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Your challenge - our solution

ACCIOMA

An eXtendable Component based Interoperable Open Model driven Architecture

Component Based DDS using C++11

R2DDS (Ruby to DDS)

RTI London Connext Conference 2014

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Your challenge - our solution

- Remedy IT is specialized in communication middleware and component technologies
- Strong focus on open standards based solutions
- Actively involved in the Object Management Group, leading several OMG open standardization efforts
- Our customers are in various domains including telecom, aerospace and defense, transportation, industrial automation

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What we do

- Develop implementations of OMG open standards
  - Open source; TAO, CIAO, R2CORBA
  - Commercial; TAOX11, AXCIOMA
- Deliver services related to OMG standards including CORBA, CCM, DDS
- Deliver services for specific implementations, including RTI Connext DDS
- Develop open standards as part of the OMG

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Component Based DDS

- DDS is a great technology but
  - It provides a messaging protocol, not a complete architecture
  - Provides a lot of freedom to the developer which can lead to misuse
  - Lots of things are left to the application like deployment and threading model design
  - Vendor portability can be a challenge
  - No vendor support for the IDL to C++11 language mapping

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CBDDS Standards

- CBDDS combines eleven OMG standards into a comprehensive software suite
  - IDL4, IDL2C++11
  - CORBA
  - DDS, DDS X-Types, DDS Security, RPC4DDS
  - LwCCM, DDS4CCM, AMI4CCM
  - D&C

CBDDS Principles

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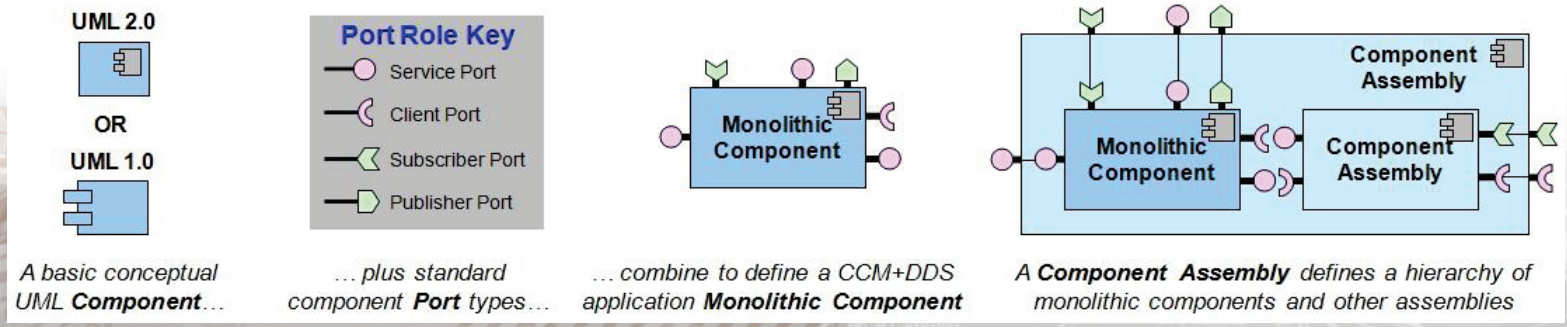
- Interoperable Open Architecture (IOA)
- Component Based Architecture (CBA)
- Service Oriented Architecture (SOA)
- Event Driven Architecture (EDA)
- Model Driven Architecture (MDA)

What is a Component?

- Independent revisable unit of software with well defined interfaces called “ports”
- Able to be packaged as an independent deployable set of files
- Smallest decomposable unit that defines standard ports is a “monolithic component”
- A “component assembly” is an aggregation of monolithic components or other component assemblies



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Why Component Based Development?

- Modularity
- Reuse
- Interoperability
- Extensibility
- Scalability
- Reduced Complexity
- Faster and Cheaper Development
- Quality and Reliability
- Deployability

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Interaction Patterns

- CBDDS uses so called interaction patterns to define the interaction between user components
- CBDDS defines request/reply, state, and event interaction patterns
- An interaction pattern is realized at deployment time using a specific communication middleware, legacy system, or hardware

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Request/Reply Interaction Pattern

- Support for synchronous and asynchronous invocations
- Delivered with a function style API
- Defined in IDL using operations with arguments and an optional return value
- The application code that uses this interaction pattern is unaware of how the interaction pattern is realized

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Event Interaction Pattern

- The event interaction pattern defines extended ports for the following roles
  - Basic many-to-many publish subscribe messaging
  - Event distribution with optional user defined data

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State Interaction Pattern

- The state interaction pattern defines extended ports for the following roles
  - Distributed state management and access
  - Distributed database functionality with eventual consistency

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Deployment

- CBDDS also includes deployment tooling
- Supports single process, single node, and distributed deployments
- Applications can be deployed using a deployment plan
- Which DDS QoS is used is a deployment decision, not hardcoded into the business logic
- Various options to define a deployment plan

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IDL to C++11

- IDL to C++11 is a formal OMG standard that greatly simplifies the development of IDL based applications
- Reuse as much as possible from the C++11 standard
  - Standard basic types
  - Uses STL containers like std::string, std::vector, std::array
  - Uses C++11 move semantics to provide a safe and fast API
- Standardized IDL::traits<T> to simplify template programming
- Automatic reference counting by using std::shared_ptr and std::weak_ptr semantics
- No new/delete and no plain C++ pointers!

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The Technical Side

- CBDDS with C++11 is implemented as part of our AXCIOMA product
- Component related glue code is generated by our Ruby based IDL compiler
  - No dependency on remote CORBA support, all local interfaces
- C++11 representation of the user defined types, including all types that are used for DDS communication
- But, no DDS vendor supports the IDL to C++11 language mapping out of the box

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C++11 to C++ Conversion Framework

- Based on the user defined IDL types, an implied IDL definition is generated by RIDLC
  - This implied IDL definition is passed to rtiddsgen
- RIDLC generates a set of conversion traits to convert between the RTI C++ type definition and the C++11 type definition
  - By using C++11 move semantics this is in most cases just a move of memory, no copy!
- C++11 representation of the DDS entities uses the RTI C++ representation and the conversion traits
- At the moment RTI supports IDL to C++11 the conversion traits will expand to nothing!

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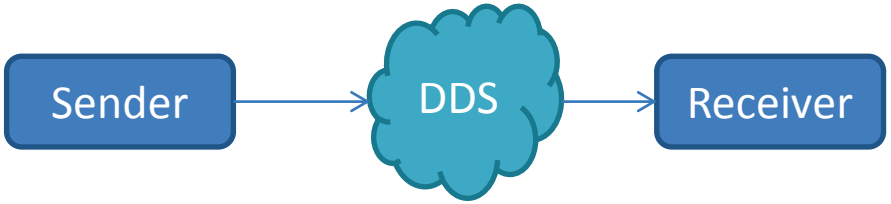
Some Code!




```
// Sender component class which publishes one sample to DDS
class Sender_i : public IDL::traits<Sender>::base_type
{
public:
  // Register an instance to DDS
  virtual void configuration_complete () override {
    IDL::traits<Shapes::ShapeType_conn::Writer>::ref_type writer =
      context_->get_connection_info_write_data();
    instance_handle_ = writer->register_instance (square_);
  }
  // Write one sample to DDS
  virtual void ccm_activate () override {
    IDL::traits<Shapes::ShapeType_conn::Writer>::ref_type writer =
      context_->get_connection_info_write_data();
    writer->write_one (square_, instance_handle_);
  }
private:
DDS::InstanceHandle_t instance_handle_;
  // Use C++11 uniform initialization to initialize the member
  ShapeType square {"GREEN", 10, 10, 1};
};
```

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Receiver Code (1)

```
// Receiver component which receives the samples from DDS
class Receiver_i : public IDL::traits<Receiver>::base_type
{
public:
virtual void configuration_complete () override {}
  // We want sample by sample
  virtual void ccm_activate () override {
    IDL::traits<CCM_DDS::DataListenerControl>::ref_type lc =
      context_->get_connection_info_data_control();
    lc->mode (CCM_DDS::ListenerMode::ONE_BY_ONE);
  }
private:
  IDL::traits<Shapes::CCM_Sender_Context>::ref_type context_;
  IDL::traits<Shapes::ShapeType_conn::CCM_Listener>::ref_type
   data_listener_;
};
```

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Receiver Code (2)

```
// Receive the sample from DDS and just dump it to the console
class info_out_i: public
    IDL::traits<Shapes::ShapeType_conn::CCM_Listener>::base_type
{
public:
  // Sample has been received by DDS
  virtual void on_one_data (const ShapeType& shape,
   CCM_DDS::ReadInfo&) override {
    std::cout << "Received " << shape << std::endl;
  }
private:
  IDL::traits<Shapes::CCM_Sender_Context>::ref_type context_;
};
```

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Ruby to DDS

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Ruby to DDS

- Ruby is a powerful scripting language
- Integrated part of the Ruby on Rails framework for developing web based applications
- R2CORBA makes it possible to use and provide CORBA functionality using Ruby
- R2DDS is a prototype developed by Remedy IT to use DDS from Ruby
- Push data from DDS to the web browser using Ruby on Rails
- Currently generates C++ code based on the IDL type definition, could potentially use Dynamic Data in the future

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Some Ruby DDS Code

```
// Create all needed DDS entities (without QoS for simplicity)
dfp = DDS.DomainParticipantFactory_init()
dp = dfp.create_participant()
topic = dp.create_topic()
pub = dp.create_publisher()
sub = dp.create_subscriber()
dw = pub.create_datawriter(topic)
dr = sub.create_datareader(topic, listener)

// Create an ORANGE shape and publish it 10 times with increasing
// size and position
shape = ShapeType.new("ORANGE", 10, 10, 10)
$i = 1
while $i <= 10  do
  dw.write(shape)
  shape.shapesize = $i * 10
  shape.x = $i * 10
  shape.y = $i * 10
  $i=$i+1
  sleep(1)
end
```

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Ruby DDS listener Code

```
// Define a new Listener that prints the received shape to the
// console
class ShapeListener < DDS::DataReaderListener
  def initialize()
  end

  def on_data_available(reader)
    shape = ShapeType.new()
    reader.read (shape);
    puts "Read sample #{shape.color()} #{shape.x()} #{shape.y()}
   #{shape.shapesize()}";
  end
end

// Create an instance and create a new DDS datareader with this
// listener
listener = ShapeListener.new()
dr = sub.create_datareader(topic, listener)
```

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Questions?

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Want to know more?

- Let us meet here at the RTI London Connext Conference 2014!
- See our website at http://www.remedy.nl
- Check our slideshare presentations at http://www.slideshare.net/RemedyIT
- Email me at jwillemsen@remedy.nl
- Call us at +31-10-5220139
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