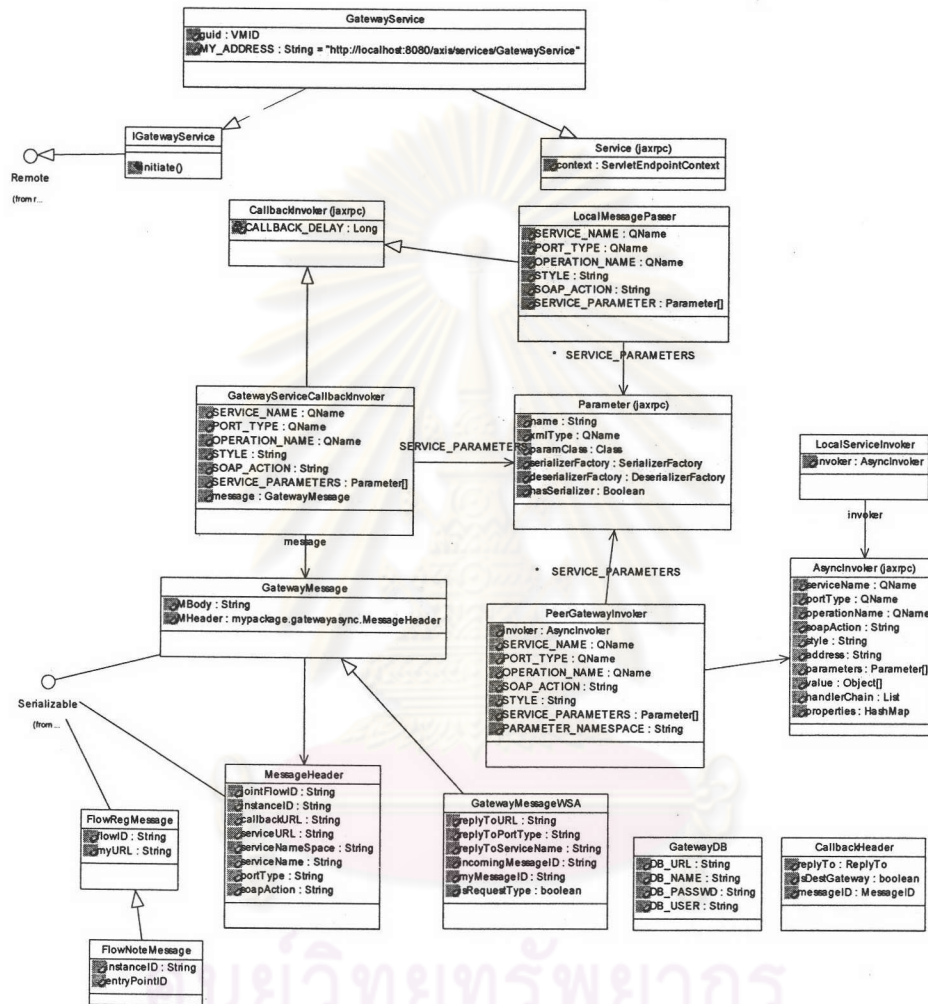# REFERENCES

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APPENDIX A

The full class diagrams

APPENDIX B

The BPEL code for the E-Tendering service:

```
<process name="E-Tendering" targetNamespace="http://acm.org/samples"
  suppressJoinFailure="yes"
  xmlns:tns="http://acm.org/samples"
  xmlns="http://schemas.xmlsoap.org/ws/2003/03/business-process/"
  xmlns:bpelx="http://schemas.oracle.com/bpel/extension"
  xmlns:ora="http://schemas.oracle.com/xpath/extension"
  xmlns:services="http://services.otn.com"
  xmlns:xsd="http://www.w3.org/2001/XMLSchema"
  xmlns:gatewayasync="http://gatewayasync.mypackage"
  xmlns:addressing="http://schemas.xmlsoap.org/ws/2003/03/addressing"
  xmlns:bpws="http://schemas.xmlsoap.org/ws/2003/03/business-process/"
  xmlns:WebAnnouncer="http://127.0.0.1:8080/axis/WebAnnouncer.jws"
  xmlns:EmailService="http://127.0.0.1:8080/axis/EmailService.jws">
  <!-- ================================================================ -->
  <!-- PARTNERLINKS                                                      -->
  <!-- List of services participating in this BPEL process              -->
  <!-- ================================================================ -->
  <bpelx:exec import="org.w3c.dom.Element"/>
  <bpelx:exec import="java.util.Calendar"/>
  <bpelx:exec import="java.util.Date"/>
  <bpelx:exec import="com.collaxa.cube.engine.ext.TaskManager"/>
  <bpelx:exec import="com.oracle.services.bpel.task.*"/>
  <bpelx:exec import="com.collaxa.cube.engine.types.BPELFault"/>
  <bpelx:exec import="com.collaxa.cube.xml.schema.XMLSchemaUtils"/>
  <partnerLinks>
    <!--
        The 'client' role represents the requester of this service. It is
        used for callback. The location and correlation information
associated
        with the client role are automatically set using WS-Addressing.
        -->
    <partnerLink name="client"
      partnerLinkType="tns:E-Tendering"
      myRole="E-TenderingProvider"
      partnerRole="E-TenderingRequester"/>
    <partnerLink name="GatewayService"
      partnerLinkType="services:GatewayService"
      partnerRole="GatewayServiceProvider"
      myRole="GatewayServiceRequester"/>
    <partnerLink name="webAnnouncer"
      partnerLinkType="WebAnnouncer:WebAnnouncerLink"
      partnerRole="WebAnnouncerProvider"/>
    <partnerLink name="EmailService"
      partnerLinkType="EmailService:EmailServiceLink"
      partnerRole="EmailServiceProvider"/>
  </partnerLinks>
  <!-- ================================================================ -->
  <!-- VARIABLES                                                         -->
  <!-- List of messages and XML documents used within this BPEL process -->
  <!-- ================================================================ -->
  <variables>
    <!-- Reference to the message passed as input during initiation -->
    <variable name="input" messageType="tns:E-TenderingRequestMessage"/>
    <!-- Reference to the message that will be sent back to the
            requester during callback
            -->
    <variable name="output"
      messageType="tns:E-TenderingResponseMessage"/>
    <variable name="breakLoop" type="xsd:boolean"/>
    <variable name="notifyIn"
```

```
          messageType="services:GatewayNotificationMessage"/>
      <variable name="deadLine" type="xsd:dateTime"/>
      <variable name="bestOffer" element="tns:BidIn"/>
      <variable name="lowestQuote" type="xsd:float"/>
      <variable name="currentOffer" element="tns:BidIn"/>
      <variable name="messageIn"
        messageType="services:GatewayServiceMessage"/>
      <variable name="bidInString" type="xsd:string"/>
      <variable name="currentQuote" type="xsd:float"/>
      <variable name="initialized" type="xsd:boolean"/>
      <variable name="winnerBid"
        messageType="WebAnnouncer:publishWinnerRequest"/>
      <variable name="emailWinner"
        messageType="EmailService:sendEmailtoWinnerRequest"/>
      <variable name="emailInvite"
        messageType="EmailService:sendOutInvitationRequest"/>
      <variable name="webPublish"
        messageType="WebAnnouncer:publishTenderingDocRequest"/>
      <variable name="temp" type="xsd:int"/>
      <variable name="webCloseBid"
        messageType="WebAnnouncer:closeBidRequest"/>
      <variable name="winnerResult"
        messageType="WebAnnouncer:publishWinnerResponse"/>
      <variable name="webPublishResult"
        messageType="WebAnnouncer:publishTenderingDocResponse"/>
      <variable name="emailWinnerResult"
        messageType="EmailService:sendEmailtoWinnerResponse"/>
      <variable name="inivitationResult"
        messageType="EmailService:sendOutInvitationResponse"/>
      <variable name="closeBidResult"
        messageType="WebAnnouncer:closeBidResponse"/>
      <variable name="currentMessage"
        messageType="services:GatewayServiceMessage"/>
  </variables>
  <!-- ================================================================= -->
  <!-- ORCHESTRATION LOGIC                                                -->
  <!-- Set of activities coordinating the flow of messages across the    -->
  <!-- services integrated within this business process                  -->
  <!-- ================================================================= -->
  <sequence name="main">
    <!-- Receive input from requestor.
             Note: This maps to operation defined in E-Tendering.wsdl
             -->
    <receive name="receiveInput"
      partnerLink="client"
      portType="tns:E-Tendering"
      operation="initiate"
      variable="input"
      createInstance="yes"/>
    <!-- Asynchronous callback to the requester.
             Note: the callback location and correlation id is transparently
handled
             using WS-addressing.
             -->
    <assign name="initializeData">
      <copy>
        <from expression="false()"/>
        <to variable="breakLoop"/>
      </copy>
      <copy>
        <from expression="false()"/>
        <to variable="initialized"/>
      </copy>
      <copy>
        <from variable="input" part="payload"
          query="/tns:E-TenderingRequest/tns:deadLine">
        </from>
        <to variable="deadLine"/>
```

```
      </copy>
      <copy>
        <from expression="'1234'">
        </from>
        <to variable="notifyIn" part="payload"
          query="/gatewayasync:flowNotnMessage/gatewayasync:flowID"/>
      </copy>
      <copy>
        <from variable="input" part="payload"
          query="/tns:E-TenderingRequest/tns:eventID">
        </from>
        <to variable="notifyIn" part="payload"
          query="/gatewayasync:flowNotnMessage/gatewayasync:instanceID"/>
      </copy>
      <copy>
        <from expression="'http://pomegranate:9700/orabpel/default/E-
Tendering'">
        </from>
        <to variable="notifyIn" part="payload"
          query="/gatewayasync:flowNotnMessage/gatewayasync:myURL"/>
      </copy>
      <copy>
        <from variable="input" part="payload"
          query="/tns:E-TenderingRequest/tns:eventID">
        </from>
        <to variable="emailInvite" part="eventID"/>
      </copy>
      <copy>
        <from variable="input" part="payload"
          query="/tns:E-TenderingRequest/tns:docURL">
        </from>
        <to variable="emailInvite" part="docURL"/>
      </copy>
      <copy>
        <from variable="input" part="payload"
          query="/tns:E-TenderingRequest/tns:emailListNumber">
        </from>
        <to variable="emailInvite" part="emailListNumber"/>
      </copy>
      <copy>
        <from variable="deadLine">
        </from>
        <to variable="emailInvite" part="deadline"/>
      </copy>
    </assign>
    <invoke name="invoke-4"
      partnerLink="EmailService"
      portType="EmailService:EmailService"
      operation="sendOutInvitation"
      inputVariable="emailInvite"
      outputVariable="inivitationResult"/>
    <assign name="initializeWebContent"><copy>
        <from variable="input" part="payload"
          query="/tns:E-TenderingRequest/tns:eventID">
        </from>
        <to variable="webPublish" part="eventID"/>
      </copy>
      <copy>
        <from variable="input" part="payload"
          query="/tns:E-TenderingRequest/tns:docURL">
        </from>
        <to variable="webPublish" part="docURL"/>
      </copy>
      <copy>
        <from variable="deadLine">
        </from>
        <to variable="webPublish" part="deadline"/>
      </copy>
```

```
        </assign>
        <invoke name="invoke-5"
        partnerLink="webAnnouncer"
        portType="WebAnnouncer:WebAnnouncer"
        operation="publishTenderingDoc"
        inputVariable="webPublish"
        outputVariable="webPublishResult"/>
        <wait until="bpws:getVariableData('input', 'payload', '/tns:E-
TenderingRequest/tns:deadLine')"/>
        <bpelx:exec xmlns:bpelx="http://schemas.oracle.com/bpel/extension" l
          anguage="java" version="1.4" name="printlnDeadLine">
          <![CDATA[
              // Java code snippet
            System.out.println("DeadLine reached");
            ]]>
        </bpelx:exec>
        <invoke name="invoke-1"
              partnerLink="GatewayService"
              portType="services:GatewayService"
              operation="notifyReadyState"
              inputVariable="notifyIn"/>
      <scope name="findWinner">
        <sequence>
          <while condition="not(bpws:getVariableData('breakLoop'))"
name="while-2">
            <sequence>
              <bpelx:exec
xmlns:bpelx="http://schemas.oracle.com/bpel/extension"
                language="java" version="1.4" name="java-exec-1">
                <![CDATA[
              // Java code snippet

   System.out.println("==Entering the while loop");
        ]]>
              </bpelx:exec>
              <pick name="pick-1" createInstance="no">
                <onMessage
                  partnerLink="GatewayService"
                  portType="services:GatewayServiceCallback"
                  operation="onMessageIn"
                  variable="messageIn">
                  <sequence>
                    <assign name="assign-1">
                      <copy>
                        <from variable="messageIn" part="payload">
                        </from>
                        <to variable="currentMessage" part="payload"/>
                      </copy>
                      <copy>
                        <from variable="currentMessage" part="payload"
query="/gatewayasync:gatewayMessage/gatewayasync:MBody">
                        </from>
                        <to variable="bidInString"/>
                      </copy>
                      <copy>
                        <from
expression="ora:parseEscapedXML(bpws:getVariableData('bidInString'))">
                        </from>
                        <to variable="currentOffer" query="/tns:BidIn"/>
                      </copy>
                      <copy>
                        <from variable="currentOffer"
query="/tns:BidIn/tns:offeredQuote">
                        </from>
                        <to variable="currentQuote"/>
                      </copy>
                    </assign>
```

```
<switch name="ifNotInitialized">
  <case
condition="not(bpws:getVariableData('initialized'))">
    <assign name="updateBestOffer">
      <copy>
        <from variable="currentQuote">
        </from>
        <to variable="lowestQuote"/>
      </copy>
      <copy>
        <from variable="currentOffer">
        </from>
        <to variable="bestOffer"/>
      </copy>
      <copy>
        <from expression="true()">
        </from>
        <to variable="initialized"/>
      </copy>
    </assign>
  </case>
  <otherwise>
    <switch name="ifCurrentLessThanLowest">
      <case
condition="bpws:getVariableData(&quot;currentQuote&quot;) &lt;
        bpws:getVariableData(&quot;lowestQuote&quot;)">
        <assign name="updateBestOffer-2">
          <copy>
            <from variable="currentQuote">
            </from>
            <to variable="lowestQuote"/>
          </copy>
          <copy>
            <from variable="currentOffer">
            </from>
            <to variable="bestOffer"/>
          </copy>
        </assign>
      </case>
    </switch>
  </otherwise>
</switch>
<assign name="prepareWinnerNotification">
  <copy>
    <from variable="input" part="payload"
      query="/tns:E-TenderingRequest/tns:eventID">
    </from>
    <to variable="winnerBid" part="eventID"/>
  </copy>
  <copy>
    <from variable="bestOffer"
      query="/tns:BidIn/tns:biddersID">
    </from>
    <to variable="winnerBid" part="winnerID"/>
  </copy>
  <copy>
    <from variable="bestOffer"
      query="/tns:BidIn/tns:biddersName">
    </from>
    <to variable="winnerBid" part="winnerName"/>
  </copy>
  <copy>
    <from expression="&quot;please check tou email for
details&quot;">
    </from>
    <to variable="winnerBid" part="details"/>
  </copy>
  <copy>
```

```
                    <from variable="input" part="payload"
                      query="/tns:E-TenderingRequest/tns:eventID">
                    </from>
                    <to variable="emailWinner" part="eventID"/>
                  </copy>
                  <copy>
                    <from variable="bestOffer"
                      query="/tns:BidIn/tns:biddersEmail">
                    </from>
                    <to variable="emailWinner" part="emailAddress"/>
                  </copy>
                  <copy>
                    <from expression="&quot;email body here&quot;">
                    </from>
                    <to variable="emailWinner" part="details"/>
                  </copy>
                </assign>
              </sequence>
            </onMessage>
            <onAlarm for="PT60S">
              <sequence>
                <bpelx:exec
xmlns:bpelx="http://schemas.oracle.com/bpel/extension"
                  language="java" version="1.4" name="java-exec-3">
                  <![CDATA[
          // Java code snippet
          System.out.println("data transfer done");
      ]]>
                </bpelx:exec>
                <assign name="updateWebContent"><copy>
                    <from variable="input" part="payload"
                      query="/tns:E-TenderingRequest/tns:eventID">
                    </from>
                    <to variable="webCloseBid" part="eventID"/>
                  </copy>
                  <copy>
                    <from expression="true()">
                    </from>
                    <to variable="breakLoop"/>
                  </copy>
                </assign>
                <invoke name="invoke-7"
                  partnerLink="webAnnouncer"
                  portType="WebAnnouncer:WebAnnouncer"
                  operation="closeBid"
                  inputVariable="webCloseBid"
                  outputVariable="closeBidResult"/>
              </sequence>
            </onAlarm>
          </pick>
        </sequence>
      </while>
    </sequence>
  </scope>
  <invoke name="invoke-3"
    partnerLink="EmailService"
    portType="EmailService:EmailService"
    operation="sendEmailtoWinner"
    inputVariable="emailWinner"
    outputVariable="emailWinnerResult"/>
  <invoke name="invoke-2"
    partnerLink="webAnnouncer"
    portType="WebAnnouncer:WebAnnouncer"
    operation="publishWinner"
    inputVariable="winnerBid"
    outputVariable="winnerResult"/>
  <invoke name="callbackClient"
    partnerLink="client"
```

```
      portType="tns:E-TenderingCallback"
      operation="onResult"
      inputVariable="output"/>
  </sequence>
</process>
```

The BPEL process definition on the bidder side:

```
<!-- Bidder BPEL Process [Generated by the Oracle BPEL Designer]  -->
<process name="Bidder" targetNamespace="http://acm.org/samples"
suppressJoinFailure="yes"
xmlns:tns="http://acm.org/samples"
xmlns="http://schemas.xmlsoap.org/ws/2003/03/business-process/"
xmlns:bpelx="http://schemas.oracle.com/bpel/extension"
xmlns:ora="http://schemas.oracle.com/xpath/extension"
xmlns:services="http://services.otn.com"
xmlns:gatewayasync="http://gatewayasync.mypackage"
xmlns:bpws="http://schemas.xmlsoap.org/ws/2003/03/business-process/"
xmlns:xsd="http://www.w3.org/2001/XMLSchema">
  <bpelx:exec import="java.util.*"/>
  <bpelx:exec import="java.lang.*"/>
  <bpelx:exec import="org.w3c.dom.Element"/>
  <!-- PARTNERLINKS                                                   -->
  <!-- List of services participating in this BPEL process           -->
  <partnerLinks>
    <partnerLink name="client"
      partnerLinkType="tns:Bidder"
      myRole="BidderProvider"
      partnerRole="BidderRequester"/>
    <partnerLink name="GatewayService"
      partnerLinkType="services:GatewayService"
      partnerRole="GatewayServiceProvider"
      myRole="GatewayServiceRequester"/>
  </partnerLinks>
  <!-- ================================================================ -->
  <!-- VARIABLES                                                      -->
  <!-- List of messages and XML documents used within this BPEL process -->
  <!-- ================================================================ -->
  <variables>
    <variable name="input"
      messageType="tns:BidInMessage"/>
    <variable name="output"
      messageType="tns:BidderResponseMessage"/>
    <variable name="gatewayIn"
      messageType="services:GatewayServiceMessage"/>
    <variable name="bidInString"
      type="xsd:string"/>
  </variables>
  <!-- ================================================================ -->
  <!-- ORCHESTRATION LOGIC                                            -->
  <!-- Set of activities coordinating the flow of messages across the  -->
  <!-- services integrated within this business process              -->
  <!-- ================================================================ -->
  <sequence name="main">
    <!-- Receive input from requestor.
            Note: This maps to operation defined in Bidder.wsdl
            -->
    <receive name="receiveInput"
      partnerLink="client"
      portType="tns:Bidder"
      operation="initiate"
      variable="input"
      createInstance="yes"/>
    <!-- Asynchronous callback to the requester.
            Note: the callback location and correlation id is transparently
handled
            using WS-addressing.
```

```
                      -->
    <assign name="assignHeader">
      <copy>
         <from expression="'1234'">
         </from>
         <to variable="gatewayIn" part="payload"
query="/gatewayasync:gatewayMessage/gatewayasync:MHeader/gatewayasync:jointF
lowID"/>
      </copy>
      <copy>
         <from variable="input" part="payload"
query="/tns:BidIn/tns:eventID">
         </from>
         <to variable="gatewayIn" part="payload"
query="/gatewayasync:gatewayMessage/gatewayasync:MHeader/gatewayasync:instan
ceID"/>
      </copy>
      <copy>
         <from expression="'http://pomegranate:9700/orabpel/default/Bidder'">
         </from>
         <to variable="gatewayIn" part="payload"
query="/gatewayasync:gatewayMessage/gatewayasync:MHeader/gatewayasync:callba
ckURL"/>
      </copy>
      <copy>
         <from expression="'http://pomegranate:9700/orabpel/default/E-
Tendering'">
         </from>
         <to variable="gatewayIn" part="payload"
query="/gatewayasync:gatewayMessage/gatewayasync:MHeader/gatewayasync:servic
eURL"/>
      </copy>
      <copy>
         <from expression="'http://acm.org/samples'">
         </from>
         <to variable="gatewayIn" part="payload"
query="/gatewayasync:gatewayMessage/gatewayasync:MHeader/gatewayasync:servic
eNameSpace"/>
      </copy>
      <copy>
         <from expression="'E-Tendering'">
         </from>
         <to variable="gatewayIn" part="payload"
query="/gatewayasync:gatewayMessage/gatewayasync:MHeader/gatewayasync:servic
eName"/>
      </copy>
      <copy>
         <from expression="'E-Tendering'">
         </from>
         <to variable="gatewayIn" part="payload"
query="/gatewayasync:gatewayMessage/gatewayasync:MHeader/gatewayasync:portTy
pe"/>
      </copy>
      <copy>
         <from expression="'requestService'">
         </from>
         <to variable="gatewayIn" part="payload"
query="/gatewayasync:gatewayMessage/gatewayasync:MHeader/gatewayasync:soapAc
tion"/>
      </copy>
```

```
    </assign>
    <bpelx:exec xmlns:bpelx="http://schemas.oracle.com/bpel/extension"
language="java" version="1.4" name="castBody">
      <![CDATA[
            // Java code snippet

      Element  eventID =
          (Element)
getVariableData("input","payload","/tns:BidIn/tns:eventID");
      Element  biddersID =
          (Element)
getVariableData("input","payload","/tns:BidIn/tns:biddersID");
      Element  offeredQuote =
          (Element)
getVariableData("input","payload","/tns:BidIn/tns:offeredQuote");
      Element  biddersEmail =
          (Element)
getVariableData("input","payload","/tns:BidIn/tns:biddersEmail");
      Element  biddersName =
          (Element)
getVariableData("input","payload","/tns:BidIn/tns:biddersName");
      Element  details =
          (Element)
getVariableData("input","payload","/tns:BidIn/tns:details");

      String output = "<BidIn>";
      output+="<eventID xmlns=\"http://acm.org/samples\">"
          +eventID.getNodeValue()+"</eventID>";
      output+="<biddersID xmlns=\"http://acm.org/samples\">"
          +biddersID.getNodeValue()+"</biddersID>";
      output+="<offeredQuote xmlns=\"http://acm.org/samples\">"
          +offeredQuote.getNodeValue()+"</offeredQuote>";
      output+="<biddersEmail xmlns=\"http://acm.org/samples\">"
          +biddersEmail.getNodeValue()+"</biddersEmail>";
      output+="<biddersName xmlns=\"http://acm.org/samples\">"
          +biddersName.getNodeValue()+"</biddersName>";
      output+="<details xmlns=\"http://acm.org/samples\">"
          +details.getNodeValue()+"</details></BidIn>";
      setVariableData("bidInString",output);
        ]]>
    </bpelx:exec>
    <assign name="assignBody"><copy>
        <from variable="bidInString">
        </from>
        <to variable="gatewayIn"
            part="payload"
            query="/gatewayasync:gatewayMessage/gatewayasync:MBody"/>
      </copy>
    </assign>
    <invoke name="invoke-1"
            partnerLink="GatewayService"
            portType="services:GatewayService"
            operation="initiate"
            inputVariable="gatewayIn"/>
    <invoke name="callbackClient"
            partnerLink="client"
            portType="tns:BidderCallback"
            operation="onResult"
            inputVariable="output"/>
  </sequence>
</process>
```

BIOGRAPHY

Kittipitch Kuptavanich was born on February 11th, 1977 in Bangkok, Thailand. He graduated from Mellon College of Science at Carnegie Mellon University with a chemistry major and a minor in computer science. He attends the master degree in computer science at Chulalongkorn University in 2001.