

# Unleashing the potential of CBM using MIMOSA standards

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PdMA Corporation

# What do we do?

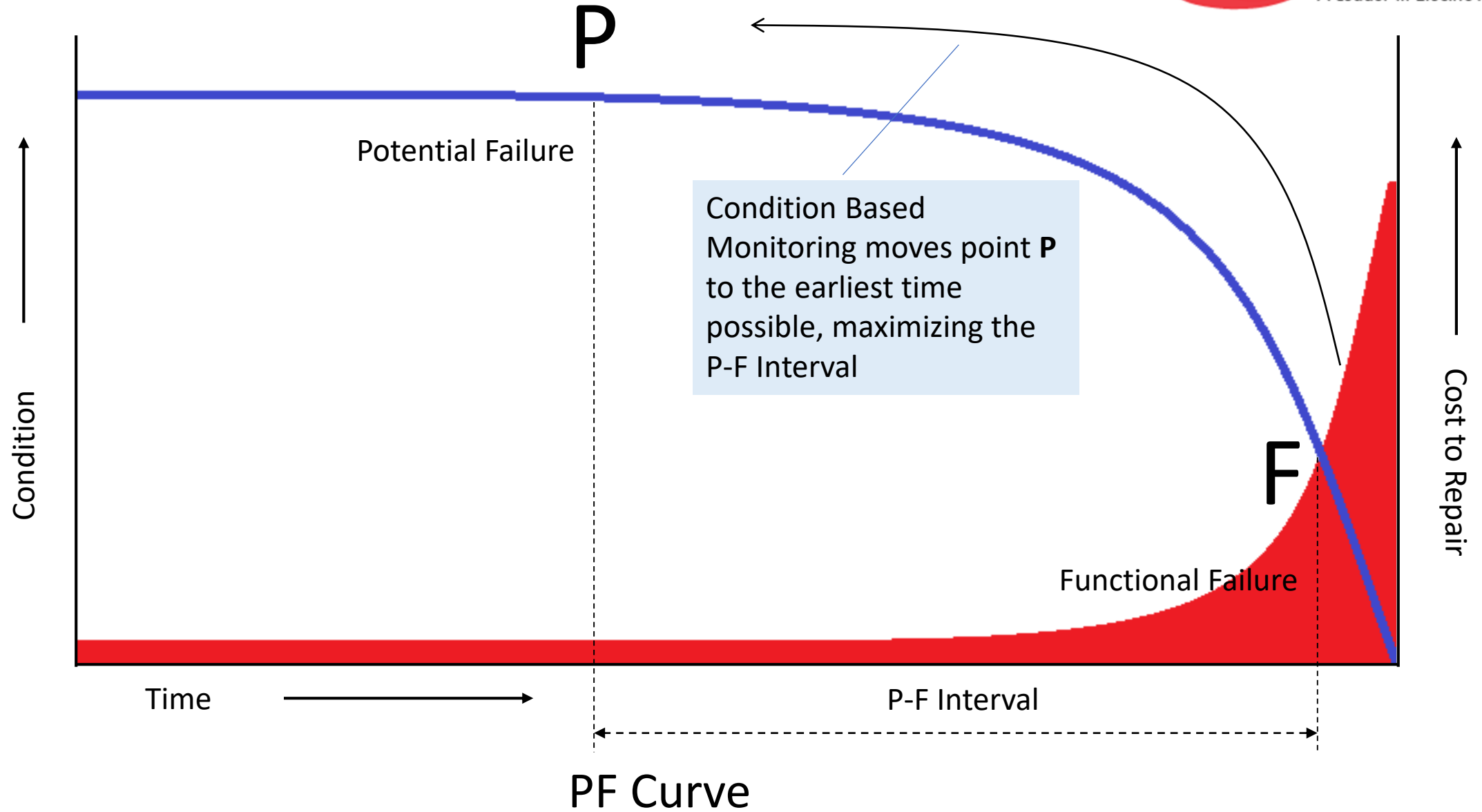
Motor diagnostics and monitoring in different phases of Asset Life Cycle

- Diagnostics and Monitoring (online and offline)
- Quality control
- Repair and Overhaul

# Industries we serve



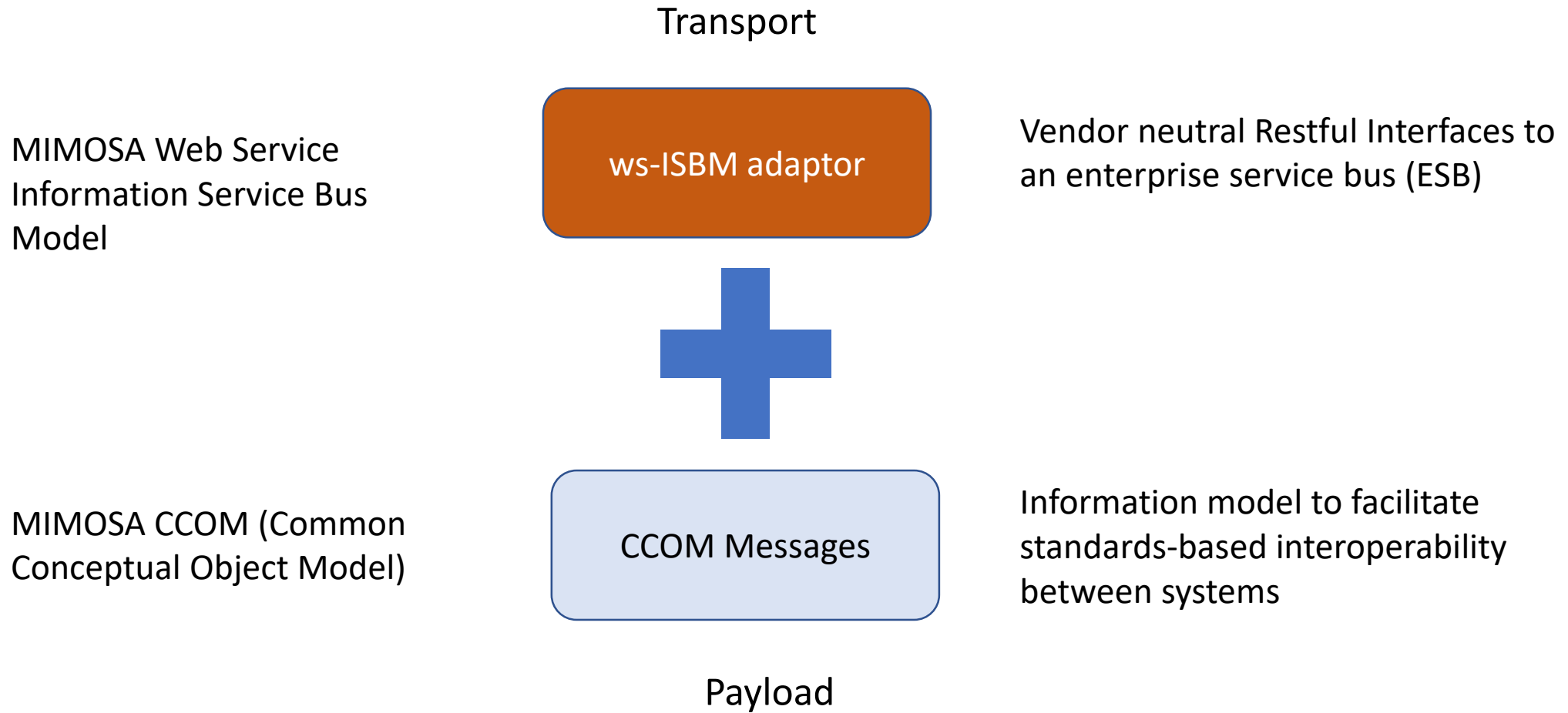
# What is Condition Based Monitoring?



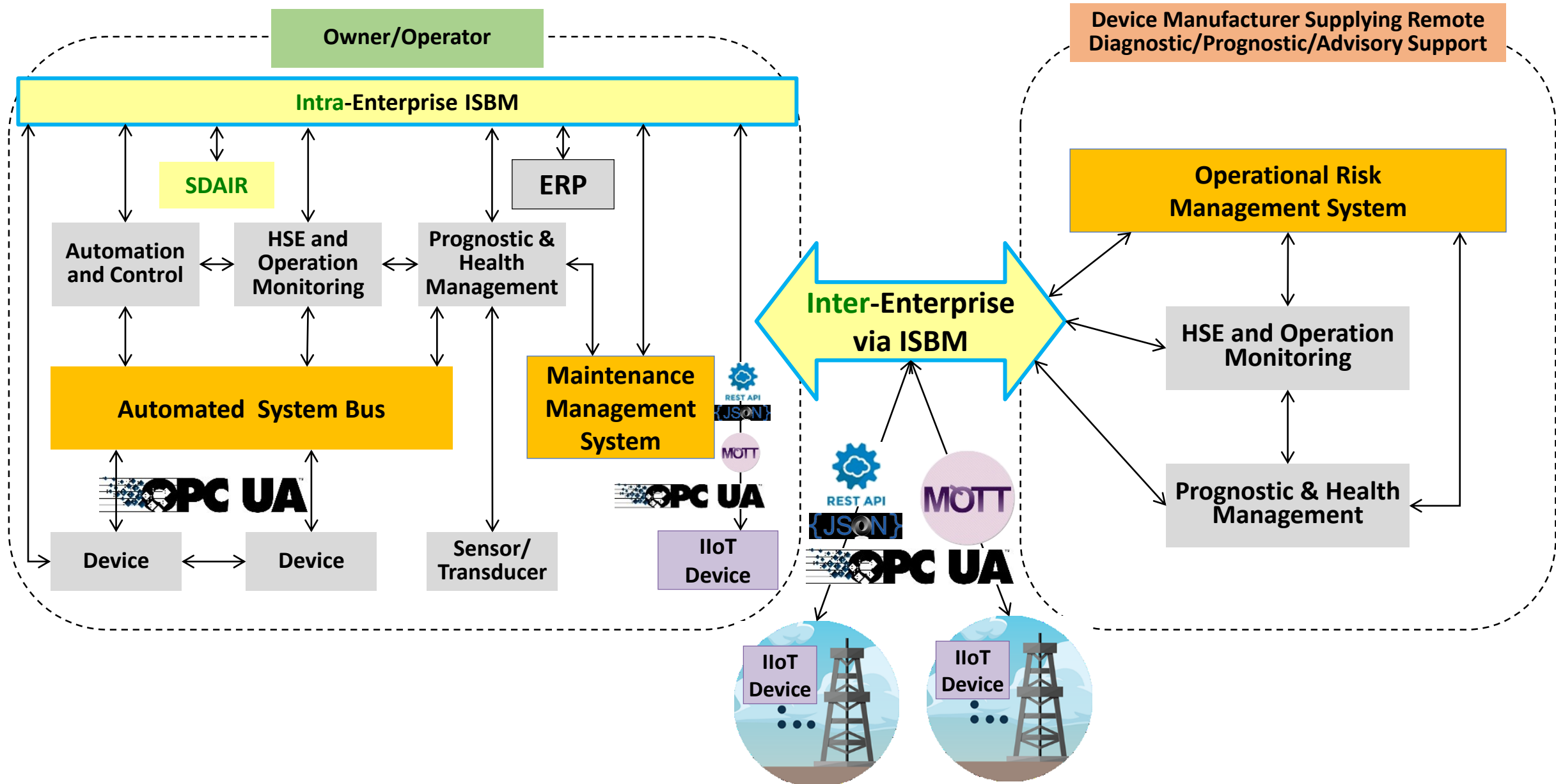
# OGI Pilot Demo

Condition Based Maintenance

# OGI Pilot: Condition Based Maintenance

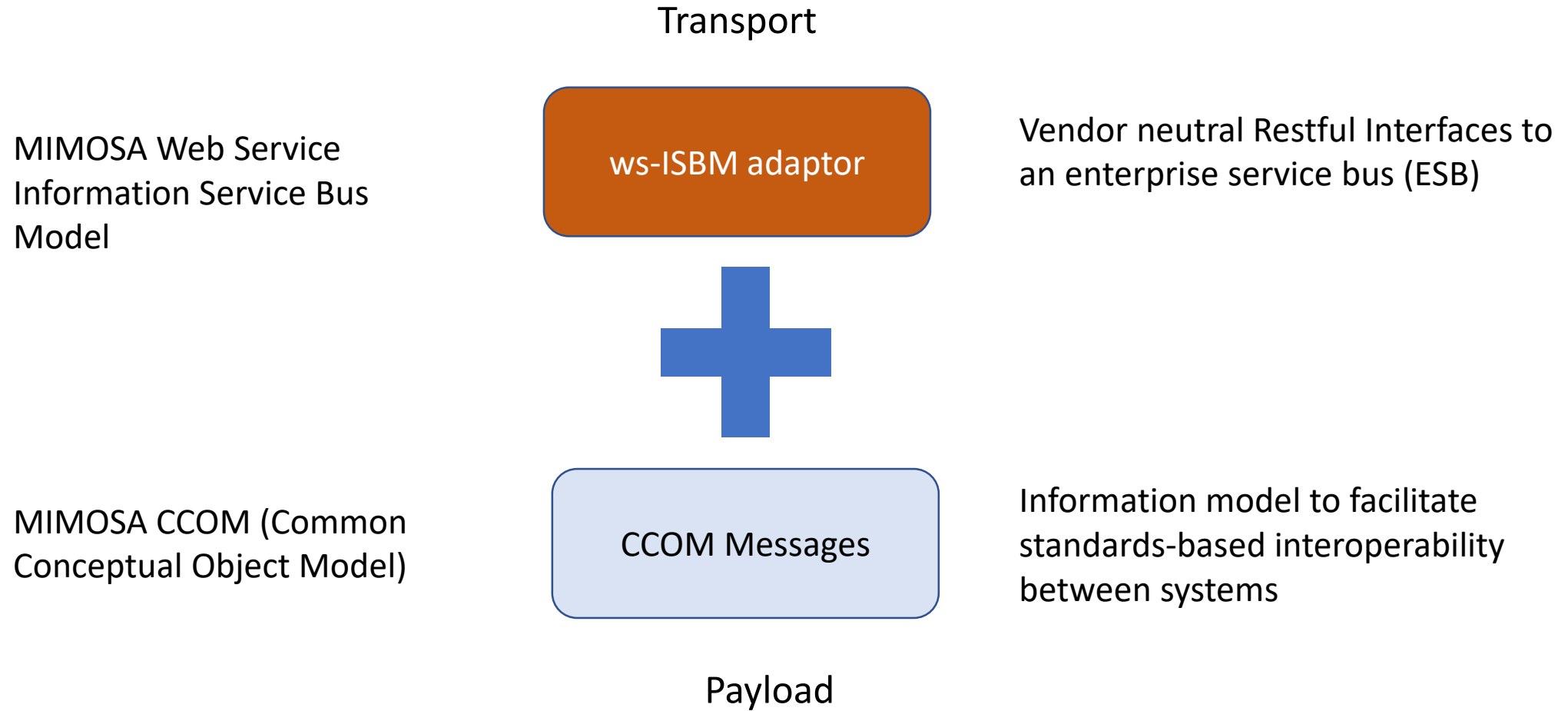


# Condition Based Maintenance and IIoT

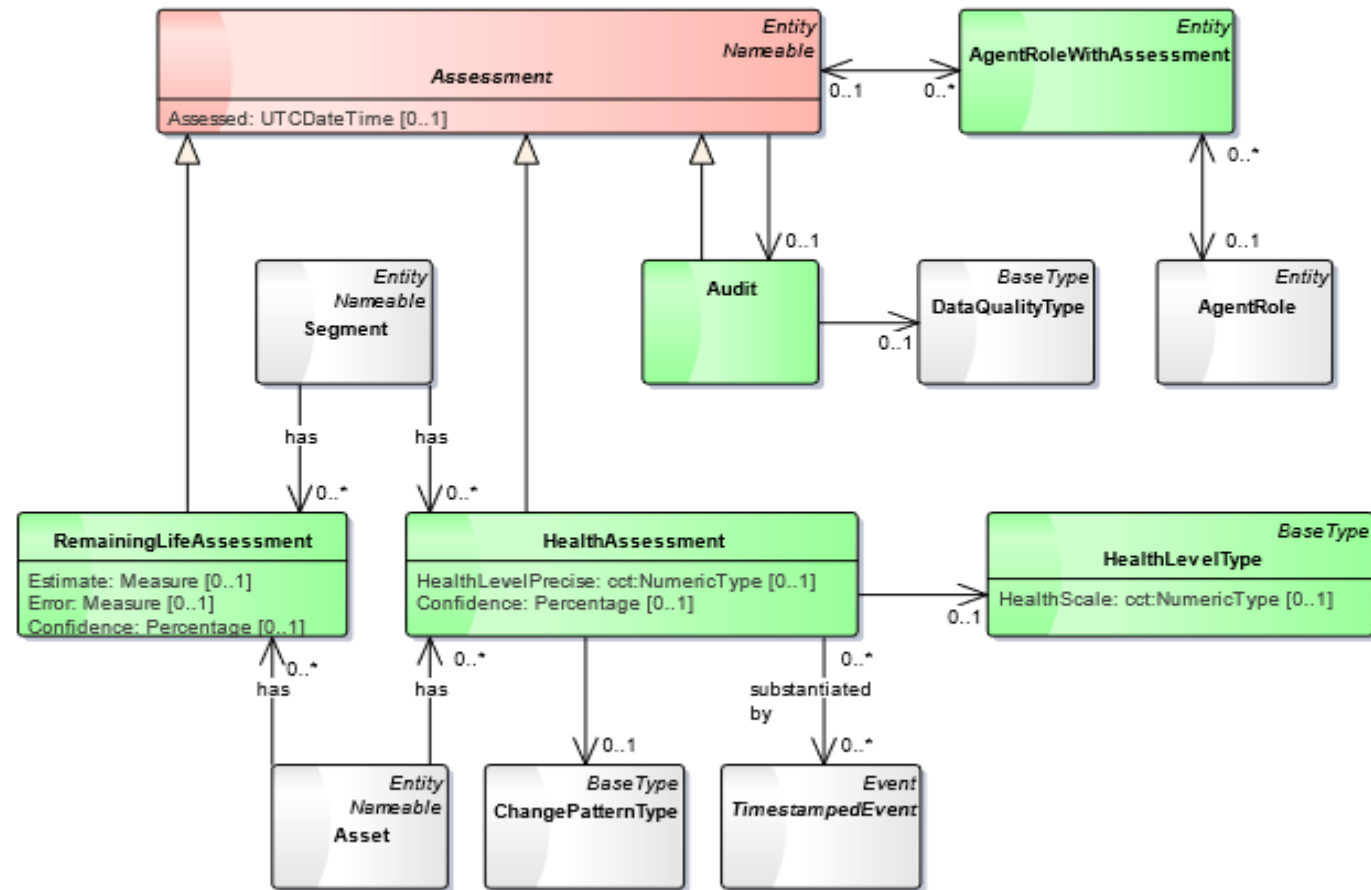




# OGI Pilot: Condition Based Maintenance

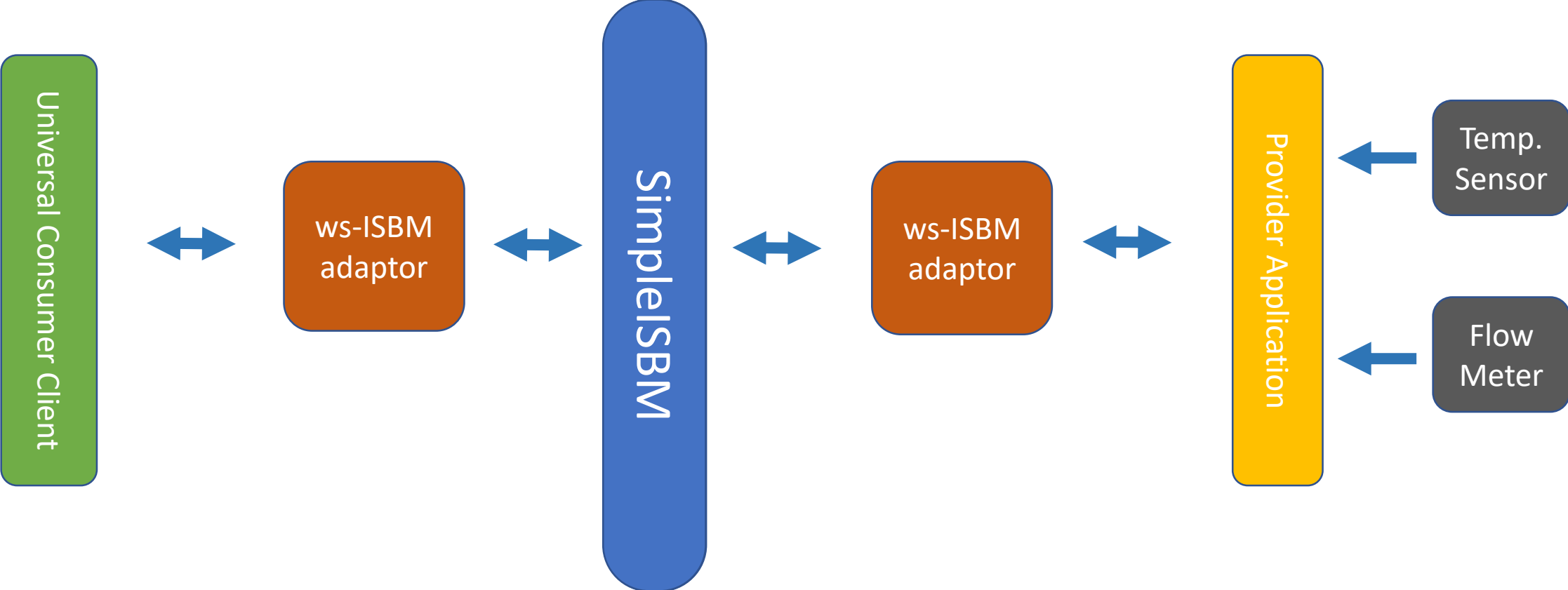


**Diagram: 25 - Health and Prognostic Assessments**

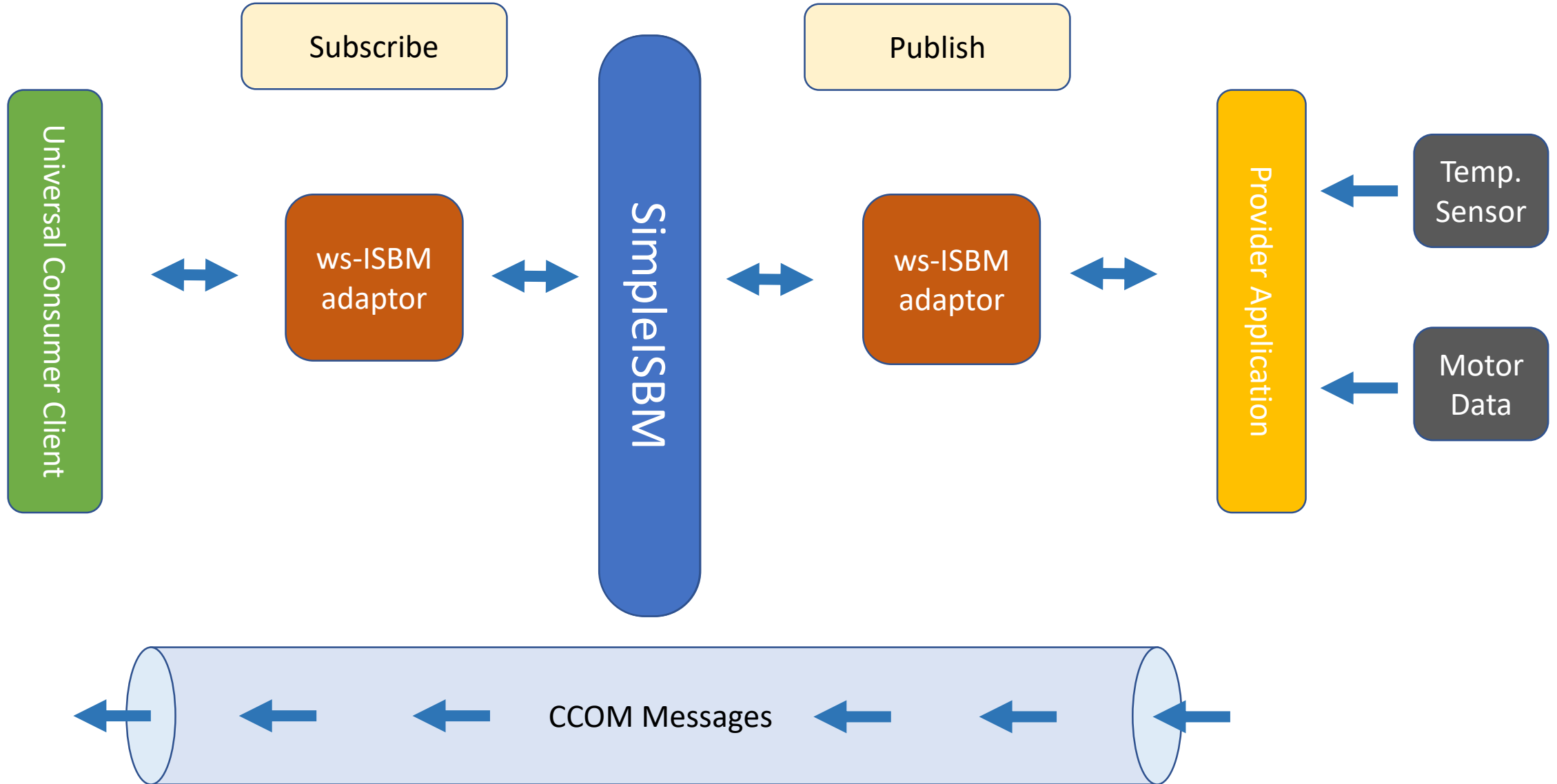


The object model defined for Health Assessment by CCOM

# OGI Pilot: Condition Based Maintenance



# OGI Pilot: Condition Based Maintenance



# Provider

The image shows two overlapping windows from the 'ws-IBSM PROVIDER' application. The background window, titled 'ws-IBSM PROVIDER', contains several buttons: 'Create Channel', 'Get Channels', 'Open Publication Session', and 'Post Publication'. To the right of these buttons are input fields for 'username' and 'password', and a 'save' button. The foreground window, titled 'Get All Channels', features a 'Get All Channels' button and a list box containing the following entries:

- /Demo Enterprise/Refinery A/Area A/ISO18435:D0-2/Publication
- /Demo Enterprise/Refinery A/Area A/ISO18435:D1-2/Publication
- /Demo Enterprise/Refinery A/Area A/ISO18435:D1-3/Publication
- /Demo Enterprise/Refinery A/Area A/ISO18435:D2-2/Publication
- /Demo Enterprise/Refinery A/Area A/ISO18435:D2-3/Publication
- /OEM/Yokogawa/ISO18435:D4-2/Request
- /Demo Enterprise/Refinery A/Area A/ISO18435:D0-2/Request
- /Demo Enterprise/Refinery A/Area A/ISO18435:D1-2/Request
- /Demo Enterprise/Refinery A/Area A/ISO18435:D2-2/Request
- /Demo Enterprise/Refinery A/Area A/ISO18435:D2-3/Request
- .

Below the list box, the 'URI' field is populated with the selected entry: '/Demo Enterprise/Refinery A/Area A/ISO18435:D1-2/Publication'. Other fields include 'Description' (empty), 'Channel Type' (set to 'Publication'), and a 'SECURITY' section with 'username' and 'password' fields both set to 'N/A'.

# Provider

PublicationSession

Open Publication Session

Channel ID  
/Demo Enterprise/Refinery A/Area A/ISO18435:D1-2/Publication

Status Code:201  
Message: Created

Response  
{ "sessionId": 650 }

# Provider

PostPublication

Measurement Health Assessment Advisory Request For Work

Channel  
/Demo Enterprise/Refinery A/Area A/ISO18435:D1-2/Publication

Session ID  
650

Topics

Status Code:

Message:

Response

Post Publication

# Provider

SyncMeasurement

Temperature

Degrees Celsius

OK

PostPublication

Measurement Health Assessment Advisory Request For Work

Channel

Session ID

Topics

Status Code:

Message:

Response

Post Publication



# Provider

PostPublication

Measurement Health Assessment Advisory Request For Work

Channel  
/Demo Enterprise/Refinery A/Area A/ISO18435:D1-2/Publication

Session ID  
650

Topics  
OIIE:S30:V1.1/CCOM-JSON:SyncMeasurements:V1.0

```
"measurement": [  
  {  
    "@@type": "SingleDataMeasurement",  
    "UUID": "611ee2af-12d5-5cec-578c-160c9aeb5118",  
    "recorded": {  
      "dateTime": "2019-08-28T13:15:30Z"  
    },  
    "infoSource": {  
      "UUID": "19a137cf-a70d-2888-343a-bc1158bf7f9f"  
    },  
    "data": {  
      "measure": {  
        "value": "55.72",  
        "unitOfMeasure": {  
          "UUID": "3912c639-8c27-4b29-868b-a0f01790770f",  
          "shortName": "Degrees Celsius",  
          "infoSource": {  
            "UUID": "cf3f3a8a-1e42-4f15-9288-9cf2241e163d"  
          }  
        }  
      }  
    }  
  }  
]
```

Status Code: 201  
Message: Created

Response

Post Publication

# Provider

PostPublication

Measurement Health Assessment Advisory Request For Work

Channel  
/Demo Enterprise/Refinery A/Area A/ISO18435:D1-2/Publication

Session ID  
650

Topics  
OIIE:S30:V1.1/CCOM-JSON:SyncMeasurements:V1.0

```
"measurement": [  
  {  
    "@@type": "SingleDataMeasurement",  
    "UUID": "611ee2af-12d5-5cec-578c-160c9aeb5118",  
    "recorded": {  
      "dateTime": "2019-08-28T13:15:30Z"  
    },  
    "infoSource": {  
      "UUID": "19a137cf-a70d-2888-343a-bc1158bf79f"  
    },  
    "data": {  
      "measure": {  
        "value": "55.72",  
        "unitOfMeasure": {  
          "UUID": "3912c639-8c27-4b29-868b-a0f01790770f",  
          "shortName": "Degrees Celsius",  
          "infoSource": {  
            "UUID": "cf3f3a8a-1e42-4f15-9288-9cf2241e163d"  
          }  
        }  
      }  
    }  
  }  
]
```

Status Code:201  
Message: Created

Response  
{ "messageId": 408 }

Post Publication

# Consumer

Get All Channels

Get All Channels

- /Demo Enterprise/Refinery A/Area A/ISO18435:D0-2/Publication
- /Demo Enterprise/Refinery A/Area A/ISO18435:D1-2/Publication**
- /Demo Enterprise/Refinery A/Area A/ISO18435:D1-3/Publication
- /Demo Enterprise/Refinery A/Area A/ISO18435:D2-2/Publication
- /Demo Enterprise/Refinery A/Area A/ISO18435:D2-3/Publication
- /OEM/Yokogawa/ISO18435:D4-2/Request
- /Demo Enterprise/Refinery A/Area A/ISO18435:D0-2/Request

URI: /Demo Enterprise/Refinery A/Area A/ISO18435:D1-2/Publication

Description:

Channel Type: Publication

----- SECURITY -----

username: N/A

password: N/A

# Consumer

Open Subscription Session

Open Subscription Session

Channel ID  
/Demo Enterprise/Refinery A/Area A/ISO18435:D1-2/Publication

Topics  
OIIE:S30:V1.1/CCOM-JSON:SyncMeasurements:V1.0

Status Code:201  
Message: Created

Response:  
{"sessionId":649}

# Consumer

Read Publication

Read Publication

Session ID

649

Status Code:

Message:

Response

# Consumer

Read Publication

Read Publication

Session ID  
649

Status Code: 200  
Message: OK

Response

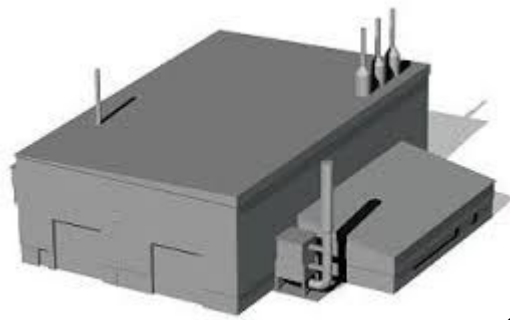
```
"measurementLocation": {  
  "UUID": "e015177c-8281-576b-56a9-87c16c3d91cc",  
  "ShortName": "Temp. Loc. 1",  
  "infoSource": {  
    "UUID": "19a137cf-a70d-2888-343a-bc1158bf7f9f"  
  }  
},  
"measurement": [  
  {  
    "@@type": "SingleDataMeasurement",  
    "UUID": "611ee2af-12d5-5cec-578c-160c9aeb5118",  
    "recorded": {  
      "dateTime": "2019-08-28T13:15:30Z"  
    },  
    "infoSource": {  
      "UUID": "19a137cf-a70d-2888-343a-bc1158bf7f9f"  
    },  
    "data": {  
      "measure": {  
        "value": "55.72",  
        "UnitOfMeasure": {  
          "UUID": "3912c639-8c27-4b29-868b-a0f01790770f",  
          "ShortName": "Degrees Celsius",  
          "InfoSource": {  
            "UUID": "cf3f3a8a-1e42-4f15-9288-9cf2241e163d"  
          }  
        }  
      }  
    }  
  }  
]
```

# OGI Pilot: Condition Based Maintenance



- Measurement
- HealthAssessment
- Advisory
- RequestForWork

CCOM objects used in OGI Pilot



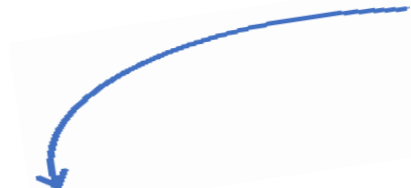
equipment Data



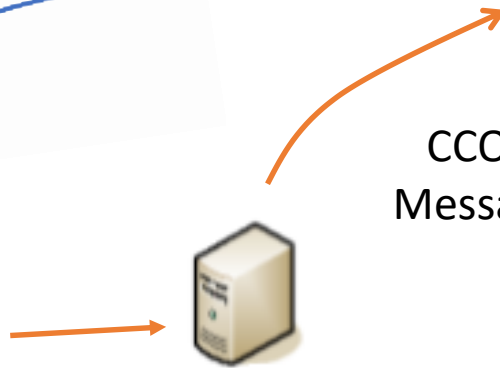
Internet



CCOM  
Messages



PdMA Cloud  
Servers



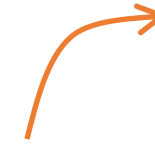
PdMA Information  
Services



Data Analytics/Monitoring



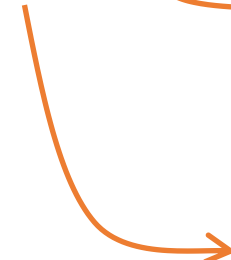
Asset Health  
Assessments and  
Advisories



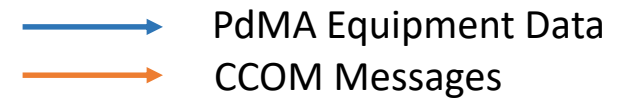
Engineering  
Field Service  
Tech Ops



Customer/Operator



Third Party Systems  
EAM, CMMS,  
Operations, etc





# CCOM Work in Process



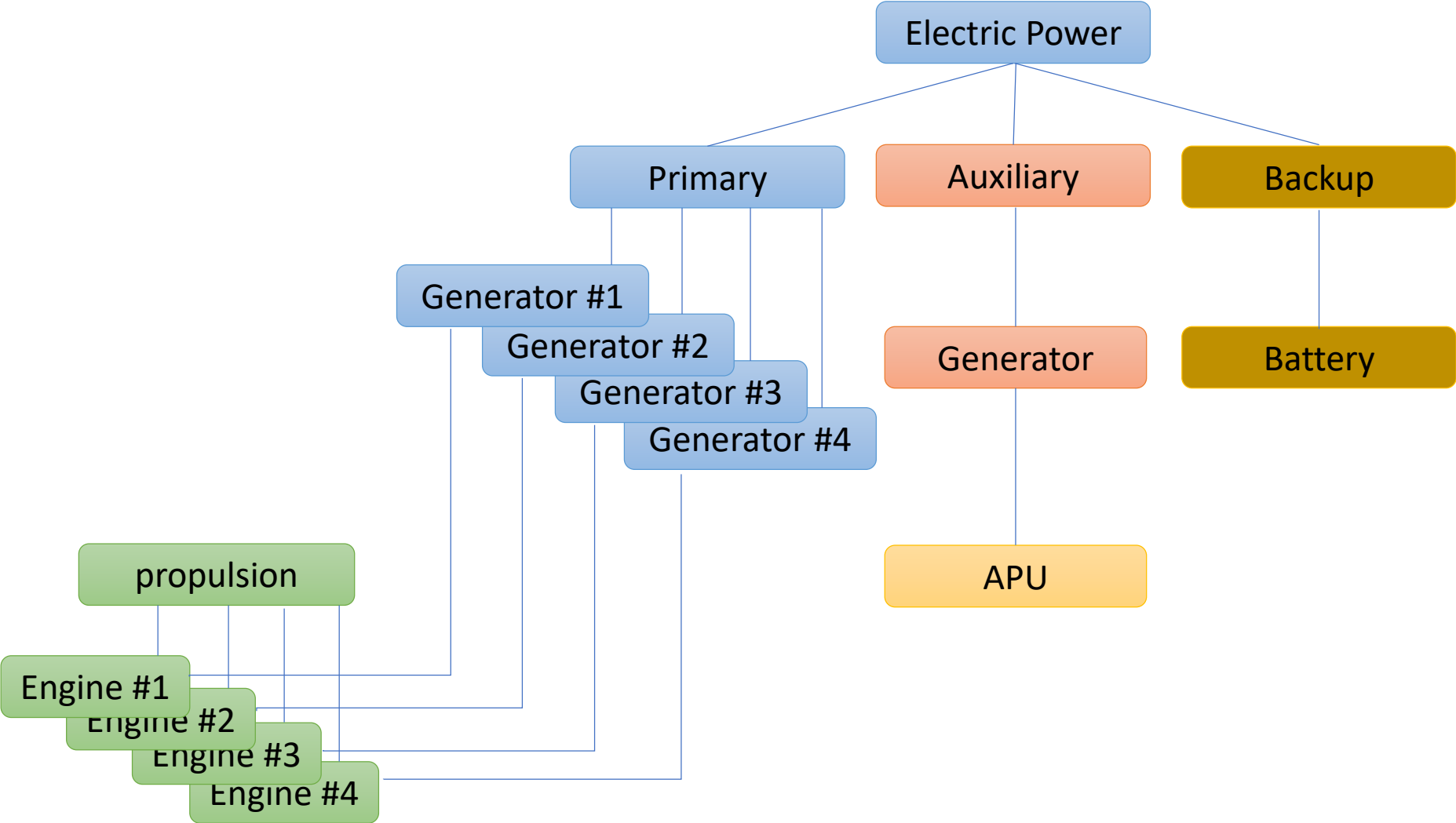




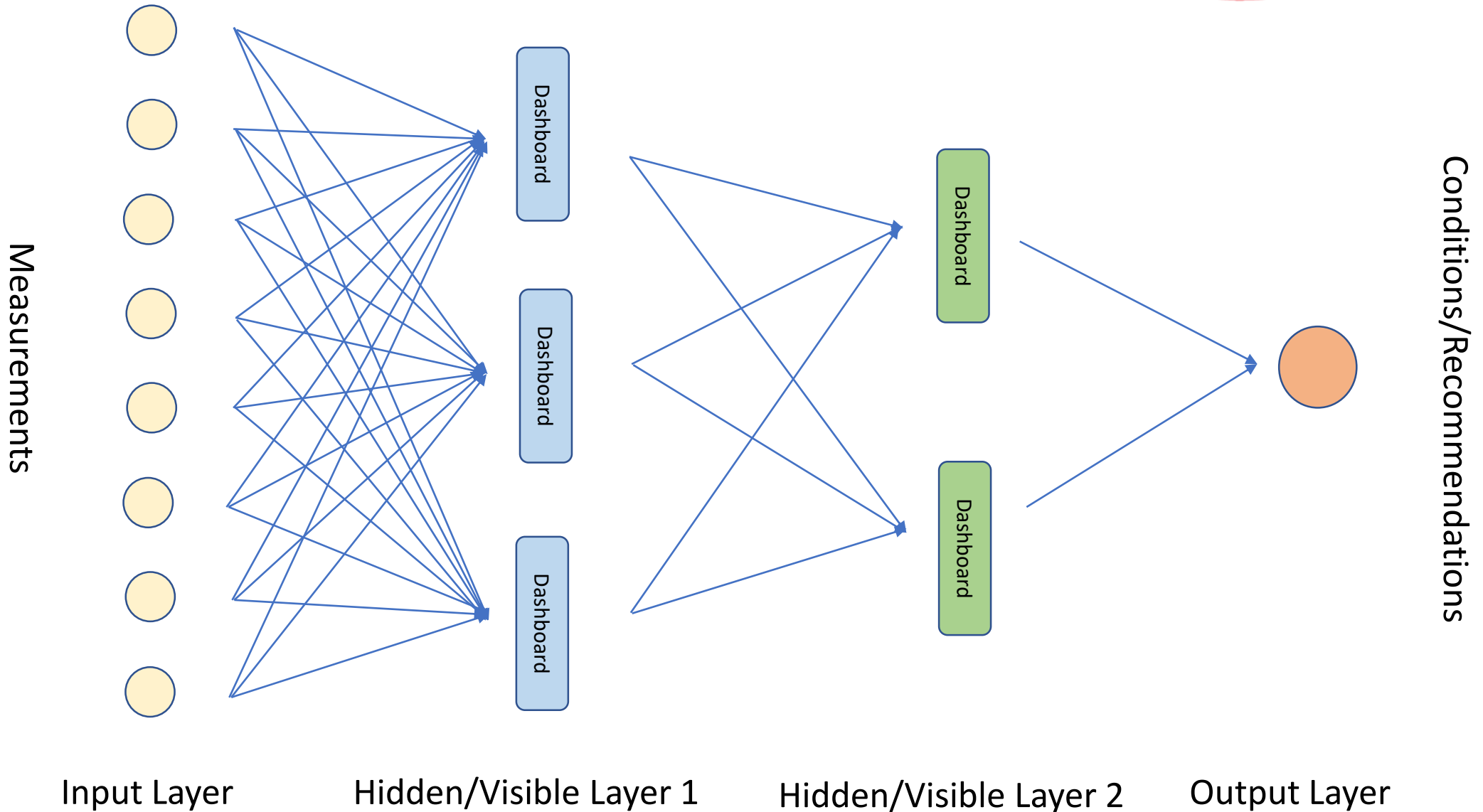
2 man crew

747-400

# Dashboard Example



# General Mapping of Decision Process



Input Layer

Hidden/Visible Layer 1

Hidden/Visible Layer 2

Output Layer

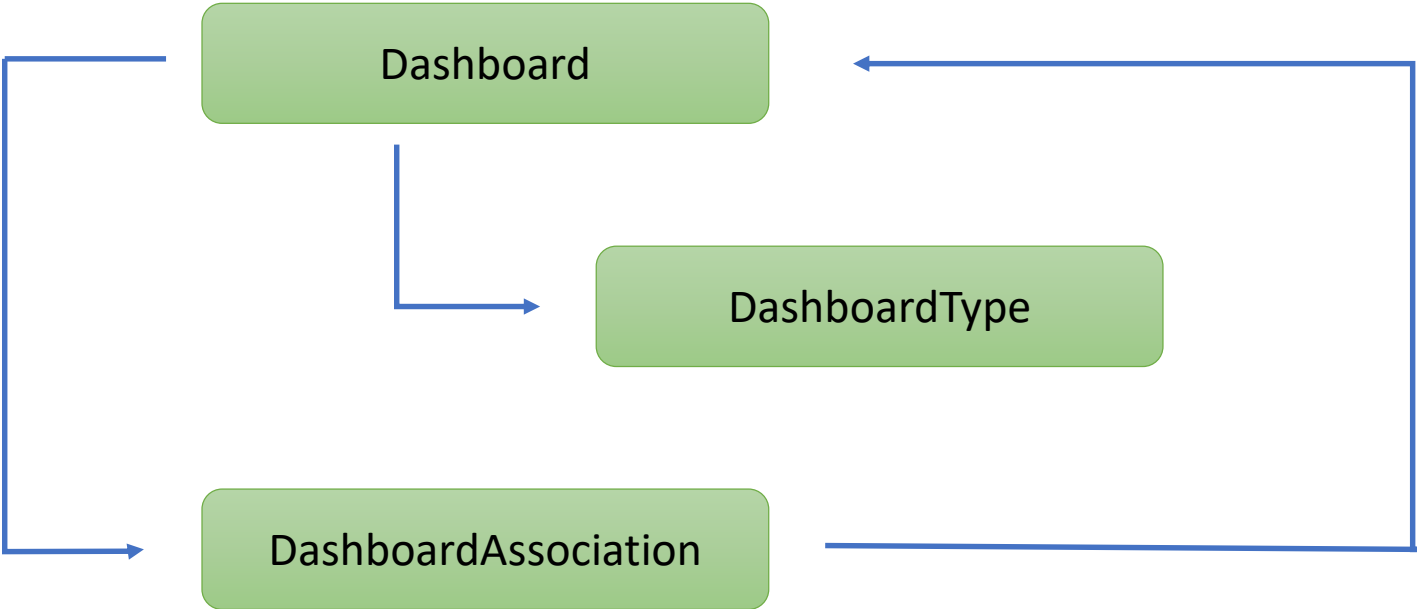
# Dashboard Example



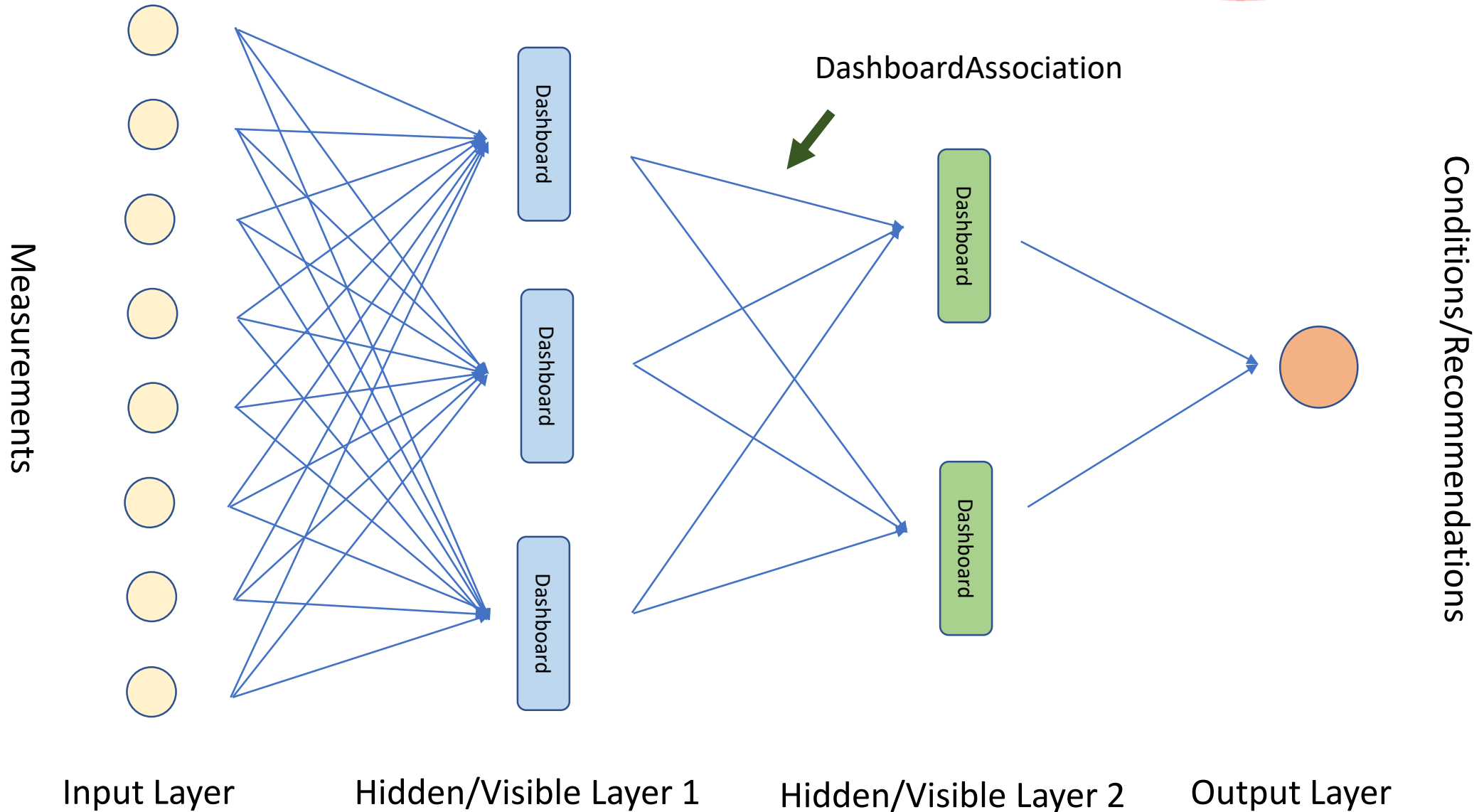
Fault Zone	Test Type		Date	Condition Code
Power Circuit	Stator			Normal
	Voltage Imbalance (%)	0.47	02/16/16 8:04 AM	
	Current Imbalance (%)	3.71	02/16/16 8:04 AM	
	Resistive Imbalance (%)	0.11	12/01/17 8:52 AM	
	Drive Input			
	Voltage Imbalance Ph-Ph (%)	Not Tested		
	Current Imbalance (%)	Not Tested		
Power Quality	Stator			Normal
	Voltage THD Ph-Ph (%)	0.50	02/16/16 8:04 AM	
	Current THD (%)	1.27	02/16/16 8:04 AM	
	HVF (%)	0.00	02/16/16 8:04 AM	
	Drive Input			
	Voltage THD Ph-Ph (%)	Not Tested		
	Current THD (%)	Not Tested		
Insulation	Stator			Caution
	<b>RTG (Meg)</b>	<b>4515.87</b>	<b>12/01/17 8:52 AM</b>	
	<b>PI</b>	<b>1.92</b>	<b>12/01/17 8:33 AM</b>	
	CTG (pF)	3200.00	12/01/17 8:52 AM	
Stator	Imp. Imbalance (%)	3.58	02/16/16 8:04 AM	Normal
	Inductive Imbalance (%)	0.22	12/01/17 8:52 AM	
Rotor	<b>Fp Amplitude (Delta dB)</b>	<b>21.40</b>	<b>02/16/16 8:10 AM</b>	<b>Severe</b>
Air Gap	Eccentricity			Normal
	Peak One (Delta dB)	-1048.46	02/16/16 8:14 AM	
	Peak Two (Delta dB)	-1046.59	02/16/16 8:14 AM	
	Peak Three (Delta dB)	-1053.98	02/16/16 8:14 AM	
	Peak Four (Delta dB)	-1075.22	02/16/16 8:14 AM	
	RIC (Eccentricity)	False	02/22/16 7:55 AM	

Motor in **Poor Health State**

# Dashboard Proposal to CCOM

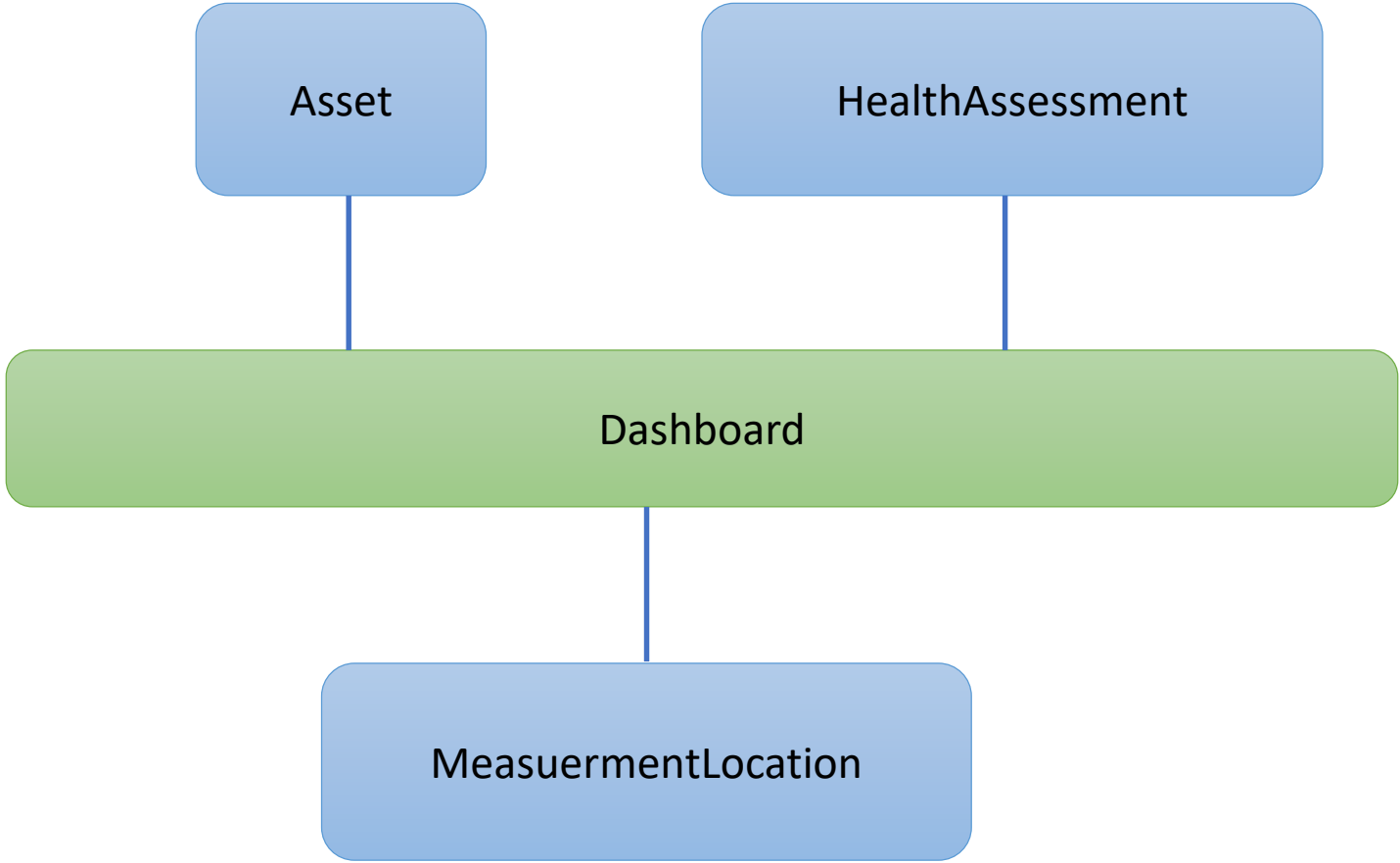


# General Mapping of Decision Process





# Dashboard Proposal to CCOM



# Dashboard Example

Fault Zone	Test Type		Date	Condition Code
Power Circuit	Stator			Normal
	Voltage Imbalance (%)	0.47	02/16/16 8:04 AM	
	Current Imbalance (%)	3.71	02/16/16 8:04 AM	
	Resistive Imbalance (%)	0.11	12/01/17 8:52 AM	
	Drive Input			
	Voltage Imbalance Ph-Ph (%)	Not Tested		
	Current Imbalance (%)	Not Tested		
Power Quality	Stator			Normal
	Voltage THD Ph-Ph (%)	0.50	02/16/16 8:04 AM	
	Current THD (%)	1.27	02/16/16 8:04 AM	
	HVF (%)	0.00	02/16/16 8:04 AM	
	Drive Input			
	Voltage THD Ph-Ph (%)	Not Tested		
	Current THD (%)	Not Tested		
Insulation	Stator			Caution
	<b>RTG (Meg)</b>	<b>4515.87</b>	<b>12/01/17 8:52 AM</b>	
	<b>PI</b>	<b>1.92</b>	<b>12/01/17 8:33 AM</b>	
	CTG (pF)	3200.00	12/01/17 8:52 AM	
Stator	Imp. Imbalance (%)	3.58	02/16/16 8:04 AM	Normal
	Inductive Imbalance (%)	0.22	12/01/17 8:52 AM	
Rotor	<b>Fp Amplitude (Delta dB)</b>	<b>21.40</b>	<b>02/16/16 8:10 AM</b>	<b>Severe</b>
Air Gap	Eccentricity			Normal
	Peak One (Delta dB)	-1048.46	02/16/16 8:14 AM	
	Peak Two (Delta dB)	-1046.59	02/16/16 8:14 AM	
	Peak Three (Delta dB)	-1053.98	02/16/16 8:14 AM	
	Peak Four (Delta dB)	-1075.22	02/16/16 8:14 AM	
	RIC (Eccentricity)	False	02/22/16 7:55 AM	

Motor in **Poor Health State**

```
"measurements": [  
  {  
    "@@type": "SingleDataMeasurement",  
    "UUID": "c60e484b-9496-40f5-9263-fb117fddcd8c",  
    "recorded": {  
      "dateTime": "2017-12-01T13:52:01.000000005Z"  
    },  
    "infoSource": [...],  
    "data": {  
      "measure": {  
        "value": {  
          "numeric": "4515.87"  
        },  
        "unitOfMeasure": [...]  
      }  
    }  
  }  
],  
"triggeredRegions": [  
  {  
    "regionType": {  
      "UUID": "64900fdc-5a71-4b56-a2f1-d09299963804",  
      "shortName": {  
        "text": "Alert"  
      },  
      "infoSource": [...]  
    }  
  }  
]
```

# Dashboard Example

Fault Zone	Test Type		Date	Condition Code
Power Circuit	Stator			Normal
	Voltage Imbalance (%)	0.47	02/16/16 8:04 AM	
	Current Imbalance (%)	3.71	02/16/16 8:04 AM	
	Resistive Imbalance (%)	0.11	12/01/17 8:52 AM	
	Drive Input			
	Voltage Imbalance Ph-Ph (%)	Not Tested		
	Current Imbalance (%)	Not Tested		
Power Quality	Stator			Normal
	Voltage THD Ph-Ph (%)	0.50	02/16/16 8:04 AM	
	Current THD (%)	1.27	02/16/16 8:04 AM	
	HVF (%)	0.00	02/16/16 8:04 AM	
	Drive Input			
	Voltage THD Ph-Ph (%)	Not Tested		
	Current THD (%)	Not Tested		
Insulation	Stator			Caution
	<b>RTG (Meg)</b>	<b>4515.87</b>	<b>12/01/17 8:52 AM</b>	
	<b>PI</b>	<b>1.92</b>	<b>12/01/17 8:33 AM</b>	
	CTG (pF)	3200.00	12/01/17 8:52 AM	
Stator	Imp. Imbalance (%)	3.58	02/16/16 8:04 AM	Normal
	Inductive Imbalance (%)	0.22	12/01/17 8:52 AM	
Rotor	<b>Fp Amplitude (Delta dB)</b>	<b>21.40</b>	<b>02/16/16 8:10 AM</b>	<b>Severe</b>
Air Gap	Eccentricity			Normal
	Peak One (Delta dB)	-1048.46	02/16/16 8:14 AM	
	Peak Two (Delta dB)	-1046.59	02/16/16 8:14 AM	
	Peak Three (Delta dB)	-1053.98	02/16/16 8:14 AM	
	Peak Four (Delta dB)	-1075.22	02/16/16 8:14 AM	
	RIC (Eccentricity)	False	02/22/16 7:55 AM	

Motor in **Poor Health State**

```
"dashboardAssociations": [  
  {  
    "UUID": "9c4bf1dc-da2b-48e1-9b67-fbd707aba91b",  
    "shortName": {  
      "text": "Insulation, Stator"  
    },  
    "dashboard": {  
      "UUID": "9c4bf1dc-da2b-48e1-9b67-fbd707aba91b",  
      "shortName": {  
        "text": "Stator"  
      },  
      "infoSource": ...,  
      "type": ...,  
      "measurementLocations": ...  
    }  
  }  
],  
"healthAssessment": {  
  "@@type": "HealthAssessment",  
  "UUID": "a8654a1d-7527-4f06-97fe-22e8b217fd3c",  
  "shortName": ...,  
  "infoSource": ...,  
  "created": ...,  
  "assessed": ...,  
  "healthLevelPrecise": ...,  
  "healthLevelType": {  
    "UUID": "7d0424c5-b214-4b22-8a82-8949c3dfdf08",  
    "infoSource": {  
      "UUID": "cf3f3a8a-1e42-4f15-9288-9cf2241e163d"  
    },  
    "shortName": {  
      "text": "Moderate Health State"  
    },  
    "healthScale": {  
      "numeric": "50"  
    }  
  }  
}
```

# Dashboard Example

Fault Zone	Test Type		Date	Condition Code
Power Circuit	Stator			Normal
	Voltage Imbalance (%)	0.47	02/16/16 8:04 AM	
	Current Imbalance (%)	3.71	02/16/16 8:04 AM	
	Resistive Imbalance (%)	0.11	12/01/17 8:52 AM	
	Drive Input			
	Voltage Imbalance Ph-Ph (%)	Not Tested		
	Current Imbalance (%)	Not Tested		
Power Quality	Stator			Normal
	Voltage THD Ph-Ph (%)	0.50	02/16/16 8:04 AM	
	Current THD (%)	1.27	02/16/16 8:04 AM	
	HVF (%)	0.00	02/16/16 8:04 AM	
	Drive Input			
	Voltage THD Ph-Ph (%)	Not Tested		
	Current THD (%)	Not Tested		
Insulation	Stator			Caution
	<b>RTG (Meg)</b>	<b>4515.87</b>	<b>12/01/17 8:52 AM</b>	
	<b>PI</b>	<b>1.92</b>	<b>12/01/17 8:33 AM</b>	
	CTG (pF)	3200.00	12/01/17 8:52 AM	
Stator	Imp. Imbalance (%)	3.58	02/16/16 8:04 AM	Normal
	Inductive Imbalance (%)	0.22	12/01/17 8:52 AM	
Rotor	<b>Fp Amplitude (Delta dB)</b>	<b>21.40</b>	<b>02/16/16 8:10 AM</b>	<b>Severe</b>
Air Gap	Eccentricity			Normal
	Peak One (Delta dB)	-1048.46	02/16/16 8:14 AM	
	Peak Two (Delta dB)	-1046.59	02/16/16 8:14 AM	
	Peak Three (Delta dB)	-1053.98	02/16/16 8:14 AM	
	Peak Four (Delta dB)	-1075.22	02/16/16 8:14 AM	
	RIC (Eccentricity)	False	02/22/16 7:55 AM	

Motor in **Poor Health State**

```
"CCOMData": {  
  "asset": {  
    "UUID": "cc604a87-542a-44a9-8b73-e5a80cd2e6e8",  
    "shortName": {  
      "text": "41-3107"  
    },  
    "infoSource": ...,  
    "dashBoard": ...,  
    "healthAssessment": [  
      {  
        "@@type": "HealthAssessment",  
        "UUID": "f37467a5-533e-4cf7-a879-e6fbee939ae5",  
        "shortName": ...,  
        "infoSource": ...,  
        "created": ...,  
        "assessed": ...,  
        "healthLevelPrecise": ...,  
        "healthLevelType": {  
          "UUID": "79094f85-dc67-4628-bb0b-83868cfde8c1",  
          "infoSource": ...,  
          "shortName": {  
            "text": "Poor Health State"  
          },  
          "healthScale": {  
            "numeric": "25"  
          }  
        }  
      }  
    ]  
  }  
}
```

# Conclusion



- CCOM has huge potential and the possibility is endless
- It seems complicated but there are good reasons
- It brings reliability engineers and IT professionals together
- CCOM has great pattern, easy to code and adding new capabilities
- Don't reinvent the bicycle