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In this appendix, a sample of AQOSA IR (described in Chapter 4.3) is presented. Listing A.1 shows the source of the AQOSA IR model for the case study mentioned in Section 5.3. It is encoded in the Eclipse EMF [Ecl] format. This model is also accessible via this URL: http://goo.gl/nio8u8.

Listing A.1: AQOSA IR EMF model for Saab Instrument Cluster system

```xml
<?xml version="1.0" encoding="UTF-8"?>
  <assembly>
    <component name="ReadWheelSpeedSensors">
      <service name="ReadWheelSpeedSensors"/>
      <inport name="ReadWheelSpeedSensors-in"/>
      <outport name="ReadWheelSpeedSensors-out"/>
    </component>
    <component name="ControlWheelSpeed">
      <service name="CalculateWheelRotation"/>
      <inport name="ControlWheelSpeed-in"/>
      <outport name="ControlWheelSpeed-out"/>
    </component>
    <component name="EngineVehicleInterface">
      <service name="ObtainEngineSpeed"/>  
      <service name="ObtainVehicleSpeed"/>
      <service name="ObtainCoolantTemp"/>
      <inport name="EngineVehicleInterface-in_Engine"/>
      <inport name="EngineVehicleInterface-in_Vehicle"/>
      <inport name="EngineVehicleInterface-in_Coolant"/>
      <outport name="EngineVehicleInterface-out_Engine"/>
      <outport name="EngineVehicleInterface-out_Vehicle"/>
      <outport name="EngineVehicleInterface-out_Coolant"/>
    </component>
    <component name="ProvidePowerModeInfo">
      <service name="PowerModeInfo"/>
      <outport name="PowerModeInfo-out"/>
    </component>
  </assembly>
</aqosa.ir:AQOSAModel>
```
<component name="ControlEngineSpeedGauge">
  <service name="DisplayEngineSpeed"/>
  <inport name="ControlEngineSpeedGauge-in"/>
  <outport name="ControlEngineSpeedGauge-out"/>
</component>

<component name="ControlVehicleSpeedGauge">
  <service name="DisplayVehicleSpeed"/>
  <inport name="ControlVehicleSpeedGauge-in"/>
  <outport name="ControlVehicleSpeedGauge-out"/>
</component>

<component name="Gauge_Engine">
  <service name="CalculateNeedlePosition"/>
  <inport name="Gauge_Engine-in"/>
</component>

<component name="TransmissionVehicleInterface">
  <service name="ReadLeverPstn"/>
  <outport name="TransmissionVehicleInterface-out"/>
</component>

<component name="ControlGearSelectedIndication">
  <service name="GearDisplayValue"/>
  <inport name="ControlGearSelectedIndication-in"/>
  <outport name="ControlGearSelectedIndication-out"/>
</component>

<component name="Display_Engine">
  <service name="IndicateGearPstn"/>  
  <service name="DisplayOAT"/>  
  <service name="DisplayOdometer"/>  
  <service name="IndicateLowWasher"/>  
  <inport name="Display_Engine-in_Gear"/>  
  <inport name="Display_Engine-in_OAT"/>  
  <inport name="Display_Engine-in_Odometer"/>  
  <inport name="Display_Engine-in_Washer"/>
</component>

<component name="ReadOATSensor">
  <service name="ObtaionOAT"/>
  <outport name="ReadOATSensor-out"/>
</component>

<component name="ControlOutsideAirTemp">
  <service name="CalculateOAT"/>
  <inport name="ControlOutsideAirTemp-in"/>
  <outport name="ControlOutsideAirTemp-out"/>
</component>

<component name="ControlCoolantTempGauge">
  <service name="DisplayCoolantTemp"/>
  <inport name="ControlCoolantTempGauge-in"/>
  <outport name="ControlCoolantTempGauge-out"/>
</component>

<component name="ReadDriverDoorAjarSwitch">
  <service name="ReadDriverDoorAjarSwitch"/>
  <outport name="ReadDriverDoorAjarSwitch-out"/>
</component>

<component name="ControlOdometer">
  <service name="OdometerValue"/>
  <inport name="ControlOdometer-in"/>
  <outport name="ControlOdometer-out"/>
</component>

<component name="ReadTripStemButton">
  <service name="ReadTripStemButton"/>
  <outport name="ReadTripStemButton-out"/>
</component>
<component name="ReadLowWasherLevel">
  <service name="ReadLowWasherLevel"/>
  <outport name="ReadLowWasherLevel-out"/>
</component>

<component name="ControlWasherLevelIndication">
  <service name="ControlWasherLevelIndication"/>
  <inport name="ControlWasherLevelIndication-in"/>
  <outport name="ControlWasherLevelIndication-out"/>
</component>

<flow name="Ignition_to_EngineSpeed">
  <action xsi:type="aqosa.ir:ComputeAction" service="/assembly/component.3/service.0"/>
  <action xsi:type="aqosa.ir:CommunicateAction" source="/assembly/component.3/outport.0" destination="/assembly/component.2/inport.0"/>
</flow>

<flow name="Ignition_to_VehicleSpeed">
  <action xsi:type="aqosa.ir:ComputeAction" service="/assembly/component.3/service.0"/>
  <action xsi:type="aqosa.ir:CommunicateAction" source="/assembly/component.3/outport.0" destination="/assembly/component.0/inport.0"/>
</flow>

<flow name="GearIndication">
  <action xsi:type="aqosa.ir:ComputeAction" service="/assembly/component.7/service.0"/>
</flow>
<flow name="VehicleSpeedIndication">
  <action xsi:type="aqosa.ir:ComputeAction" service="/assembly/@component.0/service.0"/>
  <action xsi:type="aqosa.ir:CommunicateAction" source="/assembly/@component.0/outport.0" destination="/assembly/@component.1/inport.0"/>
  <action xsi:type="aqosa.ir:ComputeAction" service="/assembly/@component.1/service.0"/>
  <action xsi:type="aqosa.ir:CommunicateAction" source="/assembly/@component.1/outport.0" destination="/assembly/@component.2/inport.1"/>
  <action xsi:type="aqosa.ir:ComputeAction" service="/assembly/@component.2/service.1"/>
</flow>

<flow name="EngineSpeedIndication">
  <action xsi:type="aqosa.ir:ComputeAction" service="/assembly/@component.2/service.0"/>
  <action xsi:type="aqosa.ir:CommunicateAction" source="/assembly/@component.2/outport.0" destination="/assembly/@component.4/inport.0"/>
  <action xsi:type="aqosa.ir:ComputeAction" service="/assembly/@component.4/service.0"/>
  <action xsi:type="aqosa.ir:CommunicateAction" source="/assembly/@component.4/outport.0" destination="/assembly/@component.6/inport.0"/>
  <action xsi:type="aqosa.ir:ComputeAction" service="/assembly/@component.6/service.0"/>
</flow>

<flow name="OATCalculation">
  <action xsi:type="aqosa.ir:ComputeAction" service="/assembly/@component.10/service.0"/>
  <action xsi:type="aqosa.ir:CommunicateAction" source="/assembly/@component.10/outport.0" destination="/assembly/@component.11/inport.0"/>
  <action xsi:type="aqosa.ir:ComputeAction" service="/assembly/@component.11/service.0"/>
  <action xsi:type="aqosa.ir:CommunicateAction" source="/assembly/@component.11/outport.0" destination="/assembly/@component.9/inport.1"/>
  <action xsi:type="aqosa.ir:ComputeAction" service="/assembly/@component.9/service.1"/>
</flow>

<flow name="EngineCoolantTemp">
  <action xsi:type="aqosa.ir:ComputeAction" service="/assembly/@component.2/service.0"/>
  <action xsi:type="aqosa.ir:CommunicateAction" source="/assembly/@component.2/outport.0" destination="/assembly/@component.12/inport.0"/>
  <action xsi:type="aqosa.ir:ComputeAction" service="/assembly/@component.12/service.0"/>
  <action xsi:type="aqosa.ir:CommunicateAction" source="/assembly/@component.12/outport.0" destination="/assembly/@component.6/inport.0"/>
  <action xsi:type="aqosa.ir:ComputeAction" service="/assembly/@component.6/service.0"/>
</flow>

<flow name="DriverDoor_to_Odometer">
  <action xsi:type="aqosa.ir:ComputeAction" service="/assembly/@component.13/service.0"/>
</flow>
<action xsi:type="aqosa.ir:CommunicateAction" source="/assembly/@component.13/outport.0" destination="/assembly/@component.14/inport.0"/>
<action xsi:type="aqosa.ir:ComputeAction" service="/assembly/@component.14/service.0"/>
<action xsi:type="aqosa.ir:CommunicateAction" source="/assembly/@component.14/outport.0" destination="/assembly/@component.9/inport.2"/>
<action xsi:type="aqosa.ir:ComputeAction" service="/assembly/@component.9/service.2"/>
</flow>
<flow name="StemButton_to_Odometer">
<action xsi:type="aqosa.ir:ComputeAction" service="/assembly/@component.15/service.0"/>
<action xsi:type="aqosa.ir:CommunicateAction" source="/assembly/@component.15/outport.0" destination="/assembly/@component.14/inport.0"/>
<action xsi:type="aqosa.ir:ComputeAction" service="/assembly/@component.14/service.0"/>
<action xsi:type="aqosa.ir:CommunicateAction" source="/assembly/@component.14/outport.0" destination="/assembly/@component.9/inport.2"/>
<action xsi:type="aqosa.ir:ComputeAction" service="/assembly/@component.9/service.2"/>
</flow>
<flow name="LowWasherIndication">
<action xsi:type="aqosa.ir:ComputeAction" service="/assembly/@component.16/service.0"/>
<action xsi:type="aqosa.ir:CommunicateAction" source="/assembly/@component.16/outport.0" destination="/assembly/@component.17/inport.0"/>
<action xsi:type="aqosa.ir:ComputeAction" service="/assembly/@component.17/service.0"/>
<action xsi:type="aqosa.ir:CommunicateAction" source="/assembly/@component.17/outport.0" destination="/assembly/@component.9/inport.3"/>
<action xsi:type="aqosa.ir:ComputeAction" service="/assembly/@component.9/service.3"/>
</flow>
</assembly>
<scenarios>
<flowset name="Average" completionTime="10000.0" missedPercentage="0.05">
<flowinstance instance="/assembly/@flow.0" start="300.0" trigger="5000.0" deadline="75.0"/>
<flowinstance instance="/assembly/@flow.1" start="400.0" trigger="5000.0" deadline="75.0"/>
<flowinstance instance="/assembly/@flow.2" start="500.0" trigger="5000.0" deadline="50.0"/>
<flowinstance instance="/assembly/@flow.3" start="1000.0" trigger="100.0" deadline="50.0"/>
<flowinstance instance="/assembly/@flow.4" start="1030.0" trigger="100.0" deadline="35.0"/>
<flowinstance instance="/assembly/@flow.5" start="100.0" trigger="1000.0" deadline="50.0"/>
<flowinstance instance="/assembly/@flow.6" start="1070.0" trigger="100.0" deadline="30.0"/>
<flowinstance instance="/assembly/@flow.7" start="2000.0" trigger="5000.0" deadline="250.0"/>
<flowinstance instance="/assembly/@flow.8" start="2500.0" trigger="5000.0" deadline="250.0"/>
<flowinstance instance="/assembly/@flow.9" start="3000.0" trigger="5000.0" deadline="125.0"/>
</flowset>
</scenarios>
<repository>
<componentinstance id="ReadWheelSpeedSensors_Instance" compatible="
<componentinstance id="ControlWheelSpeed_Instance" compatible="//@assembly/@component.1" variancePercentage="0.05">
    <service instance="//@assembly/@component.1/@service.0" cycles="500" networkUsage="2000.0">
        <provide connects="//@assembly/@component.1/@outport.0"/>
        <depend>
            <require external="//@repository/@externalport.3"/>
            <require internal="//@assembly/@component.1/@inport.0"/>
        </depend>
    </service>
</componentinstance>

<componentinstance id="EngineVehicleInterface_Instance" compatible="//@assembly/@component.2" variancePercentage="0.05">
    <service instance="//@assembly/@component.2/@service.0" cycles="500" networkUsage="2000.0">
        <provide connects="//@assembly/@component.2/@outport.0"/>
        <depend>
            <require external="//@repository/@externalport.3"/>
            <require internal="//@assembly/@component.2/@inport.0"/>
        </depend>
    </service>
</componentinstance>

<service instance="//@assembly/@component.2/@service.1" cycles="500" networkUsage="1000.0">
    <provide connects="//@assembly/@component.2/@outport.1"/>
    <depend>
        <require internal="//@assembly/@component.2/@inport.1"/>
    </depend>
</service>

<service instance="//@assembly/@component.2/@service.2" cycles="500" networkUsage="1000.0">
    <provide connects="//@assembly/@component.2/@outport.2"/>
    <depend>
        <require internal="//@assembly/@component.2/@inport.2"/>
    </depend>
</service>

<componentinstance id="ProvidePowerModeInfo_Instance" compatible="//@assembly/@component.3" variancePercentage="0.05">
    <service instance="//@assembly/@component.3/@service.0" cycles="400" networkUsage="1000.0">
        <provide connects="//@assembly/@component.3/@outport.0"/>
        <depend>
            <require external="//@repository/@externalport.2"/>
        </depend>
    </service>
</componentinstance>

<componentinstance id="ControlEngineSpeedGauge_Instance" compatible="//@assembly/@component.4" variancePercentage="0.05">
    <service instance="//@assembly/@component.4/@service.0" cycles="2850" networkUsage="2000.0">
        <provide connects="//@assembly/@component.4/@outport.0"/>
    </service>
</componentinstance>
<depend>
  <require internal="/assembly/component.4/inport.0"/>
</depend>
</service>
</componentinstance>
<componentinstance id="ControlVehicleSpeedGauge_Instance" compatible="/assembly/component.5"
  variancePercentage="0.05">
  <service instance="/assembly/component.5/service.0" cycles="2950" networkUsage="2000.0">
    <provide connects="/assembly/component.5/outport.0"/>
    <depend>
      <require internal="/assembly/component.5/inport.0"/>
    </depend>
  </service>
</componentinstance>
<componentinstance id="Gauge_Engine_Instance" compatible="/assembly/component.6"
  variancePercentage="0.05">
  <service instance="/assembly/component.6/service.0" cycles="500">
    <depend>
      <require internal="/assembly/component.6/inport.0"/>
    </depend>
  </service>
</componentinstance>
<componentinstance id="TransmissionVehicleInterface_Instance" compatible="/assembly/component.7"
  variancePercentage="0.05">
  <service instance="/assembly/component.7/service.0" cycles="100" networkUsage="1000.0">
    <provide connects="/assembly/component.7/outport.0"/>
    <depend>
      <require external="/repository/externalport.5"/>
    </depend>
  </service>
</componentinstance>
<componentinstance id="ControlGearSelectedIndication_Instance" compatible="/assembly/component.8"
  variancePercentage="0.05">
  <service instance="/assembly/component.8/service.0" cycles="2500" networkUsage="1000.0">
    <provide connects="/assembly/component.8/outport.0"/>
    <depend>
      <require internal="/assembly/component.8/inport.0"/>
    </depend>
  </service>
</componentinstance>
<componentinstance id="Display_Engine_Instance" cost="55.0" compatible="/assembly/component.9"
  variancePercentage="0.05">
  <service instance="/assembly/component.9/service.0" cycles="500" networkUsage="1000.0">
    <depend>
      <require internal="/assembly/component.9/inport.0"/>
    </depend>
  </service>
  <service instance="/assembly/component.9/service.1" cycles="500" networkUsage="1000.0">
    <depend>
      <require internal="/assembly/component.9/inport.1"/>
    </depend>
  </service>
  <service instance="/assembly/component.9/service.2" cycles="500" networkUsage="1000.0">
    <depend>
<require internal="//@assembly/@component.9/@inport.2"/>
</depend>
</service>
<service instance="//@assembly/@component.9/@service.3" cycles="500" networkUsage="1000.0">
<depend>
<require internal="//@assembly/@component.9/@inport.3"/>
</depend>
</service></componentinstance>

<componentinstance id="ReadOATSensor_Instance" compatible="//@assembly/@component.10" variancePercentage="0.05">
<service instance="//@assembly/@component.10/@service.0" cycles="1000" networkUsage="1000.0">
<provide connects="//@assembly/@component.10/@outport.0"/>
<depend>
<require external="//@repository/@externalport.6"/>
</depend>
</service>
</componentinstance>

<componentinstance id="ControlOutsideAirTemp_Instance" compatible="//@assembly/@component.11" variancePercentage="0.05">
<service instance="//@assembly/@component.11/@service.0" cycles="2744" networkUsage="1000.0">
<provide connects="//@assembly/@component.11/@outport.0"/>
<depend>
<require internal="//@assembly/@component.11/@inport.0"/>
</depend>
</service>
</componentinstance>

<componentinstance id="ControlCoolantTempGauge_Instance" compatible="//@assembly/@component.12" variancePercentage="0.05">
<service instance="//@assembly/@component.12/@service.0" cycles="1500" networkUsage="1000.0">
<provide connects="//@assembly/@component.12/@outport.0"/>
<depend>
<require internal="//@assembly/@component.12/@inport.0"/>
</depend>
</service>
</componentinstance>

<componentinstance id="ReadDriverDoorAjarSwitch_Instance" cost="1.0" compatible="//@assembly/@component.13" variancePercentage="0.05">
<service instance="//@assembly/@component.13/@service.0" cycles="100" networkUsage="1000.0">
<provide connects="//@assembly/@component.13/@outport.0"/>
<depend>
<require external="//@repository/@externalport.0"/>
</depend>
</service>
</componentinstance>

<componentinstance id="ControlOdometer_Instance" compatible="//@assembly/@component.14" variancePercentage="0.05">
<service instance="//@assembly/@component.14/@service.0" cycles="2440" networkUsage="4000.0">
<provide connects="//@assembly/@component.14/@outport.0"/>
<depend>
<require internal="//@assembly/@component.14/@inport.0"/>
<require external="//@repository/@externalport.7"/>
</depend>
</service>
<componentinstance id="ReadTripStemButton_Instance" compatible=""
  @assembly/@component.15" variancePercentage="0.05">
  <service instance="/@assembly/@component.15/@service.0" cycles="100" networkUsage="1000.0">
    <provide connects="/@assembly/@component.15/@outport.0"/>
    <require external="/repository/@externalport.1"/>
  </service>
</componentinstance>

<componentinstance id="ReadLowWasherLevel_Instance" compatible=""
  @assembly/@component.16" variancePercentage="0.05">
  <service instance="/@assembly/@component.16/@service.0" cycles="100" networkUsage="1000.0">
    <provide connects="/@assembly/@component.16/@outport.0"/>
    <require external="/repository/@externalport.8"/>
  </service>
</componentinstance>

<componentinstance id="ControlWasherLevelIndication_Instance" compatible=""
  @assembly/@component.17" variancePercentage="0.05">
  <service instance="/@assembly/@component.17/@service.0" cycles="300" networkUsage="1000.0">
    <provide connects="/@assembly/@component.17/@outport.0"/>
    <require internal="/assembly/@component.17/@inport.0"/>
  </service>
</componentinstance>

<processor id="cpu066-h" clock="66.0" cost="100.0" internalBusBandwidth="1024.0"
  internalBusDelay="0.1" lowerFail="0.015" upperFail="0.03"/>
<processor id="cpu066-l" clock="66.0" cost="140.0" internalBusBandwidth="1024.0"
  internalBusDelay="0.1" lowerFail="0.01" upperFail="0.025"/>
<processor id="cpu100-h" clock="100.0" cost="125.0" internalBusBandwidth="1024.0"
  internalBusDelay="0.1" lowerFail="0.015" upperFail="0.03"/>
<processor id="cpu100-l" clock="100.0" cost="175.0" internalBusBandwidth="1024.0"
  internalBusDelay="0.1" lowerFail="0.01" upperFail="0.025"/>
<processor id="cpu133-h" clock="133.0" cost="150.0" internalBusBandwidth="1024.0"
  internalBusDelay="0.1" lowerFail="0.015" upperFail="0.03"/>
<processor id="cpu133-l" clock="133.0" cost="210.0" internalBusBandwidth="1024.0"
  internalBusDelay="0.1" lowerFail="0.01" upperFail="0.025"/>
<processor id="cpu166-h" clock="166.0" cost="175.0" internalBusBandwidth="1024.0"
  internalBusDelay="0.1" lowerFail="0.015" upperFail="0.03"/>
<processor id="cpu166-l" clock="166.0" cost="245.0" internalBusBandwidth="1024.0"
  internalBusDelay="0.1" lowerFail="0.01" upperFail="0.025"/>
<processor id="cpu200-h" clock="200.0" cost="200.0" internalBusBandwidth="1024.0"
  internalBusDelay="0.1" lowerFail="0.015" upperFail="0.03"/>
<processor id="cpu200-l" clock="200.0" cost="280.0" internalBusBandwidth="1024.0"
  internalBusDelay="0.1" lowerFail="0.01" upperFail="0.025"/>
<processor id="cpu233-h" clock="233.0" cost="225.0" internalBusBandwidth="1024.0"
  internalBusDelay="0.1" lowerFail="0.015" upperFail="0.03"/>
<processor id="cpu233-l" clock="233.0" cost="315.0" internalBusBandwidth="1024.0"
  internalBusDelay="0.1" lowerFail="0.01" upperFail="0.025"/>
<processor id="cpu266-h" clock="266.0" cost="250.0" internalBusBandwidth="1024.0"
  internalBusDelay="0.1" lowerFail="0.02" upperFail="0.035"/>
<processor id="cpu266-l" clock="266.0" cost="350.0" internalBusBandwidth="1024.0"
  internalBusDelay="0.1" lowerFail="0.015" upperFail="0.03"/>
<processor id="cpu300-h" clock="300.0" cost="275.0" internalBusBandwidth="1024.0"
internalBusDelay="0.1" lowerFail="0.02" upperFail="0.035"/>

<processor id="cpu300-l" clock="300.0" cost="385.0" internalBusBandwidth="1024.0"
internalBusDelay="0.1" lowerFail="0.02" upperFail="0.035"/>

<processor id="cpu333-h" clock="333.0" cost="300.0" internalBusBandwidth="1024.0"
internalBusDelay="0.1" lowerFail="0.02" upperFail="0.035"/>

<processor id="cpu333-l" clock="333.0" cost="420.0" internalBusBandwidth="1024.0"
internalBusDelay="0.1" lowerFail="0.015" upperFail="0.035"/>

<processor id="cpu366-h" clock="366.0" cost="325.0" internalBusBandwidth="1024.0"
internalBusDelay="0.1" lowerFail="0.02" upperFail="0.035"/>

<processor id="cpu366-l" clock="366.0" cost="455.0" internalBusBandwidth="1024.0"
internalBusDelay="0.1" lowerFail="0.015" upperFail="0.035"/>

<processor id="cpu400-h" clock="400.0" cost="350.0" internalBusBandwidth="1024.0"
internalBusDelay="0.1" lowerFail="0.02" upperFail="0.035"/>

<processor id="cpu400-l" clock="400.0" cost="490.0" internalBusBandwidth="1024.0"
internalBusDelay="0.1" lowerFail="0.015" upperFail="0.03"/>

<bus id="CAN-HS" bandwidth="500.0" delay="0.002" cost="100.0"/>

<bus id="CAN-MS" bandwidth="125.0" delay="0.008" cost="50.0"/>

<bus id="CAN-LS" bandwidth="33.3" delay="0.016" cost="25.0"/>

<bus id="LIN" bandwidth="10.0" delay="0.05" cost="10.0"/>

<externalport id="ajar-switch" lowerFail="0.01" upperFail="0.05"/>

<externalport id="stem-button" lowerFail="0.01" upperFail="0.05"/>

<externalport id="ignition-switch" lowerFail="0.01" upperFail="0.05"/>

<externalport id="crankshaft-sensor" lowerFail="0.01" upperFail="0.05"/>

<externalport id="wheel-sensor" lowerFail="0.01" upperFail="0.05"/>

<externalport id="oat-sensor" lowerFail="0.01" upperFail="0.05"/>

<externalport id="odometer-storage" lowerFail="0.01" upperFail="0.05"/>

<externalport id="lowwasher-switch" lowerFail="0.01" upperFail="0.05"/>

</repository>

<objectives>

<settings noRun="3" noSampling="50" noDuplicate="1" minCost="200.0" maxCost="10000.0" />

<evaluations>ResponseTime</evaluations>
<evaluations>CPUUtilization</evaluations>
<evaluations>BusUtilization</evaluations>
<evaluations>Safety</evaluations>
<evaluations>Cost</evaluations>

</settings>

</objectives>

</aqosa.ir:AQOSAModel>
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