# VAMP protection relays with embedded IEC 61850 Server

# Conformance Statement for

- **VAMP 50, VAMP 51, VAMP 52, VAMP 55, VAMP 59,**
- **VAMP 210, VAMP 230, VAMP 245, VAMP 255, VAMP 260, VAMP 265, VAMP 265M,**
- **VAMP 257, VAMP 259,**
- **VAMP 300, VAMP 321**

# Revision History

| Date | Issue | Description | Author |
|------|-------|-------------|--------|
| 20-03-2007 | 0.0.1 | Initial version. | Wojciech Kozlowski |
| 28-05-2008 | 0.0.2 | Revised according to the current implementation status. | Wojciech Kozlowski<br>Marcin Pazik |
| 21-11-2008 | 0.0.3 | Revised according to the current implementation status. | Wojciech Kozlowski<br>Marcin Pazik |
| 02-02-2009 | 0.0.4 | Revised according to the current implementation status. | Wojciech Kozlowski<br>Marcin Pazik |
| 07-04-2009 | 0.0.5 | Revised according to pre-test results. | Marcin Pazik |
| 20-04-2009 | 0.0.6 | Comments about alternate access added, information about time quality flags also in PICS, GOOSE subscriber part removed | Marcin Pazik |
| 19-11-2010 | 0.0.7 | Revised according to the current implementation status. | Wojciech Kozlowski<br>Marcin Pazik |
| 25-11-2010 | 0.0.8 | Device application functions mapped to LNs described using default texts from Vampset configuration tool. | Wojciech Kozlowski |
| 04-05-2011 | 0.0.9 | Review before the planned conformance pre-test. | Wojciech Kozlowski |
| 17-05-2011 | 0.1.0 | Updated based on the new template for PIXIT. | Wojciech Kozlowski<br>Marcin Pazik |
| 22-07-2011 | 0.1.1 | Updated based on the new templates for PICS, MICS and PIXIT. | Wojciech Kozlowski<br>Marcin Pazik |
| 02-08-2011 | 0.1.2 | Updated based on conclusions from KEMA pretest (passed). | Wojciech Kozlowski |
| 14-10-2011 | 0.1.3 | Document version prepared for KEMA conformance test of VAMP 50, VAMP 51, VAMP 52, VAMP 55, VAMP 59, VAMP 210, VAMP 230, VAMP 245, VAMP 255, VAMP 260, VAMP 265, VAMP 265M, VAMP 257, VAMP 259, VAMP 321. | Wojciech Kozlowski |
| 19-10-2011 | 0.1.4 | Minor revisions (PICS for time synch. and PIXIT for datasets, reporting and control). | Wojciech Kozlowski |
| 22-04-2013 | 0.1.5 | Changes including recent new features: support for non binary GOOSE signals, changed max MMS message size. | Marcin Pazik |
| 27-05-2013 | 0.1.6 | File transfer support added. | Marcin Pazik |

| 17-06-2013 | 0.1.7 | More explanation to file transfer added to PIXIT.<br><br>Corrected FC for GOOSE data sets. | Marcin Pazik<br><br>Wojciech Kozlowski |
|---|---|---|---|
| 04-07-2013 | 0.1.8 | Revised in accordance with the latest version of DNV KEMA templates for PICS, MICS, PIXIT and TICS.<br><br>Schneider Electric logo replaces VAMP logo. | Wojciech Kozlowski |

## Table of contents

# 1. Introduction

## 1.1 Document purpose

The purpose of this document is to provide the IEC 61850 conformance details for the embedded IEC61850 server implementation in VAMP protection relays.
The information provided here may be still the subject of changes due to planned further extensions in the supported IEC61850 functionality.

## 1.2 Terms and abbreviations

| | |
|---|---|
| ACSI | Abstract Communication Service Interfaces |
| BDA | Basic Data Attribute (not structured) |
| DA | Data Attributes |
| DO | DATA in IEC 61850-7-2, data object type or instance |
| FCD | Functionally Constrained Data |
| FCDA | Functionally Constrained Data Attribute |
| ID | Identifier |
| IED | Intelligent Electronic Device |
| LD | Logical Device |
| LN | Logical Node |
| MSV | Multicast Sampled Value |
| RCB | Report Control Block |
| GCB | GOOSE Control Block or GSSE Control Block |
| SCL | Substation Configuration Language |
| SCSM | Specific Communication Service Mapping |
| XML | Extensible Markup Language |
| GSSE | Generic Substation State Events |
| GOOSE | Generic Object Oriented Substation Events |
| SCD | Substation Configuration Description File |
| ICD | IED Configuration Description |
| CID | Configured IED Description |
| PICS | Protocol Implementation Conformance Statement |
| MICS | Model Implementation Conformance Statement |
| PIXIT | Protocol Implementation eXtra Information for Testing |
| TICS | Tissue Implementation Conformance Statement |

## 2. PICS details

Conformance of the IEC61850 server in VAMP relays:

| | |
|---|---|
| Supported models and services | Yes |
| Unsupported | No |
| Not applicable to Server/publisher | -- |

### 2.1 ASCI basic conformance statement

| Basic ASCI Conformance | | Client/ subscriber | Server/ publisher | Comment |
|---|---|---|---|---|
| **Client – server roles** | | | | |
| B11 | **Server** side (of two-party application association) | | Yes | |
| B12 | **Client** side (of two-party application association) | | -- | |
| **SCSMs supported** | | | | |
| B21 | **SCSM**: IEC 61850-8-1 used | | Yes | |
| B22 | **SCSM**: IEC 61850-9-1 used | | No | |
| B23 | **SCSM**: IEC 61850-9-2 used | | No | |
| B24 | **SCSM**: other | | -- | |
| **Generic substation event model (GSE)** | | | | |
| B31 | **Publisher** side | | Yes | |
| B32 | **Subscriber** side | | Yes | |
| **Transmission of sampled value model (SVC)** | | | | |
| B41 | **Publisher** side | | No | |
| B42 | **Subscriber** side | | No | |

### 2.2 ASCI models conformance statement

| ASCI Model Conformance | | Client/ subscriber | Server/ publisher | Comment |
|---|---|---|---|---|
| M1 | **Logical device** | | Yes | |
| M2 | **Logical node** | | Yes | Only standard LN types defined in Part 7-4. |
| M3 | **Data** | | Yes | Only standard object types defined in Part 7-3, 7-4. Mandatory objects and attributes, selected optional objects and attributes. |
| M4 | **Data set** | | Yes | Supported pre-defined persistent data sets, not configurable via SCL. Supported dynamically created data sets (persistent and non-persistent). Data set members selectio\n restricted to FC such as ST and MX. |

| M5 | **Substitution** | | No | |
|---|---|---|---|---|
| M6 | **Setting group control** | | No | |
| **Reporting** | | | Yes | |
| M7 | **Buffered report control** | | Yes | |
| M7-1 | sequence-number | | Yes | |
| M7-2 | report-time-stamp | | Yes | |
| M7-3 | reason-for-inclusion | | Yes | |
| M7-4 | data-set-name | | Yes | |
| M7-5 | data-reference | | Yes | |
| M7-6 | buffer-overflow | | Yes | |
| M7-7 | entryID | | Yes | |
| M7-8 | BufTm | | Yes | |
| M7-9 | IntgPd | | Yes | |
| M7-10 | GI | | Yes | |
| M7-11 | conf-revision | | Yes | |
| M8 | **Unbuffered report control** | | Yes | |
| M8-1 | sequence-number | | Yes | |
| M8-2 | report-time-stamp | | Yes | |
| M8-3 | reason-for-inclusion | | Yes | |
| M8-4 | data-set-name | | Yes | |
| M8-5 | data-reference | | Yes | |
| M8-6 | BufTm | | Yes | |
| M8-7 | IntgPd | | Yes | |
| M8-8 | GI | | Yes | |
| M8-9 | conf-revision | | Yes | |
| **Logging** | | | No | |
| M9 | **Log control** | | No | |
| M10 | **Log** | | No | |
| **Other** | | | | |
| M11 | **Control** | | Yes | |
| M12 | **GOOSE** | | Yes | Type 1B, class P1, under 100ms, interface 8 (control to control) |
| M13 | **GSSE** | | No | |
| M14 | **Multicast SVC** | | No | |
| M15 | **Unicast SVC** | | No | |
| M16 | **Time** | | Yes | Performance class T5 (1μs accuracy) |
| M17 | **File Transfer** | | Yes | |

### 2.3 ASCI service conformance statement

| ASCI Service Conformance | | Client/ subscriber | Server/ publisher | Comment |
|---|---|---|---|---|
| **Server** | | | | |
| S1 | ServerDirectory | | Yes | |
| **Application association** | | | | |
| S2 | Associate | | Yes | |
| S3 | Abort | | Yes | |
| S4 | Release | | Yes | |
| **Logical device** | | | | |
| S5 | LogicalDeviceDirectory | | Yes | |
| **Logical node** | | | | |
| S6 | LogicalNodeDirectory | | Yes | |
| S7 | GetAllDataValues | | Yes | Note: Alternate access is not supported – all values of a particular logical node can be obtained through the use of single MMS read request with logical node name as MMS variable name. |
| **Data** | | | | |
| S8 | GetDataValues | | Yes | |
| S9 | SetDataValues | | Yes | |
| S10 | GetDataDirectory | | Yes | |
| S11 | GetDataDefinition | | Yes | |
| **Data set** | | | | |
| S12 | GetDataSetValues | | Yes | |
| S13 | SetDataSetValues | | Yes | Note: This service is of no use. Read only attributes from ST and MX functional constraint can be the only accepted members of pre-configured and created data sets. |
| S14 | CreateDataSet | | Yes | |
| S15 | DeleteDataSet | | Yes | |
| S16 | GetDataSetDirectory | | Yes | |
| **Substitution** | | | | |
| S17 | SetDataValues | | No | |
| **Setting group control** | | | | |
| S18 | SelectActiveSG | | No | |
| S19 | SelectEditSG | | No | |
| S20 | SetSGValues | | No | |
| S21 | ConfirmEditSGValues | | No | |
| S22 | GetSGValues | | No | |
| S23 | GetSGCBValues | | No | |

| | | | | |
|---|---|---|---|---|
| **Reporting** | | | | |
| **Buffered report control block (BRCB)** | | | | |
| S24 | Report | | Yes | |
| S24-1 | data-change (dchg) | | Yes | |
| S24-2 | qchg-change (qchg) | | Yes | |
| S24-3 | data-update (dupd) | | Yes | |
| S25 | GetBRCBValues | | Yes | |
| S26 | SetBRCBValues | | Yes | |
| **Unbuffered report control block (URCB)** | | | | |
| S27 | Report | | Yes | |
| S27-1 | data-change (dchg) | | Yes | |
| S27-2 | qchg-change (qchg) | | Yes | |
| S27-3 | data-update (dupd) | | Yes | |
| S28 | GetURCBValues | | Yes | |
| S29 | SetURCBValues | | Yes | |
| **Logging** | | | | |
| **Log control** | | | | |
| S30 | GetLCBValues | | No | |
| S31 | SetLCBValues | | No | |
| **Log** | | | | |
| S32 | QueryLogByTime | | No | |
| S33 | QueryLogAfter | | No | |
| S34 | GetLogStatusValues | | No | |
| **Generic substation event model (GSE)** | | | | |
| **GOOSE Control Block** | | | | |
| S35 | SendGOOSEMessage | | Yes | |
| S36 | GetGoReference | | No | |
| S37 | GetGOOSEElementNumber | | No | |
| S38 | GetGoCBValues | | Yes | |
| S39 | SetGoCBValues | | Yes | |
| **GSSE Control Block** | | | | |
| S40 | SendGSSEMessage | | No | |
| S41 | GetGsReference | | No | |
| S42 | GetGSSEElementNumber | | No | |
| S43 | GetGsCBValues | | No | |
| S44 | SetGsCBValues | | No | |
| **Transmission of sampled value model (SVC)** | | | | |
| **Multicast SVC** | | | | |
| S45 | SendMSVMessage | | No | |
| S46 | GetMSVCBValues | | No | |
| S47 | SetMSVCBValues | | No | |
| **Unicast SVC** | | | | |

| S48 | SendUSVMessage | | No | |
| S49 | GetUSVCBValues | | No | |
| S50 | SetUSVCBValues | | No | |

| **Control** | | | | |
|---|---|---|---|---|
| S51 | Select | | Yes | |
| S52 | SelectWithValue | | Yes | |
| S53 | Cancel | | Yes | |
| S54 | Operate | | Yes | |
| S55 | Command-Termination | | Yes | |
| S56 | TimeActivated-Operate | | No | |
| **File Transfer** | | | | |
| S57 | GetFile | | Yes | |
| S58 | SetFile | | No | |
| S59 | DeleteFile | | Yes | |
| S60 | GetFileAttributeValues | | Yes | |
| **Time** | | | | |
| T1 | Time resolution of internal clock | | 20 bits | |
| T2 | Time accuracy of internal clock | | T5: 1us | |
| T3 | Supported TimeStamp resolution | | 1 ms | |
| T4 | TimeSynchronization | | Yes | |

## 2.4 Protocol profile support

| A-Profile | | Client/ subscriber | Server/ publisher | Comment |
|---|---|---|---|---|
| A1 | Client/Server A-Profile | | Yes | Note: Alternate access is not supported. |
| A2 | GOOSE/GSE Management A-Profile | | Yes | |
| A3 | GSSE A-Profile | | No | |
| A4 | TimeSync A-Profile | | Yes | SNTP |

| T-Profile | | Client/ subscriber | Server/ publisher | Comment |
|---|---|---|---|---|
| T1 | TCP/IP T-Profile | | Yes | |
| T2 | OSI T-Profile | | No | |
| T3 | GOOSE/GSE T-Profile | | Yes | |
| T4 | GSSE T-Profile | | No | |
| T5 | TimeSync T-Profile | | Yes | Performance class is T5 (1µs accuracy. |

## 3.   SCL conformance degree

| SCL Conformance Degree | | Client/ subscriber | Server/ publisher | Comment |
|---|---|---|---|---|
| SCL.1 | SCL File for Implementation available offline | | Yes | VAMPSET relay configuration tool used to create ICD file. |
| SCL.2 | SCL File available from implementation online | | No | |
| SCL.3 | SCL implementation reconfiguration supported online | | No | |

| Supported ASCI Services for SCL.2 and SCL.3 | | Client/ subscriber | Server/ publisher | Comment |
|---|---|---|---|---|
| | GetFileAttributeValues | | No | |
| | GetFile | | No | |
| | SetFile | | No | |
| | DeleteFile | | No | |
| | GetDataValues | | No | |
| | SetDataValues | | No | |
| | SCL Control Block | | No | |
| | SCL File Structure | | No | |
| | Remote Creation of SCL File | | No | |

| Additional MMS Services for SCL.2 and SCL.3 | | Client/ subscriber | Server/ publisher | Comment |
|---|---|---|---|---|
| | GetCapabilityList | | Yes | |
| | GetDomainAttributes | | Yes | |
| | LoadDomainContent | | No | |
| | StoreDomainContent | | No | |

| Definition of SCL Control Block (IEC61850-8-1 Component Name) | | Client/ subscriber | Server/ publisher | Comment |
|---|---|---|---|---|
| | Validate | | No | |
| | ValState | | No | |
| | Activate | | No | |

## 4. MICS details

### 4.1 Classes of Logical Nodes supported in the server

The LN list presented below corresponds to the list of VAMP application functions available on the date of the document release. Further classes may be added when new application functions are developed.

| LN Name | LN Description | Server | Comment: corresponding VAMP functions/signals listed |
|---|---|---|---|
| | **L - System Logical Nodes** | | |
| LLN0 | Common Logical Node Zero | Yes | NamPlt object describes relay type and mode. |
| LPHD | Physical Device | Yes | |
| | **P – Protection Functions** | | |
| PDIF | Differential | Yes | 87L (LDP), 3Id>, 3Id>> |
| PDIR | Directional | | |
| PDIS | Distance | Yes | Z1<, Z2<, Z3<, Z4<, Z5<, Z1e<, Z2e<, Z3e<, Z4e<, Z5e<, Z<, Z<< |
| PDOP | Directional Over Power | Yes | P< reverse power, P<< reverse power |
| PDUP | Directional Under Power | Yes | Q<, X<, X<< |
| PFRC | Rate of Frequency Change | Yes | df/dt> |
| PHAR | Harmonic Restraint | | |
| PHIZ | Ground Detector | | |
| PIOC | Instantaneous Over Current | Yes | I Arc, Io1 Arc, Io2 Arc, CB failure protection |
| PMRI | Motor Restart Inhibition | Yes | Motor frequent start |
| PMSS | Motor Starting Time Supervision | Yes | Ist> |
| POPF | Over Power Factor | | |
| PPAM | Phase Angle Measuring | | |
| PSCH | Protection Scheme | | |
| PSDE | Sensitive Directional Earth Fault | | |
| PTEF | Transient Earth Fault | Yes | IoInt>> |
| PTOC | Time Over Current | Yes | I>, I>>, I>>>, Io>, Io>>, Io>>> (Io2>), Io>>>> (Io2>>), IoDir>, IoDir>>, I2> / I2/I1>, IDir>,IDir>>,IDir>>>,IDir>>>>, If2>, I2>> Ib>, Ib>>, Iv>, Uof3<, I2b> / I2b/I1b>, If5> |

| | | | |
|---|---|---|---|
| PTOF | Over Frequency | Yes | f><, f>><< |
| PTOV | Over Voltage | Yes | Uo>, Uo>>, U>, U>>, U>>> |
| PTRC | Protection Trip Conditioning | | |
| PTTR | Thermal Overload | Yes | T> |
| PTUC | Under Current | Yes | I< |
| PTUV | Under Voltage | Yes | U<, U<<, U<<< |
| PUPF | Under Power Factor | | |
| PTUF | Under Frequency | Yes | f<, f<< |
| PVOC | Voltage Controlled Time Over Current | | |
| PVPH | Volts per Hz | Yes | Uf> |
| PZSU | Zero Speed or Under Speed | | |
| | **R – Protection Related Functions** | | |
| RDRE | Disturbance Recorder Function | Yes | Disturbance recorder |
| RADR | Disturbance Recorder Channel Analogue | | |
| RBDR | Disturbance Recorder Channel Binary | | |
| RDRS | Disturbance Record Handling | | |
| RBRF | Breaker Failure | | |
| RDIR | Directional Element | | |
| RFLO | Fault Locator | Yes | Distance to short circuit, Distance to earth fault |
| RPSB | Power Swing Detection/Blocking | | |
| RREC | Auto Reclosing | Yes | Auto reclose (AR) |
| RSYN | Synchronism Check or Synchronizing | Yes | Synchrocheck object 1, Synchrocheck object 2 |
| | **C – Control Functions** | | |
| CALH | Alarm Handling | | |
| CCGR | Cooling Group Control | | |
| CILO | Interlocking | | |
| CPOW | Point on Wave Switching | | |
| CSWI | Switch Controller | Yes | Object 1..2, Object 3..6, Object 7..8 |
| | **G – Generic Functions** | | |
| GAPC | Generic Automatic Process Control | | |
| GGIO | Generic Process I/O | Yes | **Indications:** AR running, AR locked, AR request 1..5, AR shot 1..5, AR critical request, AR final trip, AR critical final trip, AR1..4 final trip, CB wear alarm 1..2, |

| | | | |
|---|---|---|---|
| | | | CT alarm,<br>VT alarm,<br>Digital input 1..18,<br>Digital input 21..28,<br>Digital input 29..32<br>Line 1..3 fault,<br>Motor starting, Motor running,<br>Programmable stage1..8 start,<br>Programmable stage 1..8 trip,<br>Logical output 1..20,<br>Virtual outputs 1..6,<br>Counter 1..32,<br>External DI 1..18<br>L> inputs<br>Arc master stage 1<br>Arc master stage 2<br>Arc master stage 3<br>Arc master stage 4<br>Arc master stage 5<br>Arc master stage 6<br>Arc master stage 7<br>Arc master stage 8<br>Arc master Act Zones<br>Arc master Binary Inputs<br>Arc master Sensors<br>Generic events<br>Line alarm status<br>GOOSE NI 1..16<br>GOOSE NI 17..32<br>GOOSE NI 33..48<br>GOOSE NI 49..64<br>GOOSE Validity Groups<br>GOOSE Publisher properties<br>Final TRIP for Objects<br>Fault distance indication<br>**Controls with status:**<br>Setting group 1..2,<br>Virtual inputs 1..4,<br>**Controls without status:**<br>Release latches<br>**Analog data:**<br>Fault current of I>,<br>Fault current of I>>,<br>Fault current of I>>>,<br>Fault reactance,<br>External AI 1..16<br>IL1,IL2,IL3 AI<br>UL1,UL2,UL3 AI<br>U12,U23,U31 AI<br>Temperature PT100<br>GOOSE Virtual AI<br>Current for distance to SC |
| GSAL | Generic Security Application | | |
| | **I – Interfacing and Archiving Functions** | | |
| IARC | Archiving | | |
| IHMI | Human Machine Interface | | |
| ITCI | Telecontrol Interface | | |

| ITMI | Telemonitoring Interface | | |
|------|--------------------------|---|---|
| | **A – Automatic Control Functions** | | |
| ANCR | Neutral Current Regulator | | |
| ARCO | Reactive Power Control | | |
| ATCC | Automatic Tap Changer Controller | | |
| AVCO | Voltage Control | | |
| | **M – Metering and Measurement Functions** | | |
| MDIF | Differential Measurements | | |
| MHAI | Harmonics or Interharmonics | Yes | THD IL1,IL2,L3 , THD Ua,Ub,Uc , THD IL1b,IL2b,IL3b , Harmonics IL1,IL2,IL3 , Harmonics Ua,Ub,Uc , Harmonics IL1b,IL2b,IL3b |
| MHAN | Non-Phase Related Harmonics or Interharmonics | | |
| MMTR | Metering | Yes | Energy exported imported |
| MMXN | Non-Phase Related Measurement | | |
| MMXU | Measurement | Yes | Io1, Io2, Io calculated , Uo, IL1,IL2,IL3 , UL1,UL2,UL3 , U12,U23,U32 , P,Q,S,PF , frequency, IL1,IL2,IL3 RMS , P,Q,S RMS , IL1,IL2,IL3 demand , P,Q,S,PF demand , frequency demand , P,Q,S RMS demand , Synchrocheck Uy, Synchrocheck Uz, Synchrocheck fy, Synchrocheck fz, IL1b,IL2b,IL3b , IL1,IL2,IL3 Diff , IL1b,IL2b,IL3b RMS |
| MSQI | Sequence and Imbalance | Yes | ILb symmetrics |
| MSTA | Metering Statistics | Yes | ILb average , ILb RMS average |
| | **S – Sensors and Monitoring Functions** | | |
| SARC | Monitoring and Diagnostics for Arcs | Yes | Arc light on |
| SIMG | Insulation Medium Supervision (gas) | | |
| SIML | Insulation Medium Supervision (liquid) | | |
| SPDC | Monitoring and Diagnostics for Partial Discharges | | |
| | **X – Switchgear Functions** | | |
| XCBR | Circuit Breaker | | |
| XSWI | Circuit Switch | | |

| | | | |
|---|---|---|---|
| | **T – Instrument Transformers** | | |
| TCTR | Current Transformer | | |
| TVTR | Voltage Transformer | | |
| | **Y – Power Transformers** | | |
| YEFN | Earth Fault Neutralizer | | |
| YLTC | Tap Changer | | |
| YPSH | Power Shunt | | |
| YPTR | Power Transformer | | |
| | **Z – Further Power Systems Equipment** | | |
| ZAXN | Auxilliary Network | | |
| ZBAT | Battery | | |
| ZBSN | Bushing | | |
| ZCAB | Power Cable | | |
| ZCAP | Capacitor Bank | | |
| ZCON | Converter | | |
| ZGEN | Generator | | |
| ZGIL | Gas Insulated Line | | |
| ZLIN | Power Overhead Line | | |
| ZMOT | Motor | | |
| ZREA | Reactor | | |
| | **LN classes from Edition 2 (optional)** | | |
| QVVR | Voltage Variation | Yes | Voltage Sag & Swell |

### 4.2     Logical Node extensions

*4.2.1    New Logical Nodes*

LN QVVR (Voltage Variation) as defined in IEC 61850-7-4 Edition 2.

| QVVR class | | | | | |
|---|---|---|---|---|---|
| **Data object name** | **Common data class** | **Explanation** | **T** | **M/O/ C** | |
| LNName | | The name shall be composed of the class name, the LN-Prefix and LN-Instance-ID according to IEC 61850-7-2, Clause 22. | | | |
| **Data objects** | | | | | |
| *Status information* | | | | | |
| VarStr | SPS | Start (voltage variation event in progress) | | M | |
| DipStr | SPS | Start (voltage dip event in progress) | | O | |
| SwlStr | SPS | Start (voltage swell event in progress) | | O | |
| IntrStr | SPS | Start (voltage interruption event in progress) | | O | |
| VarEnd | SPS | Event finished but not reset | T | O | |
| *Measured and metered values* | | | | | |
| VVa | MV | Voltage variation magnitude of the last completed event | | O | |
| EvtCnt | HST | Event counter histogram | | O | |
| VVaTm | MV | Voltage variation duration of the last completed event | | O | |
| *Controls* | | | | | |
| OpCntRs | INC | Resettable counter operation | | O | |
| *Settings* | | | | | |
| | | | | | |
| DipStrVal | ASG | Voltage dip set point | | O | |
| SwlStrVal | ASG | Voltage swell set point | | O | |
| IntrStrVal | ASG | Voltage Interruption set point | | O | |
| IntrDetMth | ENG | Interruption detection method | | O | |

### 4.2.2   Extended Logical Nodes

The following logical nodes have been extended with extra data. These logical nodes contain the "lnNs" attribute.

#### 4.2.2.1   CSWI - switch controller

| CSWI class | | |
|---|---|---|
| Data object name | Common data class | Explanation |
| **Controls** | | |
| BlkCls | SPC | Block closing |
| BlkOpn | SPC | Block opening |

## 4.3    Common Data Class extensions

### 4.3.1    New common data classes

No new common data classes are implemented.

### 4.3.2    Extended common data classes

No extensions to common data class definitions given in IEC 61850-7-3 are implemented.

## 4.4    Enum types extensions

*4.4.1　New Enum types*

None

*4.4.2　Extended Enum types*

Enum type SIUnit is extended by the following enumerations:

```
<EnumVal ord="-1">Hz/s</EnumVal>
<EnumVal ord="-2">char</EnumVal>
<EnumVal ord="-3">char/s</EnumVal>
<EnumVal ord="-4">kgm²</EnumVal>
<EnumVal ord="-5">dB</EnumVal>
<EnumVal ord="-6">pu</EnumVal>
<EnumVal ord="-7">%</EnumVal>
```

## 5. PIXIT details

The following section defines extra information on IEC61850 server implementation in VAMP relay.

### 5.1 PIXIT for Assocation Model

| ID | Property Description | Value / Clarification | |
|----|---------------------|----------------------|---|
| As1 | Maximum number of clients that can set-up an association simultaneously | 8 | |
| As2 | TCP_KEEPALIVE value | Configurable: from 2 to 20s | |
| As3 | Lost connection detection time | Maximum 20s (minimum cycle of TCP Keep-alive message 2s, 10 retransmissions) | |
| As4 | Is authentication supported | No | |
| As5 | What association parameters are necessary for successful association | Transport selector<br>Session selector<br>Presentation selector<br>AP Title<br>AE Qualifier | Yes  (checking can be disabled)<br>Yes  (checking can be disabled)<br>Yes  (checking can be disabled)<br>Yes  (checking can be disabled)<br>Yes  (checking can be disabled)<br>**Checking for ALL or for NONE** |
| As6 | Association parameters are configurable, default values are | Transport selector<br>Session selector<br>Presentation selector<br>AP Title<br>AE Qualifierr | 1<br>1<br>1<br>1.1.1.999.1<br>12 |
| As7 | What is the maximum and minimum MMS PDU size | Max: 12kbytes<br>Min: There is no limit (message syntax must be correct) | |
| As8 | Time taken for startup | VAMP relay start-up including server function is at average **30s**, it depends on the configuration size (number & types of logical nodes) | |

### 5.2 PIXIT for Server Model

| ID | Property Description | Value / Clarification |
|----|---------------------|----------------------|
| Sr1 | Which analogue value (MX) quality bits are supported (can be set by server) | Validity:<br>Y        Good,<br>N        Invalid,<br>N        Reserved,<br>N        Questionable<br><br>N        Overflow<br>N        OutofRange<br>N        BadReference<br>N        Oscillatory<br>N        Failure<br>N        OldData |

| | | |
|---|---|---|
| | | N      Inconsistent |
| | | N      Inaccurate |
| | | Source: |
| | | Y      Process |
| | | N      Substituted |
| | | N      Test |
| | | N      OperatorBlocked |
| Sr2 | Which status value (ST) quality bits are supported (can be set by server) | Validity: <br> Y      Good, <br> Y      Invalid, <br> N      Reserved, <br> N      Questionable <br><br> N      BadReference <br> N      Oscillatory <br> N      Failure <br> N      OldData <br> N      Inconsistent <br> N      Inaccurate <br> Source: <br> Y      Process <br> N      Substituted <br><br> N      Test <br> N      OperatorBlocked |
| Sr3 | What is the maximum number of data values in one GetDataValues request | The stack does not limit the amount of the data values. MMS PDU is the limit. |
| Sr4 | What is the maximum number of data values in one SetDataValues request | The stack does not limit the amount of the data values. MMS PDU is the limit. |
| Sr5 | Which Mode / Behaviour values are supported | On            Y <br> Blocked    N <br> Test        N <br> Test/Blocked  N <br> Off          N |

## 5.3     PIXIT for Data Set Model

| ID | Property Description | Details |
|---|---|---|
| | Maximum number of data sets handled by DUT | 16 <br> (up to 5 pre-defined datasets and up to 11 dynamically created datasets) |
| Ds1 | Maximum number of data elements in one data set | 150 data attributes in pre-defined data sets to be referenced by RCB, <br> 100 data attributes in dynamically created data sets to be referenced by RCB |

| Ds2 | How many persistent data sets can be created by one or more clients | 11 | |
|---|---|---|---|
| Ds3 | How many non-persistent data sets can be created by one or more clients | 11 | |
| | Maximum number of data elements in GOOSE publisher data set | 16 data attributes in data set to be referenced by GCB | |
| | Data set members in RCB data set | Only functionally constrained data with FC = ST or FC = MX (value, quality and time stamp) | |
| | Data set members in GOOSE publisher data set | Only functionally constrained data with FC = ST or FC = MX, pre-selected list of signals, only value attribute | |
| | Persistent data sets – pre-defined (using VAMPSET tool) | 3 for RCB and 2 for GCB | |
| | GOOSE publisher data set | Only pre-defined | |
| | SetDataSetValues service | Supported but with negative response for all data sets (data sets can be composed of read-only attributes) | |

## 5.4     PIXIT for Reporting Model

| ID | Property Description | Details | |
|---|---|---|---|
| Rp1 | The supported trigger conditions | integrity | Yes |
| | | data change | Yes |
| | | quality change | Yes[1] |
| | | data update | Yes[1] |
| | | general interrogation | Yes |
| Rp2 | The supported optional fields | sequence-number | Yes |
| | | report-time-stamp | Yes |
| | | reason-for-inclusion | Yes |
| | | data-set-name | Yes |
| | | data-reference | Yes |
| | | entryID | Yes |
| | | conf-rev | Yes |
| Rp3 | Support for sending segmented reports | No | |
| Rp4 | Mechanism on second internal data change notification of the same analogue data value within buffer period | Send report immediately | |
| Rp5 | Multi client URCB approach (compare IEC 61850-7-2 $14.2.1) | All RCB instances are visible to clients; client can reserve selected instances and subscribe for reports. | |
| Rp6 | Format of EntryID | Octet string 8, four LSB bytes are used as counter. | |
| Rp7 | Buffer size for each BRCB or how many reports can be buffered | 8192 bytes per report control block | |

| | | |
|---|---|---|
| Rp8 | Pre-configured RCB attributes that cannot be changed online when RptEna = FALSE (see also the ICD report settings) | None |
| Rp9 | May the reported data set contain: - structured data objects? - data attributes? - timestamp data attributes? | Y Y Y |
| Rp 10 | What is the scan cycle for binary events? Is this fixed, configurable | 5 milliseconds Fixed |
| <span style="color:red">Rp 11</span> | <span style="color:red">Does the device support to pre-assign a RCB to a specific client in the SCL</span> | <span style="color:red">N</span> |
| | Can unbuffered or buffered reporting be disabled by changing Mod or Beh to Off or Blocked? | N |

[1]) Due to relay application configuration it may be not possible to trigger reports according to these conditions.


### 5.5     PIXIT for Generic substation events model (GOOSE)

| ID | Description | Value / Clarification |
|---|---|---|
| Go1 | What elements of a subscribed GOOSE header are checked to decide the message is valid and the allData values are accepted? If yes, describe the conditions.<br><br>Note: The VLAN tag may be removed by a ethernet switch and should not be checked | N     source MAC address<br>Y     destination MAC address (equal to configured)<br>Y     Ethertype = 0x88B8<br>Y     APPID (equal to configured)<br>N     gocbRef<br>N     timeAllowedtoLive     (see Remarks)<br>N     datSet<br>Y     goID (equal to configured, checking can be set off)<br>N     t<br>Y     stNum     (see Remarks)<br>N     sqNum     (see Remarks)<br>Y     test (if true, values not passed to application)<br>Y     confRev (equal to configured)<br>Y     ndsCom (if true, values not passed to applic.)<br>Y     numDatSetEntries     (see Remarks) |
| Go2 | Can the test flag in the published GOOSE be turned on / off | Y |
| Go3 | What is the behavior when the GOOSE publish configuration is incorrect | If in DUT the GOOSE publisher configuration is incorrect the publisher keeps GoEna=F and ndsCom=T |
| Go4 | When is a subscribed GOOSE marked as lost? | Delayed messages are processed as normal. Internally in the relay there is a status indication to the |

| | | | |
|---|---|---|---|
| | | (TAL = time allowed to live value from the last received GOOSE message) | application about GOOSE problem (data is marked as OLD if the message does not arrive prior to TAL if TAL>1s or prior to 1s if TAL<1s ). |
| Go5 | | What is the behavior when one or more subscribed GOOSE messages isn't received or syntactically incorrect (missing GOOSE) | The subsequently received GOOSE message is accepted even if the new state number is not equal to the incremented value of the previously received state number (it is enough that it is not equal to the last received state number). |
| Go6 | | What is the behavior when a subscribed GOOSE message is out-of-order | Message is treated as normal (it is assumed that previous messages have been lost). |
| Go7 | | What is the behavior when a subscribed GOOSE message is duplicated | Duplicated message is ignored |
| Go8 | | Does the device subscribe to GOOSE messages with/without the VLAN tag? | Y  with the VLAN tag<br>Y  without the VLAN tag |
| Go9 | | May the GOOSE data set contain:<br>- structured data objects?<br>- data attributes?<br>- timestamp data attributes? | Subscribed        Published<br><br>N                            N<br>Y                            Y<br>N                            N |
| Go 10 | | Published FCD supported common data classes / data types are | BOOL<br>DBPOS<br>FLOAT |
| Go 11 | | Subscribed FCD supported common data classes / data types are | BOOL<br>INT<br>BITSTRING<br>FLOAT |
| Go 12 | | What is the slow retransmission time?<br>Is it fixed or configurable? | Default 20000 mseconds with TAL = 40000<br><br>Configurable by configuration tool |
| Go 13 | | What is the fast retransmission scheme?<br><br><br><br><br><br><br><br>Is it fixed or configurable? | First message upon data change, followed by 3 messages with 5 ms interval. Then the retransmission interval calculated from geometric growth formula by doubling the interval with rounding to 5ms unit (the consecutive intervals are 10, 20, 35, 65, 130, 260, 515, 1025, 2050, 4100, 8195, 16385 and finally 20000 ms).<br><br>Fixed |
| Go 14 | | Can the Goose publish be turned on / off by using SetGoCBValues(GoEna) | Y |
| | | Maximum number of different GOOSE data items that can be received and processed by GOOSE subscriber | 64 boolean and 5 analog |

| | Maximum number of GOOSE publishers from which the data can be received and processed subscriber | 64+5=69 (with maximum number of publishers only one data item per publisher) |
|---|---|---|

TAL = Time Allowed to Live

Remarks:
A GOOSE message will be accepted and processed by the subscriber in DUT:
- Even if it is received after expiration of the time alllowed to live sent in the previous message,
- Even if the new state number is not equal to the incremented value of the previously received state number - it is enough that it is not equal to the last received state number,
- If the state number differs from the previously received state number, the sequence number is accepted with any value (if the state number is equal to the previously received state number, the message is treated as retransmission),
- Even if the received message contains a dataset of the size different than the size of the previously received dataset.

The value of numDatSetEntries from the header determines how many data entries from the message are processed. With numDatSetEntries = 0 no data entries are processed from the received message.

## 5.6    PIXIT for Control Model

| ID | Description | Value / Clarification |
|---|---|---|
| Ct1 | Control modes supported | Y status-only |
| | | Y direct-with-normal-security |
| | | Y sbo-with-normal-security |
| | | Y direct-with-enhanced-security |
| | | Y sbo-with-enhanced-security |
| Ct2 | Is the control model fixed, configurable and/or online changeable? | CONFIGURABLE FOR CSWI CLASS<br>All controllable objects Obj1..Obj6 under CSWI class are configured to use the same chosen control model.<br>Objects Obj7..Obj8 under CSWI class have fixed control model status-only.<br>FIXED FOR GGIO<br>All controllable objects under GGIO class the control model is fixed: direct-with-normal-security. |
| Ct3 | Time activated operate (operTm) supported | N |
| Ct4 | Is "operate-many" supported | N |
| Ct5 | What is the behavior of the DUT when the test attribute is set in the SelectWithValue and/or Operate request | DUT will accept the command but will not perform it on the hardware. |
| Ct6 | What are the conditions for the time (T) attribute in the SelectWithValue and/or Operate request | No functionality |
| Ct7 | Is pulse configuration supported | N |
| Ct8 | What is the behavior of the DUT when the check conditions are set | N synchrocheck<br>N interlock-check<br>DUT ignores the check value and the command is executed as usual |

| | | |
|---|---|---|
| | Is this behavior fixed, configurable, online changeable? | Fixed |
| Ct9 | What additional cause diagnosis are supported | Y Blocked-by-switching-hierarchy<br>N Select-failed<br>Y Invalid-position<br>Y Position-reached<br>Y Parameter-change-in-execution<br>N Step-limit<br>N Blocked-by-Mode<br>Y Blocked-by-process<br>N Blocked-by-interlocking<br>N Blocked-by-synchrocheck<br>Y Command-already-in-execution<br>N Blocked-by-health<br>N 1-of-n-control<br>Y Abortion-by-cancel  (see Remarks)<br>Y Time-limit-over<br>N Abortion-by-trip<br>Y Object-not-selected<br>Y Not-supported |
| Ct 10 | How to force a "test-not-ok" respond with SelectWithValue request? | Put device into local mode |
| Ct 11 | How to force a "test-not-ok" respond with Select request? | Put device into local mode |
| Ct 12 | How to force a "test-not-ok" respond with Operate request? | DOns:        Operate with orCat out of range<br>SBOns:      Operate without Select<br>DOes:        Operate with orCat out of range<br>SBOes:      Operate without Select |
| Ct 13 | Which origin categories are supported? | All |
| Ct 14 | What happens if the orCat is not supported?<br>Out of range or within the range but not supported | DOns:        Negative response<br>SBOns:      Negative response<br>DOes:        Negative response<br>SBOes:      Negative response |
| Ct 15 | Does the IED accept an SelectWithValue/Operate with the same ctlVal as the current status value? | DOns:        N<br>SBOns:      N<br>DOes:        N<br>SBOes:      N |
| Ct 16 | Does the IED accept a Select/Operate on the same control object from 2 different clients at the same time? | DOns:        Y (see Remarks)<br>SBOns:      N<br>DOes:        N<br>SBOes:      N |

| Ct 17 | Does the IED accept a Select/SelectWithValue from the same client when the control object is already selected (tissue 334) | SBOns:     N<br>SBOes:     N |
|---|---|---|
| Ct 18 | Is for SBOes the internal validation performed during the SelectWithValue and/or Operate step? | Y During SelectWithValue and during Operate |
| Ct 19 | Can a control operation be blocked by Mod=Off or Blocked | N (Mod not configurable) |
| Ct 20 | Does the IED support local / remote operation? | Y |
| <span style="color:red">Ct 21</span> | <span style="color:red">Does the IED send an InformationReport with LastApplError as part of the Operate response- for control with normal security?</span> | <span style="color:red">SBOns:     N</span><br><span style="color:red">DOns:     N</span> |

Remarks:
- Additional cause Abortion-by-cancel is returned after the first Operate command that follows successful Cancel command (the next Operate will produce additional cause Object-not-selected).
- In DOns model: When two client sends Operate request with very short interval (e.g. 10ms) then for processing the second command the object position is still unchanged due to the first command, thus both clients receive positive Operate response.

### 5.7 PIXIT for Time Synchronization

| ID | Description | Value / Clarification |
|---|---|---|
| Tm 1 | What quality bits are supported | N LeapSecondsKnown<br>N ClockFailure<br>Y ClockNotSynchronized |
| Tm 2 | Describe the behavior when the time synchronization signal/messages are lost | Time is taken from internal RTC |
| Tm 3 | When is the time quality bit "Clock failure" set? | This time quality bits is not supported |
| Tm 4 | When is the time quality bit "Clock not synchronised" set? | It is done when the device detects that the configured NTP server does not respond; the latency depends on measured drift of the internal clock.<br>Usually it can take 1 to 3 minutes. |
| Tm 5 | Is the timestamp of a binary event adjusted to the configured scan cycle? | Y |

| Tm 6 | Does the device support time zone and daylight saving? | Y | |
|---|---|---|---|
| Tm 7 | Which attibutes of the SNTP response packet are validated? | N | Leap indicator not equal to 3 |
| | | N | Mode is equal to SERVER |
| | | N | OriginateTimestamp is equal to value sent by the SNTP client as Transmit Timestamp |
| | | Y | RX/TX timestamp fields are checked for reasonableness |
| | | Y | SNTP version 3 or 4 |
| | | N | other |

### 5.8    PIXIT for File Transfer Model

| ID | Description | Value / Clarification |
|---|---|---|
| Ft1 | What is structure of files and directories? | Root/<br>  COMTRADE/<br><br>In COMTRADE directory all recording files are stored (*.cfg and *.dat files).<br><br>Only the files from COMTRADE directory can be deleted. Files from Root directory cannot be deleted. |
| | Is the IETF FTP protocol also implemented | Y |
| Ft2 | Directory names are separated from the file name by | "/" |
| Ft3 | The maximum file name size including path (recommended 64 chars) | 37 chars<br>Disturbance recorder file is named in the following way:<br>vamp_dd-mm-yyyy_hh-mm-ss.cfg<br>or<br>vamp_dd-mm-yyyy_hh-mm-ss.dat<br>With the leading path "COMTRADE/" it makes 37 characters in total. |
| Ft4 | Are directory/file name case sensitive | Case sensitive |
| Ft5 | Maximum file size | The maximum file size is not restricted over the MMS file transfer interface, however it is dependent upon the configuration of the disturbance recorder (recording time and number of signals to be stored) and stored values (COMTRADE *.dat file is in ASCII format). |
| Ft6 | Is the requested file path included in the file name of the MMS fileDirectory respond? | Y |

| ID | Description | Value / Clarification |
|---|---|---|
| Ft7 | Is the wild char supported MMS fileDirectory request? | Yes, wild card = *, but only allowed as equivalent of all files (i.e. requests with patterns "test*" or "all.*" will be rejected) |
| Ft8 | Is it allowed that 2 clients get a file at the same time? | Not the same file, but it is possible for different files. In case of accessing the same file by two clients a negative response (confirmed error, class: file, code: file busy) will be sent to the second client. |

## 6. TICS details

### 6.1 Introduction

This part of the document is based on a template for the tissues conformance statement. According to the UCA IUG QAP the tissue conformance statement is required to perform a conformance test and is referenced on the certificate.

### 6.2 Mandatory Intop Tissues

During the October 2006 meeting IEC TC57 working group 10 decided that:
- green Tissues with the category "IntOp" are mandatory for IEC 61850 edition 1
- Tissues with the category "Ed.2" Tissues should not be implemented.

Below table gives an overview of the implemented IntOp Tissues.

| Part | Tissue No. | Description | Implemented Y/na |
|------|-----------|-------------|------------------|
| 8-1 | 116 | GetNameList with empty response? | Y |
| | 165 | Improper Error Response for GetDataSetValues | Y |
| | 183 | GetNameList error handling | Y |
| 7-4 | None | | |
| 7-3 | 28 | Definition of APC | na |
| | 54 | Point def xVal, not cVal | na |
| | 55 | Ineut = Ires ? | Y |
| | 60 | Services missing in tables | na |
| | 63 | mag in CDC CMV | Y |
| | 219 | operTm in ACT | na |
| | 270 | WYE and DEL rms values | See note 3) |

| Part | Tissue No. | Description | Implemented Y/na |
|------|-----------|-------------|------------------|
| 7-2 | 30 | control parameter T | Y |
| | 31 | Typo | na |
| | 32 | Typo in syntax | na |
| | 35 | Typo Syntax Control time | na |
| | 36 | Syntax parameter DSet-Ref missing | na |
| | 37 | Syntax GOOSE "T" type | Y |
| | 39 | Add DstAddr to GoCB | Y |
| | 40 | GOOSE Message "AppID" to "GoID" | Y |
| | 41 | GsCB "AppID" to "GsID" | na |
| | 42 | SV timestamp: "EntryTime" to "TimeStamp" | na |
| | 43 | Control "T" semantic | na |
| | 44 | AddCause - Object not sel | Y |
| | 45 | Missing AddCauses (neg range) | na |
| | 46 | Synchro check cancel | na |
| | 47 | "." in LD Name? | Y |
| | 50 | LNName start with number? | Y |
| | 51 | ARRAY [0..num] missing | Y |
| | 52 | Ambiguity GOOSE SqNum | Y |
| | 53 | Add DstAddr to GsCB, SV | na |
| | 151 | Name constraint for control blocks etc. | Y |
| | 166 | DataRef attribute in Log | na |

| | 185 | Logging - Integrity periode | na |
| | 189 | SV Format | na |
| | 234 | New type CtxInt (Enums are mapped to 8 bit integer) | na |
| | 278 | EntryId not valid for a server (part of #453) | Y |
| | 453 | Reporting & Logging model revision | Y |

| Part | Tissue No. | Description | Implemented Y/na |
|------|-----------|-------------|------------------|
| 6 | 1 | Syntax | na |
| | 5 | tExtensionAttributeNameEnum is restricted | Y |
| | 8 | SIUnit enumeration for W | Y |
| | 10 | Base type for bitstring usage | Y |
| | 17 | DAI/SDI elements syntax | Y |
| | 169 | Ordering of enum differs from 7-3 | Ns |

Note:
1) Editorial tissues are marked as "na".
2) Final proposal on tissue 45 is not defined yet
3) Tissue 270: In VAMP data model the LNs with WYE and DEL data are described (in the LN prefix and in the description attributes) whether they provide amplitude or rms values.

## 6.3    Optional IntOp Tissues

After the approval of the server conformance test procedures version 2.2 the following IntOp tissues were added or changed. It is optional to implement these tissues.

| Part | Tissue No. | Description | Implemented Y/na |
|------|-----------|-------------|------------------|
| 8-1 | 246 | Control negative response (SBOns) with LastApplError | N |
| 8-1 | 545 | Skip file directories with no files | Y |
| 7-4 | 79 | AutoRecSt value 4 = "unsuccessful" | N |
| 7-2 | 333 | Enabling of an incomplete GoCB | Y |
| 7-2 | 453 | Combination of all reporting and logging tissues | See note above |
| 6 | 245 | Attribute RptId in SCL | Y |
| 6 | 529 | Replace sev - Unknown by unknown | na |

## 6.4    Other Implemented Tissues

Other implemented tissues that should have no impact on interoperability.

| Part | Tissue No. | Description | Implemented Y/na |
|------|-----------|-------------|------------------|
| | | | |
| | | | |
| | | | |