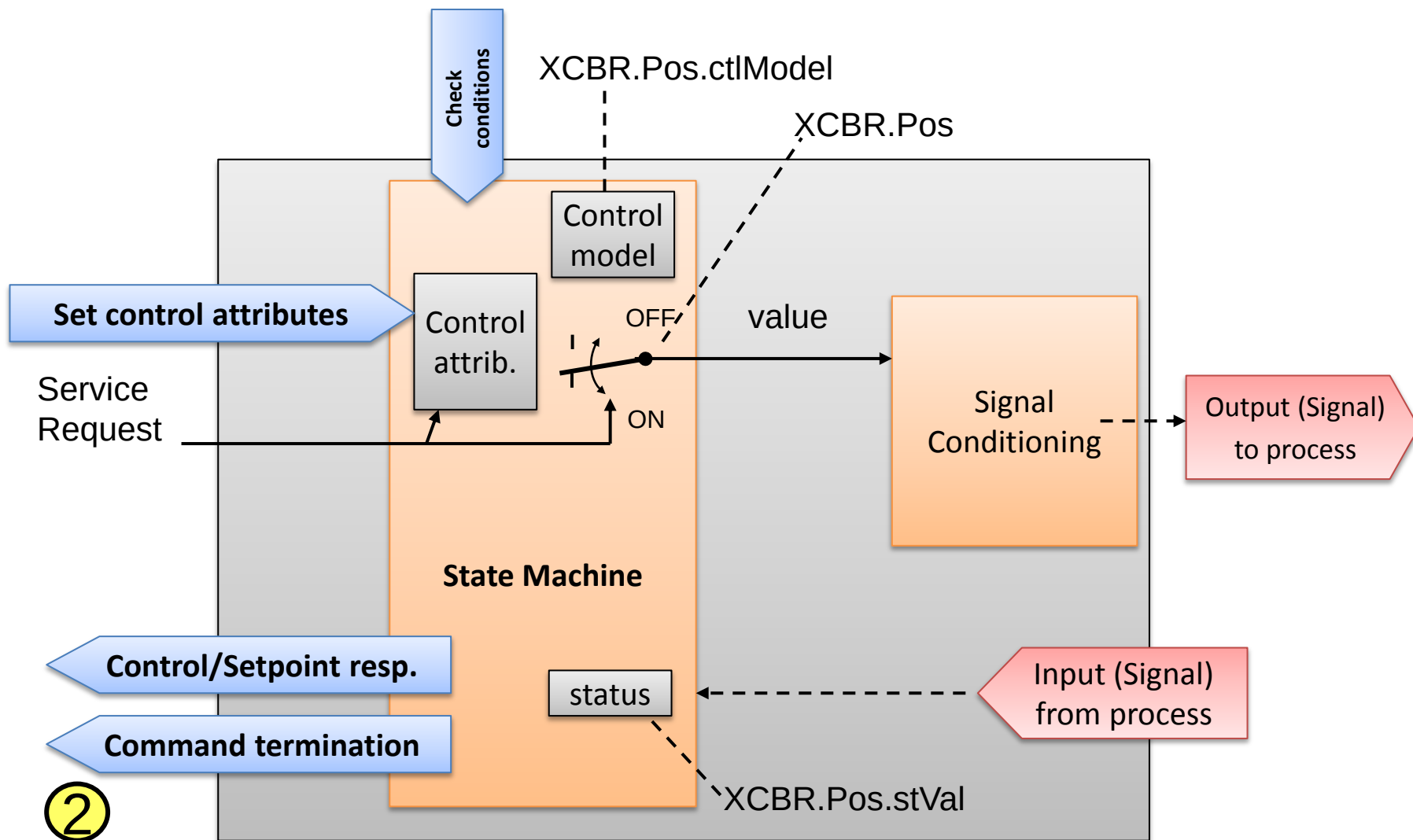
samples of measured values



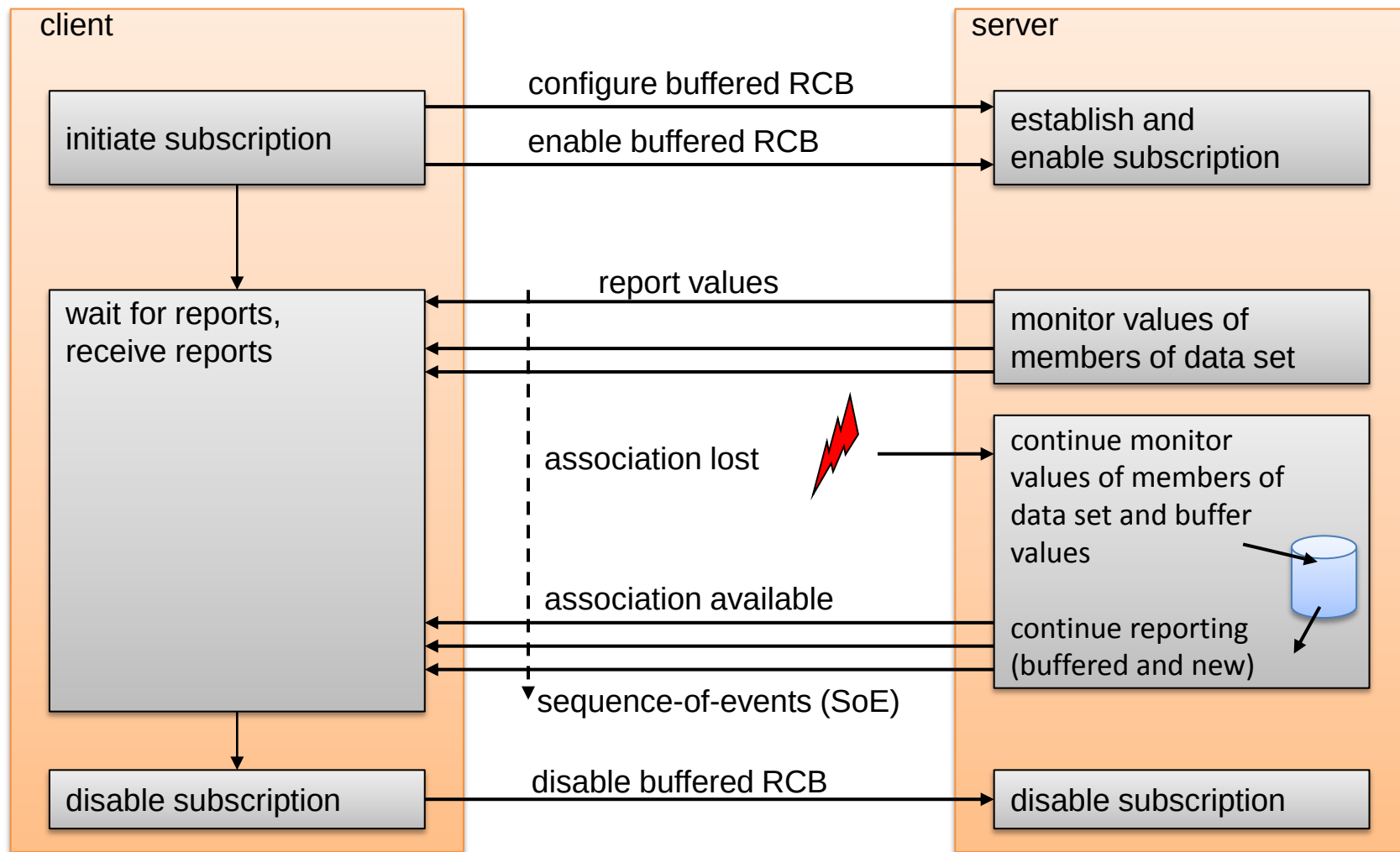
IEC 61850 – Vertikalna komunikacija



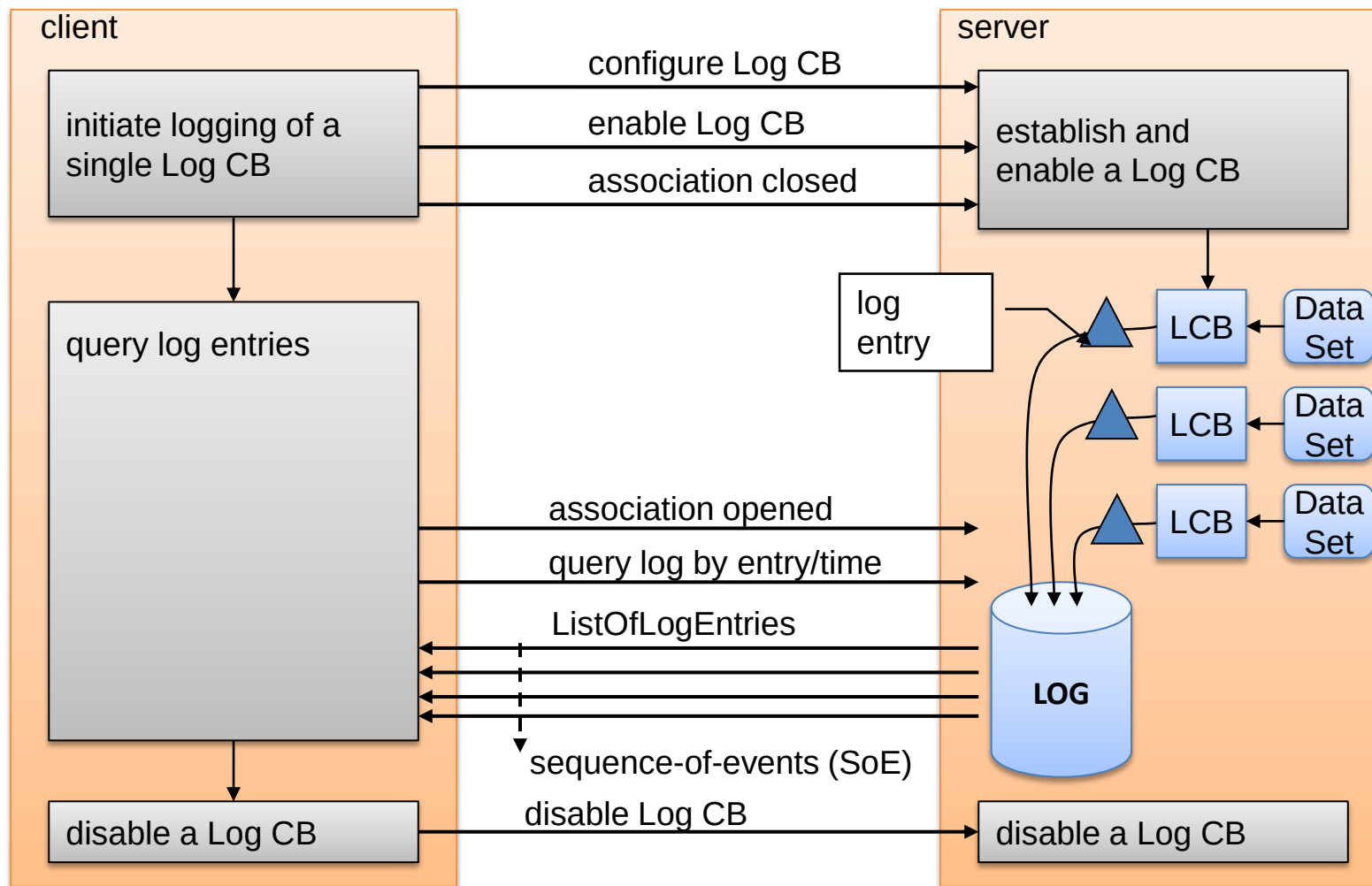
IEC 61850 – Vertikalna komunikacija (upravljanje)



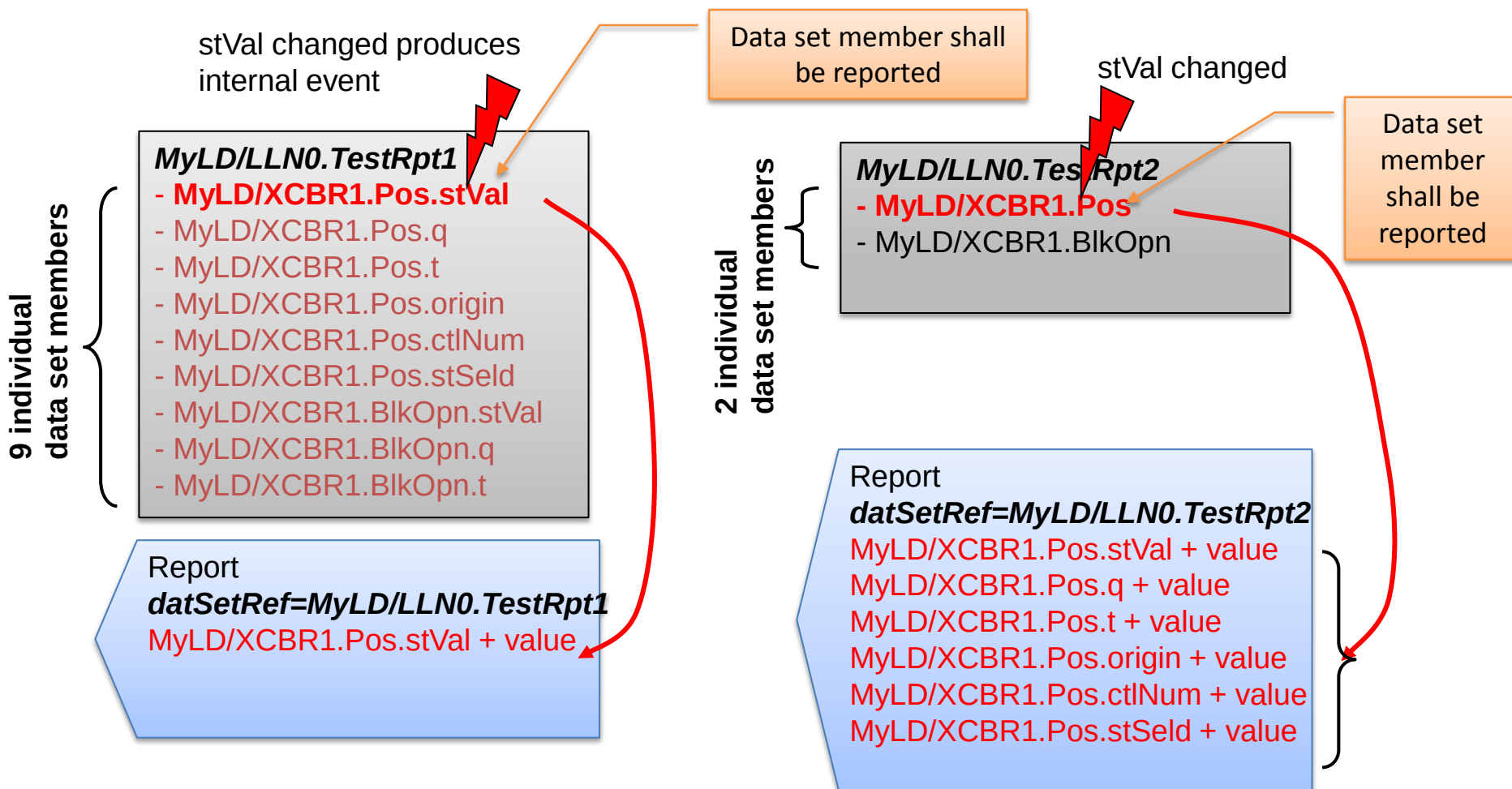
IEC 61850 – Vertikalna komunikacija (reporting)



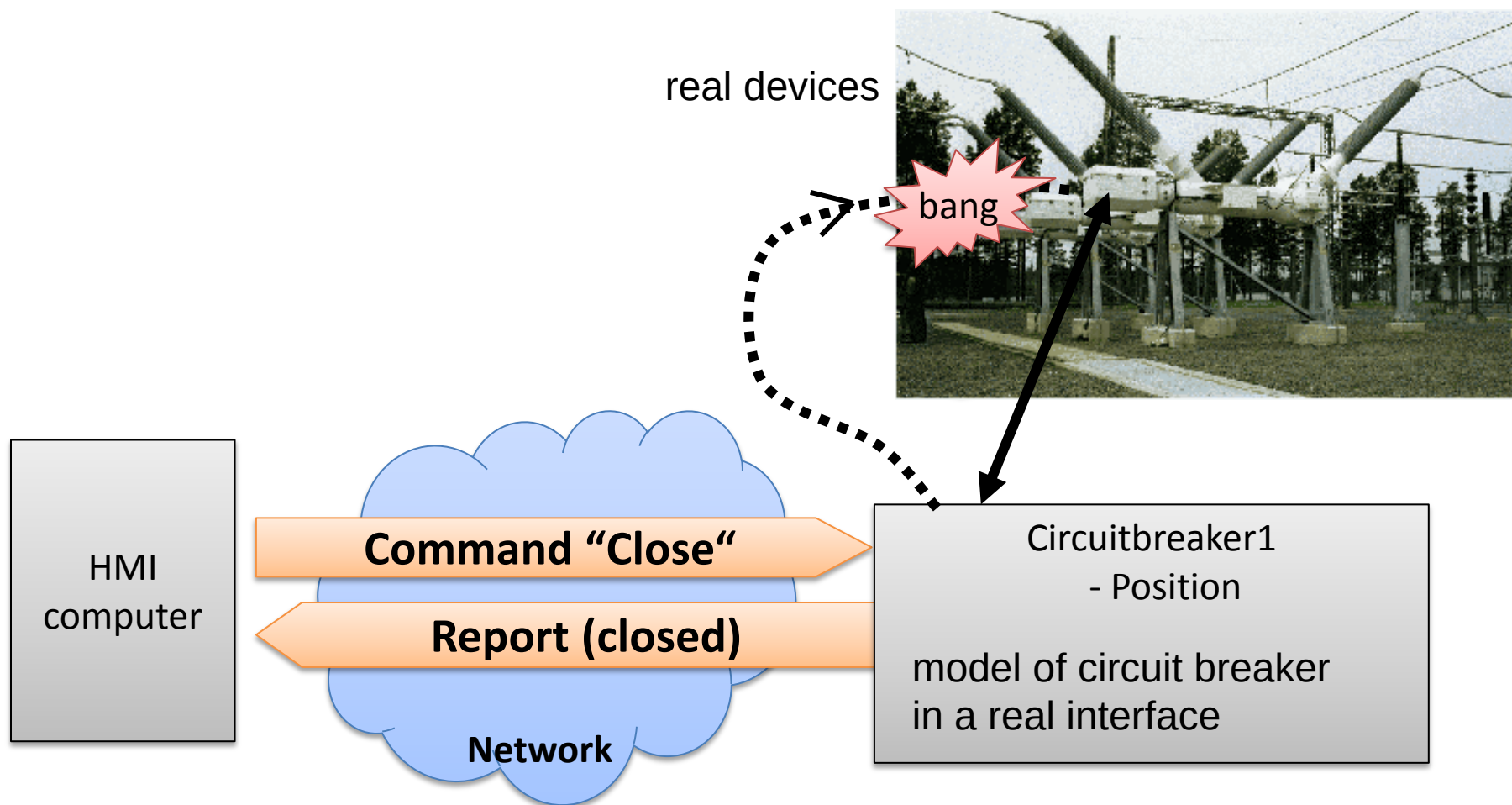
IEC 61850 – Vertikalna komunikacija (logging)



IEC 61850 – Vertikalna komunikacija



IEC 61850 – Uobičajena primjena

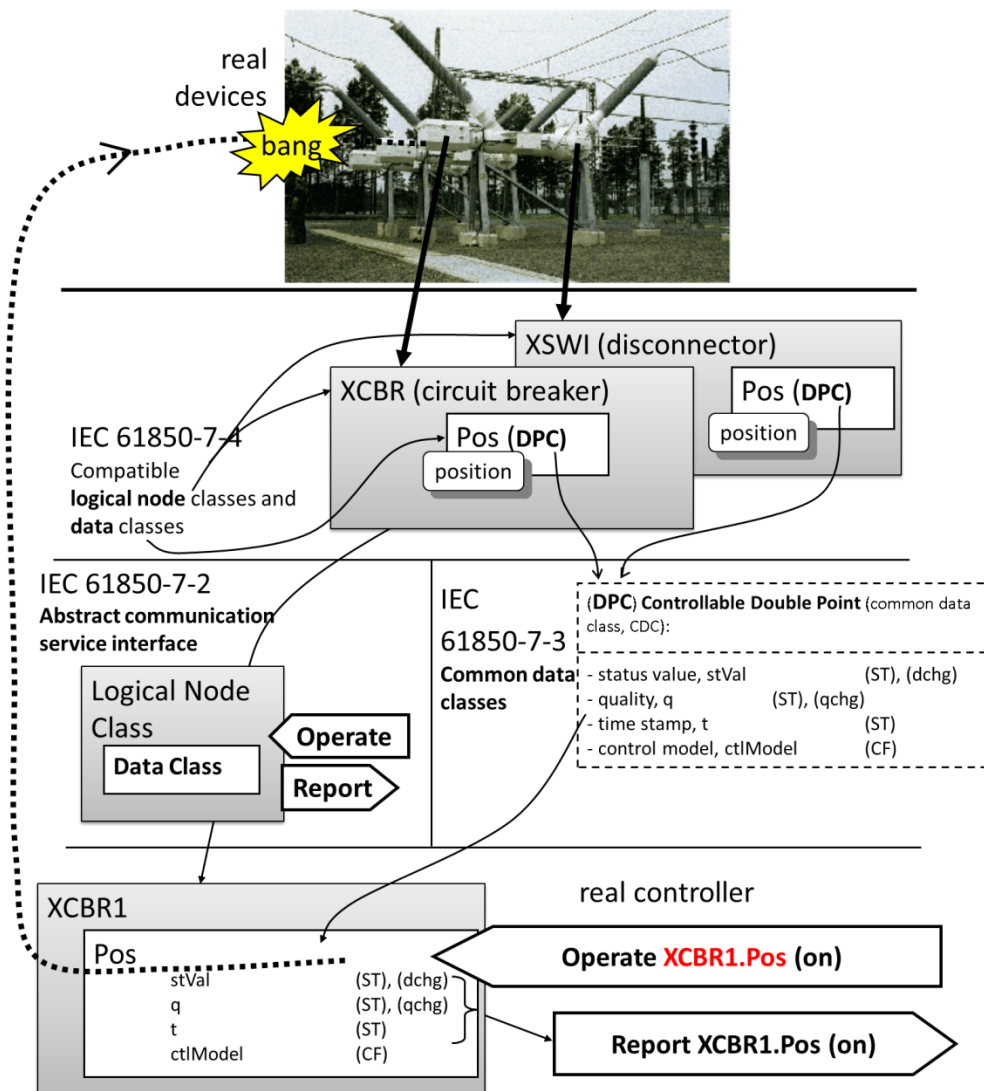


IEC 61850 – Usporedba metoda dohvata podataka

Retrieval method	Time-critical information exchange	Can lose changes (of sequence)	Multiple clients to receive information	Last change of data stored by	Typical client (but not exclusive)
Polling (GetDataValues)	NO	YES	YES	–	Browser
Unbuffered Reporting	YES	YES	NO	–	Real-time GUI
Buffered Reporting	YES	NO	NO	Server	Data concentrator
Log (used for SOE logging)	NO	NO	YES	Client	Engineering stations

IEC 61850 – Uobičajena primjena

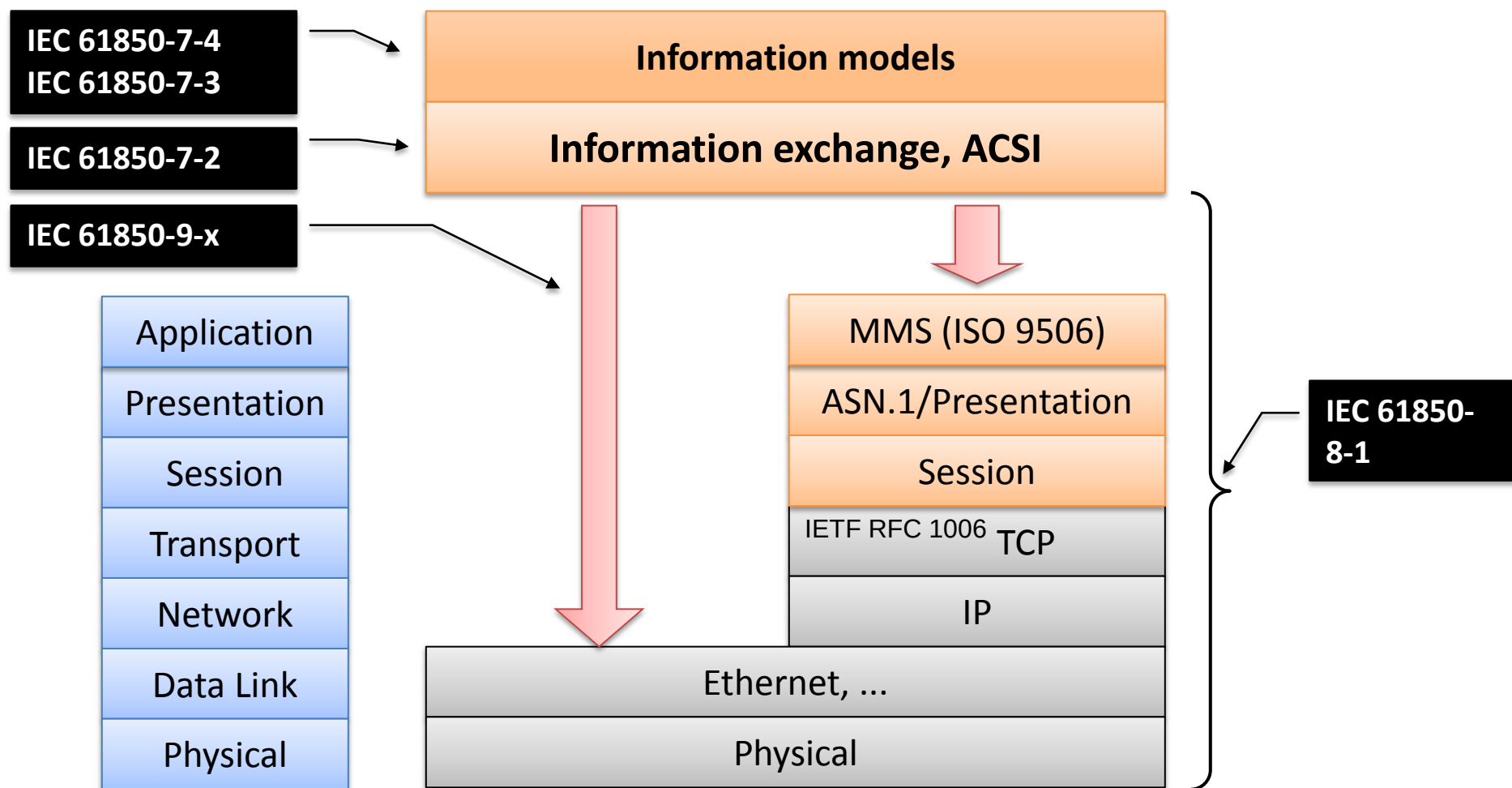
- Odnos među dijelovima standarda
- Funkcionalnosti upravljanog sustava



Sadržaj

- 1 • Arhitektura
- 2 • Arhitektura IEC 61850 sustava
- 3 • Informacijsko modeliranje
- 4 • Komunikacijski servisi
- 5 • Implementacijski zahtjevi**
- 6 • Konfiguracija

IEC 61850 – Implementacija





SEMINAR

Pregled, praksa i budući razvoj IEC 61850

Zagreb, 29. 03. 2012.

IEC 61850 – Implementacija (MMS)

What to be mapped?	Maps to
Logical device (contains logical nodes); IEC 61850-7-2	MMS domain
Logical nodes (contains data); IEC 61850-7-4	MMS named variable
Data; IEC 61850-7-4	MMS named variable (and structured components of the named variable representing the “logical node data”)
Data attribute; IEC 61850-7-3	MMS named variable (and structured components of the named variable representing the “data”)
Data set; IEC 61850-7-2	MMS named variable list
Control blocks (attributes); IEC 61850-7-2	MMS named variable
Control blocks (behaviour); IEC 61850-7-2	Needs to be programmed as defined in IEC 61850-7-2
Log; IEC 61850-7-2	MMS journal

IEC 61850 – Implementacija (MMS)

Identifier (Tag)
Length
Content

A3	52	
A0	50	
A1	05	
80	03	XX XX XX
A0	47	
8A	11	XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX
84	03	07 30 00
8C	06	XX XX XX XX XX XX
84	02	03 08
A2	1D	
A2	08	
85	01	03
8A	03	XX XX XX
84	02	06 40
84	03	03 00 00
91	08	XX XX XX XX XX XX XX XX
84	02	02 40

1 octet for the tag;
1 octet for length;
2 octets for value

```

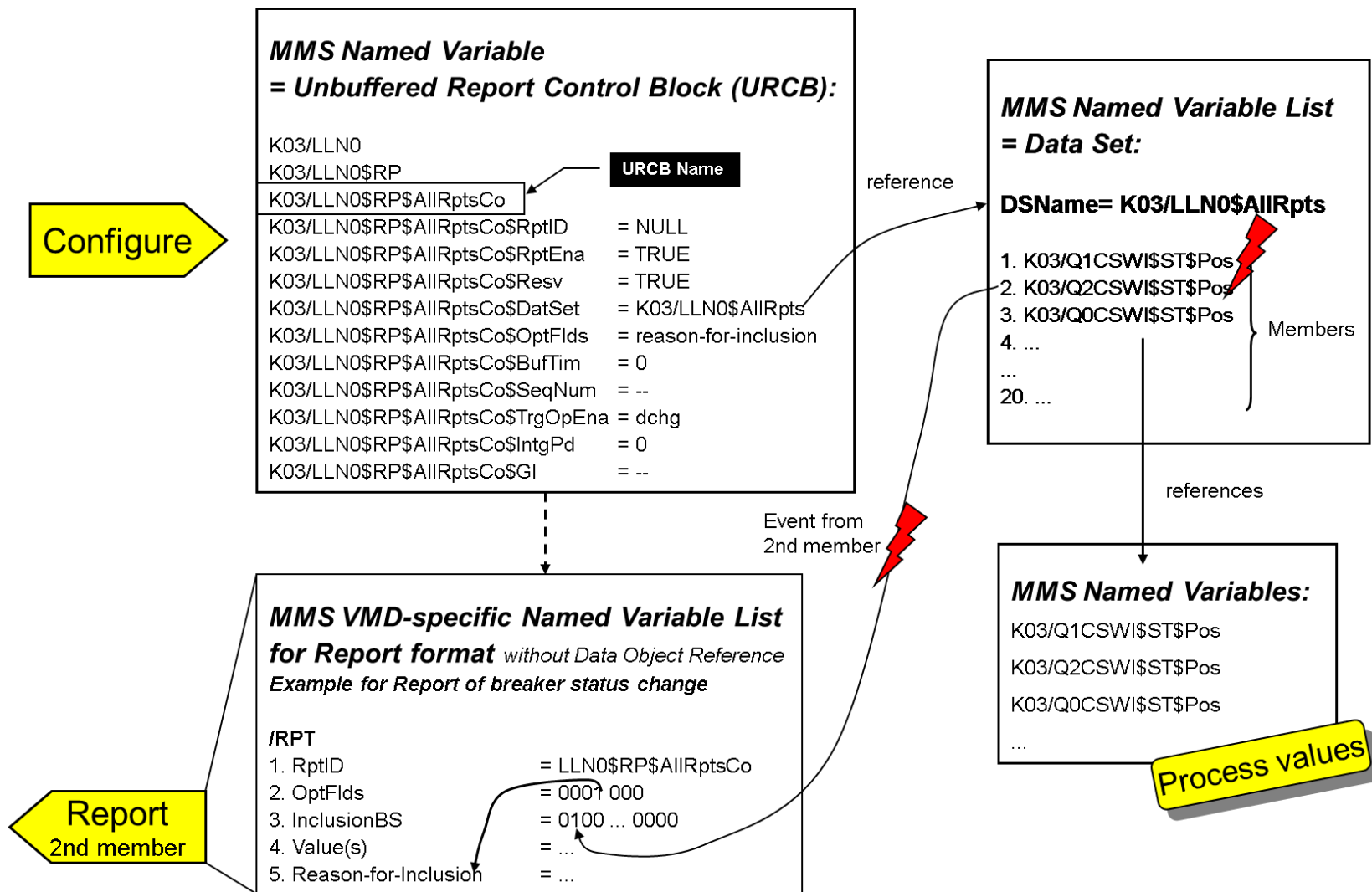
MMSpdu ::= CHOICE { ...
  . unconfirmed-PDU [8] IMPLICIT SEQUENCE { ...
    . CHOICE { ...
      . . . informationReport [0] IMPLICIT SEQUENCE { ...
        . . . . variableAccessSpecification CHOICE { ...
          . . . . . variableListName [1] CHOICE { ...
            . . . . . vmdSpecific [0] IMPLICIT VisibleString <RPT>}
            . . . . . }, -- end of variableAccessSpecification
            . . . . . listOfAccessResult [0] IMPLICIT SEQUENCE OF CHOICE { ...
              . . . . . . CHOICE {... visible-string [10] IMPLICIT VisibleString <LLN0$RP$AllRptsCo>}, -- RptID
              . . . . . . CHOICE {... bit-string [4] IMPLICIT BIT STRING <0011 0000 0>}, -- OptFlds
              . . . . . . CHOICE {... binary-time [12] IMPLICIT BINARY TIME <DD DD MS MS MS MS>}, -- TimeOfEntry
              . . . . . . CHOICE {... bit-string [4] IMPLICIT BIT STRING <0000 1>}, -- InclBS
              . . . . . . -- Value(s) - here only one
              . . . . . . CHOICE {... structure [2] IMPLICIT SEQUENCE OF
                . . . . . . . CHOICE {... structure [2] IMPLICIT SEQUENCE OF
                  . . . . . . . . CHOICE {... integer [5] IMPLICIT INTEGER <3> }, -- origin
                  . . . . . . . . CHOICE {... visible-string [10] IMPLICIT VisibleString <ADM> } } -- origin.orCat
                  . . . . . . . . CHOICE {... bit-string [4] IMPLICIT BIT STRING <01> }, -- stVal
                  . . . . . . . . CHOICE {... bit-string [4] IMPLICIT BIT STRING <0000 0000 0000 0>}, -- q
                  . . . . . . . . CHOICE {... utc-time [17] IMPLICIT UtcTime<SS SS SS SS QQ MM MM MM>}, -- t
                  . . . . . . . . } -- end of „Value“
                  . . . . . . . . CHOICE {... integer [4] IMPLICIT BIT STRING <0100 00>} -- reasonCode
                  . . . . . . . . } -- end of ListOfAccessResult
                . . . . . . . . } -- end of informationReport
              . . . . . . }
            . . . . . } -- end of unconfirmedPDU
          . . . . . } -- end of MMSpdu

```

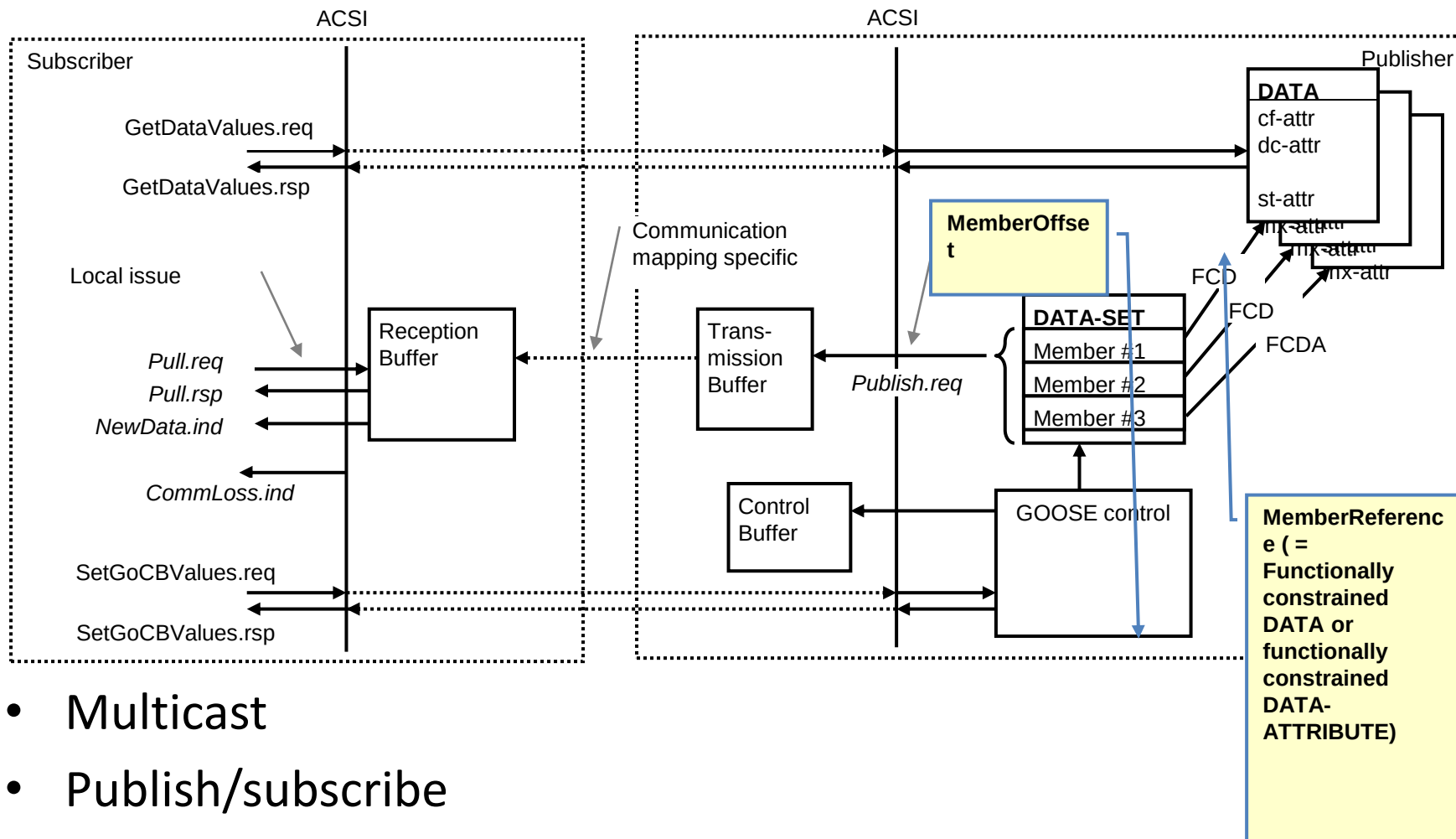
Interpretation of received message
(Tag values -> ASN.1 syntax (Schema))

MMS Syntax (written in ASN.1) defined in ISO 9506-2

IEC 61850 – Implementacija (MMS)



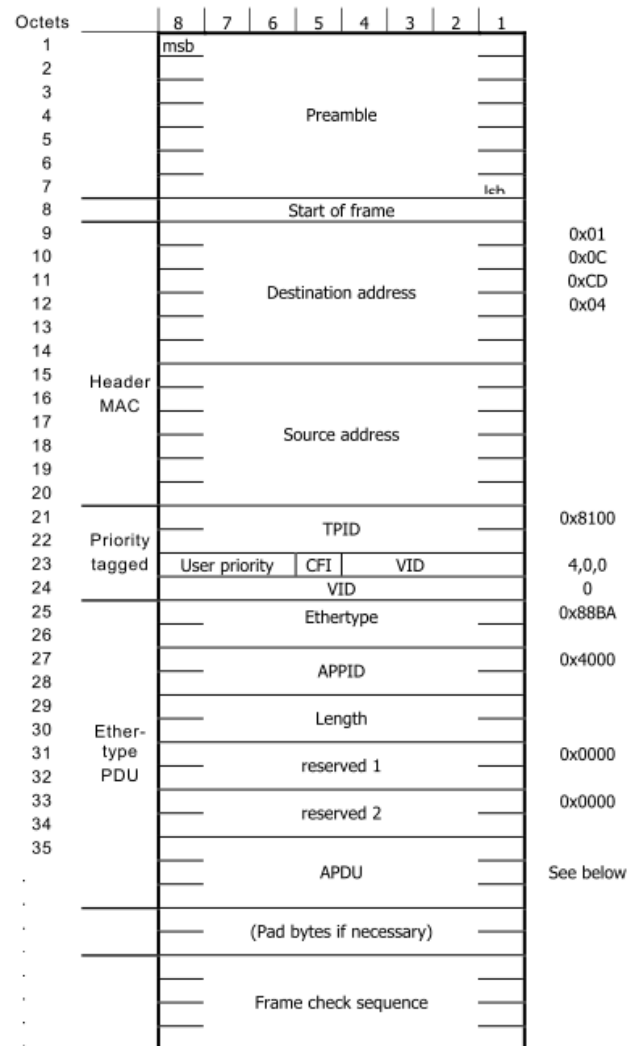
IEC 61850 – Implementacija (GOOSE)



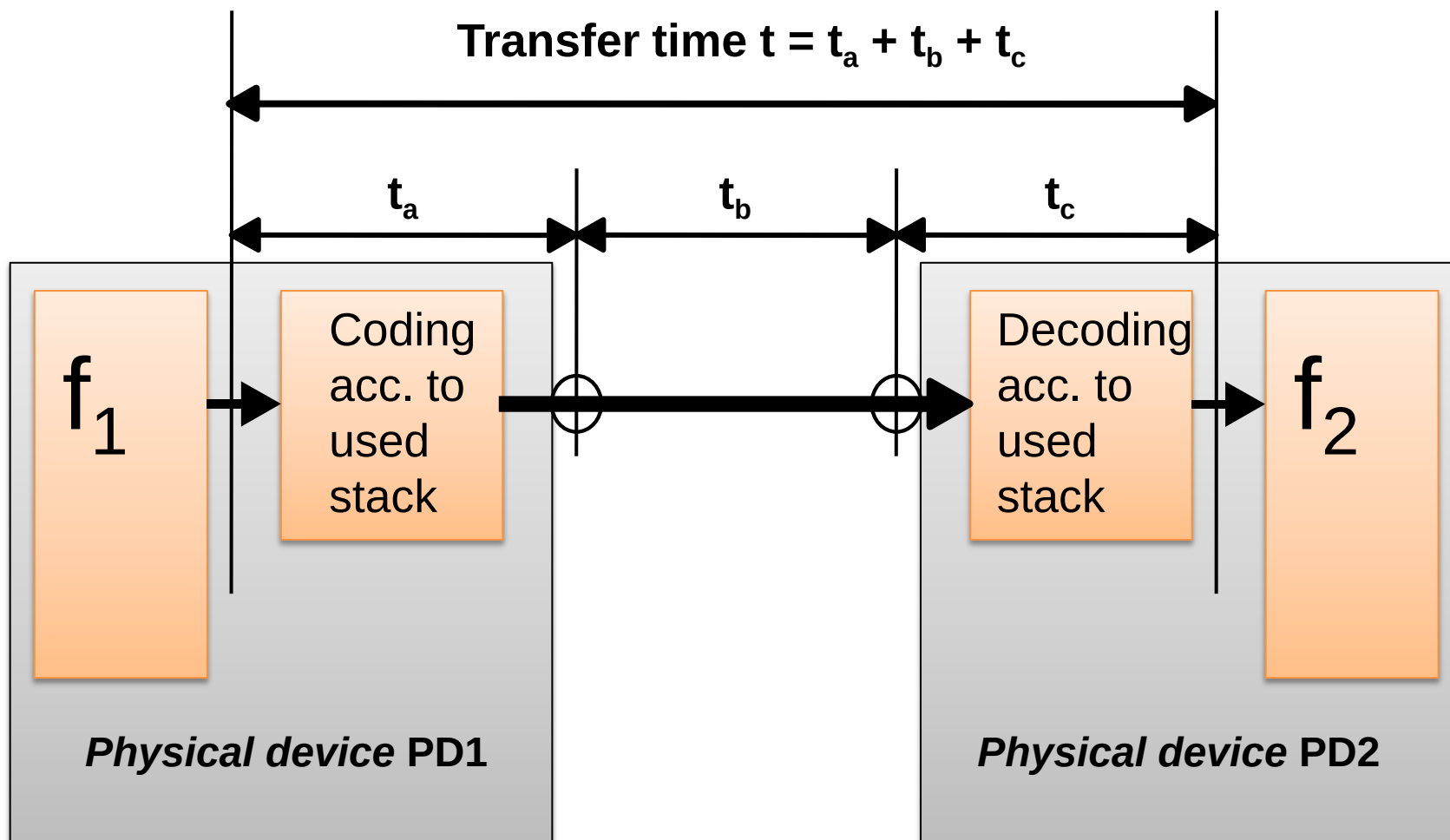
- Multicast
- Publish/subscribe
- Cikličko slanje

IEC 61850 – Implementacija (SMV)

- 4800 Hz za zaštitne funkcije
- 14400 Hz za mjerenje kvalitete eklektične mreže
- Multicast
- Publish/subscribe
- Cikličko slanje



IEC 61850 – Vremena dostave poruka



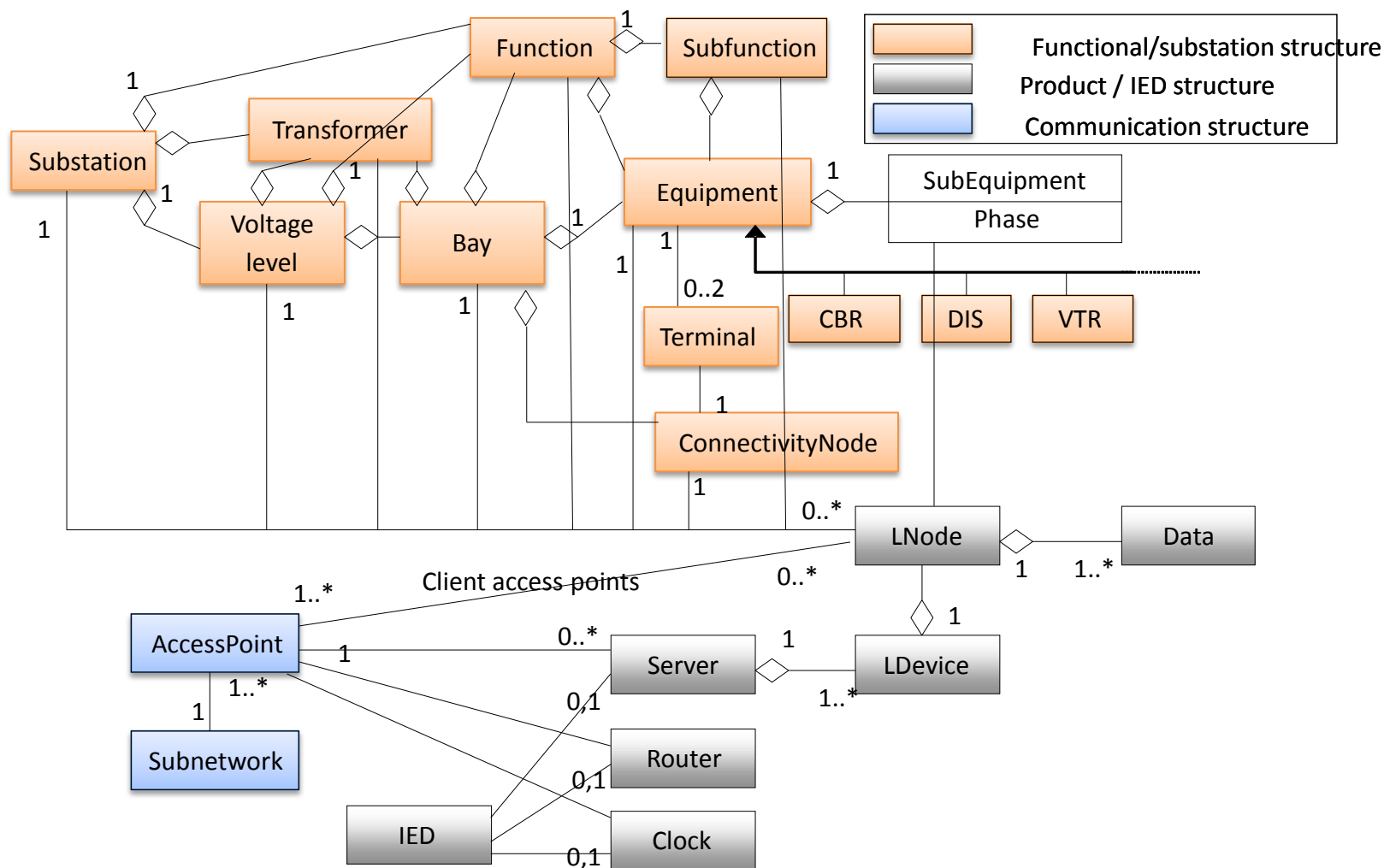
IEC 61850 – Vremenske klase poruka

Transfer time class	Transfer time [ms]	Application examples: Transfer of
TT0	>1 000	Files, events, log contents
TT1	1 000	Events, alarms
TT2	500	Operator commands
TT3	100	Slow automatic interactions
TT4	20	Fast automatic interactions
TT5	10	Releases, Status changes
TT6	3	Trips, Blockings

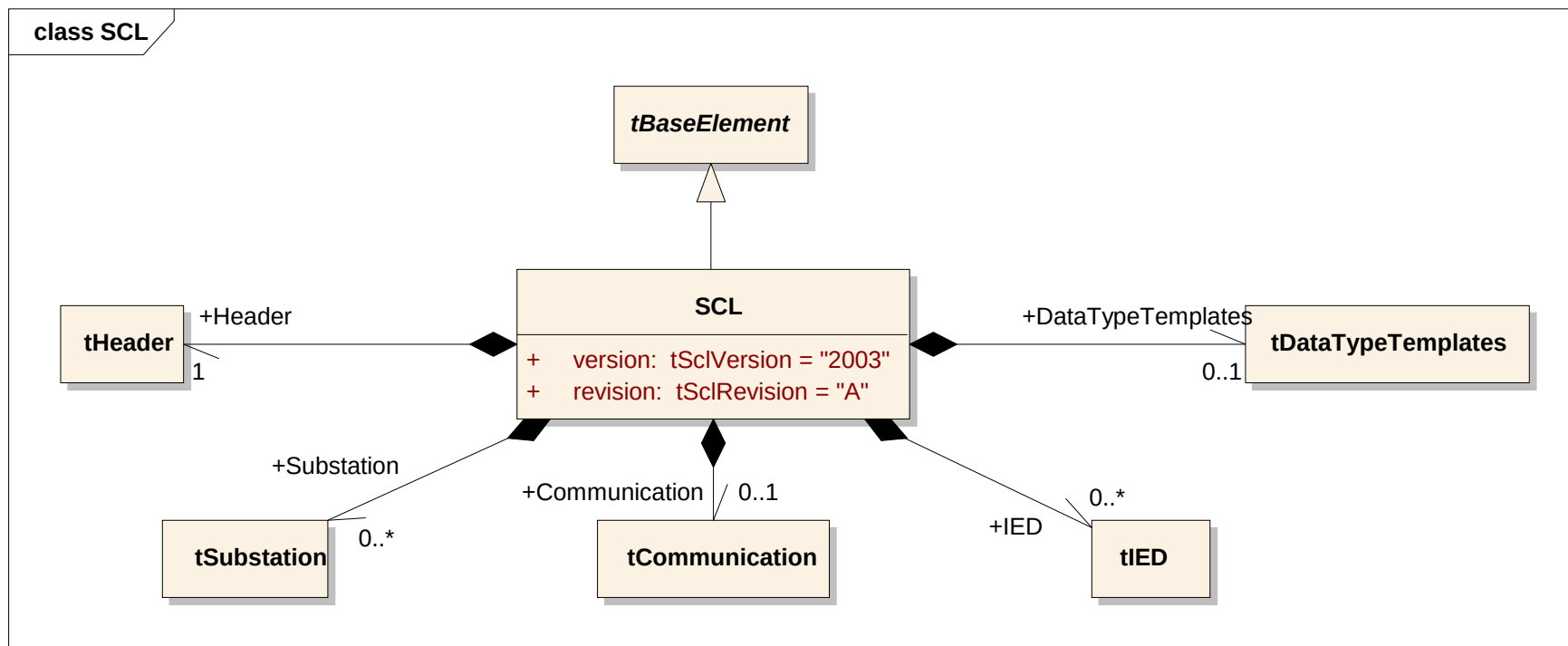
Sadržaj

- 1 • Arhitektura
- 2 • Arhitektura IEC 61850 sustava
- 3 • Informacijsko modeliranje
- 4 • Komunikacijski servisi
- 5 • Implementacijski zahtjevi
- 6 • **Konfiguracija**

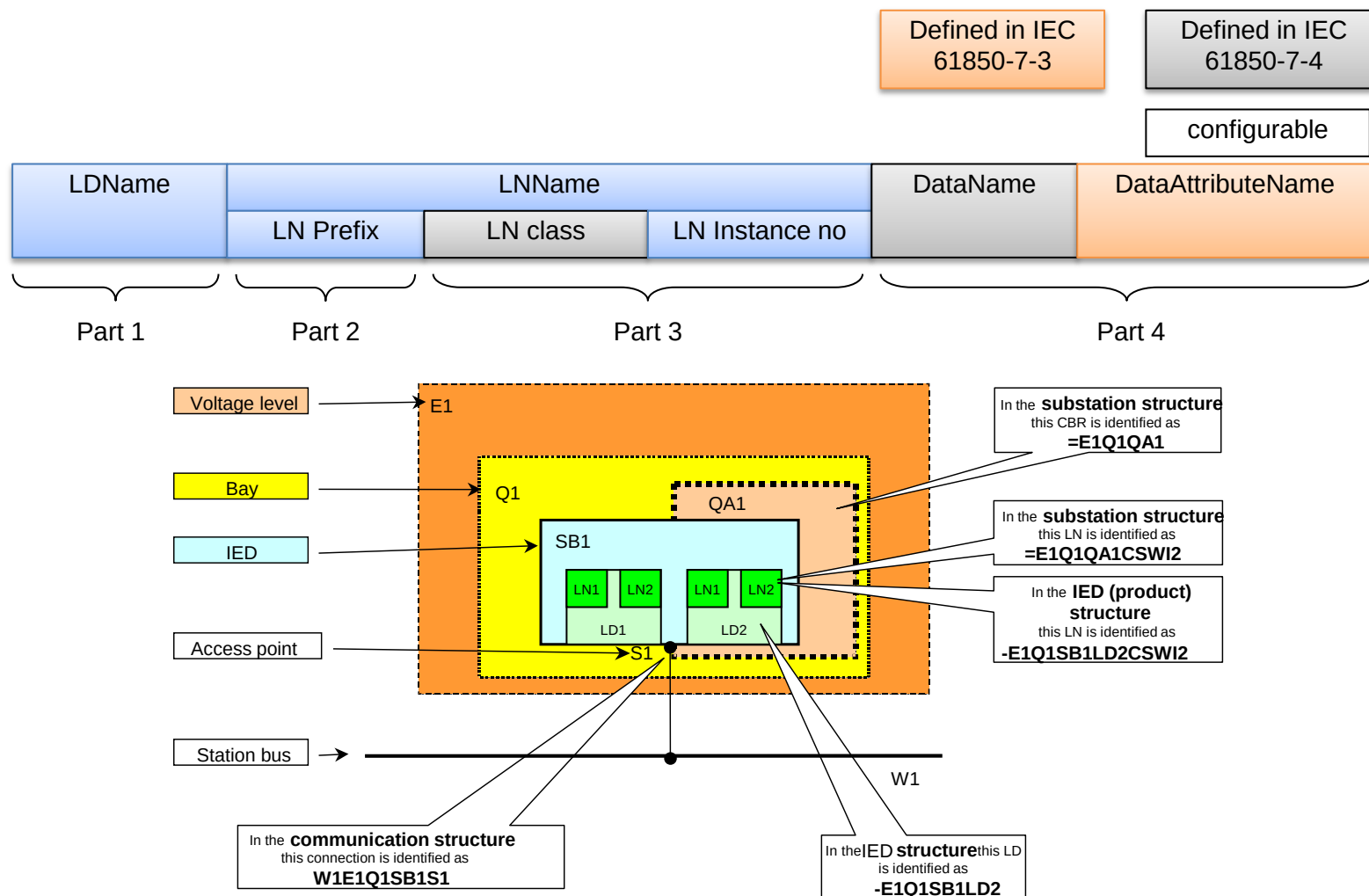
IEC 61850 – Konfiguracija



IEC 61850 – SCL struktura

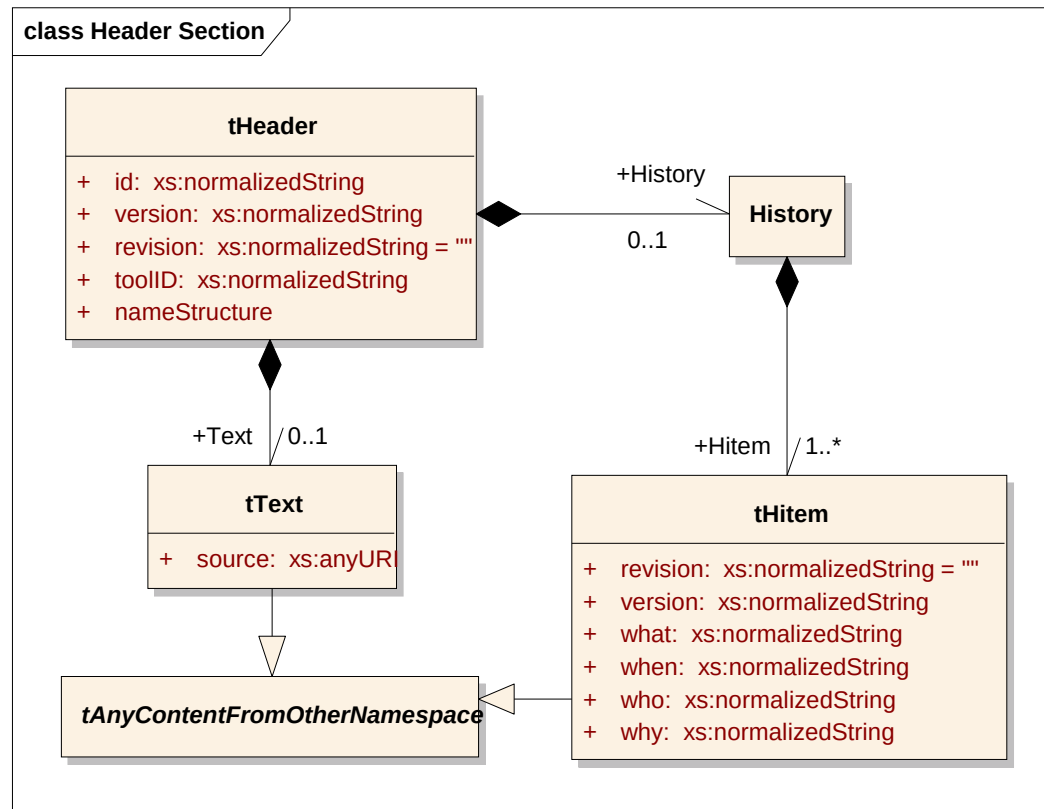


IEC 61850 – Identifikacija signala

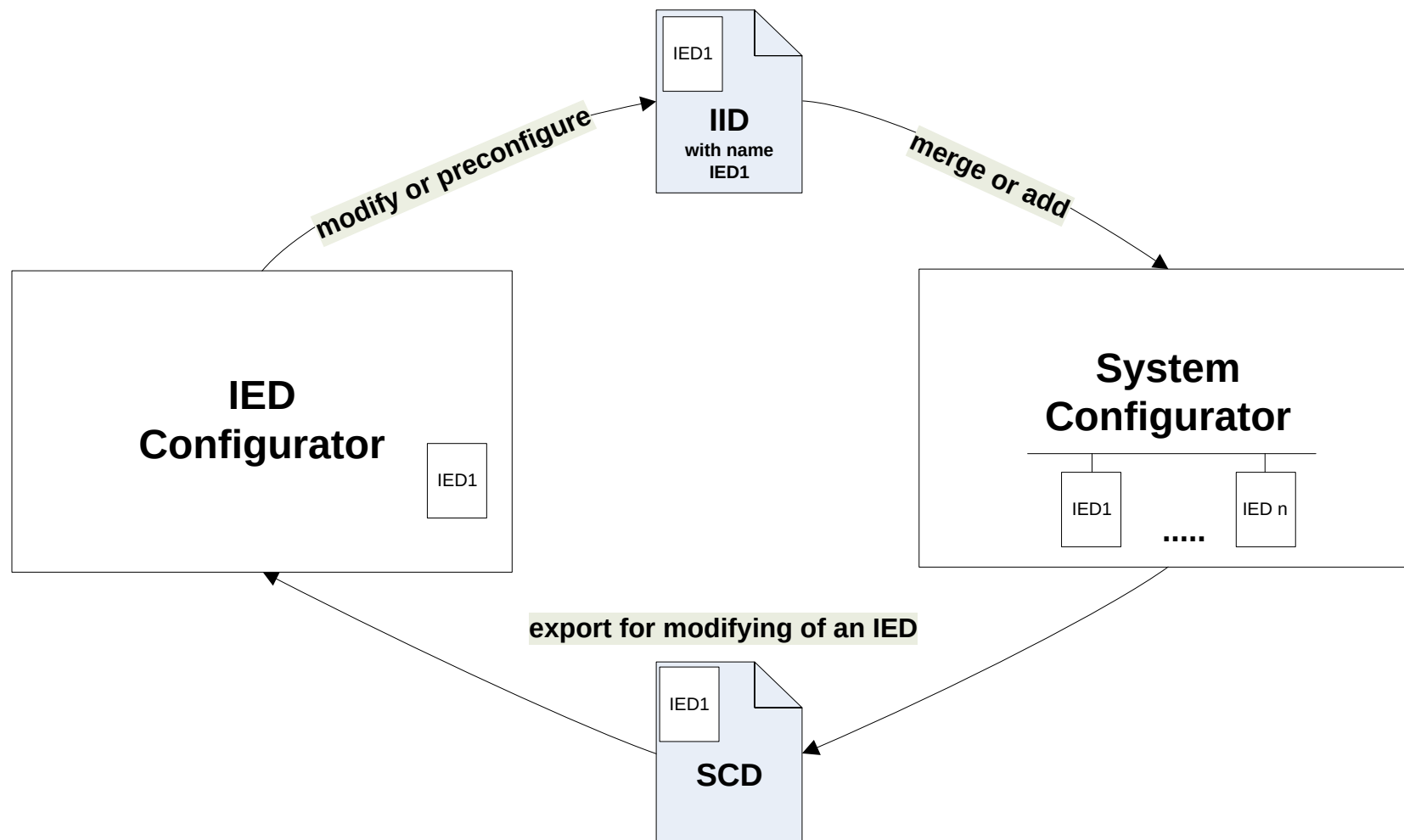


IEC 61850 – XML struktura

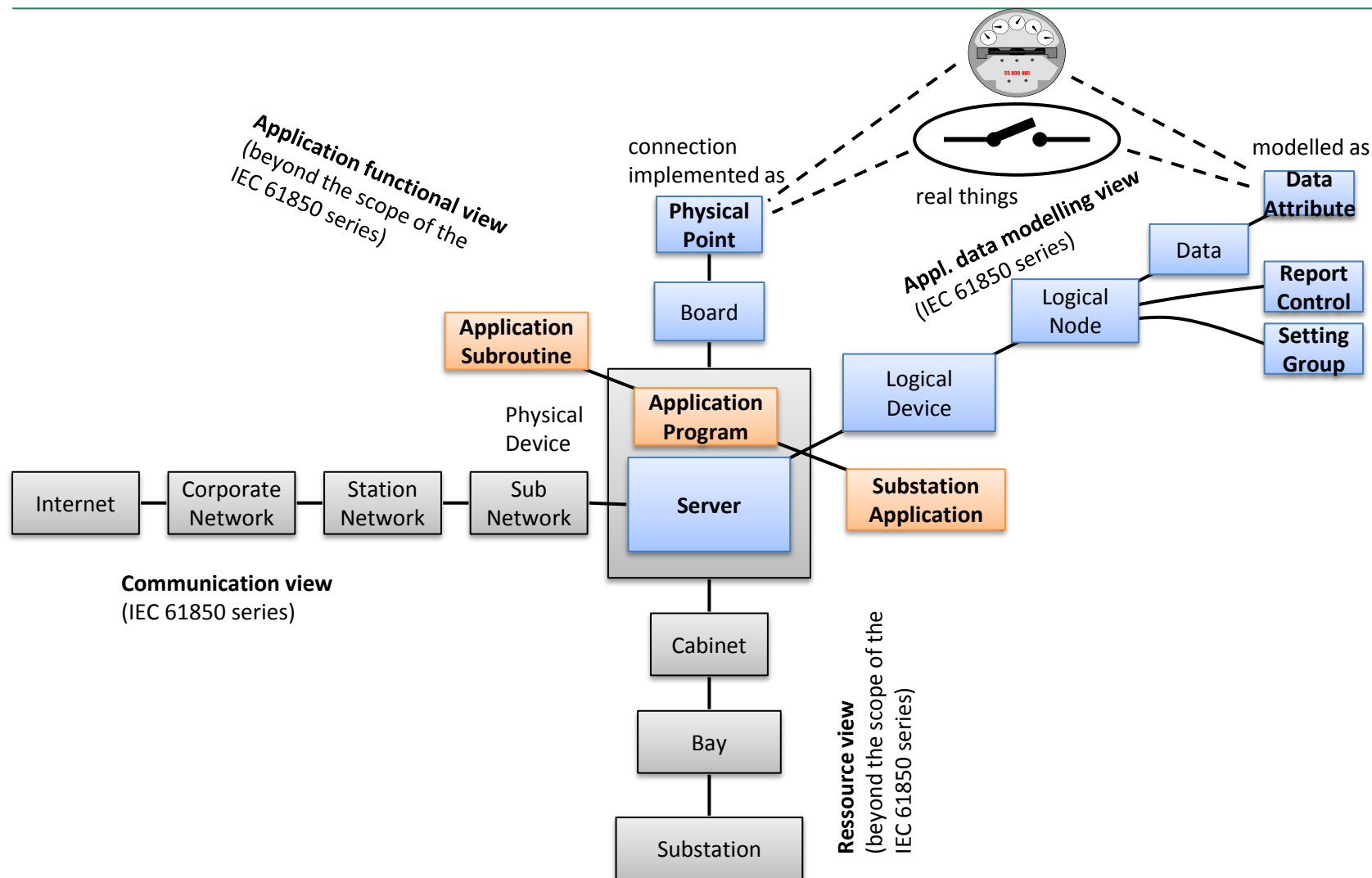
```
<xs:complexType name="tHeader">
  <xs:sequence>
    <xs:element name="Text" type="tText" minOccurs="0" maxOccurs="1"/>
    <xs:element name="History" minOccurs="0" maxOccurs="1">
      <xs:complexType>
        <xs:sequence>
          <xs:element name="Hitem" type="tHitem"/>
        </xs:sequence>
      </xs:complexType>
    </xs:element>
  </xs:sequence>
  <xs:attribute name="id" type="xs:normalizedString" use="optional"/>
  <xs:attribute name="version" type="xs:normalizedString" use="optional"/>
  <xs:attribute name="revision" type="xs:normalizedString" use="optional"/>
  <xs:attribute name="toolID" type="xs:normalizedString" use="optional"/>
  <xs:attribute name="nameStructure" type="xs:string" use="optional" default="IEC 61850-7-410" />
  <xs:simpleType>
    <xs:restriction base="xs:Name">
      <xs:enumeration value="IEDName"/>
    </xs:restriction>
  </xs:simpleType>
</xs:attribute>
</xs:complexType>
```



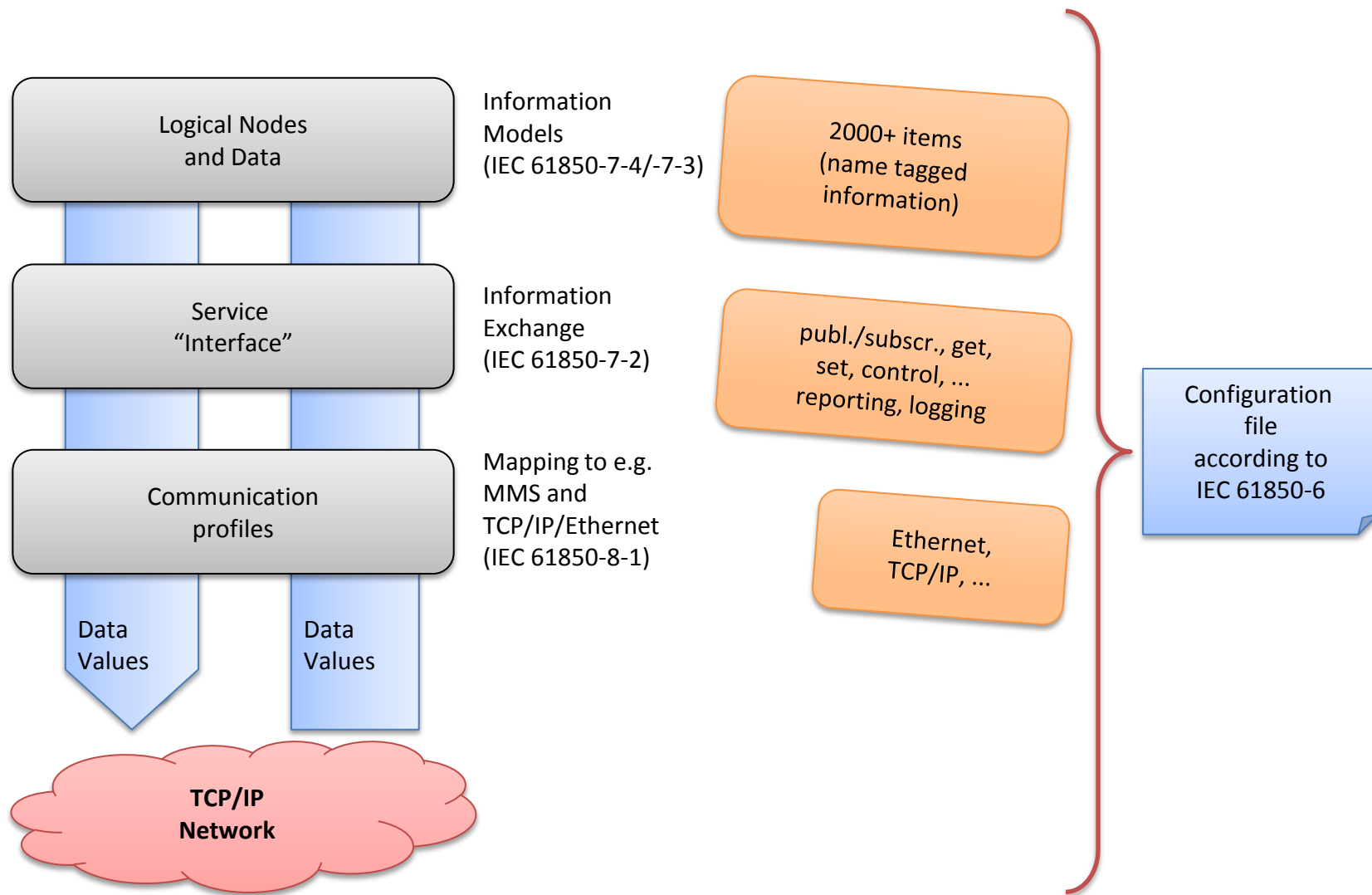
IEC 61850 – Konfiguracija



IEC 61850 – Perspektiva sustava



IEC 61850 – Pregled



ČETVRTI DIO:

NOVITETI DRUGOG IZDANJA I BUDUĆI RAZVOJ NORME IEC 61850

Predavač: Stjepan Sučić, mag. ing. el.

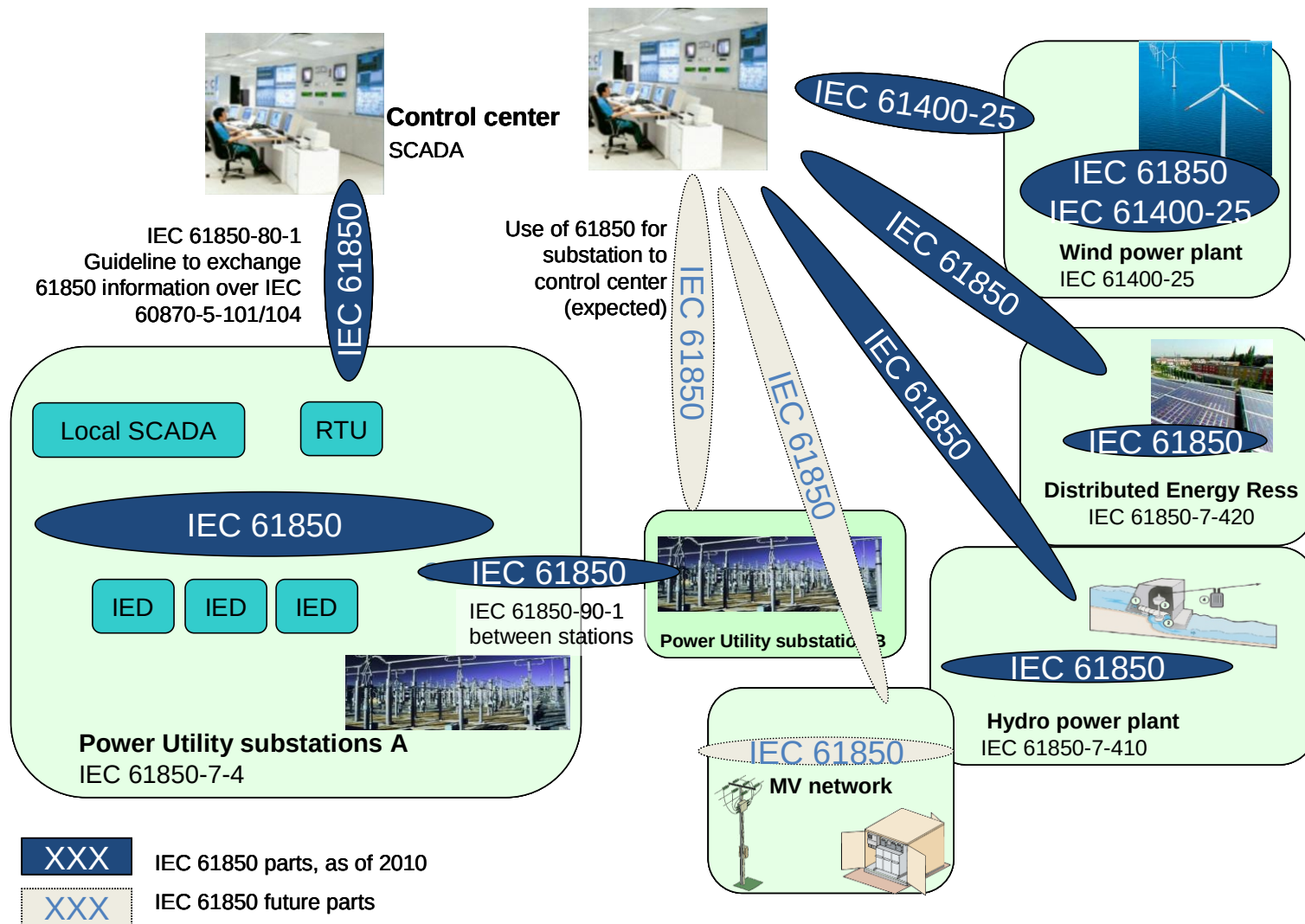


S E M I N A R

Pregled, praksa i budući razvoj IEC 61850

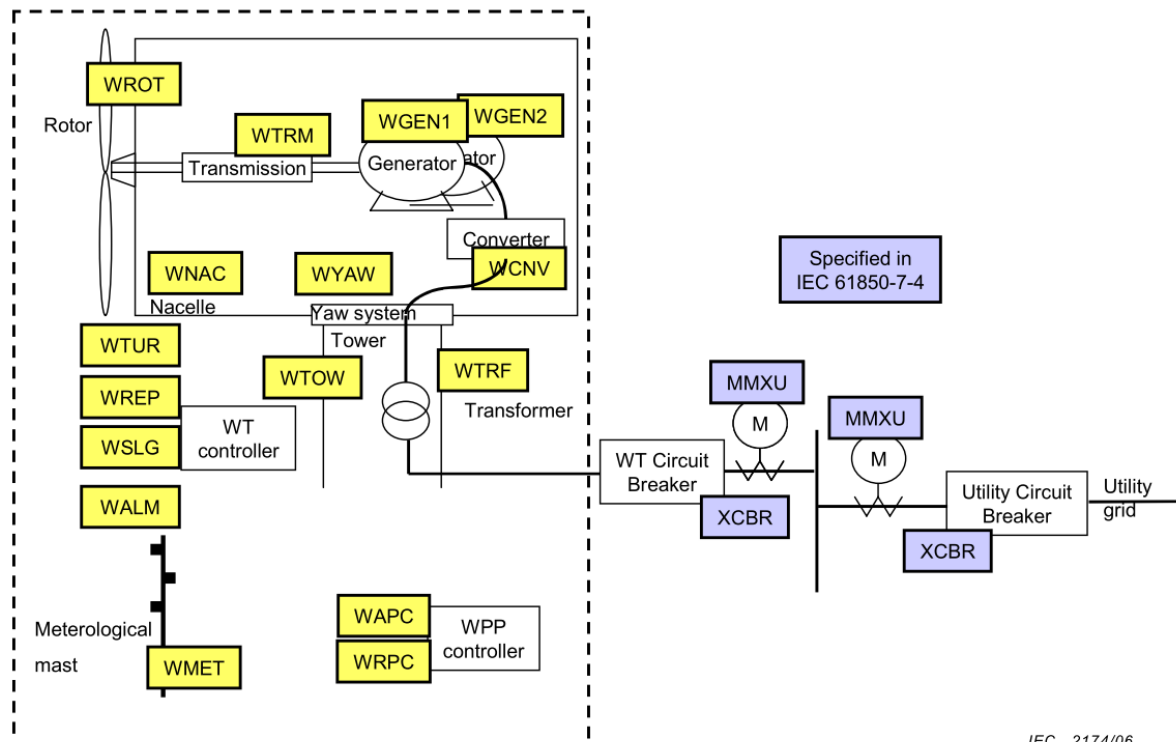
Zagreb, 29. 03. 2012.

IEC 61850 - Područja primjene danas



IEC 61850 - Vjetroelektrane

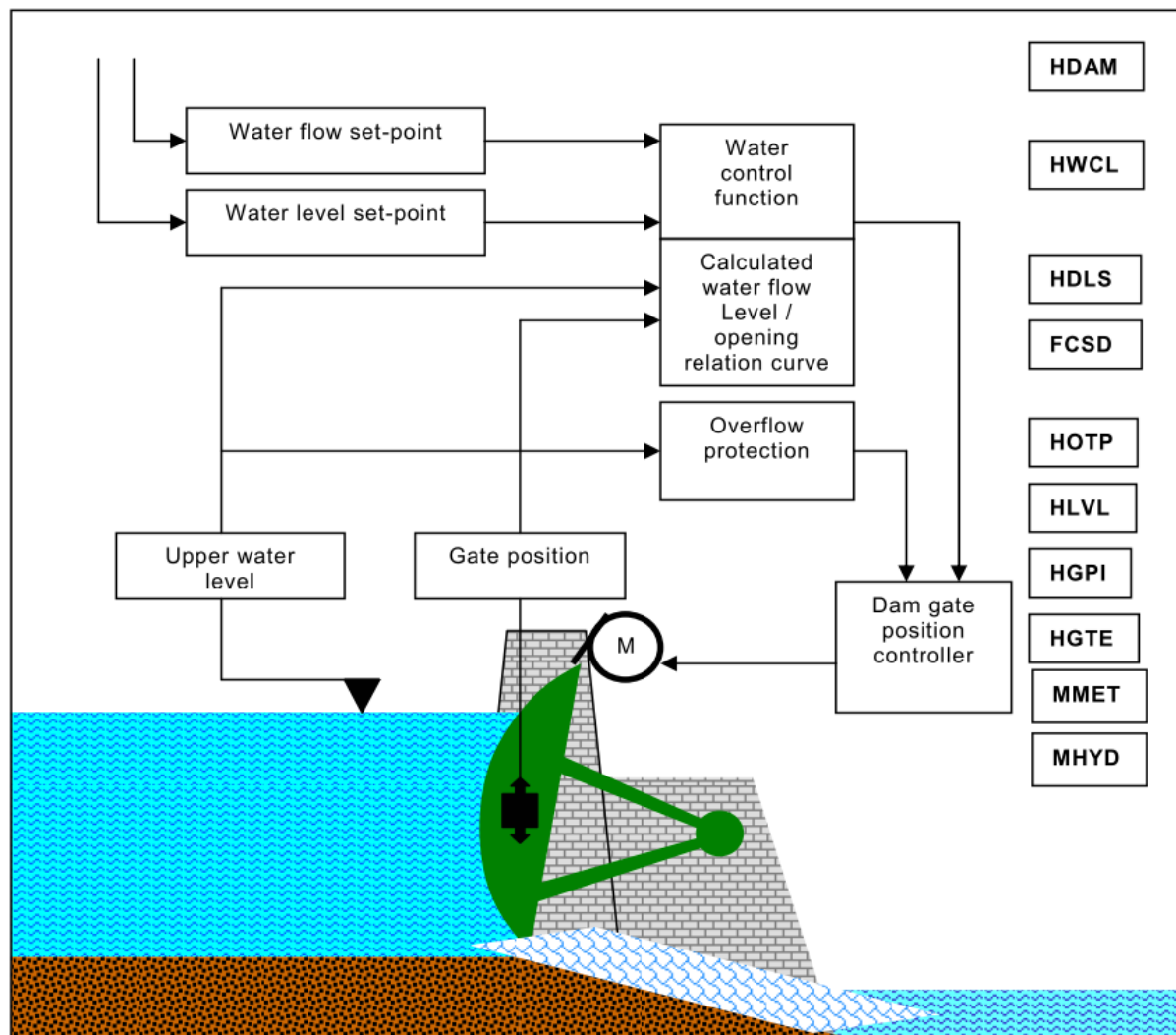
- TC88 – TC57
- IEC 61400-25
- Višestruka ACSI mapiranja
- Dodatni servisi
- Bez SCL-a



IEC 2174/06

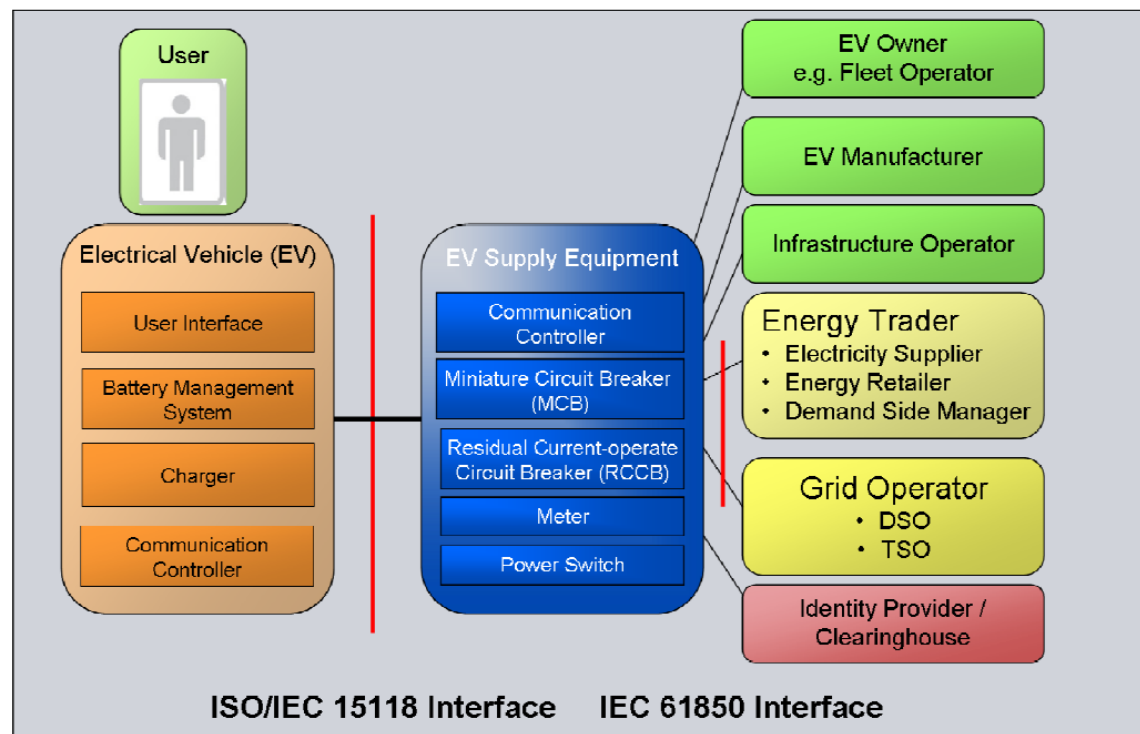
IEC 61850-7-410 - Hidroelektrane

- TC57 WG18
- Upravljanje
- Nadzor
- Zaštita
- Automatika



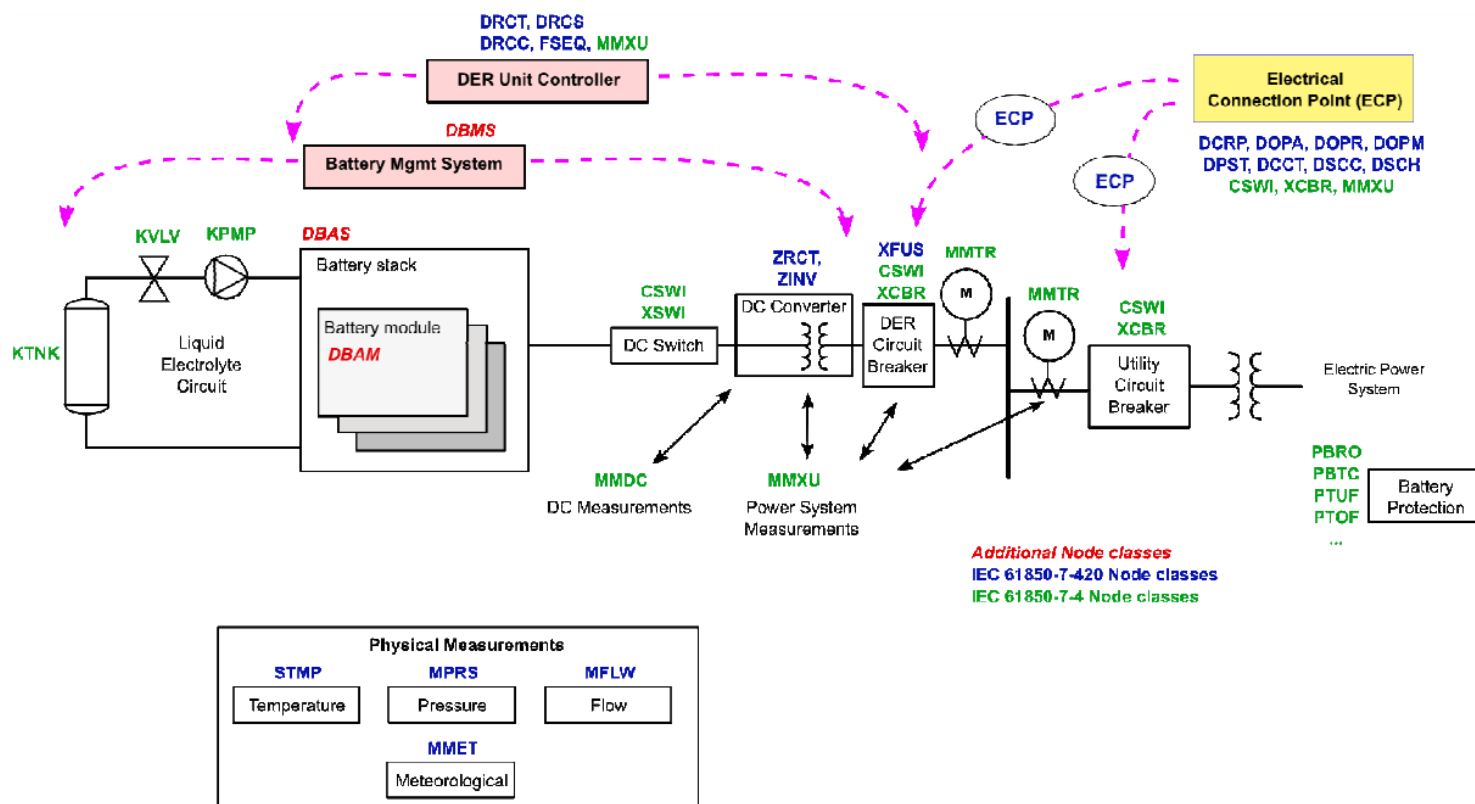
IEC 61850-90-8 - Punionice elektromobila

- TC57 WG17
- Harmonizirani model
- IEC 15118



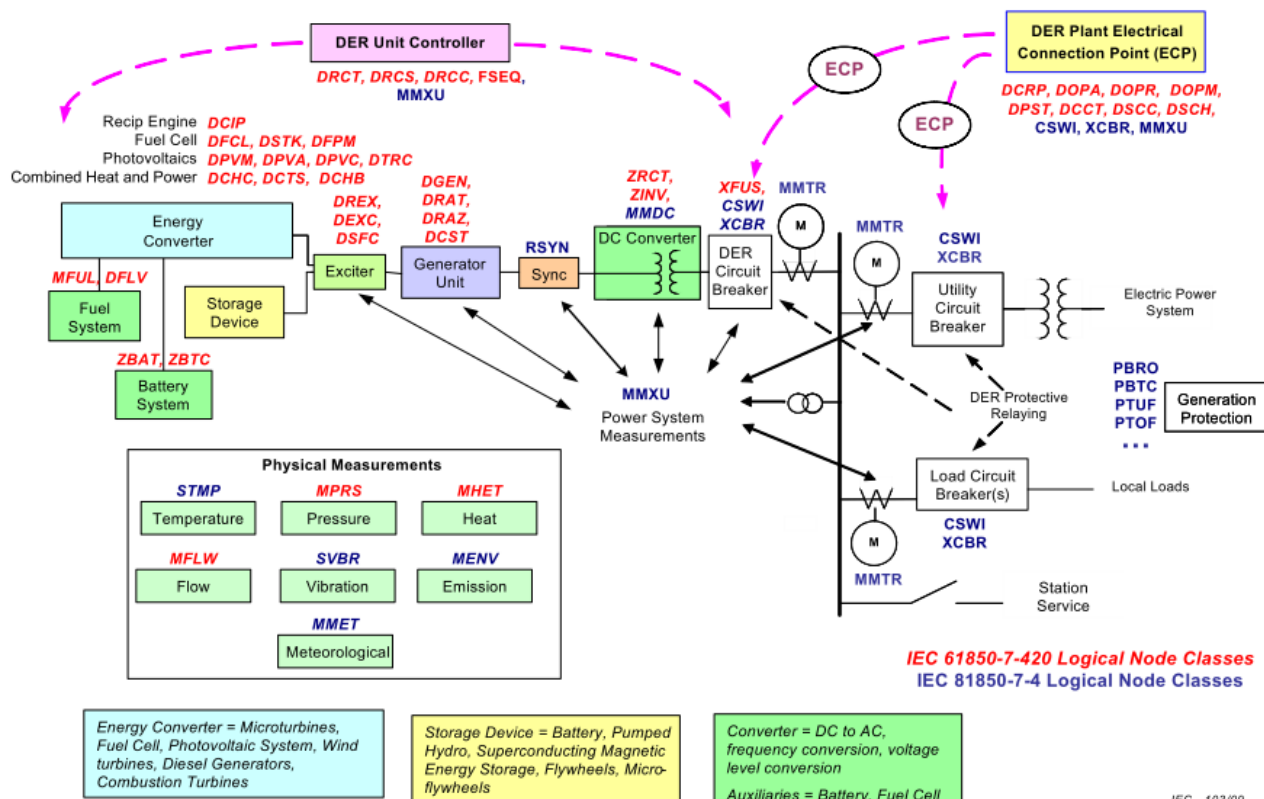
IEC 61850-90-9 - Baterije

- TC57 WG17
- Centralizirano upravljanje baterijskim sustavima



IEC 61850-7-420 - Distribuirani izvori energije (DIE)

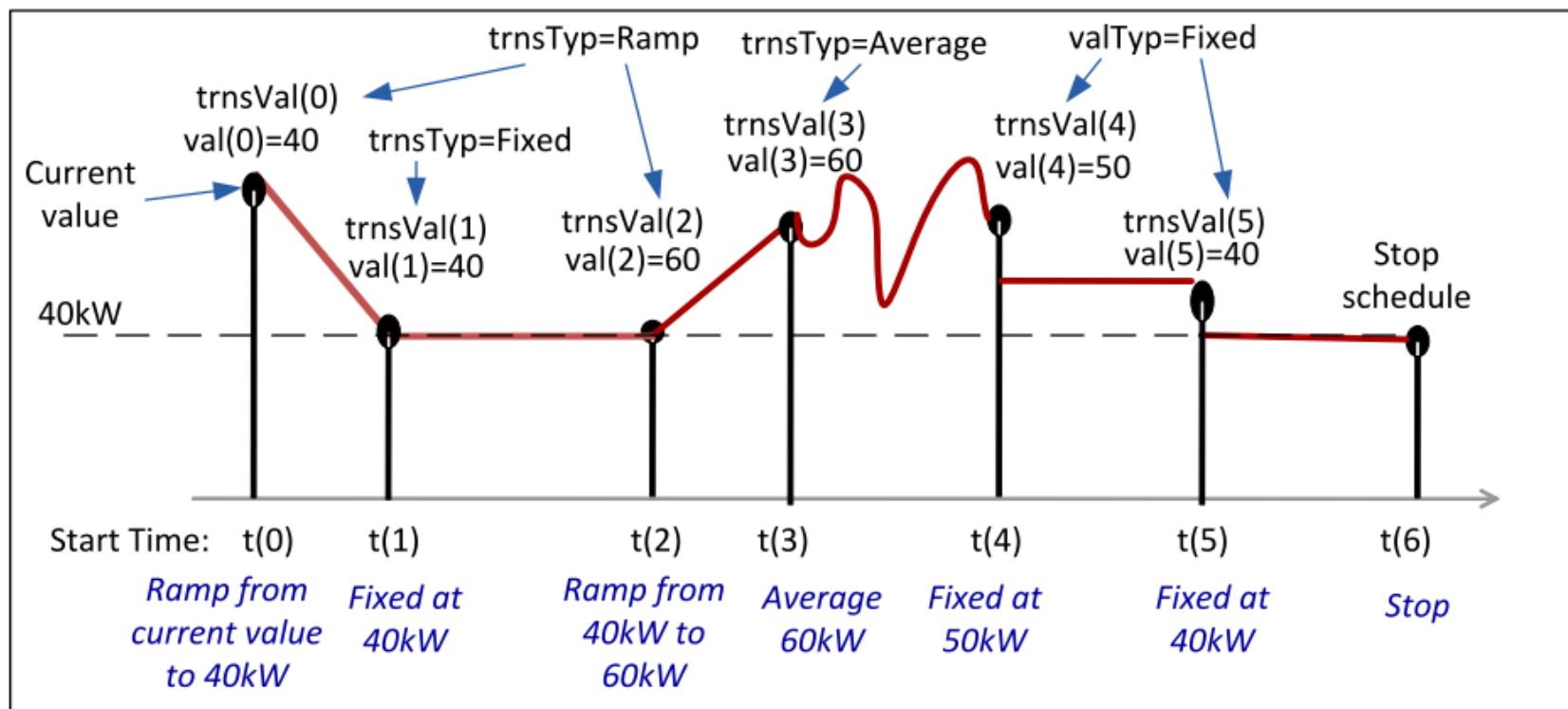
- TC57 WG17
- Solarni paneli, CHP, Diesel agregati



IEC 103/09

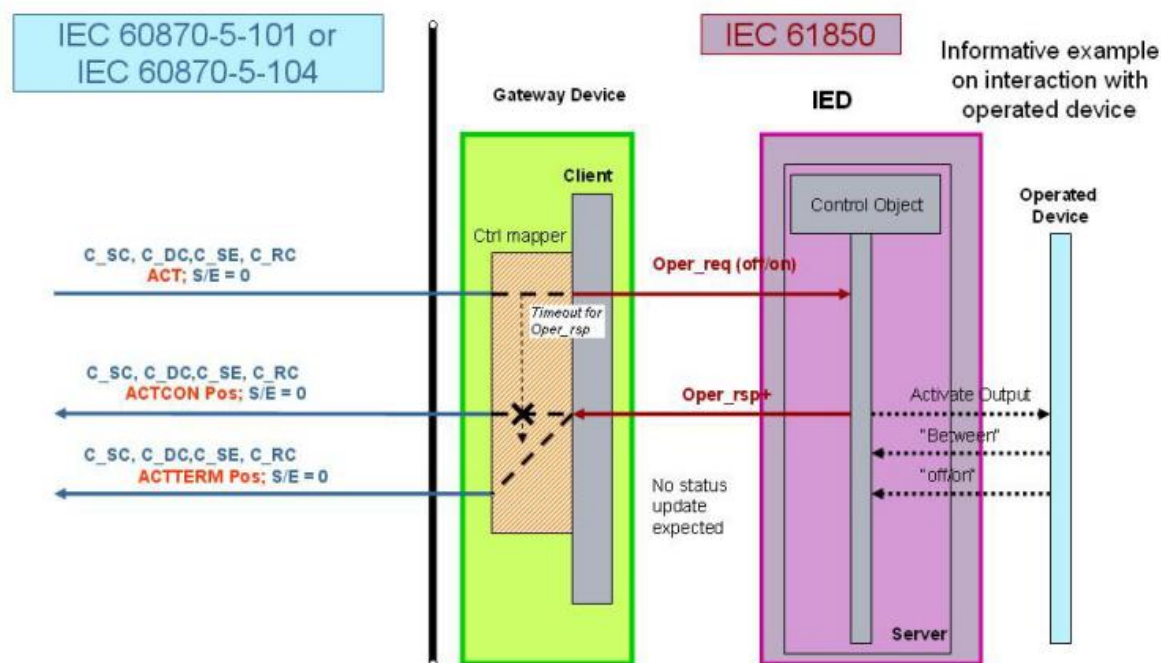
IEC 61850-90-10 - Planiranje rada DIE

- TC57 WG17
- Logička čvorišta za planiranje rada DIE



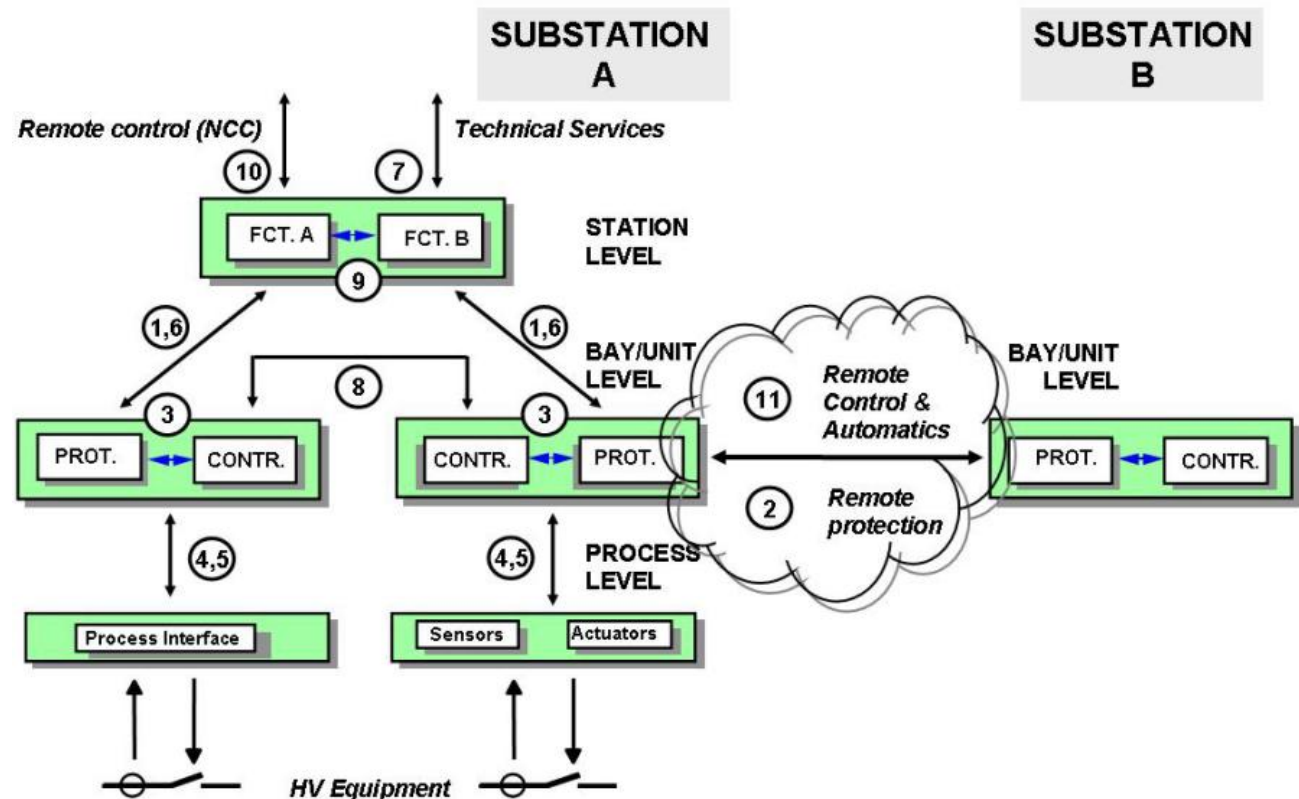
IEC 61850-80-1 - Pretvornik za IEC 104 protokol

- TC57 WG10
- Definirani odnosi ASDU-CDC
- Preslikavanje servisa IEC 104 - ACSI



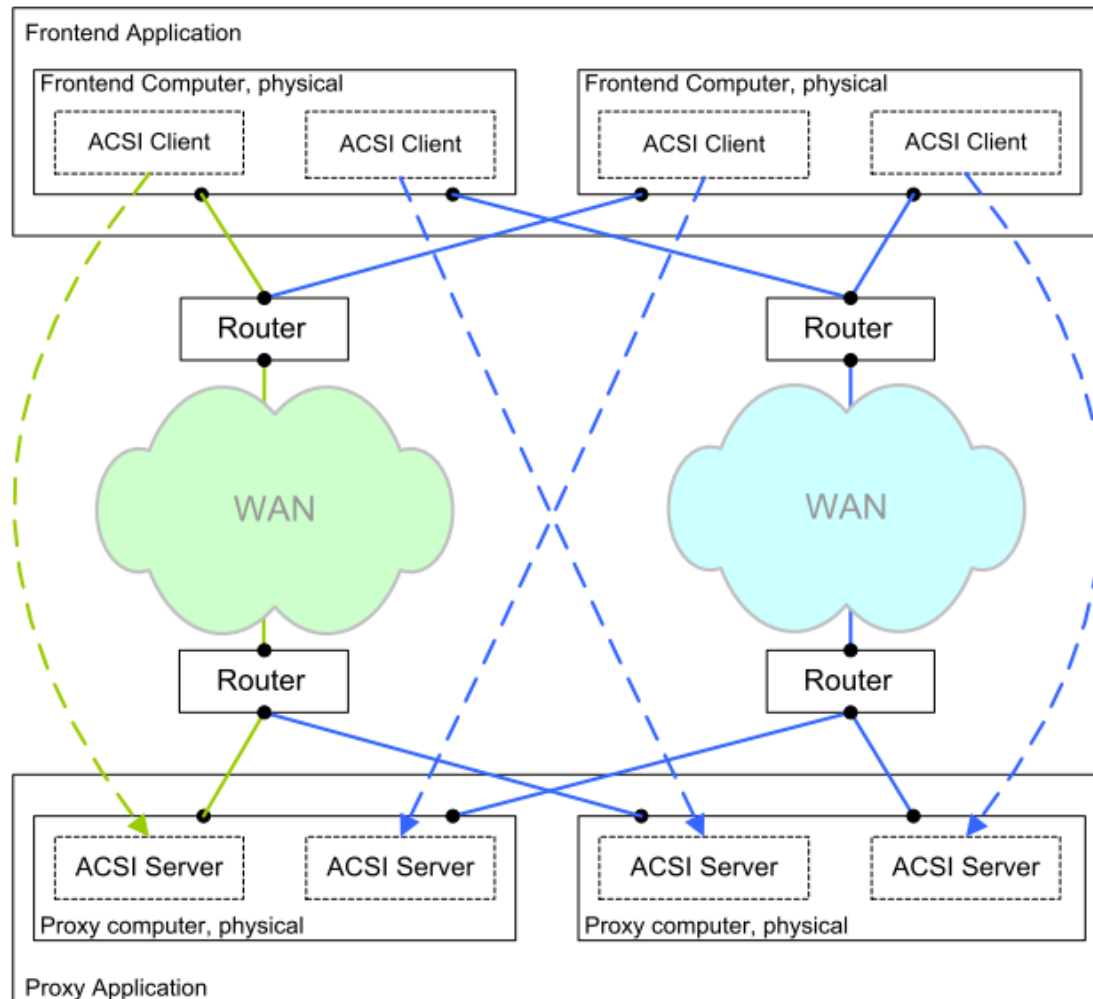
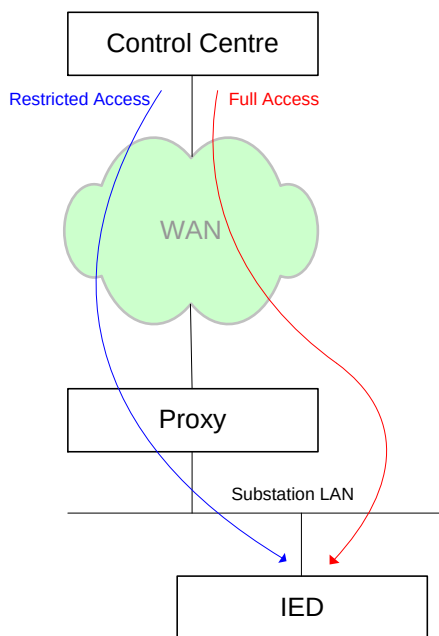
IEC 61850-90-1 - Komunikacija između TS-ova

- TC57 WG10
- Posebne funkcije zaštite
- Gateway
- VPN



IEC 61850-90-2 - Komunikacija prema centru

- Koncentrator
- Redundancija
- Proxy/gateway



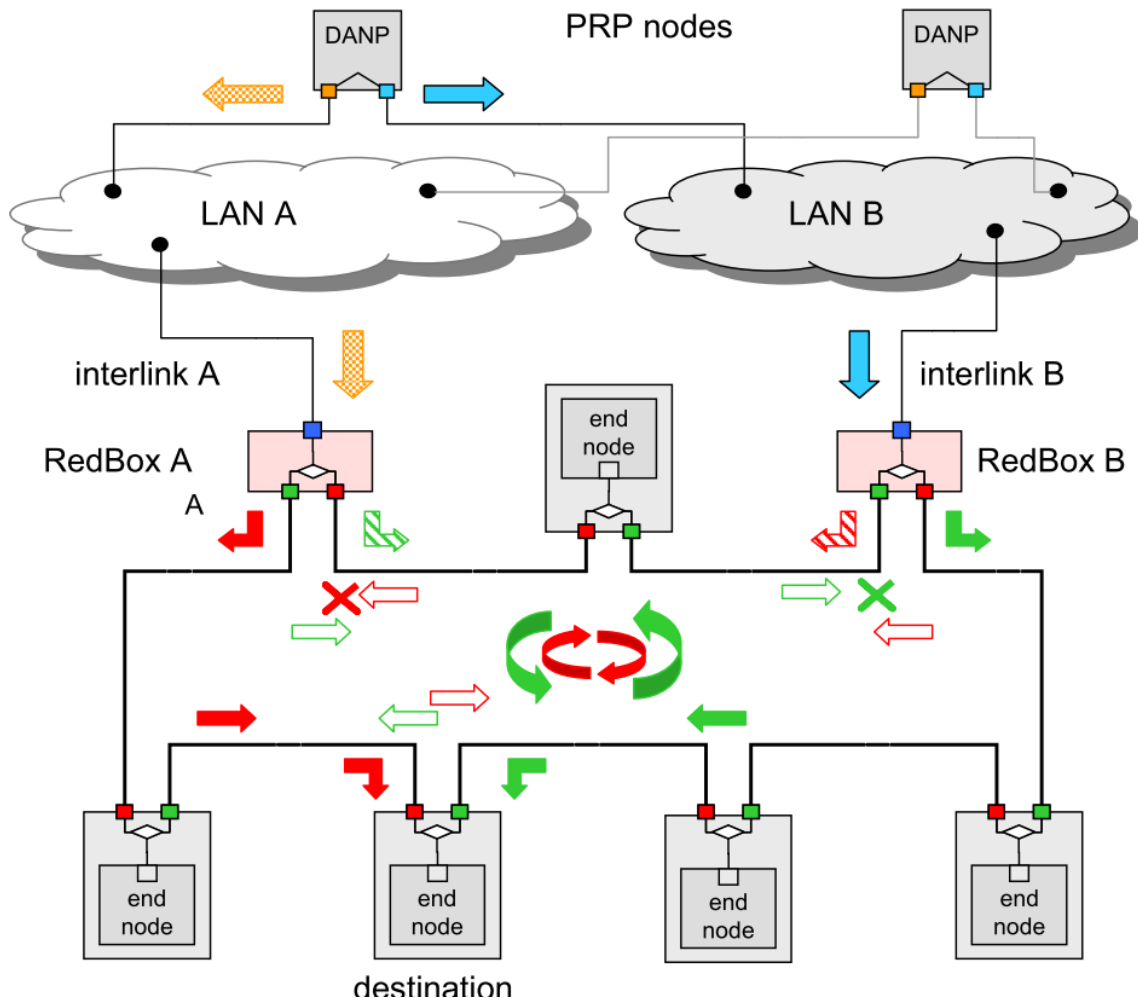
IEC 61850-90-3 - Funkcije nadzora opreme

- TC57 WG10
- Slučajevi primjene: GIS, TL, UGC, LTC, AUX,....
- Senzori
- WSN
- Analitičke funkcije nadzora opreme



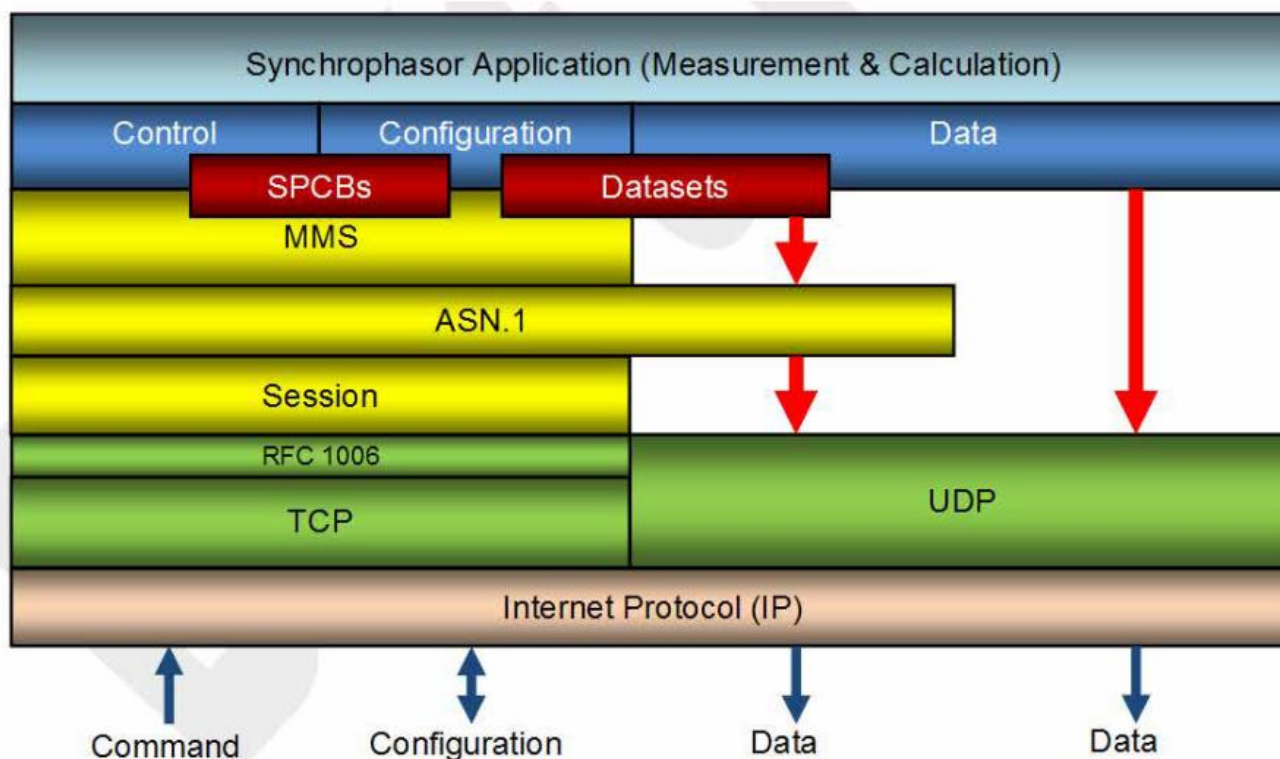
IEC 61850-90-4 - Mrežne konfiguracije

- TC57 WG10
- Preporuke
- Redundancija
- PRP
- HSR
- VLAN



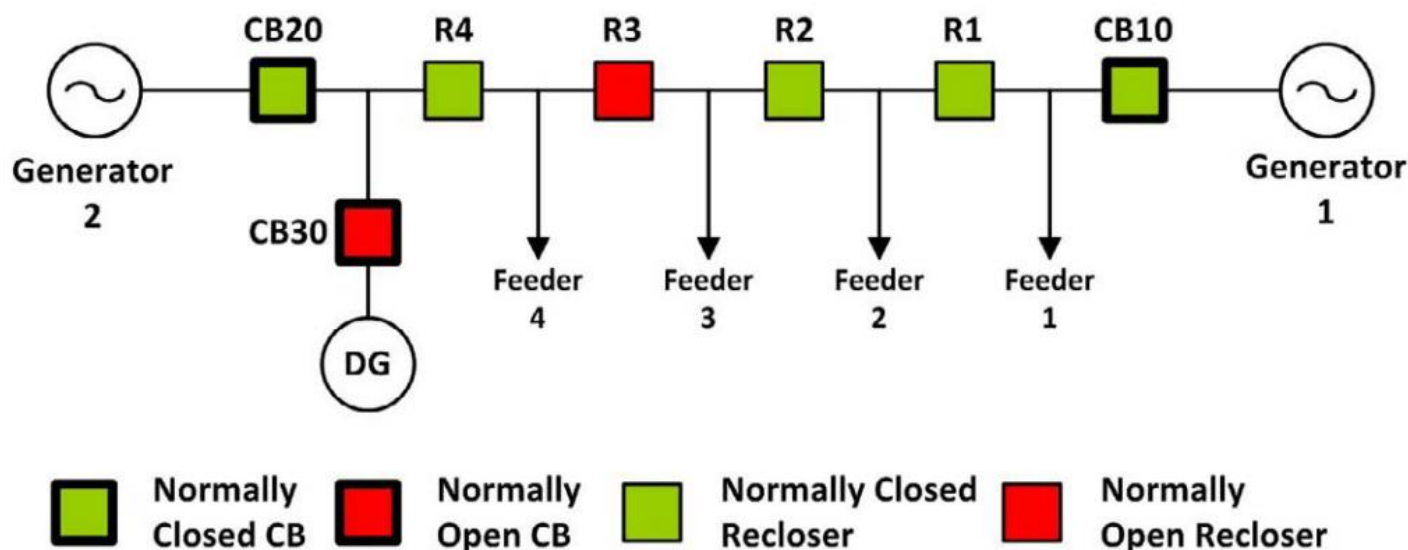
IEC 61850-90-5 - Primjena u WAMPC sustavima

- TC57 WG10
- Sukladnost sa IEEE C37.118



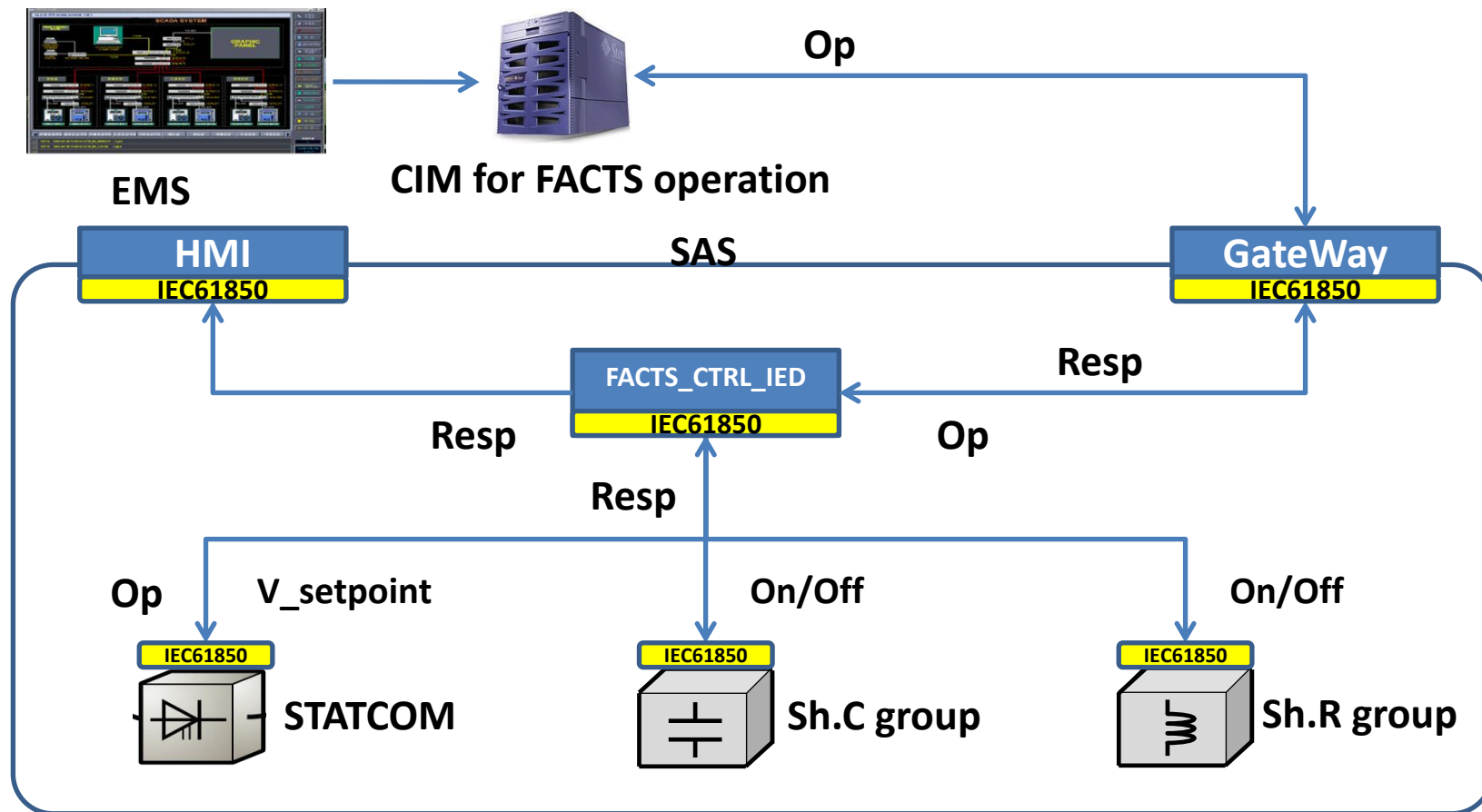
IEC 61850-90-6 - Automatizacija distribucije EES-a

- TC57 WG10
- Slučajevi primjene
- DA funkcije



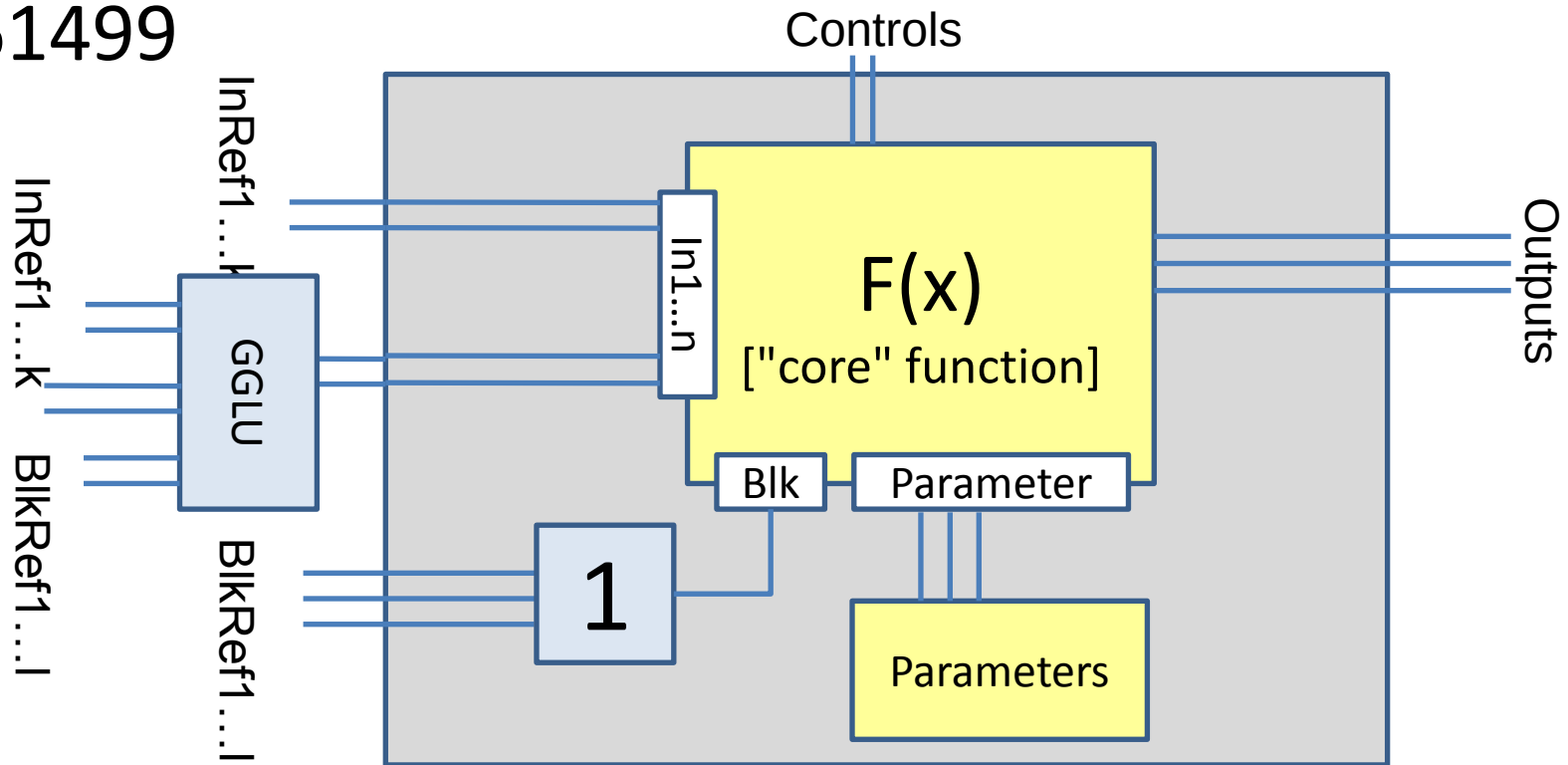
IEC 61850 - Primjena za FACTS uređaje

- TC57 WG10



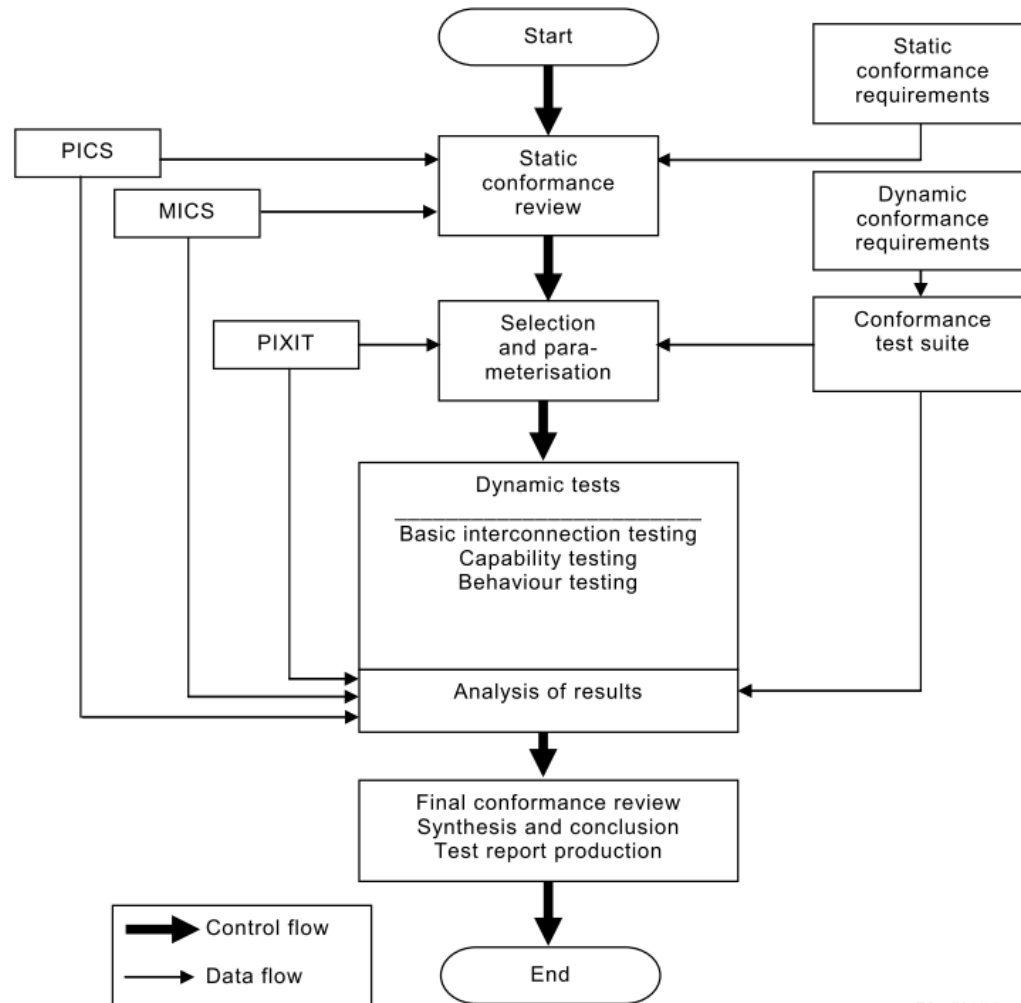
IEC 61850-90-11 - Modeliranje logičkih funkcija

- TC57 WG10
- IEC 61131 (PLC)
- IEC 61499



IEC 61850-10 ed2.0 – Provjera sukladnosti

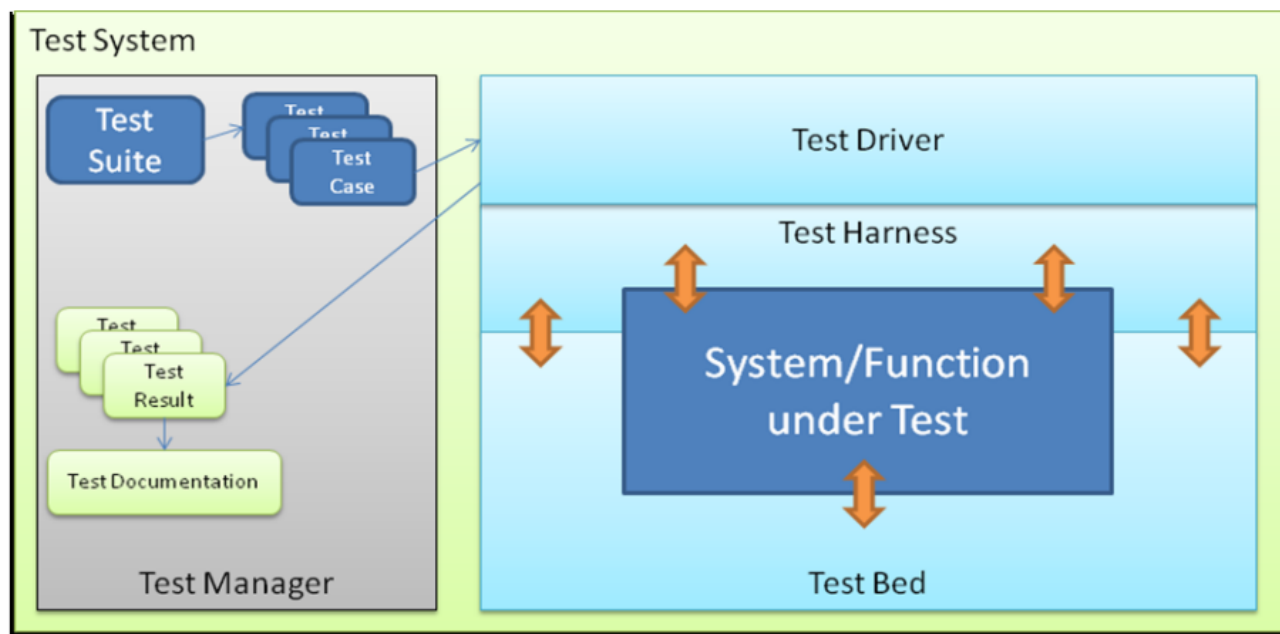
- PICS
- MICS
- PIXIT
- Server/klijent
- UCA IUG
- KEMA
- TUV SUED



IEC 598/05

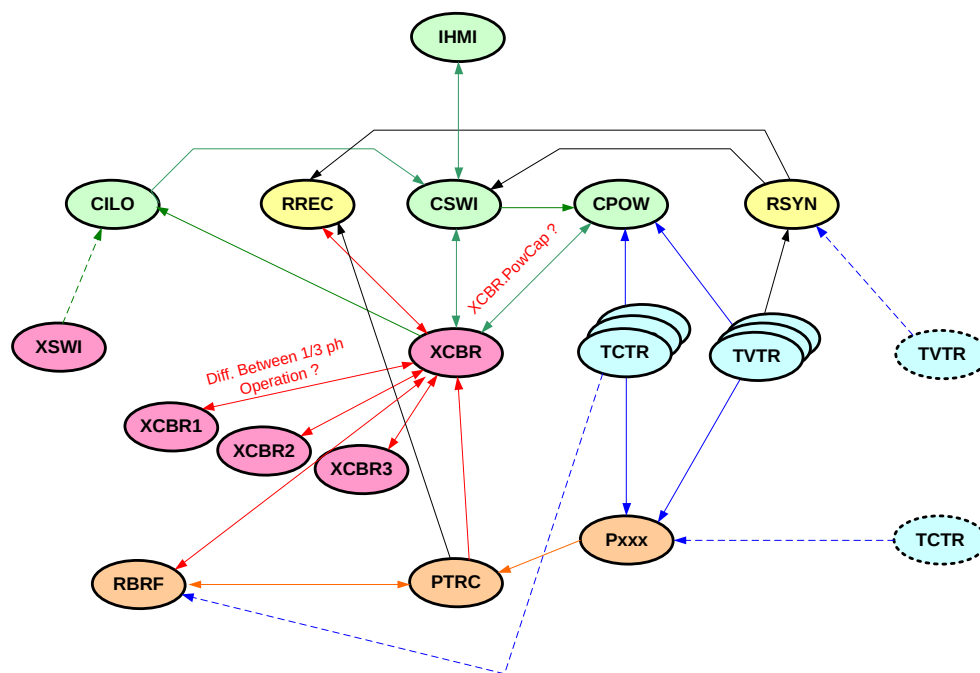
IEC 61850 – Funkcionalno testiranje

- TC57 WG10
- Simulacijska okruženja
- Provjeravanje semantike procesnih podataka



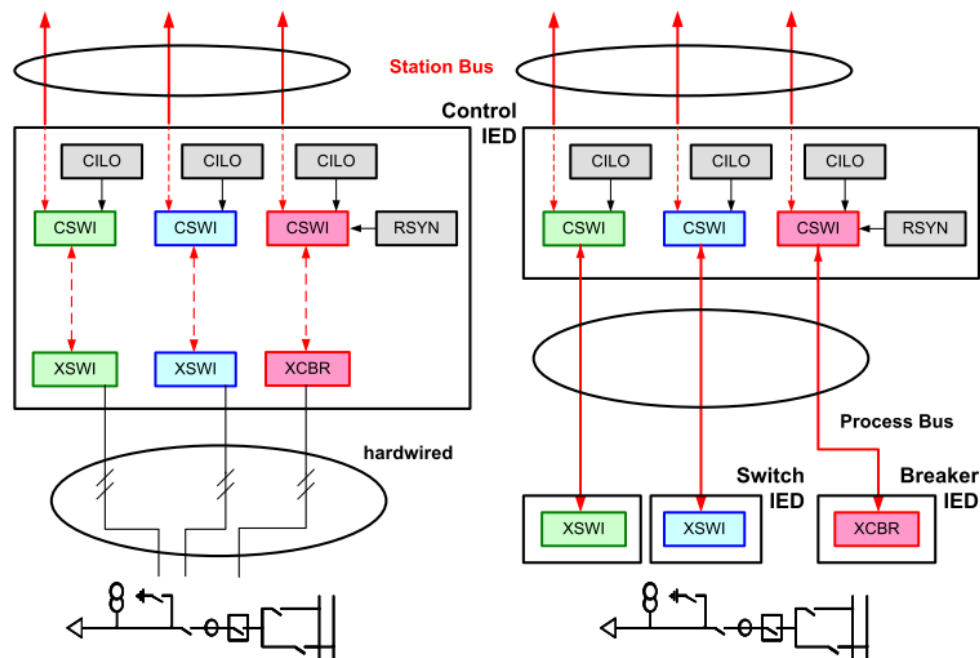
IEC 61850-7-5 – Modeliranje aplikacija

- TC57 WG10
- Standardne IEC 61850 aplikacije
- Modeliranja pomoću LN-ova



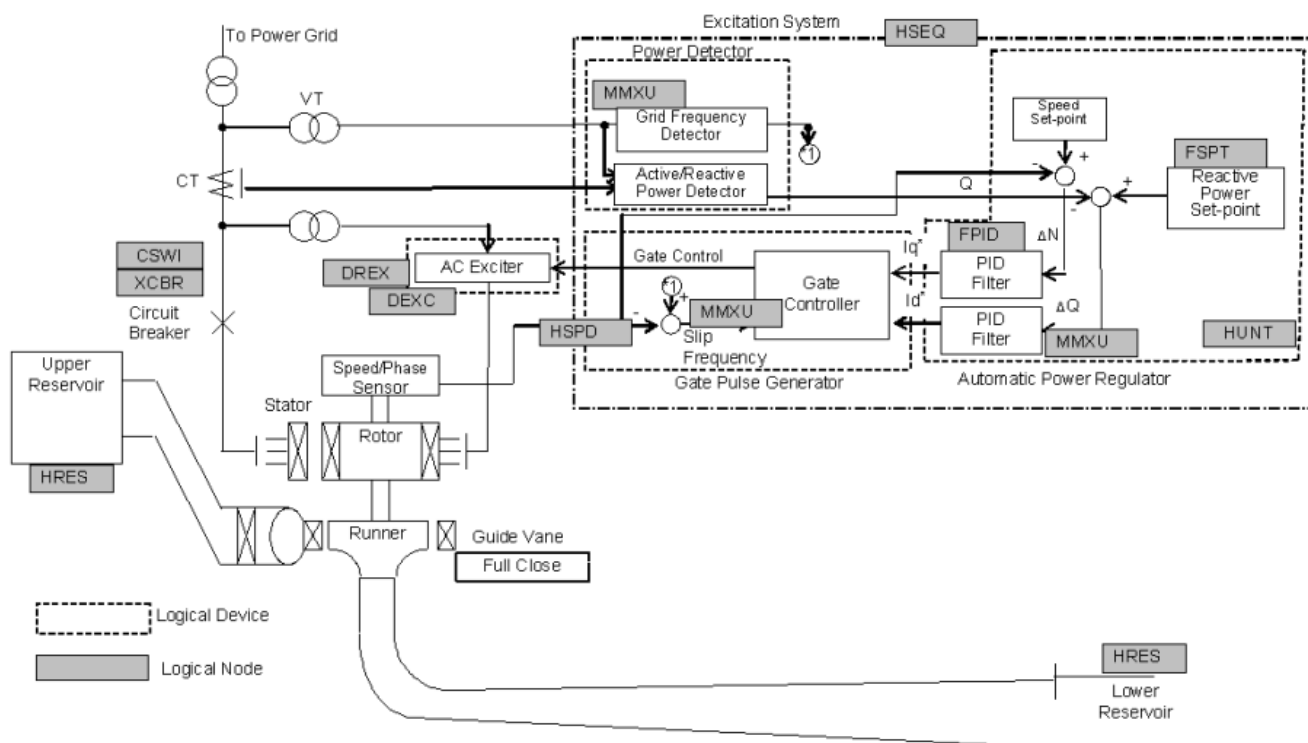
IEC 61850-7-500 – Aplikacije zaštite

- TC57 WG10
- Interakcije logičkih čvorišta
- Generičke funkcije zaštite



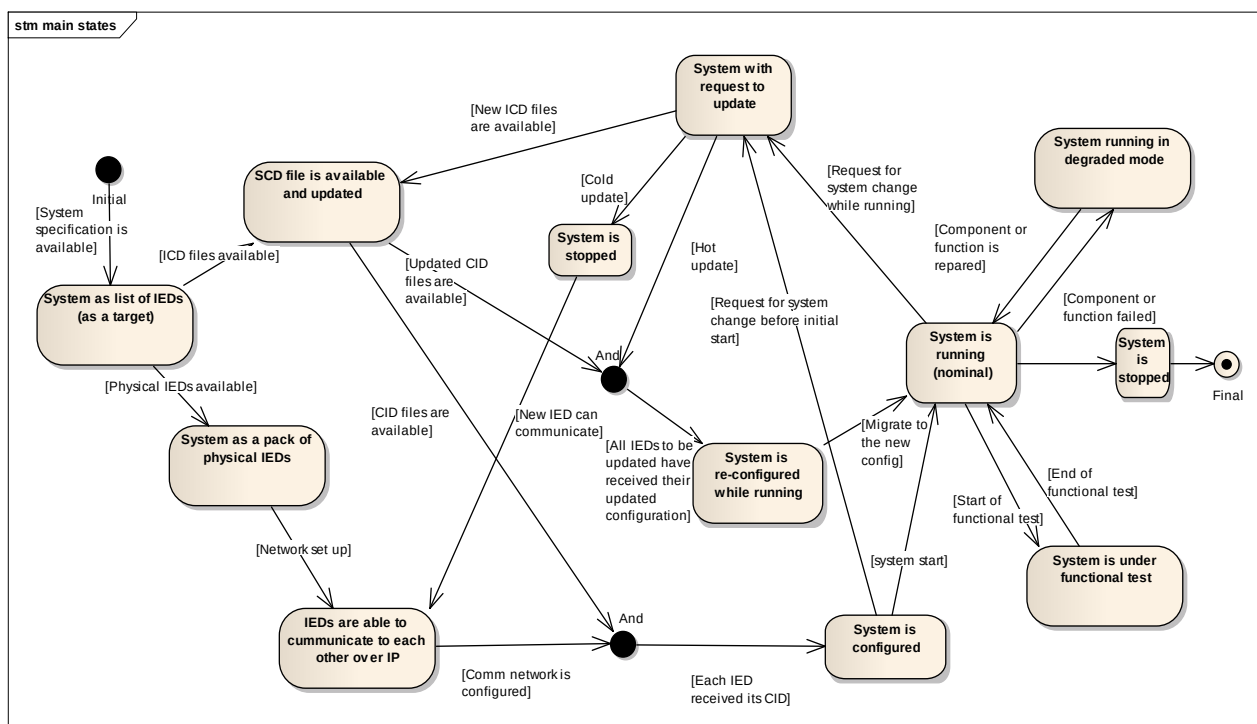
IEC 61850-7-510 – Aplikacije u hidroelektranama

- TC57 WG10
- Generičke funkcije upravljanja

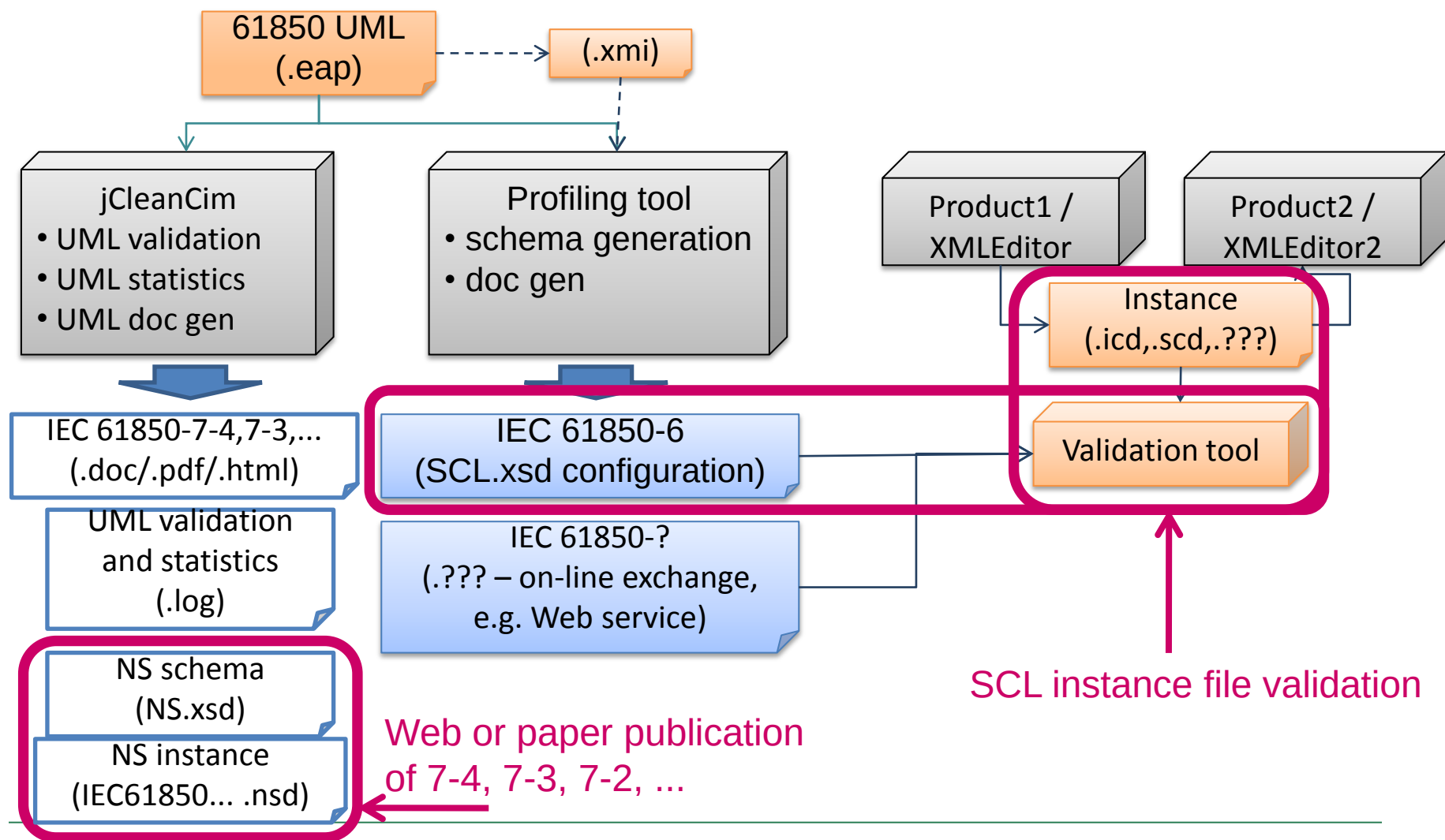


IEC 61850 – Upravljanje sustavom

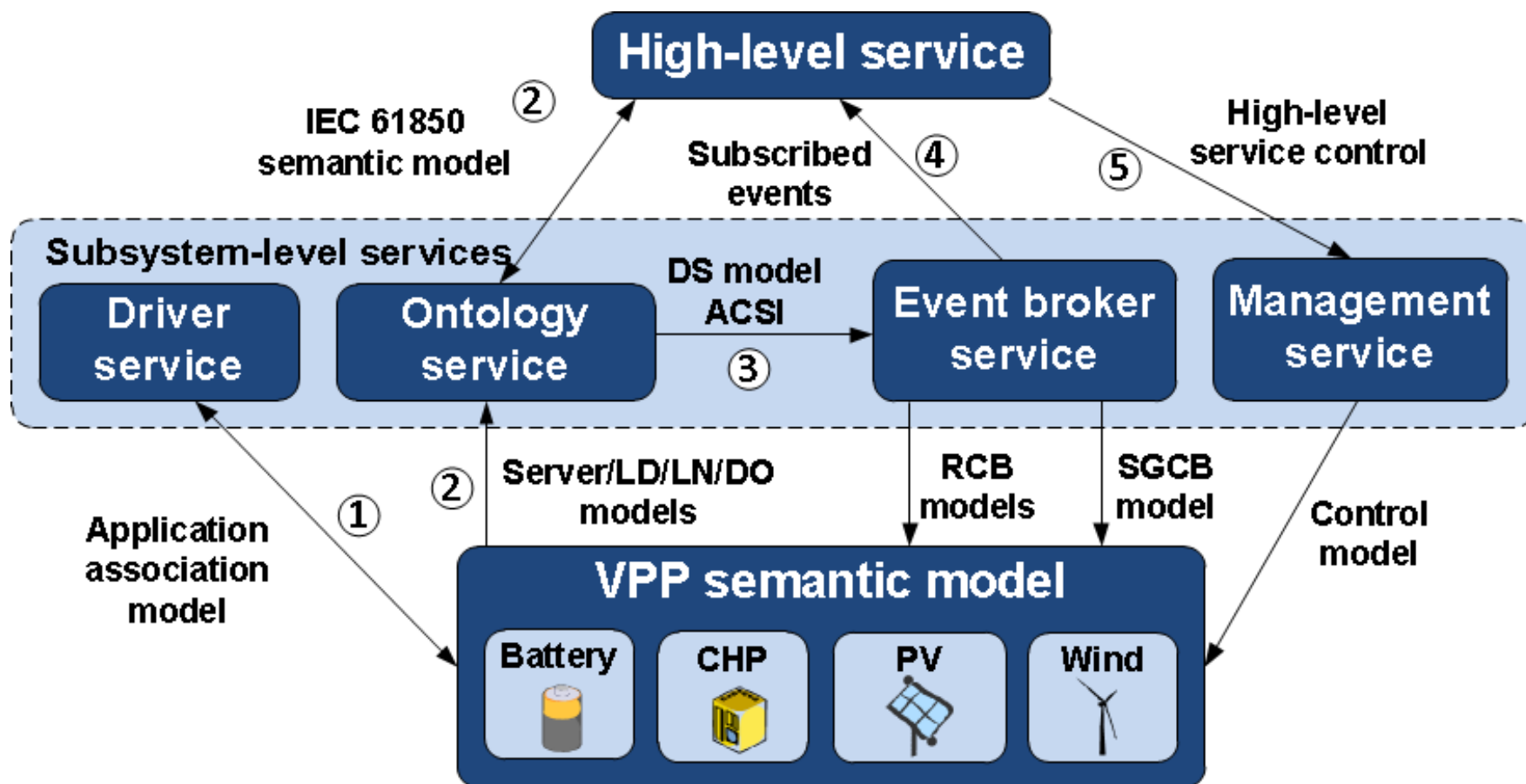
- TC57 WG10
- Faze upravljanja sustavom i uređajima
- Integracija
- Nadogradnje firmware-a



IEC 61850 – Razvoja UML modela



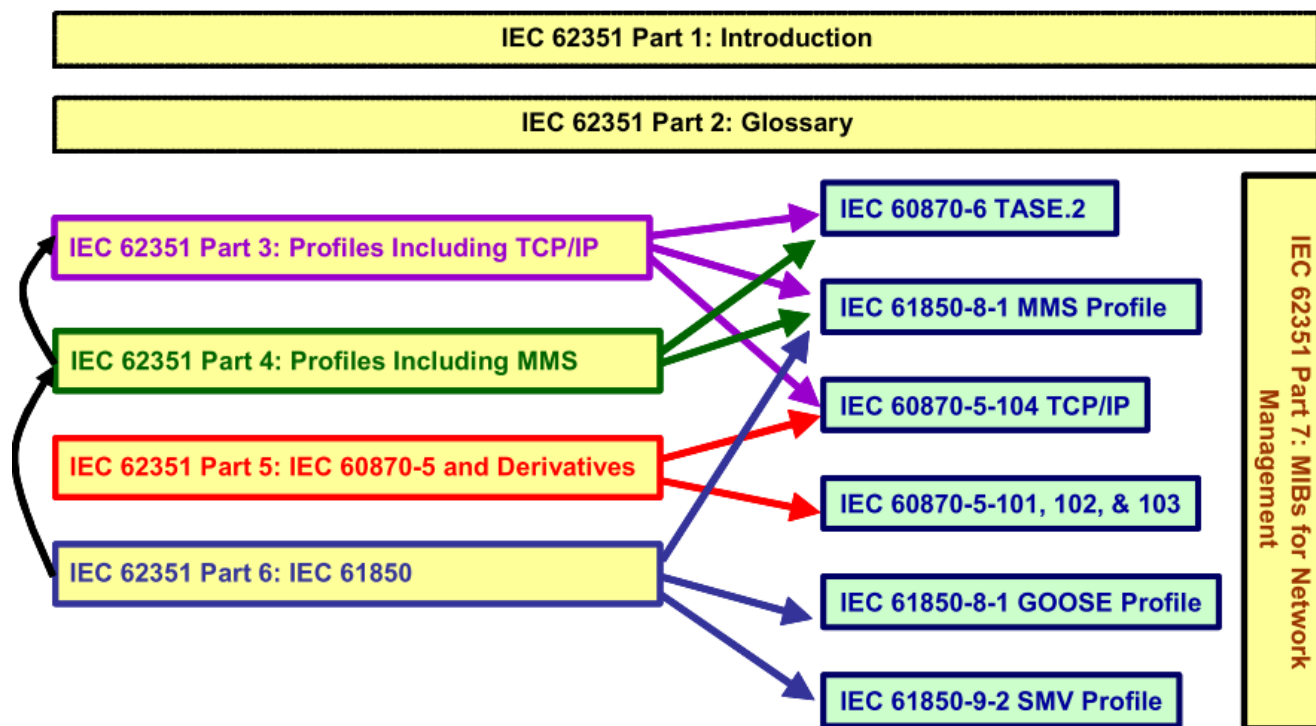
IEC 61850 – Povezivanje s CIM servisima



IEC 61850 – Informacijska sigurnost (IEC 62351)

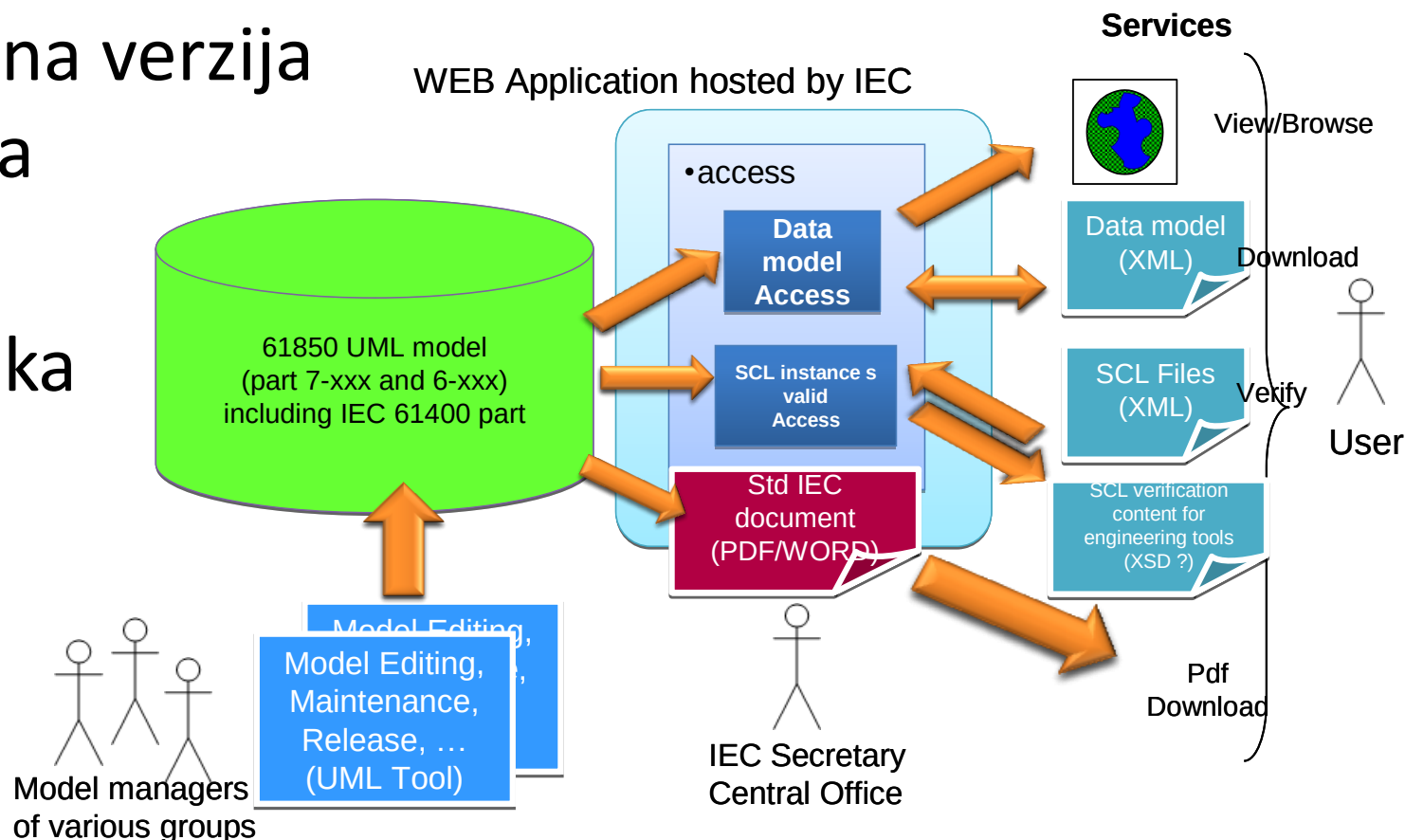
- TC57 WG15
- RBAC
- NSM
- Sigurnosna arhitektura

IEC 62351 Security Standards: Correlations to TC57 Standards



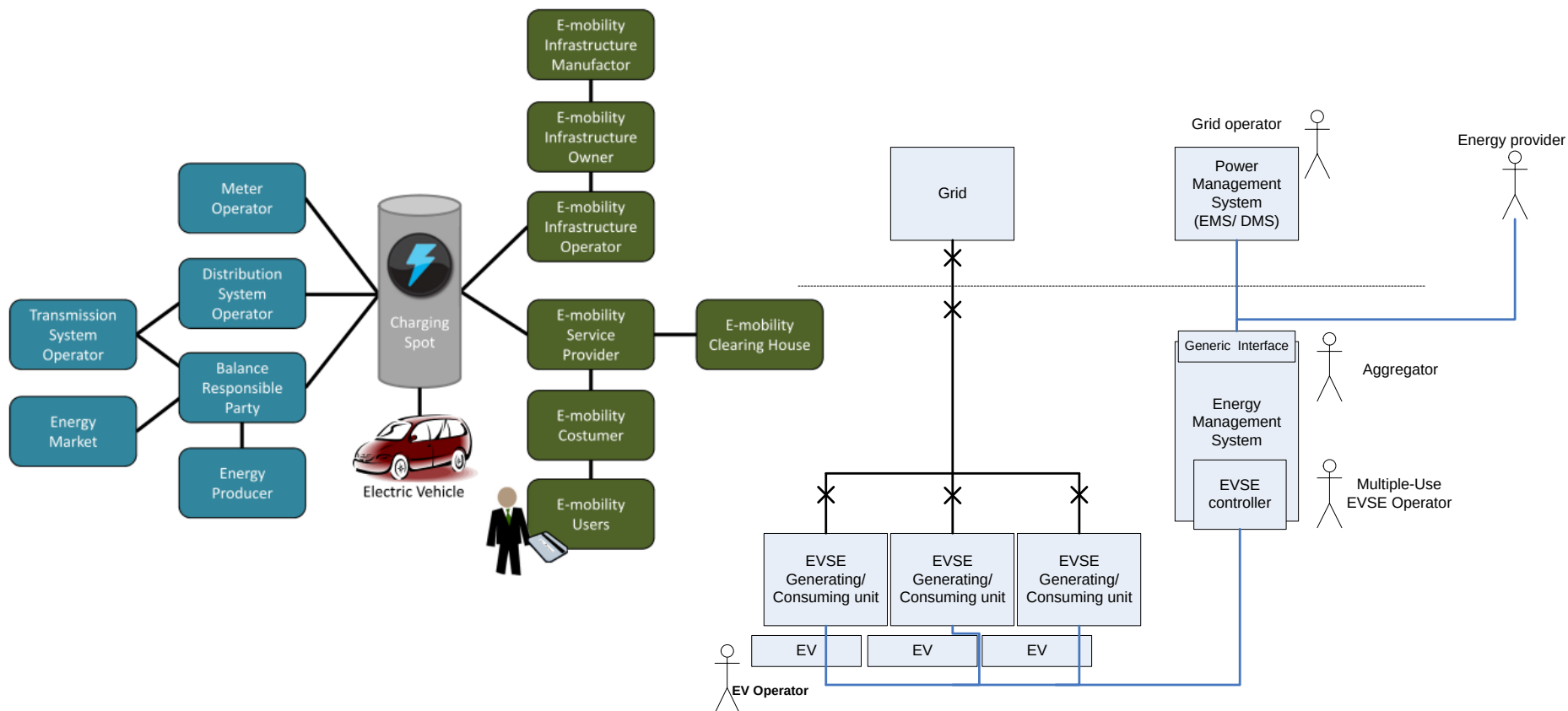
IEC 61850-7-10 – Web pristup

- Daljinski pristup
- Trenutna verzija modela
- Grupe korisnika



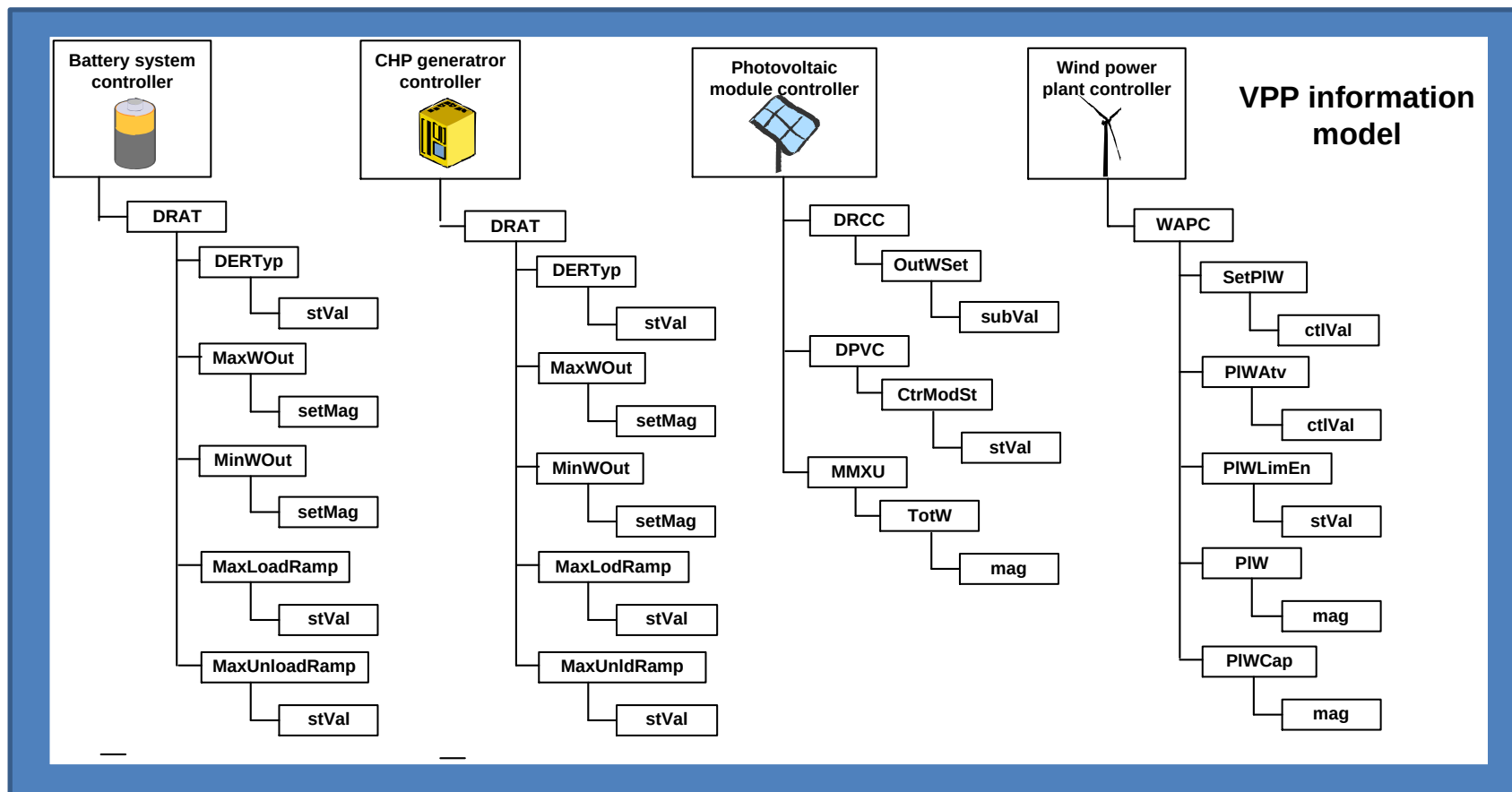
IEC 61850 – Novi upravljački modeli

- Upravljanje punionicama elektromobila

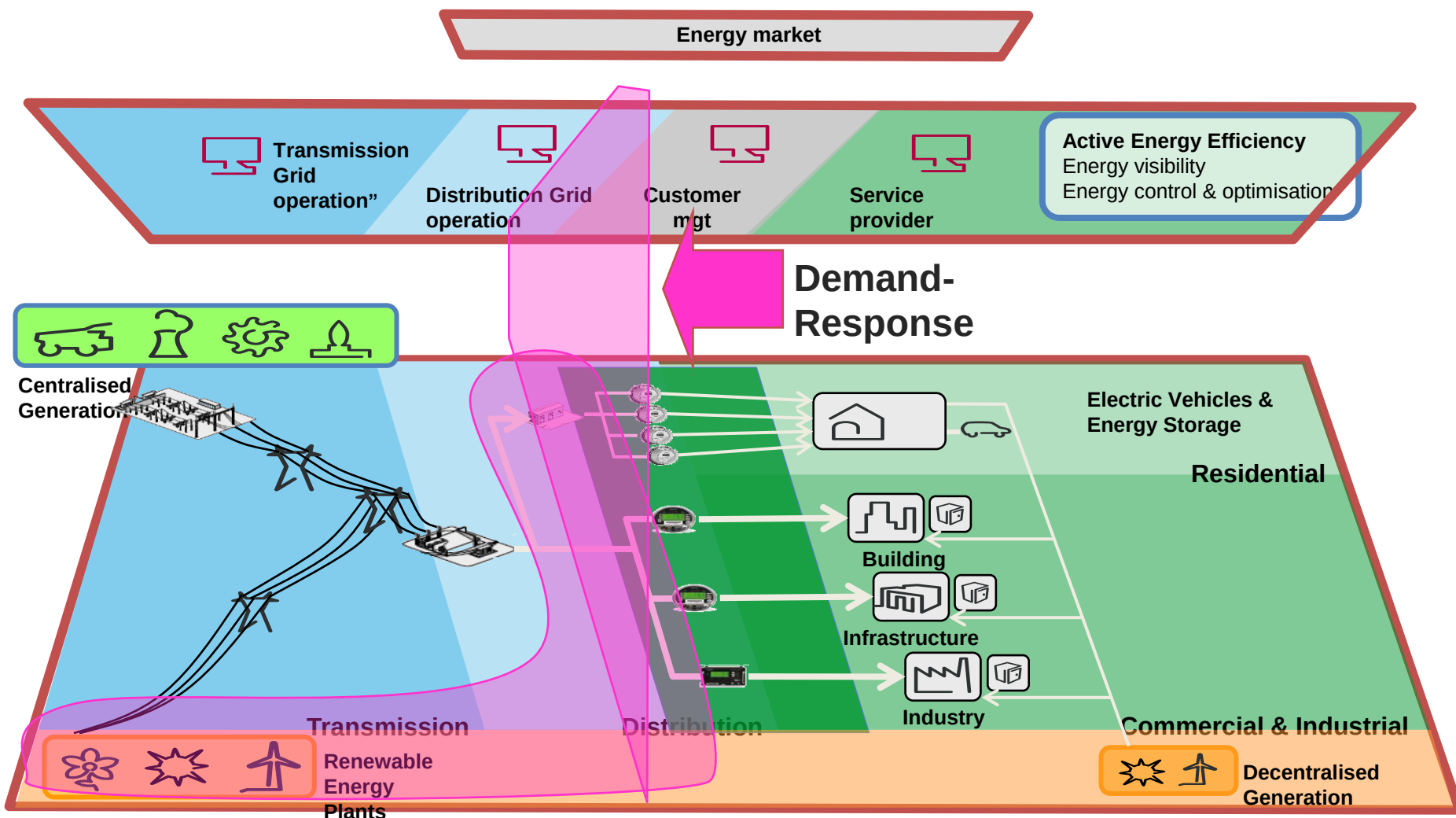


IEC 61850 – Novi upravljački modeli

- Upravljanje virtualnim elektranama



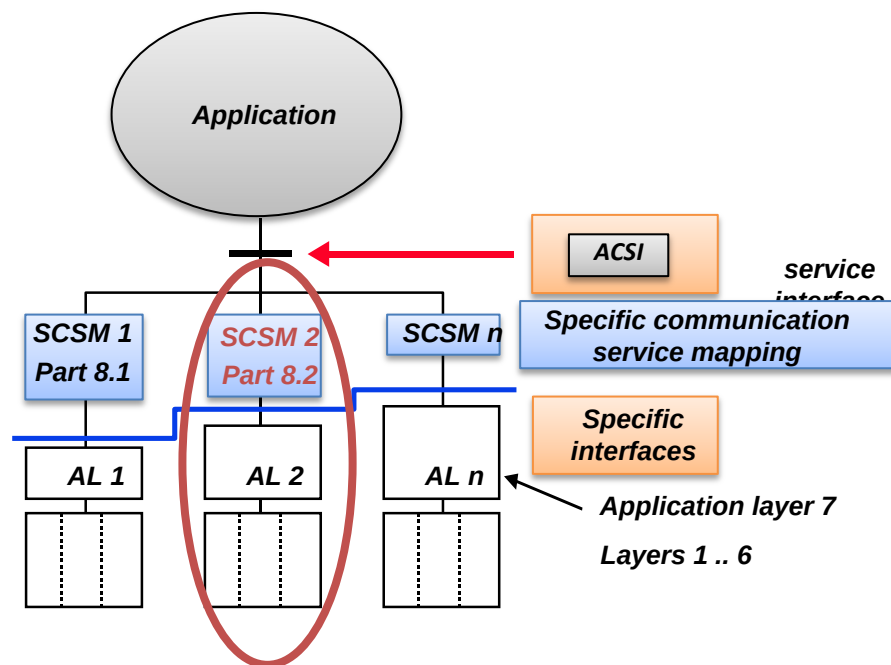
IEC 61850-8-2 – Mapiranje na Web servise



Field level

IEC 61850-8-2 – Mapiranje na Web servise

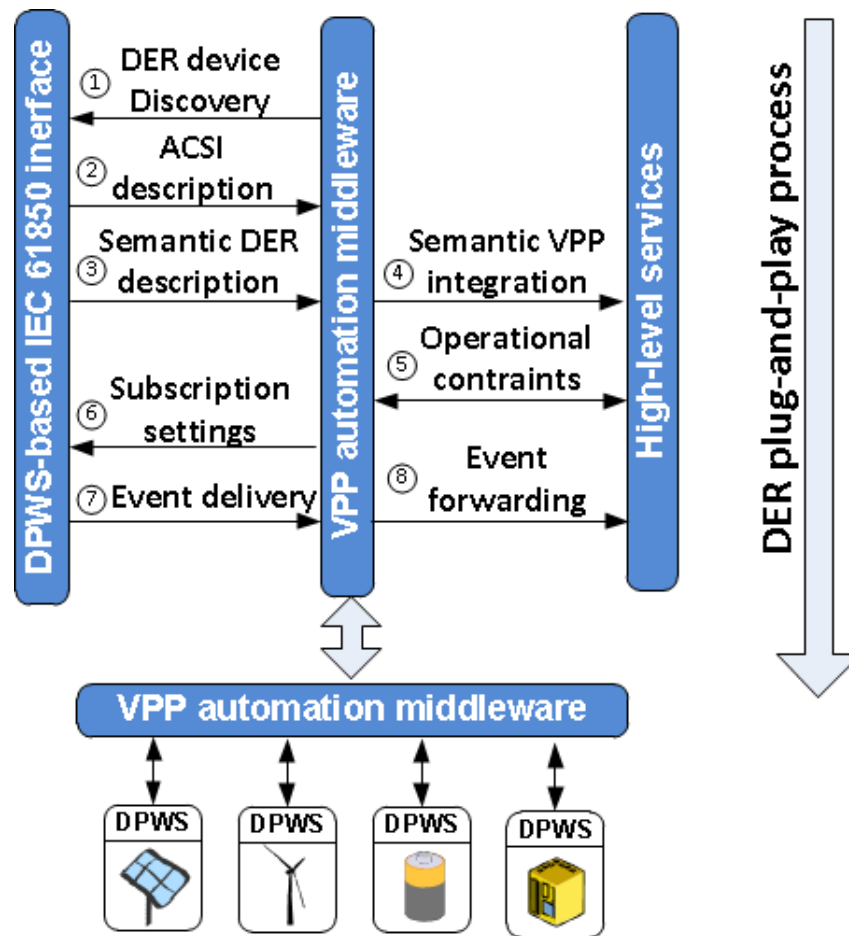
- OPC UA
- DPWS
- IEC 61400-25-4 (Annex A)
- REST
- IEC 61970-502-8
- IEC 61968-100



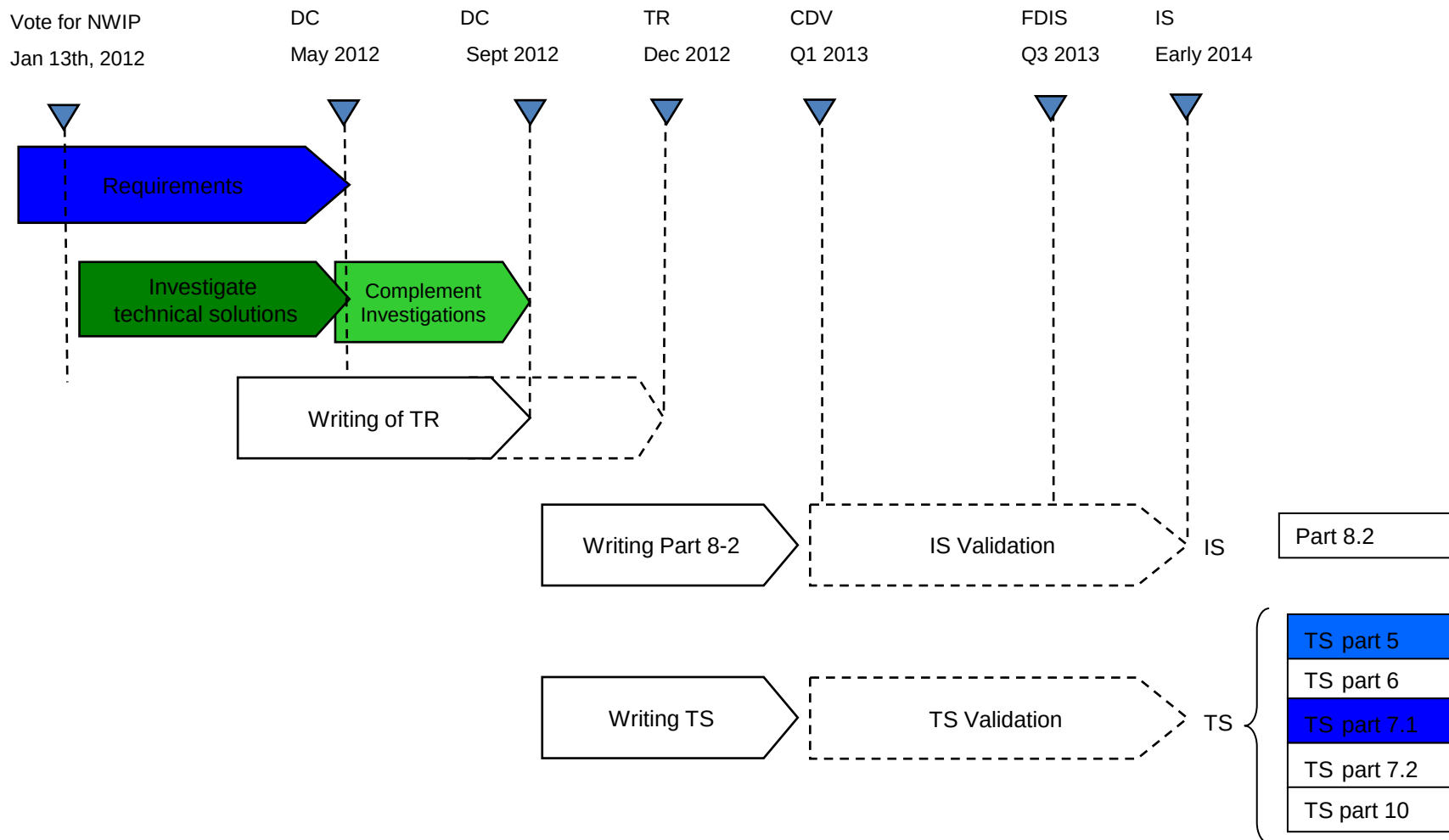
Field
level

IEC 61850-8-2 – Mapiranje na Web service

- „Plug-and-play” za IEC 61850 sustave
- DPWS
- OPC UA modeliranje
- Semantički servisi



IEC 61850-8-2 – Mapiranje na Web servise



IEC 61850 - Smart Grid

