

CMG'12

Load Testing: See a Bigger Picture

Paper 1112
Session 542

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Agenda

- *Load testing and its role in performance risk mitigation*
- Different approaches: load generation
- Different approaches: environments
- Load testing tools

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Load Testing: Terminology

Applying multi-user synthetic load to the system

- Load testing
- Performance testing
- Stress testing
- Scalability testing
- Volume testing
- Reliability testing
- Concurrency testing
- Endurance testing
- Longevity testing
- Soak testing
- Stability testing

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The Stereotype

- Load / Performance Testing is:
 - Last moment before deployment
 - Last step in the waterfall process
 - Protocol Level Record-and-Playback
 - Large corporations
 - Expensive tools requiring special skills
 - Lab environment
 - Scale-down environment
 - ...

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The Stereotype

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Load Testing

- **It is only one very specific kind of load testing**
 - Most popular due to easier integration in corporate SDLC
- **But load testing in no way limited to this one**
 - Technology evaluation
 - Infrastructure evaluation
 - Prototypes / POC
 - Component / unit
 - What/if
 - Performance troubleshooting
 - Performance optimization
 - Benchmarking

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Performance Risk Mitigation

- **Single-user performance engineering**
 - Profiling, WPO, single-user performance
- **Software Performance Engineering**
 - Modeling, Performance Patterns
- **Instrumentation / APM / Monitoring**
 - Production system insights
- **Capacity Planning/Management**
 - Resources Allocation
- **Continuous Integration / Deployment**
 - Ability to deploy and remove changes quickly

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**But all of them
don't replace
load testing**

**Load testing
complements
them in several
important ways**

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What Load Testing Adds

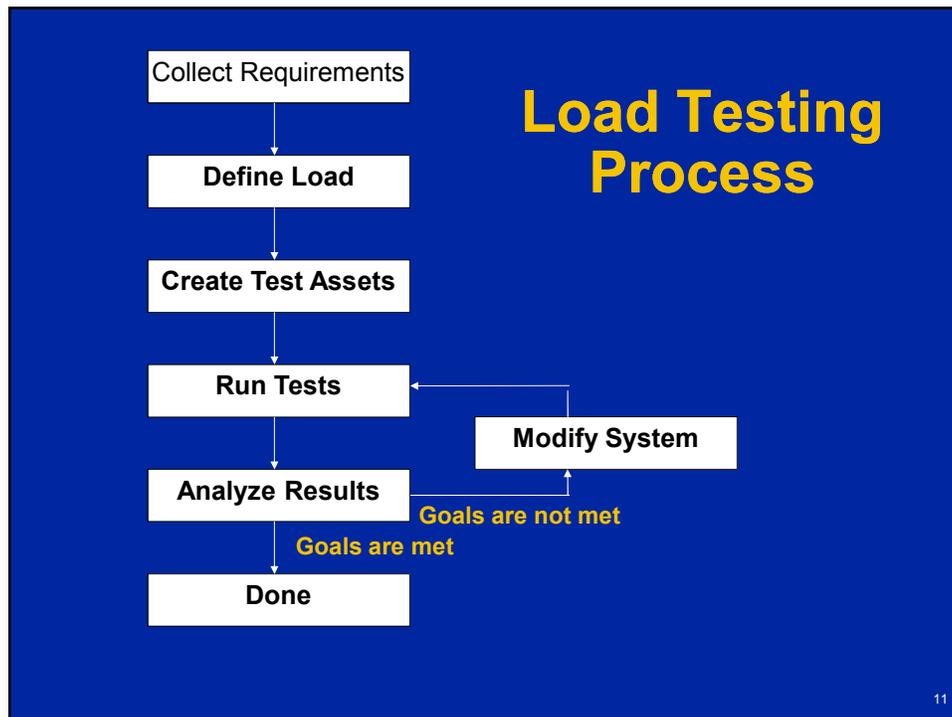
- Verification that the system handles the load
- Verification of multi-user performance
- Performance optimization
 - Exactly the same load
- Debugging/verification of multi-user issues
- Testing self-regulation functionality
 - Such as auto-scaling or changing the level of service depending on load

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- Load testing and its role in performance risk mitigation
- *Different approaches: load generation*
- Different approaches: environments
- Load testing tools

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Load Generation

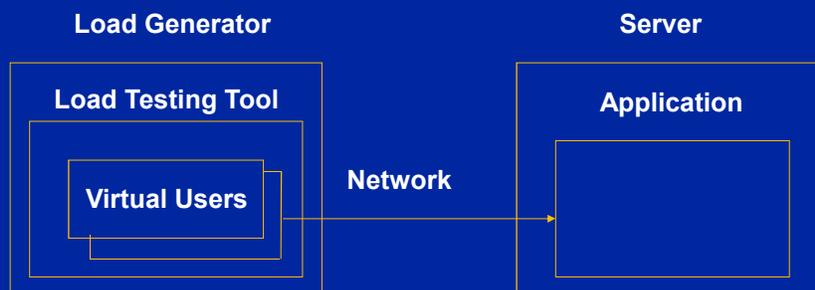
- Create tests assets – run test
- A must step in load testing
- ‘Tests assets’ - usually scripts or programs in load testing
- Time constraints can make it very challenging
 - Different for each product / interface

Record and Playback: Protocol Level

- **Virtual users: record communication between two tiers and then playback an automatically created script**
- **Usually after proper correlation / parameterization**

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Record and Playback: Protocol Level



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Issues

- Usually doesn't work for testing components
- Each tool support a limited number of technologies (protocols)
- Some technologies are very time-consuming
- Workload validity in case of sophisticated logic on the client side is not guaranteed

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Recalling Challenges

- 199x – SMB (Server Message Block), DCOM, Java RMI
- 200x – Applets and ActiveX controls
- 201x – Rich Internet Applications

It was just a short period of time when Web sites were simple – it was rather an exception

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Not so Simple: Example

- **Back-end calculation (Financial consolidation)**
 - Long time, shows progress bar
 - Polling back-end
 - Explicit loop is needed to work properly

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Recorded Script

```
web_custom_request("XMLDataGrid.asp_7","URL={URL}/  
Data/XMLDataGrid.asp?Action=EXECUTE&TaskID=1024  
&RowStart=1&ColStart=2&RowEnd=1&ColEnd=2&SelTy  
pe=0&Format=JavaScript", LAST);  
web_custom_request("XMLDataGrid.asp_8","URL={URL}/  
Data/XMLDataGrid.asp?Action=GETCONSOLSTATUS",  
LAST);  
web_custom_request("XMLDataGrid.asp_9","URL={URL}/  
Data/XMLDataGrid.asp?Action=GETCONSOLSTATUS",  
LAST);  
web_custom_request("XMLDataGrid.asp_9","URL={URL}/  
Data/XMLDataGrid.asp?Action=GETCONSOLSTATUS",  
LAST);
```

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Working Script

```
web_custom_request("XMLDataGrid.asp_7","URL={URL}/  
Data/XMLDataGrid.asp?Action=EXECUTE&TaskID=1024  
&RowStart=1&ColStart=2&RowEnd=1&ColEnd=2&SelTy  
pe=0&Format=JavaScript", LAST);  
do {  
  sleep(3000);  
  web_reg_find("Text=1","SaveCount=abc_count",LAST);  
  web_custom_request("XMLDataGrid.asp_8","URL={UR  
L}/Data/XMLDataGrid.asp?Action=GETCONSOLSTATU  
S", LAST);  
} while (strcmp(lr_eval_string("{abc_count}"),"1")==0);
```

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Alternatives

- Manual
- Record and Playback, UI-Level
- Programming
- Mixed

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Manual

- Not an option for a large number of users
- Always variation in human input times
- Can be a good option to simulate quickly a few users
- Can be used with other methods to verify correctness

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Record and Playback: UI Level

- Functional / regression testing tools
- Record and playback communication between user and client GUI
- Don't care about communication protocols / internals
- Accurate data (real client, end-to-end)

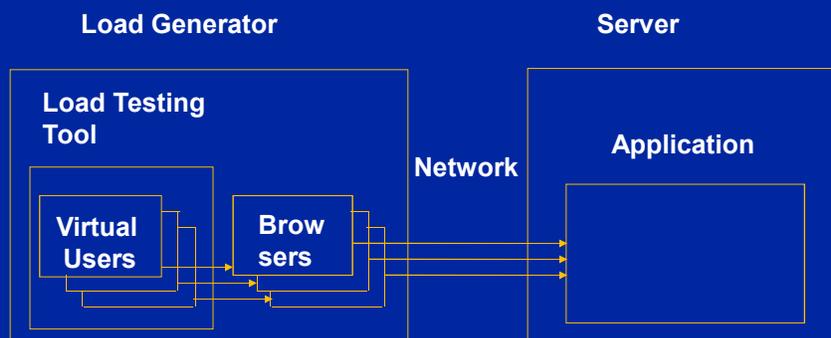
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History of the Approach

- **Traditional tools, fat clients**
 - Require a separate machine (or at least terminal session per user)
- **Low-level graphical protocols**
 - Citrix, Remote Desktop
- **Web tools, browser**
 - Require a separate browser instance
- **Web tools, light-weight browser**
 - Require a separate light-weight browser instance
 - For example, HtmlUnit or PhantomJS

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Record and Playback: UI Level



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Challenges

- **Scalability**
 - Still require more resources
- **Supported technologies**
- **Timing accuracy**
- **Playback accuracy**
 - For example, for HtmlUnit

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Programming: Custom Test Harness

- **Special program to generate workload**
- **Requires access to the API or source code**
- **Requires programming**
- **Could be cost effective solution in some simple cases**

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Advantages

- Doesn't require any special tool
- Starting version could be quickly created by a programmer familiar with API
- Should work if API works
- You don't care what protocol is used for communication

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Disadvantages

- Efforts to update and maintain harness increase drastically as you need to add features
- When you have numerous products you really need to create something like a commercial load testing tool

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Mixed Approach

- **Programming using load testing tools**
 - Program a script instead of recording
 - Run it using a load testing tool
- **Implementation depends on the particular tool**
 - Scripting support
 - Supporting languages
 - API calls (may require external dll / client stubs)

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Advantages

- **Eliminates dependency on supporting specific protocols**
- **Leverages all the features of the load testing tool and allows using it as a test harness**
- **Sometimes simplifies work with difficult to parameterize protocols**

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Considerations

- Requires access to API or source code
- Requires programming
- Minimal transaction that could be measured is a request / API call
- Requires understanding of internals

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More Considerations

- Requires a load test tool license for the necessary number of users
- Environment may need to be set on all agents
- May require more resources on agents
- Results should be cautiously interpreted

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Example 1: Essbase Query

- Multi-Dimensional Database
- C API
 - Used by many applications and middleware
 - Winsock scripts
- Quite difficult to parameterize and verify
- External DLL was made for major functions

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Winsock Script

```
lrs_create_socket("socket0", "TCP", "LocalHost=0",  
"RemoteHost=ess001.hyperion.com:1423",  
LrsLastArg);  
lrs_send("socket0", "buf0", LrsLastArg);  
lrs_receive("socket0", "buf1", LrsLastArg);  
lrs_send("socket0", "buf2", LrsLastArg);  
lrs_receive("socket0", "buf3", LrsLastArg);  
lrs_save_searched_string("socket0",  
LRS_LAST_RECEIVED, "Handle1",  
"LB/BIN=\\x00\\x00\\v\\x00\\x04\\x00",  
"RB/BIN=\\x04\\x00\\x06\\x00\\x06", 1, 0, -1);  
lrs_send("socket0", "buf4", LrsLastArg);  
lrs_receive("socket0", "buf5", LrsLastArg);  
lrs_close_socket("socket0");
```

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Winsock Script

```
send buf22 26165
"\xff\x00\xff0\xa"
"\x00\x00\x00\x00\x01\x00\x00\x00\x01\x00\x03\x00"
"d\x00\b\x00"
"y'<Handle1>\x00"
"\br\x00\x06\x00f\x00\x1be\x00\x00r\x00\xd6aRN"
"\x1a\x00\x06\x00\x00\x00\x00\x00\x00\x00\x00\x00\b"
"\x00\x00\x00\xe7\x00\x00\x01\x00\x03\x00\x04\x00"
"\x10\x00\xcc\x04\x05\x00\x04\x00\x80\xd0\x05\x00t"
"\x00\x02\x00\x02\x00\b\x00<\x00\x04"
"FY04aWorkingtYearTotaltELEMENT-FtProduct-P"
"\x10<entity>t\x00\x02\x00"
...
```

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Script Using External DLL

```
lr_load_dll("c:\\temp\\lr_msas2k.dll");
pCTX = Init_Context();
hr = Connect(pCTX, "ess01", "user001", "password");
...
lr_start_transaction("Mdx_q1");
sprintf(report, "SELECT %s.children on columns,
%s.children on rows FROM Shipment WHERE
([Measures].[Qty Shipped], %s, %s)",
lr_eval_string("{day}"), lr_eval_string("{product}"),
lr_eval_string("{customer}"),
lr_eval_string("{shipper}"));
hr = RunQuery(pCTX, report);
lr_end_transaction("Mdx_q1", LR_AUTO);
```

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Example 2: EDS

- Essbase Deployment Services
- Middleware, no GUI interface
- Test scripts in Java from the QA group
- Solution - creation of LoadRunner scripts from the test script

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EDS Java Script

```
import lrapi.lr;
import com.essbase.api.base.*;
import com.essbase.api.session.*;
...
public class Actions{
    public int init() {
        return 0;
    } //end of init
    public int action() {
        String s_username = "system";
        String s_password = "password";
```

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EDS Java Script

```
lr.enable_redirection(true);
try {
    lr.start_transaction("01_Create_API_instance");
        ess =
    IEssbase.Home.create(IEssbase.JAPI_VERSION);
    lr.end_transaction("01_Create_API_instance",
    lr.AUTO);
    lr.start_transaction("02_SignOn");
        IEssDomain dom = ess.signOn(s_userName,
    s_password, s_domainName, s_prefEesSvrName,
    s_orbType, s_port);
    lr.end_transaction("02_SignOn", lr.AUTO);
    ...
}
```

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- Different approaches: load generation
- Different approaches: environments
- Load testing tools

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Environments

- **Lab vs. Service (SaaS) vs. Cloud (IaaS)**
 - For both the SUT and load testing tool
- **Test vs. Production**
- **No best solution, depends on your goals / system**

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Scenarios

- **System validation for high load**
 - Outside load (service or cloud), production system
 - Wider scope, lower repeatability
- **Performance optimization / troubleshooting**
 - Isolated lab environment
 - Limited scope, high repeatability
- **Testing in Cloud**
 - Lowering costs (in case of periodic tests)
 - Limited scope, low repeatability

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Load Testing Tools

- Differ drastically
 - Supported approaches / protocols
 - Scripting / extendibility
 - Supported environments
 - Scalability
 - Integration
 - Result analysis
 - Environment monitoring
 - Cost/Licensing
 - Available support and skills

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Load Testing Tools

- There is no best tool – it depends on your needs
- Almost every tool will work for a simple web site
- If using more sophisticated technologies, always check if the tool / approach supports it

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Summary

- Load testing is an important way of performance risk mitigation / part of the performance engineering process
 - Other ways don't substitute load testing
- There are many ways to do load testing.
- There is no best approach or tool – it depends on your needs.

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Questions?

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*Links and references may be found in the paper
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