Generation of Distributed System Test-beds from High-level Software Architecture Descriptions

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ASE 2001
Outline

- Motivation
- Our Approach
- Modelling architectures with SoftArch/MTE
- Generating test-bed code, deployment files etc
- Visualising performance results
- Experiences with SoftArch/MTE
- Future work directions
Motivation

- Distributed system performance evaluation
- Complexity: new software architectures; middleware; database management; UI technology
- How do we evaluate DS performance???
  - Rapid prototyping
  - Software architecture-based simulation
  - Existing system evaluation

- Bottom line: its HARD/time-consuming...
Example...

- On-line video system
- Search for videos
- Rent/return videos
- Maintain data

**Choices:**
- Architectures
- Middleware/DBs/UIs
Our Approach...

1. High-level architecture designs

2. Generate XML-encoded architecture design

3. Run XSLT transformation scripts

4. Generate code, IDLs, deployment info, etc

5. Compile & upload to multiple host machines

6. Run tests & send results to SoftArch/MTE for visualisation

(rest is automated...)
Modelling Architectures in SoftArch/MTE

Meta-model: client, server, request, service, DB etc

For RMI, CORBA, EJBs

Use MM abstractions in visual architectural models
Code Generation

- Model architecture using SoftArch/MTE visual language
- XML encoding of architecture generated
- XSLT scripts used to generate .java, .bat, .xml etc files (see examples in paper...)

SoftArch/MTE model/meta-model → SoftArch/MTE

XML-encoded architecture → Xalan XSLT engine

Compiled Code etc

XSLT transforms → Compiled Code etc

Source code; IDLs; scripts; ...

Compilers (idlj/c; javac; g++; ...)
XSLT Example

**Client_ClientTest.xml**

```xml
<?xml version="1.0" encoding="UTF-8" ?>
<Client>
  <Name>ClientTest</Name>
  <Hosts>LocalHost</Hosts>
  <Threads>1</Threads>
  <Request>
    <Type>CorbaRequest</Type>
    <Name>findVideo</Name>
    <RemoteObject>VideoManager</RemoteObject>
    <TimesToCall>10</TimesToCall>
    <RecordTime>yes</RecordTime>
  </Request>
  <Request>
    <Name>rentVideo</Name>
    <Type>CorbaRequest</Type>
    <RemoteObject>VideoManager</RemoteObject>
    <TimesToCall>4</TimesToCall>
    <RecordTime>yes</RecordTime>
  </Request>
</Client>
```

**ClientTest.java**

```java
public class ClientTest {
  ...

  public static void findVideo(VideoManager server) {
    int iter = 10;
    String name = "findVideo";
    String recordTime = "yes";
    System.gc();
    long start = System.currentTimeMillis();
    int i = 0;
    while (i != iter) {
      server.findVideo_service();
      i++;
    }
    if (recordTime.equals("yes")) {
      long time = System.currentTimeMillis() - start;
      double elapse = (double) (time) / (double) (Math.max(1, iter));
      String perf = name + "\t" + time + "\t" + iter + "\t" + elapse;
      System.out.println(perf);
      System.err.println(perf);
    }
  }
```

**Corba_client.xsl**

```xml
<xsl:template match="Request[Type='CorbaRequest']">
  public static void <xsl:value-of select="Name"/>
  (<xsl:value-of select="RemoteObject"/> server){
    int iter = <xsl:value-of select="TimesToCall"/>;
    String name = <xsl:value-of select="Name"/>
    String recordTime = <xsl:value-of select="RecordTime"/>
    System.gc();
    long start = System.currentTimeMillis();
    int i = 0;
    while(i != iter){
      server.<xsl:value-of select="Name"/>_service();
      i++;
    }
    if(recordTime.equals("yes")){
      long time = System.currentTimeMillis() - start;
      double elapse = (double) (time) / (double) (Math.max(1, iter));
      String perf = name + "\t" + time + "\t" + iter + "\t" + elapse;
      System.out.println(perf);
      System.err.println(perf);
    }
  }
```

Running Performance Tests and Viewing Results

- Upload code to hosts (clients and servers)
- Deploy (EJBs)
- Start (RMI, CORBA)
- Run clients
- Results sent back to SoftArch/MTE
- Results displayed

Diagram:
- Generated scripts
- Source Code
- Compilers
- Compiled Code
- Remote Deployment Agent
- Running client/server
- Performance Results
- Remote Hosts
- SoftArch/MTE
- MS Excel
Viewing Performance Results...
Other Architecture Examples...

<<GET FROM Yuhong...>>
Experiences...

- Generates 2-, 3-, 4-tier architectures
- Analysed several systems e.g. video, travel system, workflow system
- Very efficient way of obtaining useful performance measures of software architecture+middleware performance
- Figuring out reasons for performance can be hard!
- Hampered by ability of designers to accurately “guess” likely request mixes etc; availability of hosts to run on (threading OK but skews results)
- Need to use throughout development of systems
Conclusions/Future Work

- SoftArch/MTE demonstrates one-button generate/compile/deploy/run/capture/visualise complex architecture performance feasible
- Provides effective, efficient automated performance testing suite
- P2P architectures; HTTP/WAP, .NET middleware
- Incorporate SoftArch/MTE usage in design process
- Improvements to visualisation of performance
- **Solving** performance problems still hard! 😊
References