Model2ADF Framework

A complete Model Driven “Spacecraft Reference Database application” automatic generation

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TEC-SW & TEC-ED Final Presentation Days

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AGENDA

- BACKGROUND
- THE CHALLENGE
- SIB APPLICATION
- Model2ADF
- CONCLUSIONS

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- **BACKGROUND**
- **THE CHALLENGE**
- **SIB APPLICATION**
- **Model2ADF**
- **CONCLUSIONS**

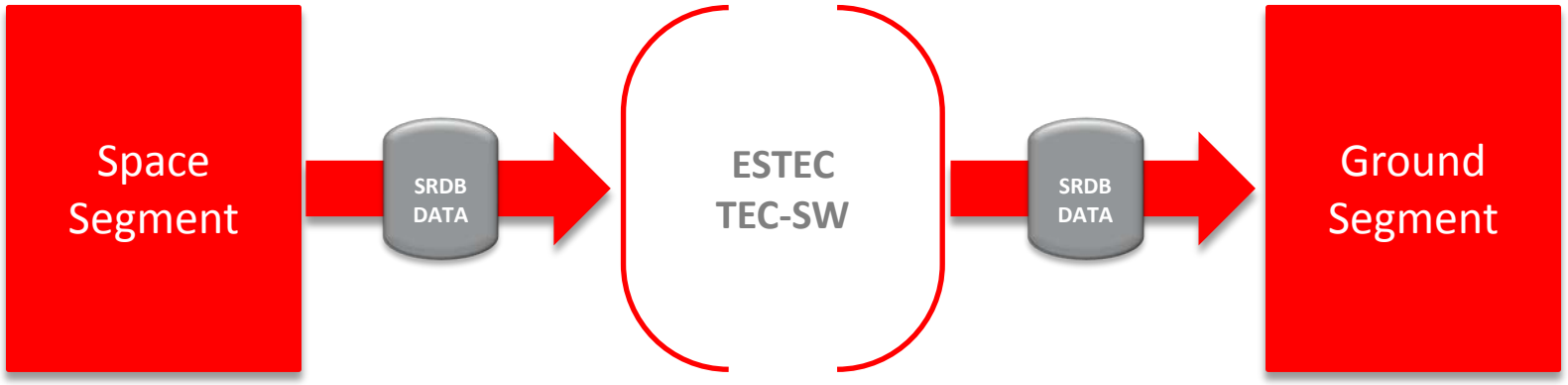
SPACECRAFT REFERENCE DATABASES (SRDBs)

They mainly collect and maintain all the knowledge related to spacecraft M&C (e.g. TM/TC) for allowing:

- On board SW development
- System AIT
- Delivery of data for in-flight operations

TEC-SW SRDB PROJECT SUPPORT

Verify that the SRDB data delivered by the Space Segment (Prime) to the Ground Segment (Operations) are valid and complete according to the ESA project requirements.



TEC-SW SRDB PROJECT SUPPORT (cont'd)

The TEC-SW-SRDB projects support includes:

- The verification of the compliance of the delivered data with the applicable ICDs
- The verification of the compliance of the delivered data with the applicable validation rules
- The identification of the changes occurred among deliveries
- The impact analysis of occurred changes for non-regression tests

TEC-SW SRDB PROJECT SUPPORT (cont'd)

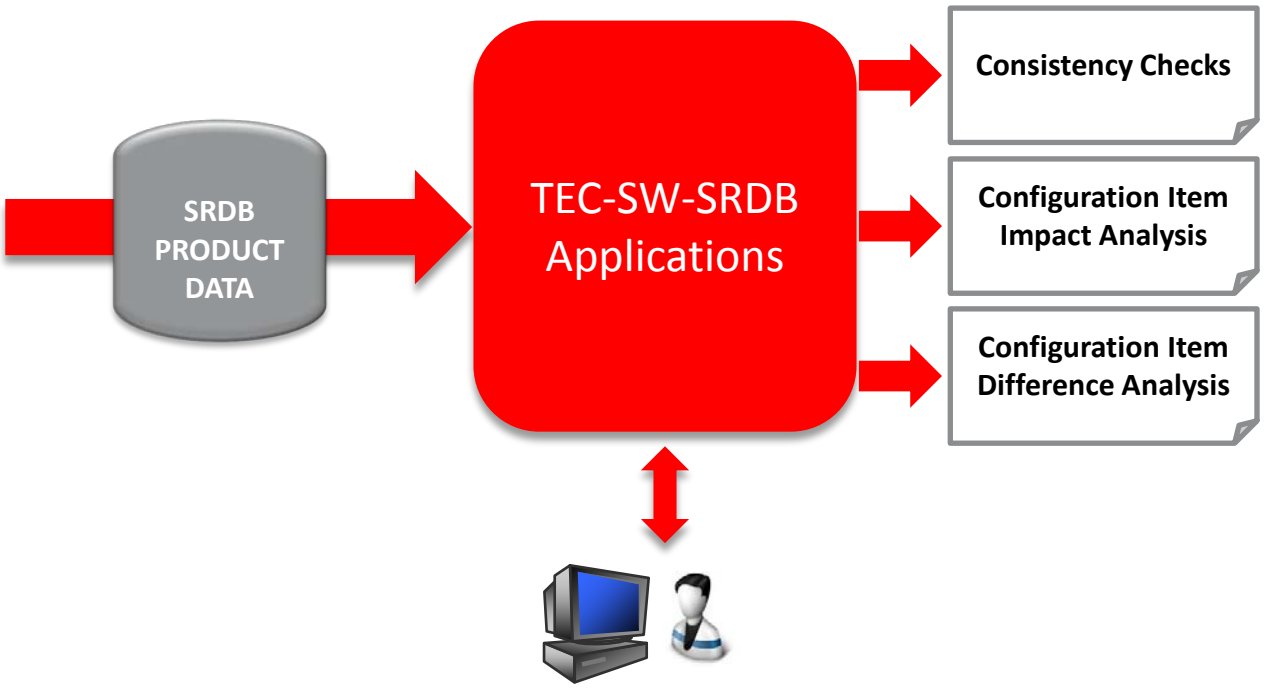
TEC-SW-SRDB Applications are the main means for this project support.

Several Applications have been developed during the last years complying with the project specific data requirements.

This experience has identified for this type of applications:

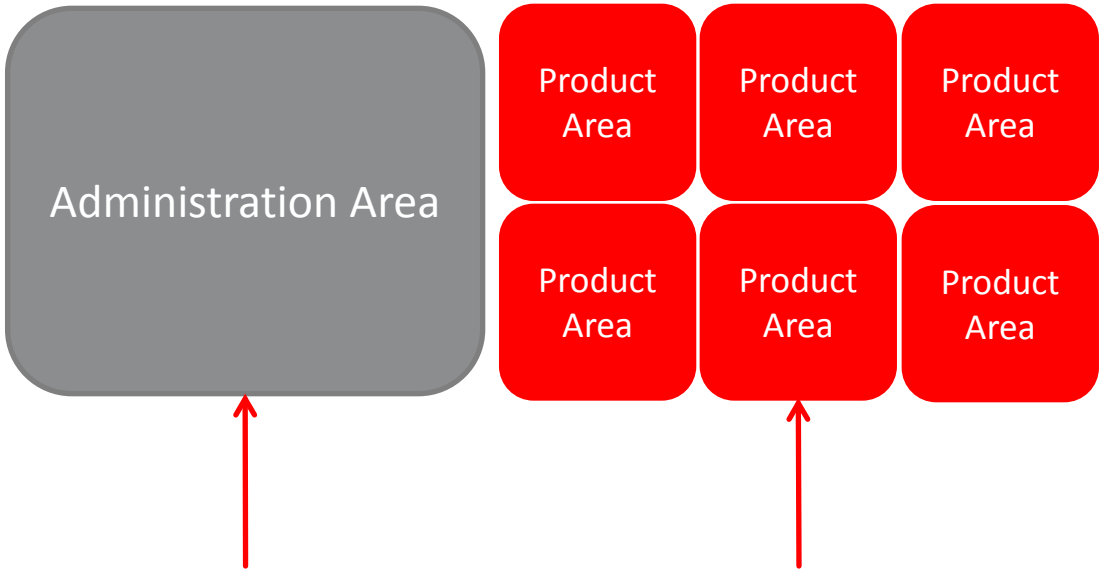
- Main functional requirements
- High-level architecture

TEC-SW-SRDB APPLICATIONS: MAIN REQUIREMENTS



MMI to navigate SRDB data and consistency violations

TEC-SW-SRDB APPLICATIONS: HIGH-LEVEL ARCHITECTURE



One Administration Area, managing all SRDB data deliveries

Many Product Areas, one for each SRDB data delivery

TEC-SW-SRDB APPLICATIONS TAILORED FOR ESA PROJECTS

For each project a specific TEC-SW-SRDB application is developed:

- based on the same Architecture
- implementing the same type of functionalities (Import, Export, Consistency checks, …)

BUT

- with data models that differ i.e. project specific
- resulting in project specific interfaces (Import, Export, MMI, …)

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THE CHALLENGE

ESA-ESTEC needs to:

timely and cost effectively (i.e. in line with the project schedule and constraints) produce means to assess the SRDB data quality by automatically generating the TEC-SW-SRDB applications in compliance with the project specific model requirements.

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SPACE SYSTEM BASE (SIB) APPLICATION

Through the years, many TEC-SW-SRDB applications (e.g. SSM, METOPDB, SSDB, CSDB, FEDs, VIDB) have been developed in support to projects such as METOP, VEGA, IOV, Sentinels, EarthCare, FOC.

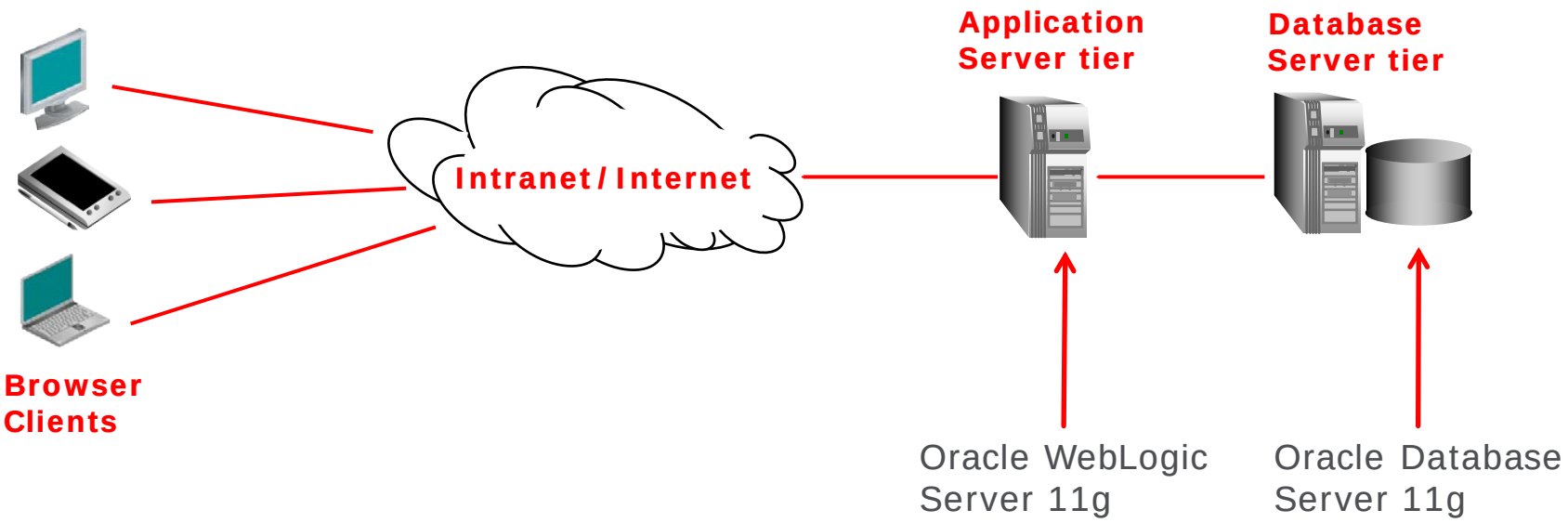
The SIB TEC-SW-SRDB application is the result of this evolution:

- Moving from a client-server to a three-tier Deployment
- Fully model-driven application specification, design and development:
  - SIB Application Framework Software, able to adapt its behaviour to the input model
  - SIB MMI automatically generated according to the input model

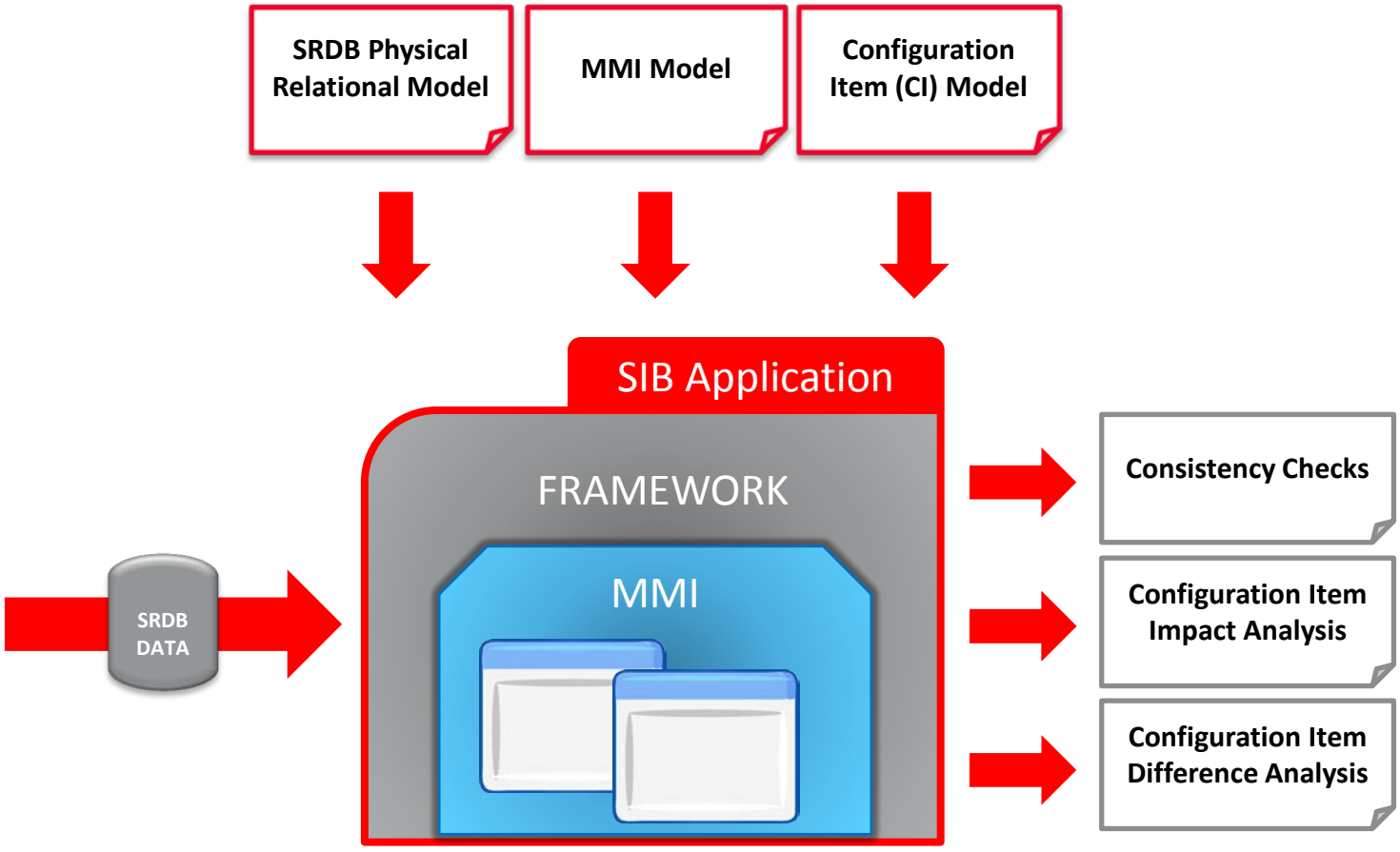
SIB DEPLOYMENT

Classic three-tier deployment allowing:

- Seamless remote access
- No client installation (standard Internet browsers)
- Performance isolation and optimization on server tiers



SIB MODEL-DRIVEN APPROACH



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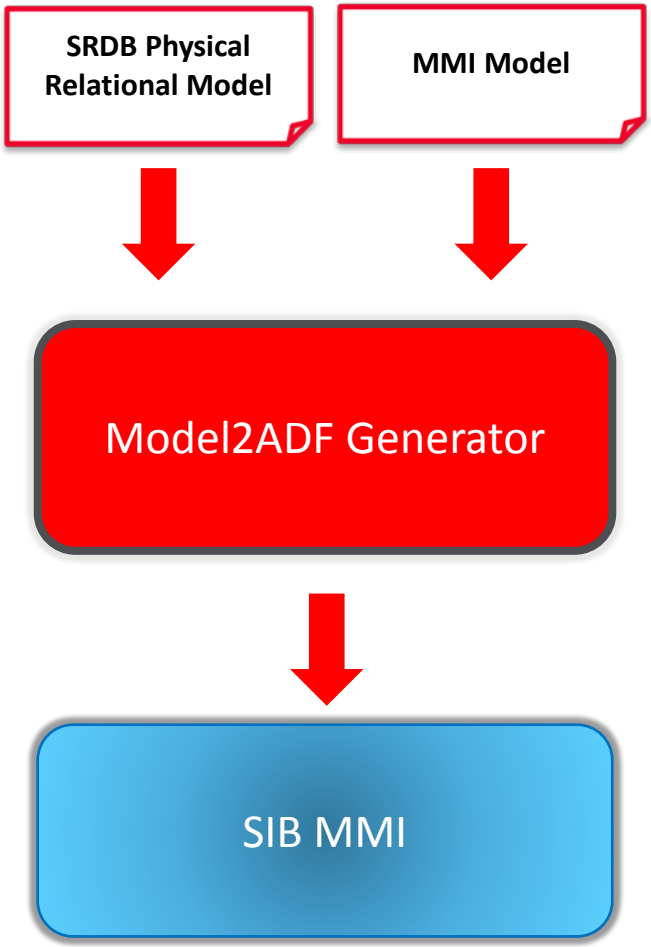
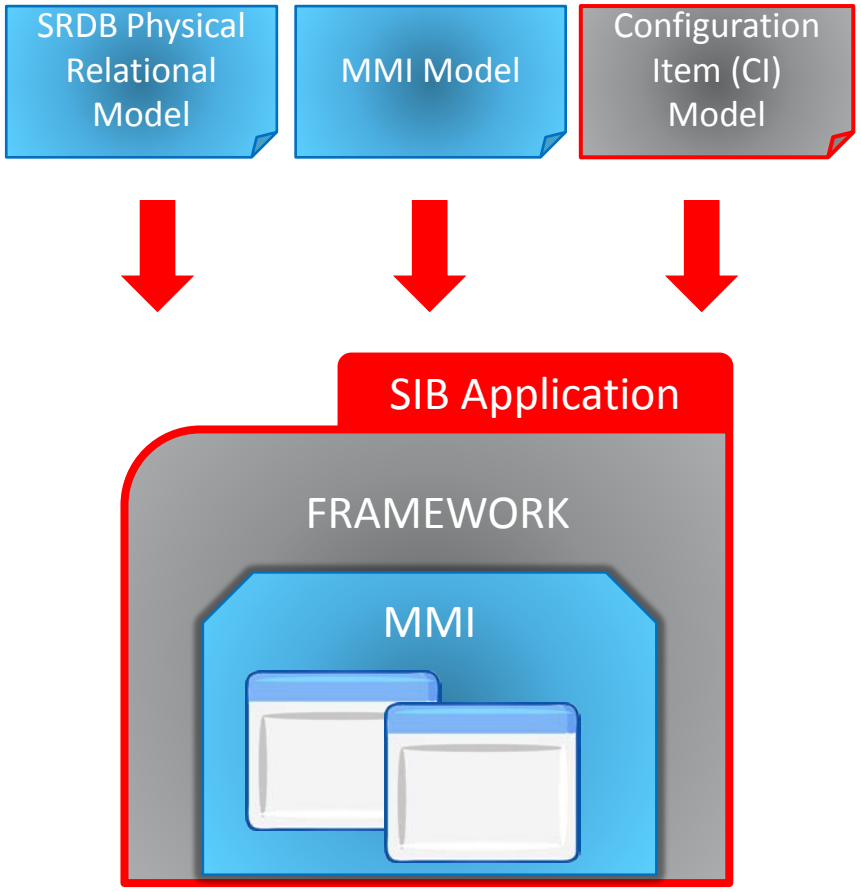
Model2ADF

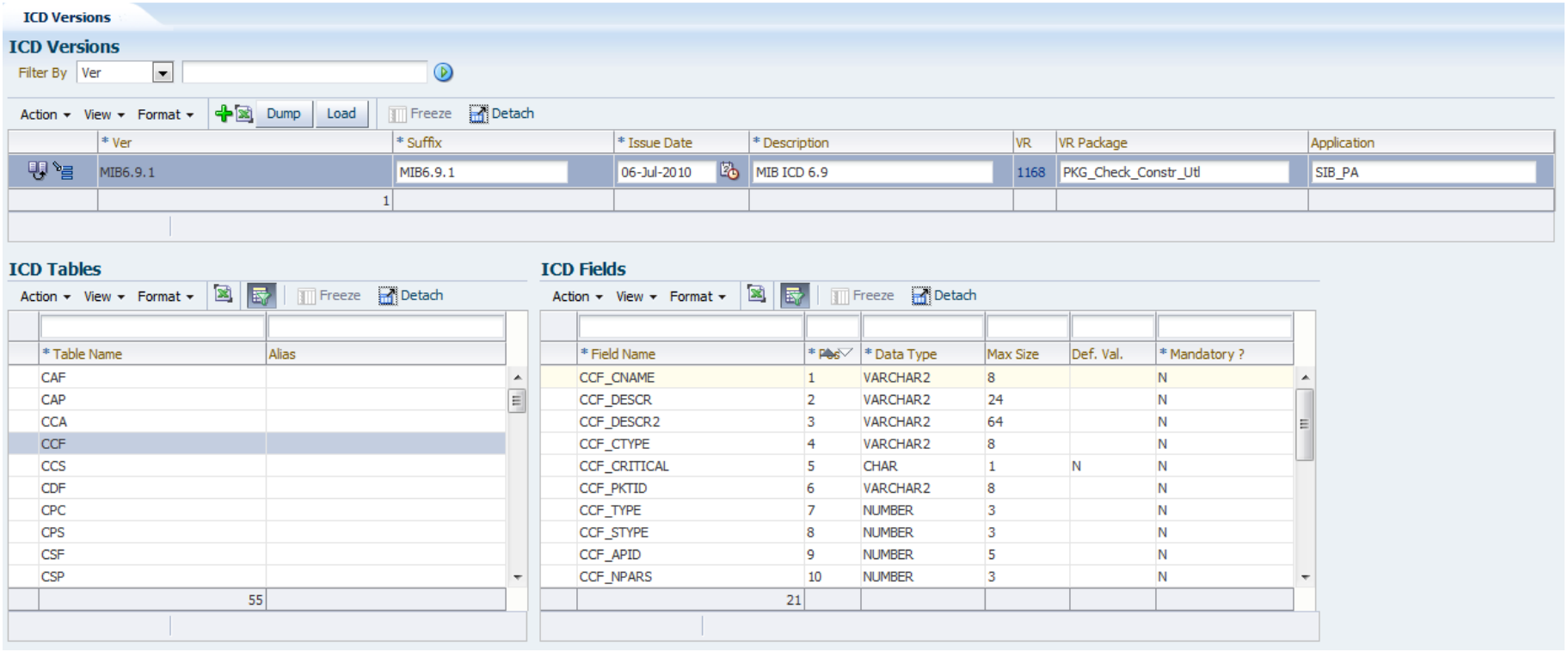

SRDB Physical Relational Model
MMI Model
Model2ADF Generator
SIB MMI

THE MODELS

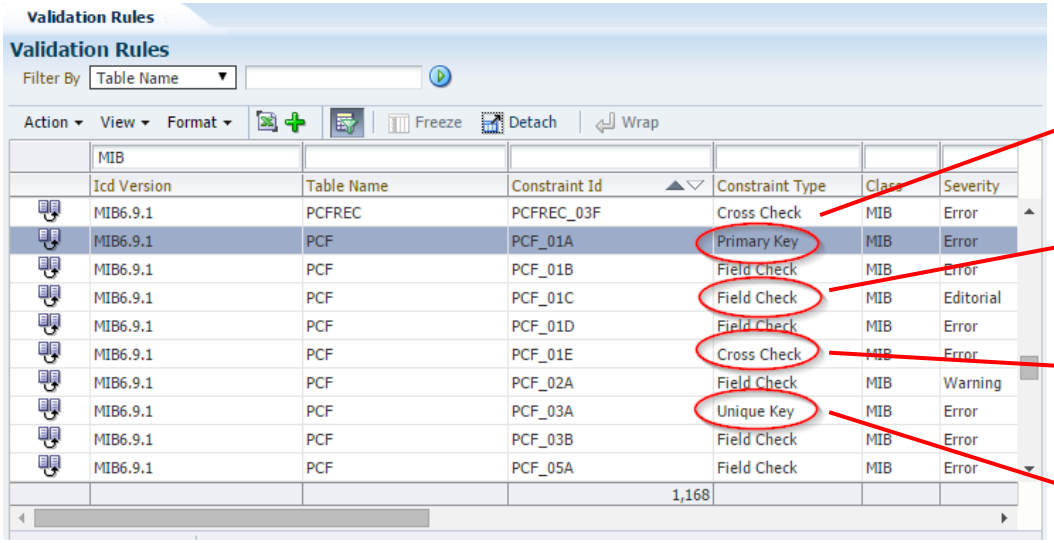
- **SRDB Physical Relational Model**
  - ICD Database Schema Model
  - Validation Rules Model
- **MMI Model**
  - Menu Model
  - Configuration Item View Model
- ***Configuration Item Model***
  - *"Part of" Model*
  - *Impact Analysis Model*

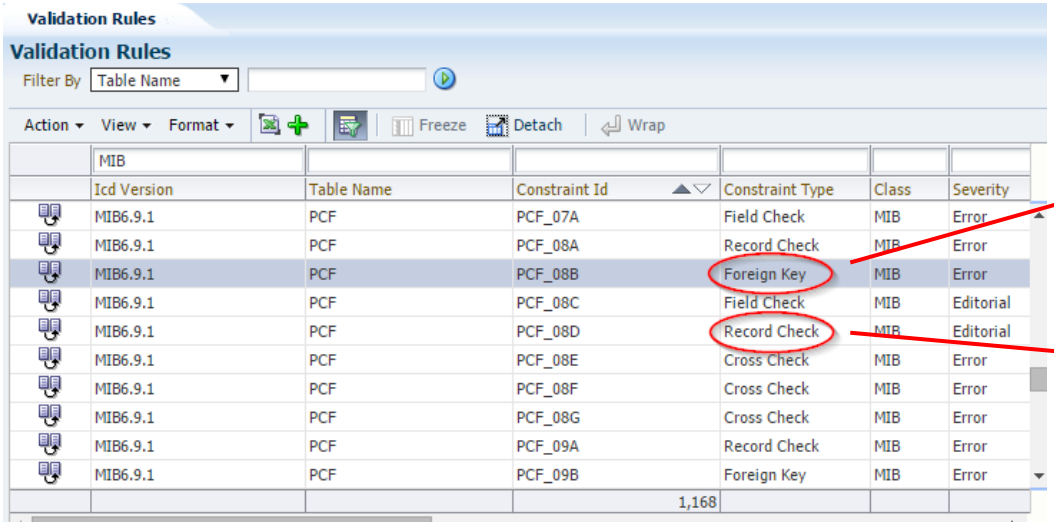


SRDB PHYSICAL RELATIONAL MODEL: ICD Database Schema Model



SRDB PHYSICAL RELATIONAL MODEL: Validation Rules Model





Description: PCF_NAME shall be unique (i.e. PK).
Definition: PCF_NAME
Encoding: [PCF].[PCF_NAME]

Description: PCF_NAME should be uppercased.
Definition: PCF_NAME=UPPER(PCF_NAME)
Encoding: [PCF].[PCF_NAME=UPPER(PCF_NAME)]

Description: IF PCF_USCON='Y' then shall exist at least one CVE entry having CVE_PARNAM=PCF_NAME.
Definition: [nvl(PCF_USCON,'#') = 'Y'] implies [exists (select 1 from CVE where CVE_PARNAM = PCF_NAME)]
Encoding: [PCF].[(exists (select 1 from CVE where CVE_PARNAM = PCF_NAME)) OR NOT (nvl(PCF_USCON,'#') = 'Y')]

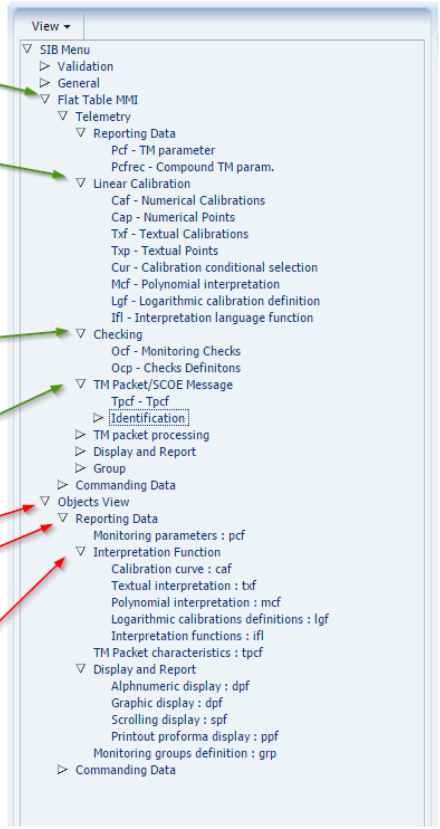
Description: PCF_PID shall be unique.
Definition: PCF_PID
Encoding: [PCF].[PCF_PID]

Description: PCF_VALID shall point to a PCF entry having PCF_NAME = PCF_VALID.
Definition: PCF_VALID -> PCF_NAME
Encoding: [PCF].[PCF].[PCF_VALID.PCF_NAME]

Description: IF PCF_VALPAR is not null then PCF_VALID is not null.
Definition: (PCF_VALPAR is not null) implies (PCF_VALID is not null)
Encoding: [PCF].[(PCF_VALID is not null) OR NOT (PCF_VALPAR is not null)]

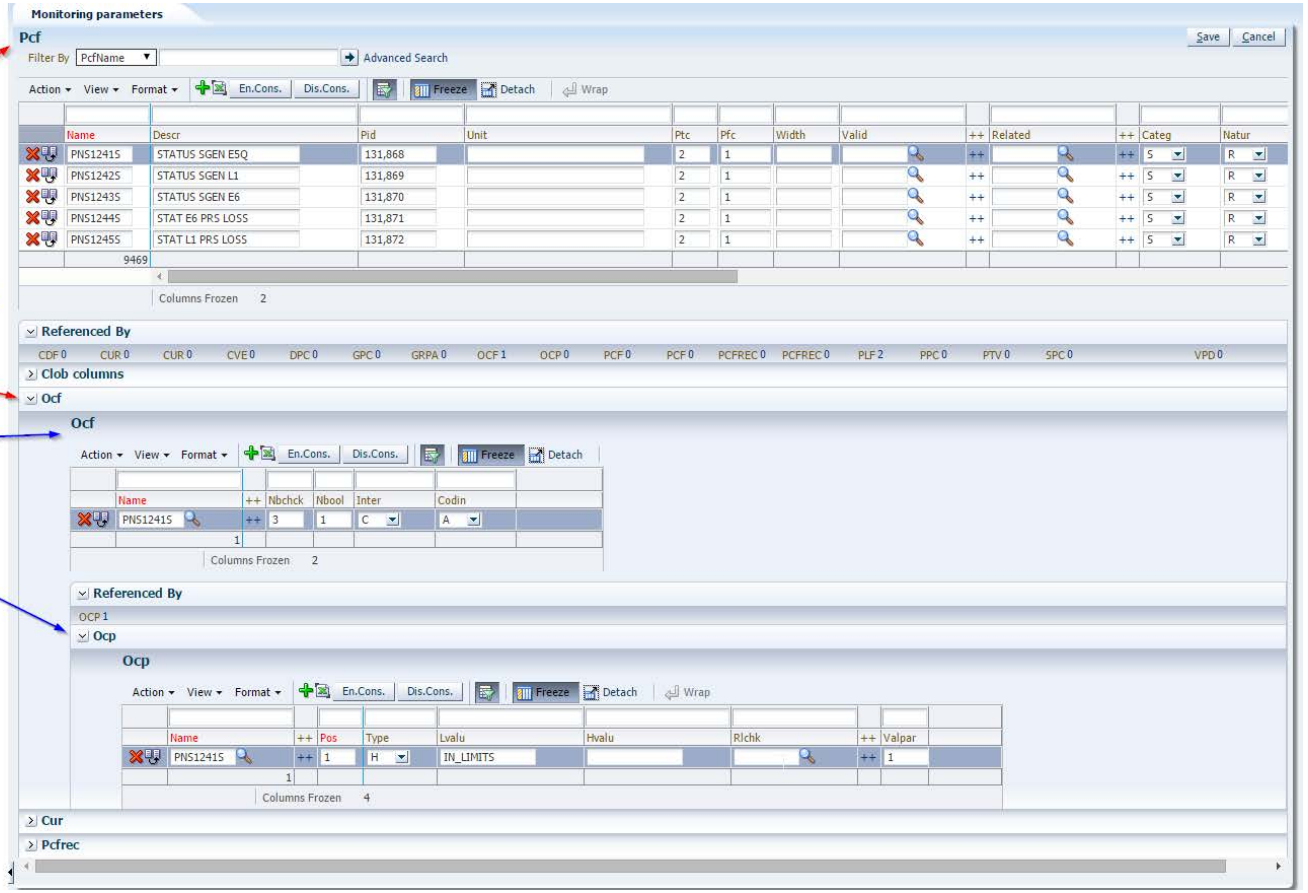
MMI MODEL: MENU MODEL

```
<groupNode id="FlatMMI" idref="FlatMMIMenu" label="Flat Table MMI">

    <groupNode id="TelemetryMMI" idref="TelemetryMMIMenu" label="Telemetry">

        <groupNode id="ReportingDataMMI" idref="ReportingDataMMIMenu" label="Reporting Data">
            <itemNode id="PcfMI" label="Pcf - TM parameter" action="uishell:Pcf" focusViewId="Pcf"/>
            <itemNode id="PcfrecMI" label="Pcfrec - Compound TM param." action="uishell:Pcfrec" focusViewId="Pcfrec"/>
        </groupNode>

        <groupNode id="LinearCalibrationMenuMMI" idref="LinearCalibrationMenuMMIMenu" label="Linear Calibration">

            <itemNode id="CafMI" label="Caf - Numerical Calibrations" action="uishell:Caf" focusViewId="Caf"/>
            <itemNode id="CapMI" label="Cap - Numerical Points" action="uishell:Cap" focusViewId="Cap"/>
            <itemNode id="TxfMI" label="Txf - Textual Calibrations" action="uishell:Txf" focusViewId="Txf"/>
            <itemNode id="TxpMI" label="Txp - Textual Points" action="uishell:Txp" focusViewId="Txp"/>
            <itemNode id="CurMI" label="Cur - Calibration conditional selection" action="uishell:Cur" focusViewId="Cur"></itemNode>
            <itemNode id="McfMI" label="Mcf - Polynomial interpretation" action="uishell:Mcf" focusViewId="Mcf"></itemNode>
            <itemNode id="LgfMI" label="Lgf - Logarithmic calibration definition" action="uishell:Lgf" focusViewId="Lgf"></itemNode>
            <itemNode id="IflMI" label="Ifl - Interpretation language function" action="uishell:Ifl" focusViewId="Ifl"></itemNode>

        </groupNode>

        <groupNode id="CheckingMenu" idref="CheckingMMIMenu" label="Checking">

            <itemNode id="OcfMI" label="Ocf - Monitoring Checks" action="uishell:Ocf" focusViewId="Ocf"/>
            <itemNode id="OcfMI" label="Ocp - Checks Definitons" action="uishell:Ocp" focusViewId="Oc"/>

        </groupNode>

        <groupNode id="TMPacketSCOEMessageMenu" idref="TMPacketSCOEMessageMMIMenu" label="TM Packet/SCOE Message">

            <itemNode id="TpcfMI" label="Tpcf - Tpcf" action="uishell:Tpcf" focusViewId="Tpcf"/>
            <groupNode id="TMpacketIdentification" idref="TMpacketIdentificationMenu" label="Identification">



<groupNode id="ObjectViewMI" idref="ObjectViewMenu" label="Objects View">

    <groupNode id="ReportingDataMMI" idref="ReportingDataMMIMenu" label="Reporting Data">
        <itemNode id="PcfObjectMI" label="Monitoring parameters : pcf" action="uishell:PcfObject" focusViewId="PcfObject"/>

        <groupNode id="InterpretationFunctionMMI" idref="InterpretationFunctionMMIMenu" label="Interpretation Function">

            <itemNode id="CalibrationCurveMI" label="Calibration curve : caf" action="uishell:CafObject" focusViewId="CafObject"/>
            <itemNode id="TextualInterpretationMI" label="Textual interpretation : txf" action="uishell:TxfObject" focusViewId="TxfObject"/>
```



MMI MODEL: Configuration Item View Model

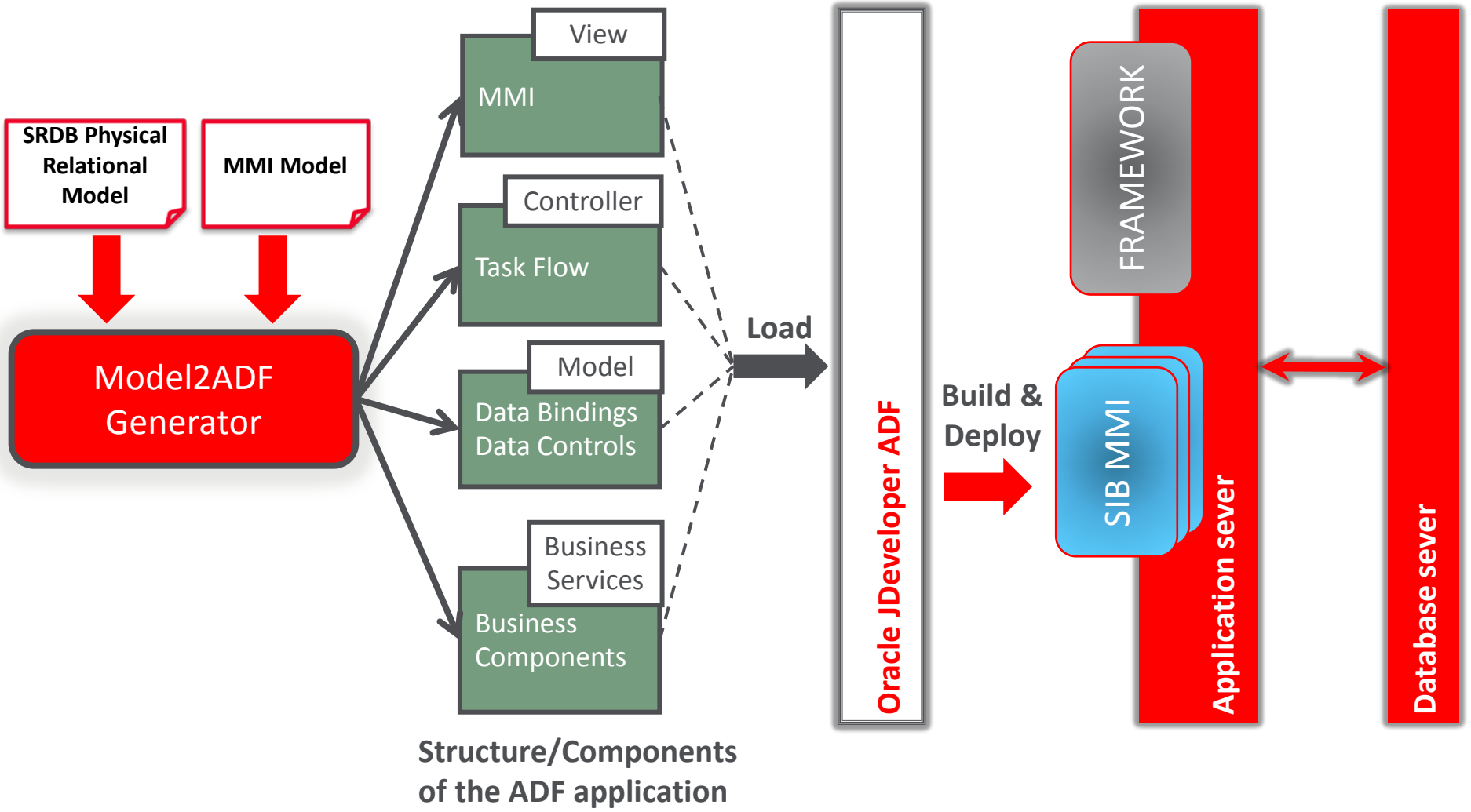
```
<Group Name="Pcf" tableName="PCF" label="Monitoring parameters">

        <GroupRegion name="Ocf"/>
        <GroupRegion name="Cur"/>
        <GroupRegion name="Pcfreq"/>
</Group>

<Group Name="Ocf" tableName="Ocf" label="Checking">
        <GroupRegion name="Ocp"/>

</Group>
```



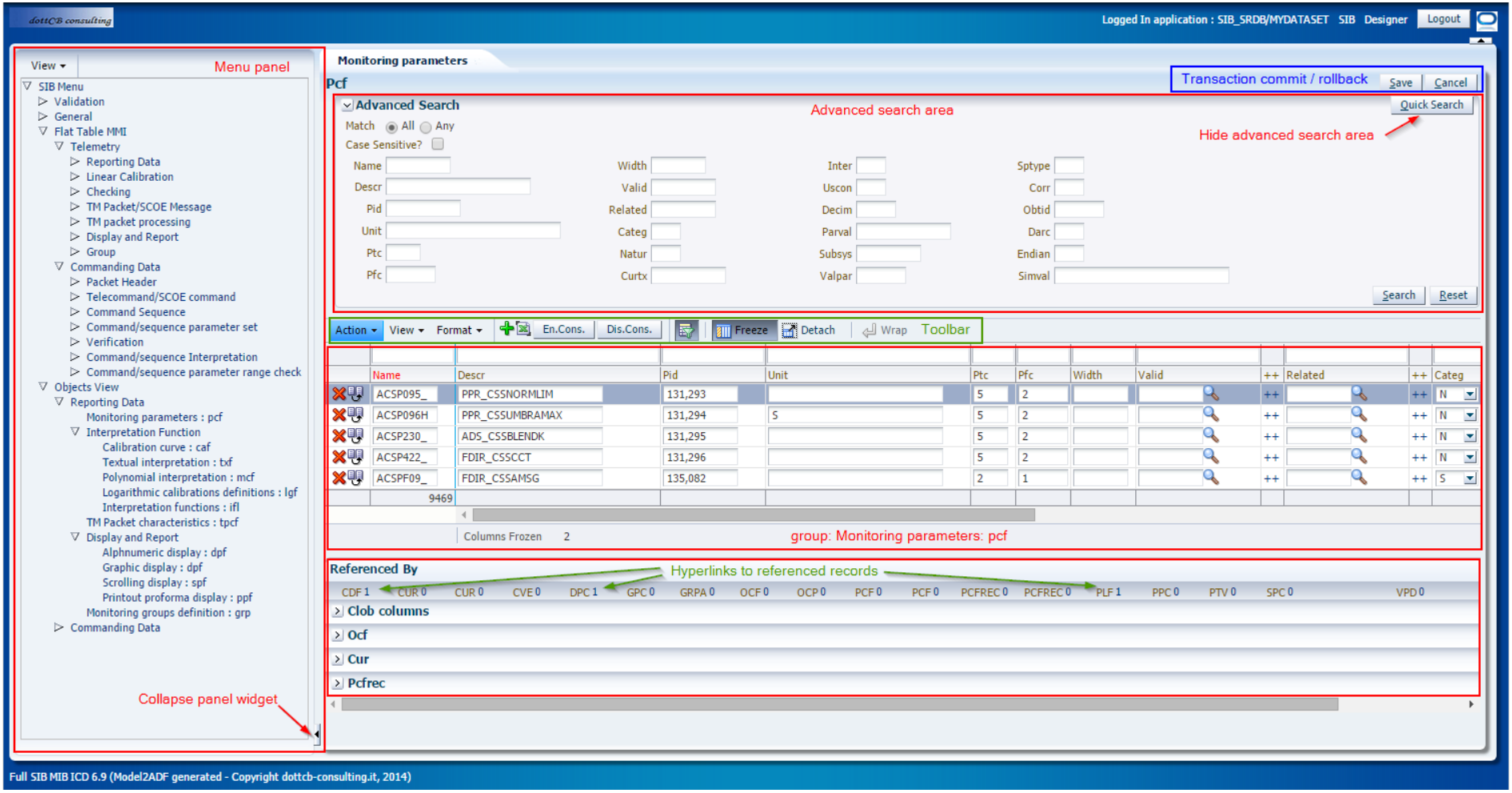
CONFIGURATION ITEM MODEL

```
<UserObjectType Name="Alphanumeric Display" Description="AND" IsContainer="False">
    <PhysicalTableMapping TableName="DPF">
        <PrimaryKeyField>DPF_NUMBE</PrimaryKeyField>
        <IsRootTable>true</IsRootTable>
        <ChangeImpactDefinition FieldName="DPF_HEAD" Severity="Editorial"/>
        <ChangeImpactDefinition FieldName="DPF_NUMBE" Severity="Critical"/>
        <ChangeImpactDefinition FieldName="DPF_TYPE" Severity="Editorial"/>
    </PhysicalTableMapping>
    <PhysicalTableMapping TableName="DPC">
        <PrimaryKeyField>DPC_NUMBE</PrimaryKeyField>
        <PrimaryKeyField>DPC_FLDN</PrimaryKeyField>
        <HasParentTable TableName="DPF">
            <ForeignKey SourceFieldName="DPF_NUMBE" TargetFieldName="DPC_NUMBE"/>
        </HasParentTable>
        <ConceptReference TargetConcept="Reporting Data">
            <ForeignKey SourceFieldName="PCF_NAME" TargetFieldName="DPC_NAME"/>
        </ConceptReference>
        <ChangeImpactDefinition FieldName="DPC_COMM" Severity="Critical"/>
        <ChangeImpactDefinition FieldName="DPC_FLDN" Severity="Minor"/>
        <ChangeImpactDefinition FieldName="DPC_FORM" Severity="Minor"/>
        <ChangeImpactDefinition FieldName="DPC_MODE" Severity="Critical"/>
        <ChangeImpactDefinition FieldName="DPC_NAME" Severity="Critical"/>
        <ChangeImpactDefinition FieldName="DPC_NUMBE" Severity="Critical"/>
        <ChangeImpactDefinition FieldName="DPC_TEXT" Severity="Minor"/>
    </PhysicalTableMapping>
</UserObjectType>
```

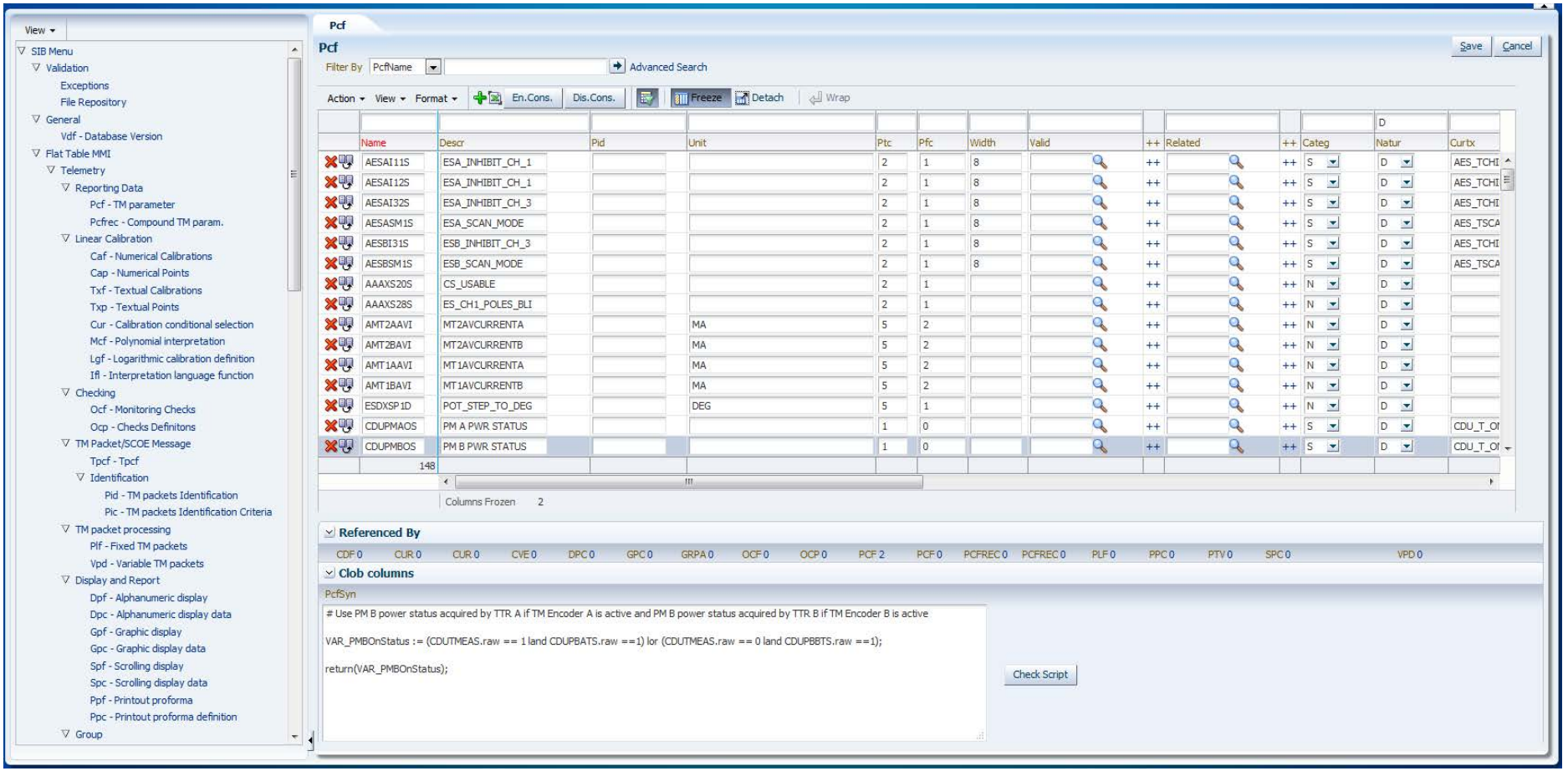
HOW IT WORKS



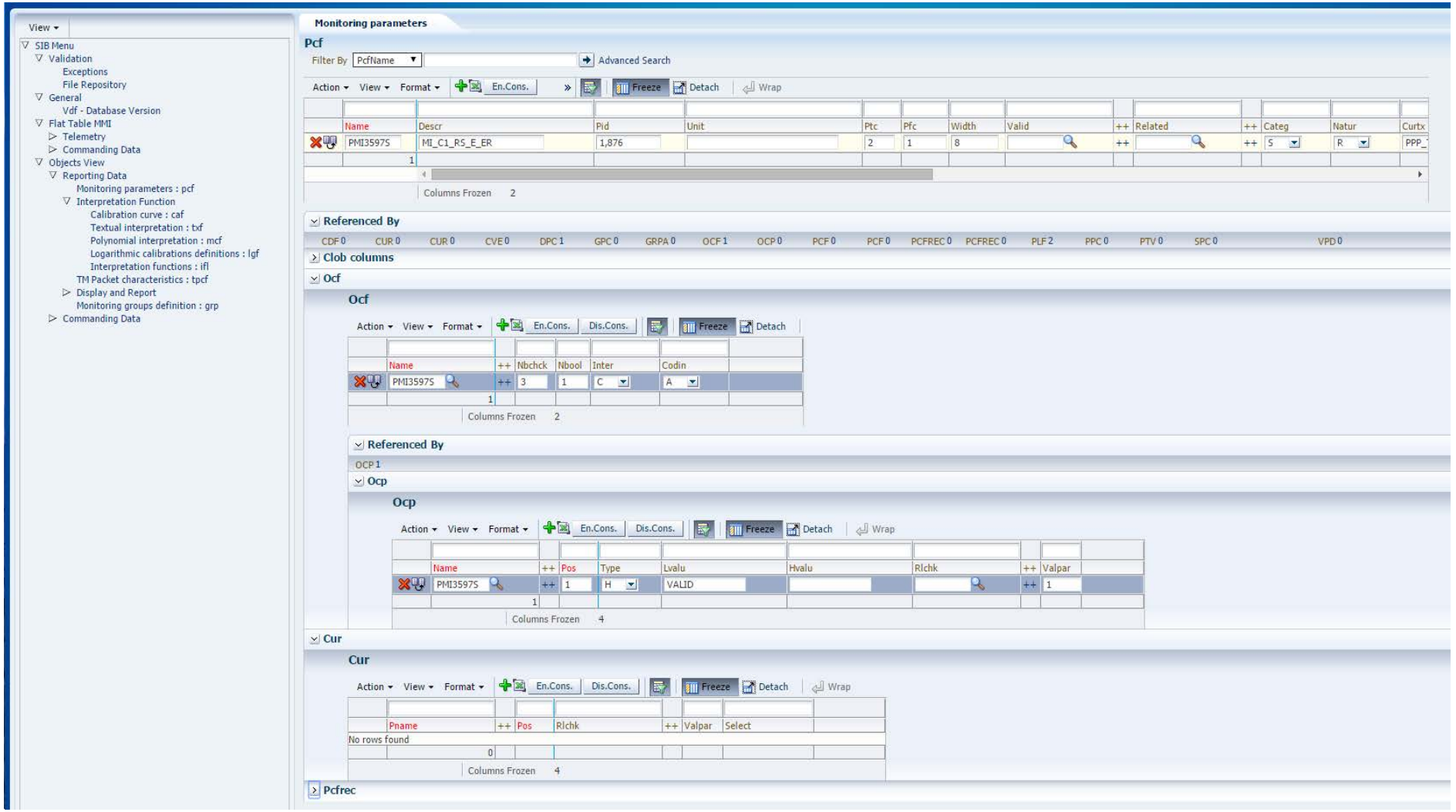
STANDARD FEATURES OF GENERATED MMI



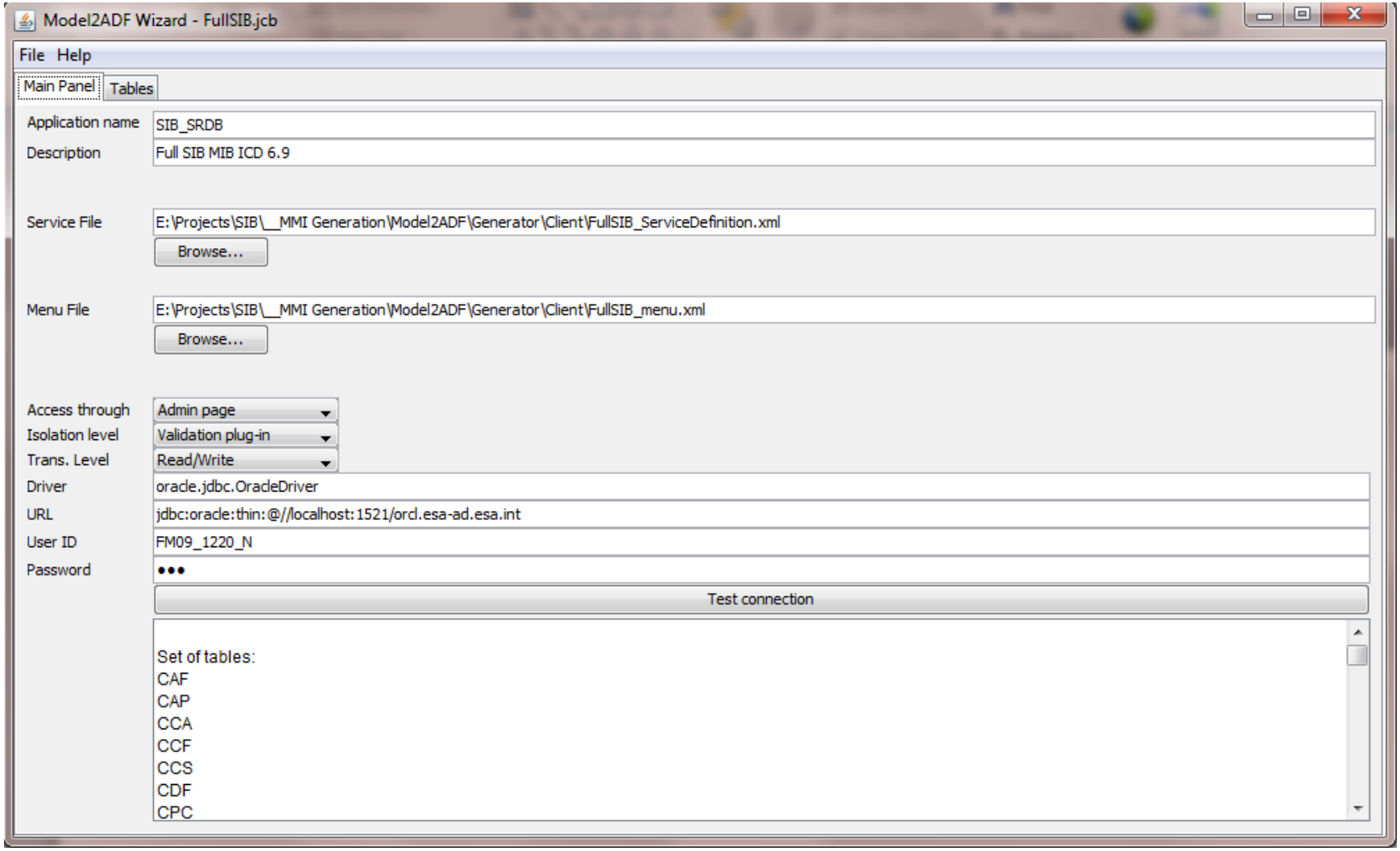
FLAT MMI


View
SIB Menu
Validation
Exceptions
File Repository
General
Vdf - Database Version
Flat Table MMI
Telemetry
Reporting Data
Pcf - TM parameter
Pcfrec - Compound TM param.
Linear Calibration
Caf - Numerical Calibrations
Cap - Numerical Points
Txf - Textual Calibrations
Txp - Textual Points
Cur - Calibration conditional selection
Mcf - Polynomial interpretation
Lgf - Logarithmic calibration definition
Ifl - Interpretation language function
Checking
Ocf - Monitoring Checks
Ocp - Checks Definitons
TM Packet/SCOE Message
Tpcf - Tpcf
Identification
Pid - TM packets Identification
Pic - TM packets Identification Criteria
TM packet processing
Plf - Fixed TM packets
Vpd - Variable TM packets
Display and Report
Dpf - Alphanumeric display
Dpc - Alphanumeric display data
Gpf - Graphic display
Gpc - Graphic display data
Spf - Scrolling display
Spc - Scrolling display data
Ppf - Printout proforma
Ppc - Printout proforma definition
Group
Pcf
Pcf
Save
Cancel
Filter By
PcfName
Advanced Search
Action
View
Format
En.Cons.
Dis.Cons.
Freeze
Detach
Wrap
Name
Descr
Pid
Unit
Ptc
Pfc
Width
Valid
Related
Categ
Natur
Curtx
AESAI11S ESA_INHIBIT_CH_1
AESAI12S ESA_INHIBIT_CH_1
AESAI32S ESA_INHIBIT_CH_3
AESASM1S ESA_SCAN_MODE
AESBI31S ESB_INHIBIT_CH_3
AESBSM1S ESB_SCAN_MODE
AAAXS20S CS_USABLE
AAAXS28S ES_CH1_POLES_BLI
AMT2AAVI MT2AVCURRENTA MA
AMT2BAVI MT2AVCURRENTB MA
AMT1AAVI MT1AVCURRENTA MA
AMT1BAVI MT1AVCURRENTB MA
ESDXSP1D POT_STEP_TO_DEG DEG
CDUPMAOS PM A PWR STATUS
CDUPMBOS PM B PWR STATUS
148
Columns Frozen 2
Referenced By
CDF 0 CUR 0 CUR 0 CVE 0 DPC 0 GPC 0 GRPA 0 OCF 0 OCP 0 PCF 2 PCF 0 PCFREC 0 PCFREC 0 PLF 0 PPC 0 PTV 0 SPC 0 VPD 0
Clob columns
PcfSyn
Use PM B power status acquired by TTR A if TM Encoder A is active and PM B power status acquired by TTR B if TM Encoder B is active
VAR_PMBOnStatus := (CDUTMEAS.raw == 1 land CDUPBATS.raw ==1) lor (CDUTMEAS.raw == 0 land CDUPBBTS.raw ==1);
return(VAR_PMBOnStatus);
Check Script

CONFIGURATION ITEM VIEW MMI



THE Model2ADF CONSOLE



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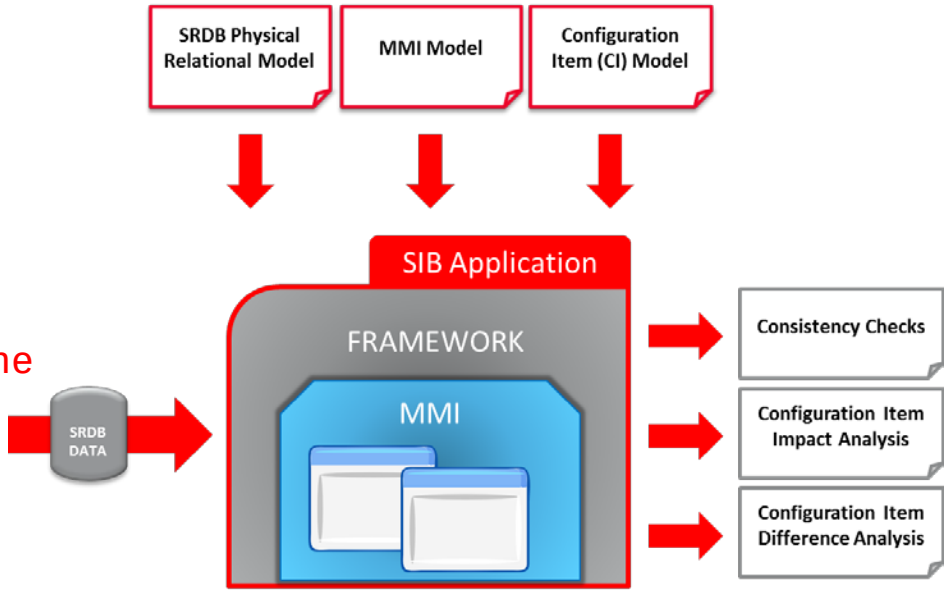
CURRENT ACHIEVEMENTS

100% Model Driven SRDB Application:

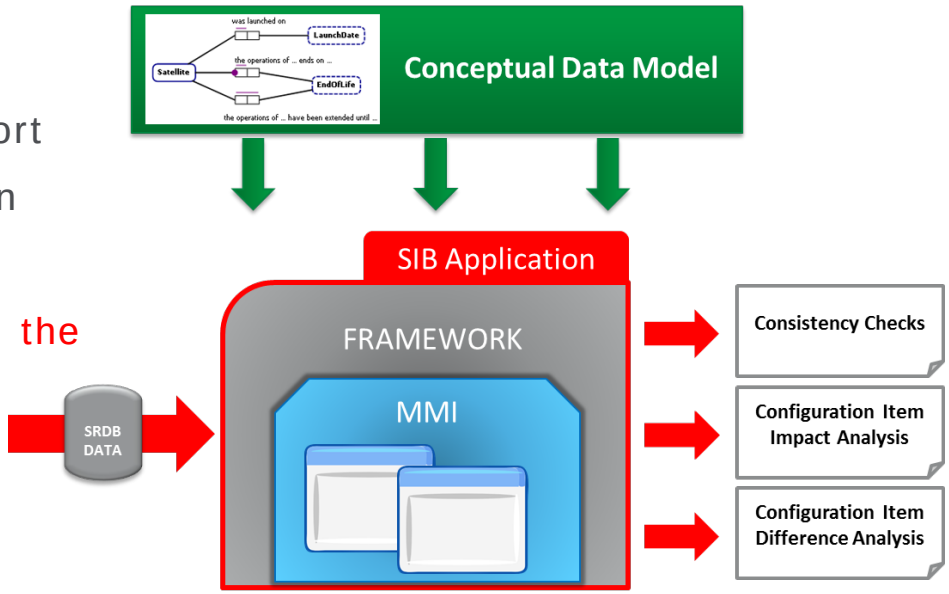
- Fulfilled Requirements:
  - Import/Export (driven by the SRDB Physical Data model)
  - Consistency Checks
  - Impacts Analysis & Differences Report
  - MMI for Data & Violations Navigation
  - Flat MMI
  - Configuration Item MMI (based on the master-detail pattern)
- Input Models:
  - SRDB Physical Data Model
  - MMI Model
  - Configuration Item Model
- Three Tier Deployment



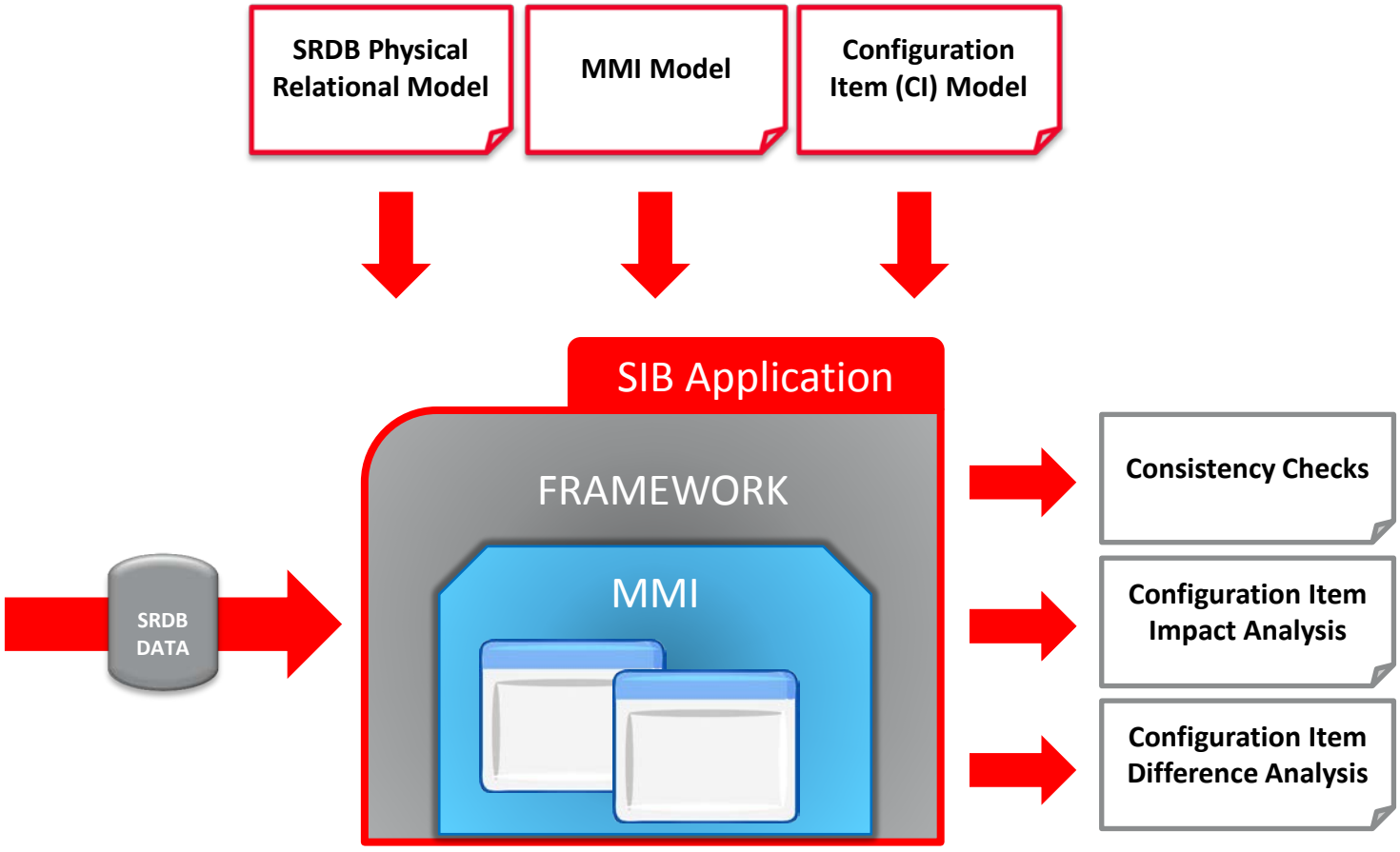
NEXT CHALLENGE

100% Model Driven SRDB Application:

- Fulfilled Requirements:
  - Import/Export (based on the user specific conceptual views)
  - Consistency Checks
  - Impacts Analysis & Differences Report
  - MMI for Data & Violations Navigation
  - Flat MMI
  - Configuration Item MMI (based on the user specific conceptual views)
- Input Model:
  - Conceptual Data Model
- Three Tier Deployment



Any Questions?



Thank you!

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