

# Conformance Testing

of open interfaces in  
healthcare applications

- case context management

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# In this presentation

- ✍ Introduction
- ✍ Software testing vs. conformance testing of open interfaces
- ✍ Interface specifications
  - ✍ Case context management
- ✍ Conformance testing model developed and used in the PlugIT project
  - ✍ Phases of the model
  - ✍ Test case example
- ✍ Challenges in conformance testing



# Motivation

- ✍ Number of information systems and integration needs is large in healthcare organizations
  - ✍ For example, more than 180 information systems in Kuopio University Hospital in Finland
- ✍ At the moment, new systems are integrated to existing ones by tailoring
- ✍ If the systems have open, standard-based interfaces their interoperability improves and less local adaptation work is needed ->
  - ✍ Standard-based interfaces
  - ✍ Conformance testing



# Definitions (by ISO)

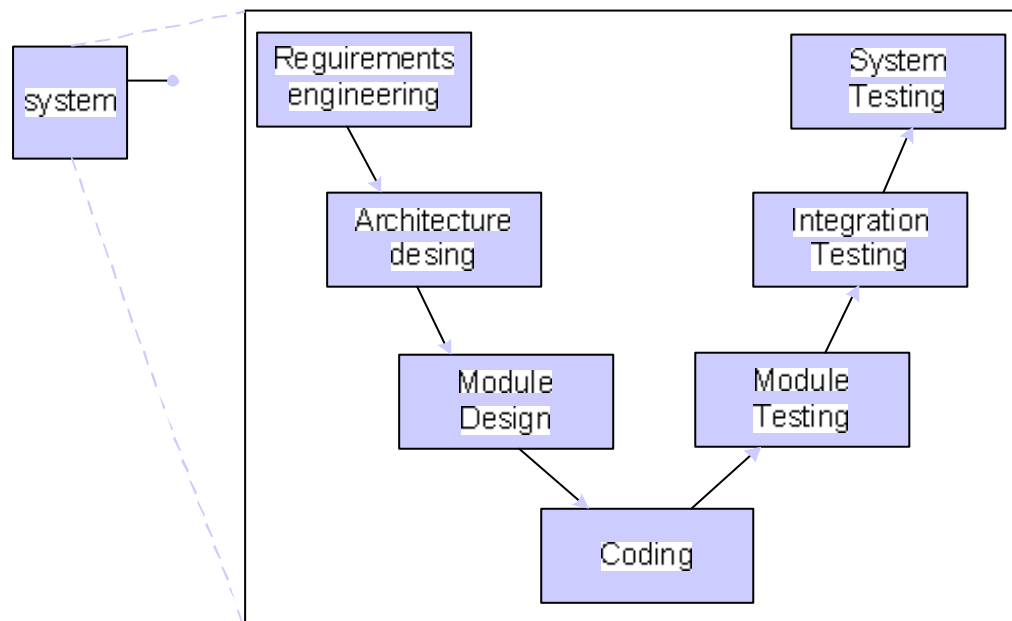
- ✍ Conformance = fulfilment of a product, process or service of specified requirements
- ✍ Conformance clause = a section of a specification that states all the requirements or criteria that must be satisfied to claim conformance



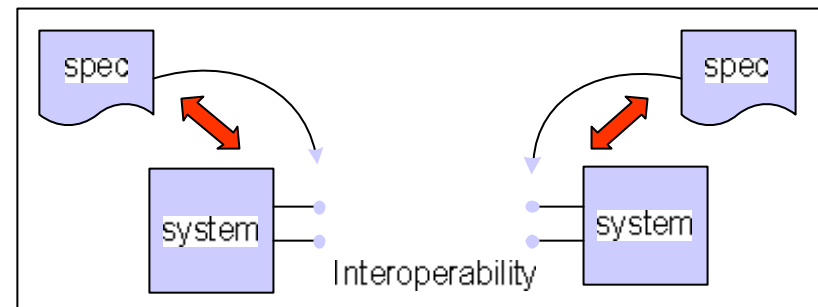
# Definitions (by ISO)

- ✍ Conformance testing = a way to verify implementations of a specification to determine whether or not deviations from the specifications exists
  - ✍ Internal structure of the product under test not accessible (black box testing)
  - ✍ Necessary, but not sufficient for interoperability

# Software testing vs. conformance testing



Software Testing



Conformance Testing

Note: Conformance testing can't be used as verification. It only increases the probability that systems are implemented correctly.



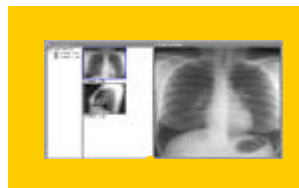
# Interface specifications

- ✍ CCOW (Clinical Context Object Workgroup) standard in context management
  - ✍ Allows information in separate healthcare applications to be synchronized so that each individual application is referring to the same patient, encounter or user
  - ✍ Too extensive, complex and expensive
- ✍ In PlugIT project Minimum level specification of CCOW was developed
  - ✍ Only the most essential and worthwhile parts (i.e. user and patient context management)

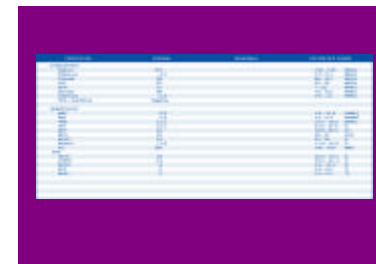
# Context Management

Application B

Application A



Application C



CCOW

CCOW

Context Manager

Mapping Agent

Annotation Agent

Morwood, 2001

Tanja Toroi

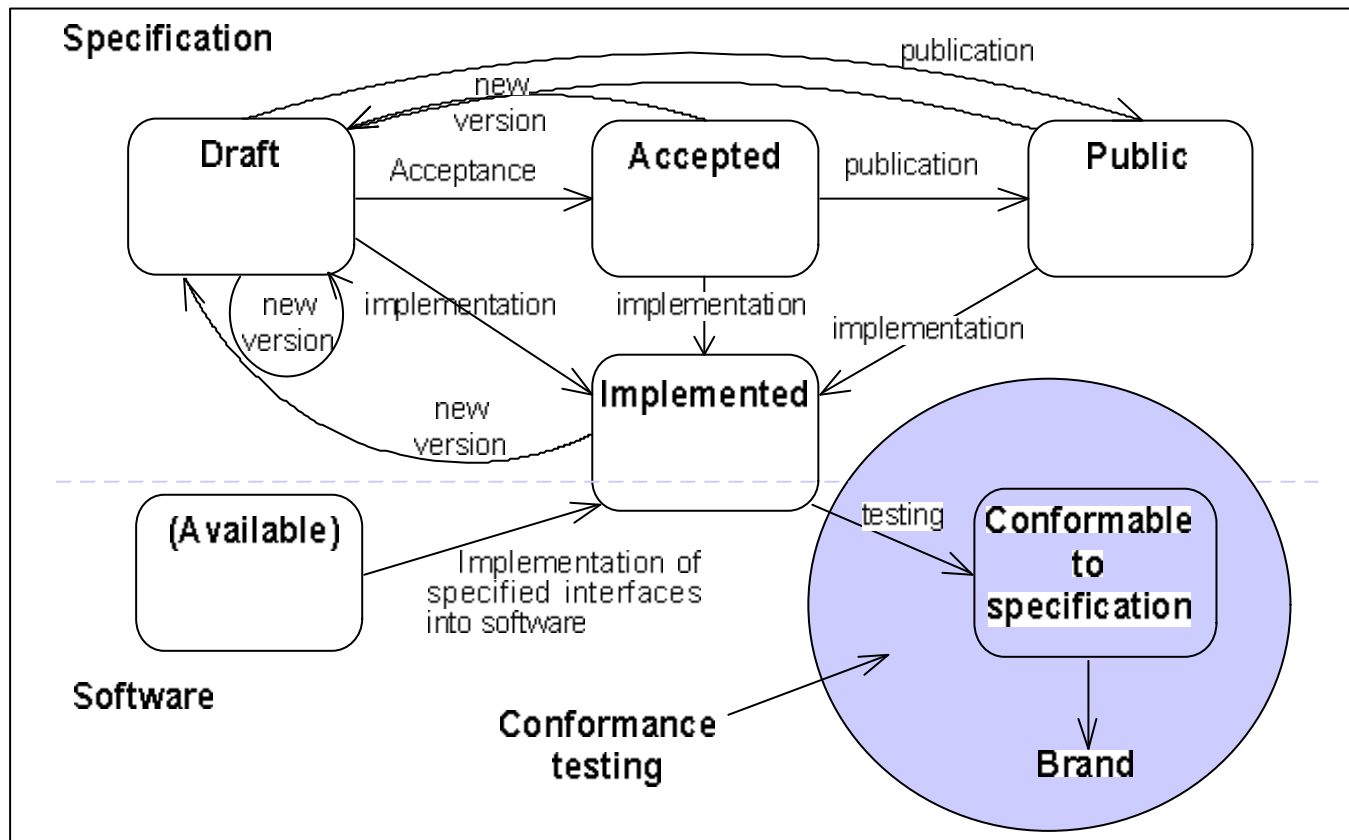




# The basic context management operations

- ✍ A client application **joins** the context management
- ✍ The client application **asks** a user context
- ✍ The client application **asks** a patient context
- ✍ The client application **changes** the patient
- ✍ The client application **updates** the patient context
- ✍ The client application **leaves** the context

# Relationship between specification and software

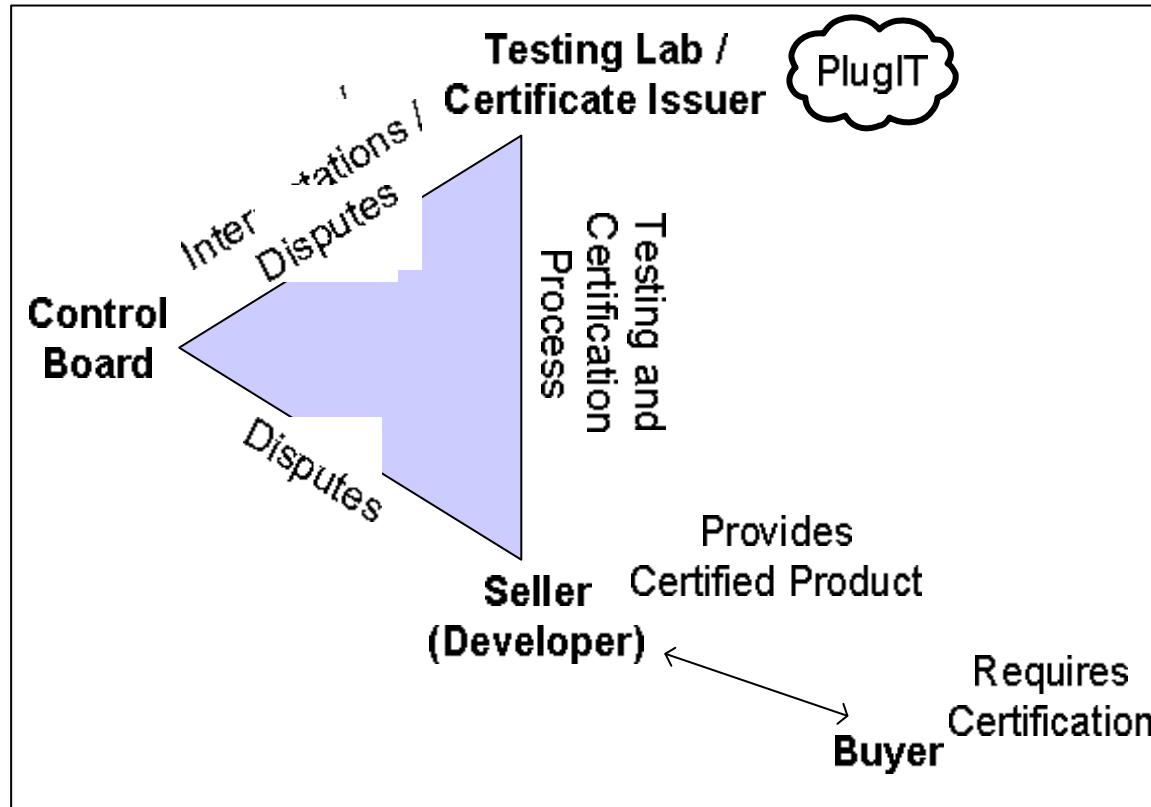




# Brand (certificate)

- ✍ Brand means that
  - ✍ The product has passed the conformance testing process of the open interface specifications
  - ✍ Product is supported by adequate documentation
- ✍ Includes the following information:
  - ✍ Software product and version
  - ✍ Interface specification and version
  - ✍ The level of conformance
  - ✍ Date and signatures

# Interaction among roles and activities



Interaction among roles and activities in conformance testing model in the PlugIT project (Adapted from Carnahan)



# Conformance testing model

✍ The model has been developed and evaluated with co-operation of healthcare software companies and hospital districts


✍ Phases of the model:

1. Initial phase
2. Testing performed by the developer
3. Testing performed by the testing lab
4. Brand issuing



# 1. Initial phase

- ✍ Developer informs the testing lab/certificate issuer that the integration solution is implemented into the product
- ✍ Must be defined
  - ✍ Product version,
  - ✍ Interface specifications and the level of conformance,
  - ✍ Contact person
- ✍ Product interoperability description of the implementation to the testing lab
  - ✍ concerning interoperability, integration, and introduction



## 2. Testing performed by the developer

- ✍ Assure conformance and to fix failures before applying for the brand
- ✍ Developer tests the product with test cases received from the testing lab and with own test cases
- ✍ Only the interfaces in the specification are tested
- ✍ Reference implementation of the context management server



# 3. Testing performed by the testing lab

- ✍ The aim

  - ✍ Complement testing

  - ✍ Ensure conformance to the specification

  - ✍ Make sure that the implementation is functioning in practice

- ✍ Testing the product together with the other "branded" products

- ✍ Testing passed -> test report

- ✍ PlugIT project = testing lab and certificate issuer





## 4. Brand issuing

- ✍ All the tests have been passed and the documentation is adequate
- ✍ The certificate issuer issues the brand and delivers it to the contact person of the developer
- ✍ Test reports are made public and published on the project's website

# Example of test cases

Definition:	Client application joins the context management.
Precond.:	Application name must be accepted and another application has not joined the context with the same application name.
Input:	<code>http://193.167.225.119/cm.pp?interface=ContextManager&amp;method=JoinCommonContext&amp;applicationName&gt;LoginMaster</code>
Output:	<code>participantCoupon=11900200</code>
Pass/Fail:	

`http://url.fi/cm?interface=ContextManager&method=JoinCommonContext&param=...`





# Present state of the model

- ✍ Developed and evaluated with co-operation of several healthcare software companies and hospital districts
- ✍ At the moment conformance testing is performed against the minimum level context management specification
- ✍ Several commercial implementations of the context manager
- ✍ One brand has been issued



# Challenges in conformance testing

- ✍ Software product versions in a rapid cycles
- ✍ Test data
- ✍ A standard way of identifying and classifying parameters for test case definitions is needed
- ✍ How to get software customers to demand certified and interoperable software products?
- ✍ Standards are only one part of the interoperability
- ✍ Conformance testing in future, who will issue brands?



# Future work

- ✍ Further development of test cases and test methods
- ✍ Study related work
  - ✍ AHML, NIST, IHE, HL7 Conformance SIG...
- ✍ Survey: How to arrange conformance testing in Finland
- ✍ The model will be further elaborated in Open Integration Testing Environment project (2004-2006)



# Open Integration Testing Environment - Why?

- ✍ Health Information Systems
- ✍ Distributed systems
- ✍ Interoperability of systems is important
- ✍ Individual applications and regional information systems need testing environments in order to
  - ✍ test conformance of open interfaces
  - ✍ develop interoperability between systems
  - ✍ increase probability that products are implemented correctly



# Open Integration Testing Environment - Goals

- ✍ Develop common methods and practices in testing
- ✍ Test system integration, interfaces and their conformance to the specification in Health Information Systems
- ✍ Specify and develop testing services:
  - ✍ web-based testing service specification for regional healthcare systems
  - ✍ testing service for context management and common services against PlugIT and HL7 specifications
- ✍ Gather a common test data library with standard testing material (patient scenarios)

# Open Integration Testing Environment - Organisation

- ✍ VTT / Information Technology (Technical Research Centre of Finland), in Tampere
- ✍ University of Kuopio
  - ✍ Software Engineering,
  - ✍ HIS R&D Unit, and
  - ✍ Shiftec
- ✍ Prime Solutions Ltd., in Vantaa
- ✍ Duration: 09 / 2004 – 04 / 2006
- ✍ Tekes grant no. 40449/04







# Thank You!

✍ Do you have any questions?

✍ Contact: [Tanja.Toroi@cs.uku.fi](mailto:Tanja.Toroi@cs.uku.fi)