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ArcGIS Server Performance and Scalability—Testing Methodologies

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Introductions

- Who are we?
 - Enterprise implementation
- Target audience
 - GIS administrators
 - DBAs
 - Architects
 - Developers
 - Project managers
- Level
 - Intermediate

Please! Turn OFF cell phones and paging devices



Objectives

Performance engineering—concepts and best practices

Technical

- Solution performance factors
- Tuning techniques
- Performance testing
- Capacity planning
- Managerial
 - Skills
 - Level of effort
 - Risks
 - ROI

Agenda

Solution performance engineering

- Introduction
- Performance engineering in project phases
 - Requirements
 - Design
 - Lunch
 - Development
 - Deployment
 - Operation and maintenance

Performance, Scalability, and Capacity—Introduction

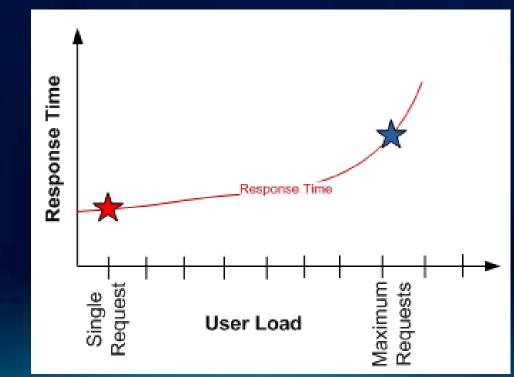
Performance Engineering

Benefits

- Lower costs
 - Optimal resource utilization
 - Less hardware and licenses
 - Higher scalability
- Higher user productivity
 - Better performance
- Reputation
 - User satisfaction

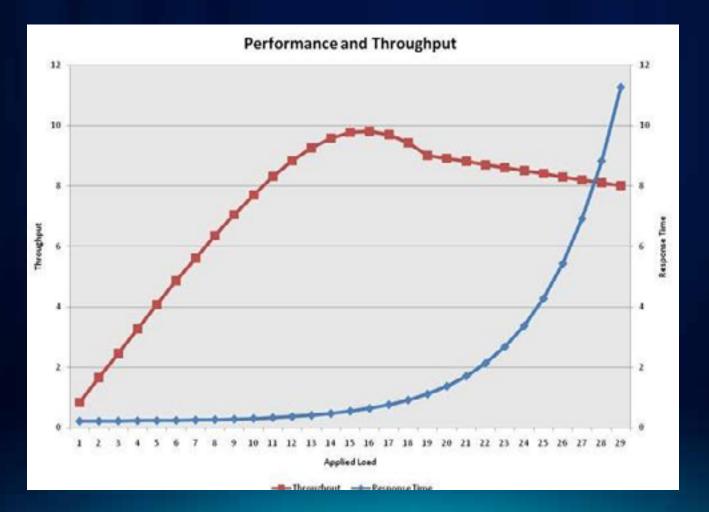
Performance and Scalability Definitions

- Performance: The speed at which a given operation occurs
- Scalability: The ability to maintain performance as load increases



Performance and Scalability Definitions

Throughput: The amount of work accomplished by the system in a given period of time



Performance and Scalability Definitions

Defining system capacity

- System capacity can be defined as a user load corresponding to
 - Maximum throughput
 - Threshold utilization, e.g., 80
 - SLA response time

Project Life Cycle Phase

Performance engineering applied at each step



Project Life Cycle Phase

Performance engineering applied at each step

- Requirements
 - Quality attributes, e.g., SLA
- Design
 - Performance factors, best practices, capacity planning
- Development
 - Performance and load testing
 - Tuning
- Deployment
 - Configuration, tuning, performance, and load testing
- Operation and maintenance
 - Tuning
 - Capacity validation

Performance Engineering —Solution Requirements

Requirements Phase

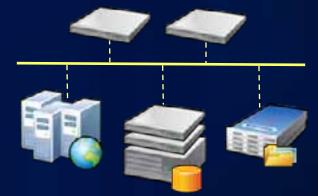
Performance engineering addresses quality attributes.

Functional Requirements



- Visualization
- Analysis
- Workflow Integration

Quality Attribute Requirements



- Availability
- Performance & Scalability
- Security

Requirements Phase

- Define System Functions
 - What are the functions that must be provided?
- Define System Attributes
 - Nonfunctional requirements should be explicitly defined.
- Risk Analysis
 - An assessment of requirements
 - Intervention step designed to prevent project failure
- Analyze/Profile Similar Systems
 - Design patterns
 - Performance ranges

Performance Engineering —Solution Design Phase

Design Phase

Selection of optimal technologies

- Meet functional and quality attributes.
- Consider costs and risks.
- Understand technology tradeoffs, e.g.:
 - Application patterns
 - Infrastructure constraints
 - Virtualization
 - Centralized vs. federated architecture

Design Phase

Performance Factors

Design, Configuration, Tuning, Testing

- Application
- GIS Services
- Hardware Resources

Application

- Type, e.g., mobile, web, desktop
- Stateless vs. state full (ADF)
- Design
 - Chattiness
 - Data access (feature service vs. map service)
- Output image format

Application Types

- Architecture
 - <u>resources.arcgis.com/content/enterprisegis</u> /10.0/architecture

Rich Client Applications



Desktop applications that operate in stand-alone, connected, and sometimes connected scenarios.



Web Applications

Browser-based applications that operate in connected scenarios and optionally leverage browser plug-ins.



Services

Standards-based service interfaces that support external applications and systems.



Mobile

Mobile applications that operate in stand-alone, connected, and sometimes connected scenarios.



Application Security

Security

resources.arcgis.com/content/enterprisegis /10.0/application_security

Strategy



View Esri's security strategy and discover GIS security patterns based on industry standards.

Principles Patterns Compliance

Mechanisms



Enterprise-wide security mechanisms that can be utilized across multiple applications.

Authentication Authorization Filters Encryption Logging

Application Security



Security options for specific Esri application architectures and products.

> Rich Client Applications Mobile Applications Services Web Applications

Design Phase—Performance Services

Application—Output image format

• PNG8/24/32

- Transparency support
- 24/32 good for antialiasing, rasters with many colors
- Lossless: Larger files (> disk space/bandwidth, longer downloads)

JPEG

- Basemap layers (no transparency support)
- Much smaller files

GIS Services

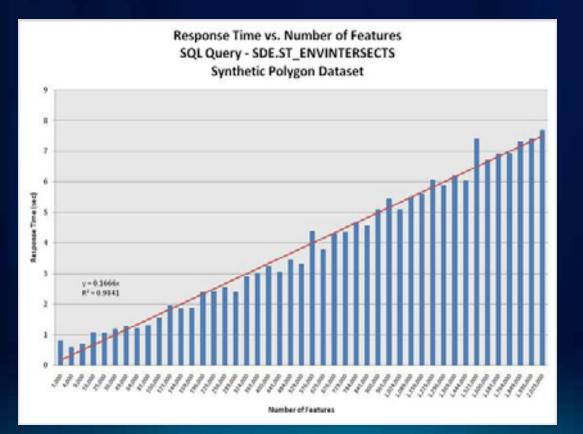
GIS Services—Map Service

Source document (MXD) optimizations

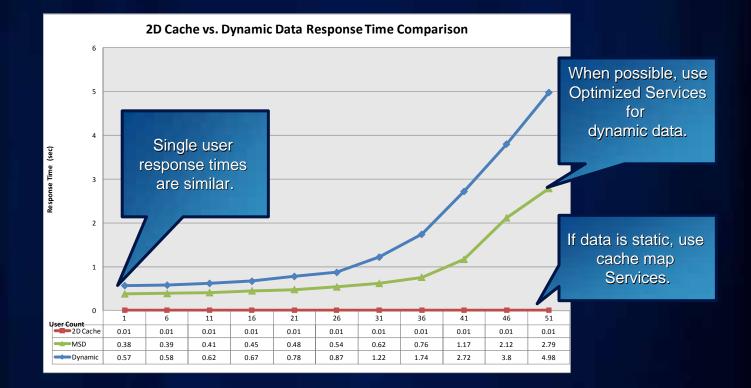
- Keep map symbols simple.
 - Avoid multilayer, calculation-dependent symbols.
 - Spatial index.
 - Avoid reprojections on the fly.
 - Optimize map text and labels for performance.
 - Use annotations.
 - Cost for Maplex and antialiasing.
 - Use fast joins (no cross db joins).
 - Avoid wavelet compression-based raster types (MrSid, JPEG2000).

GIS Services—Map service

Performance linearly related to number of features



Performance Test Cache vs. MSD vs. MXD

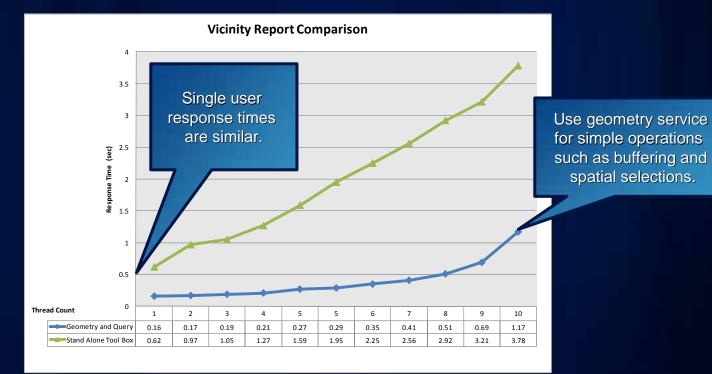


Cache map services use the least of hardware resources.

GIS Services—Geoprocessing

- Precompute intermediate steps when possible.
- Use local paths to data and resources.
- Avoid unneeded coordinate transformations.
- Add attribute indexes.
- Simplify data.

GIS Services—GP vs. Geometry



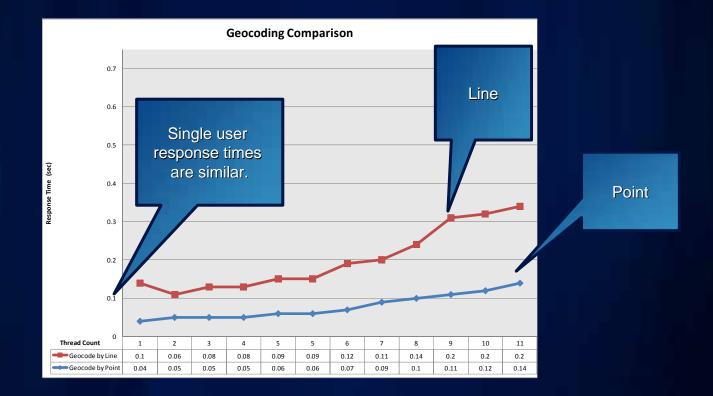
GIS Services—Image

- Tiled, JPEG compressed TIFF is the best (10–400% faster).
- Build pyramids for raster datasets and overviews for mosaic datasets.
- Tune mosaic dataset spatial index.
- Use JPGPNG request format in web and desktop clients.
 - Returns JPEG unless there are transparent pixels (best of both worlds).

GIS Services—Geocode

- Use local instead of UNC locator files.
- Services with large locators take a few minutes to warm up.
- New 10 Single Line Locators offer simplicity in address queries but might be slower than traditional point locators.

GIS Services—Geocode



GIS Services—Geodata

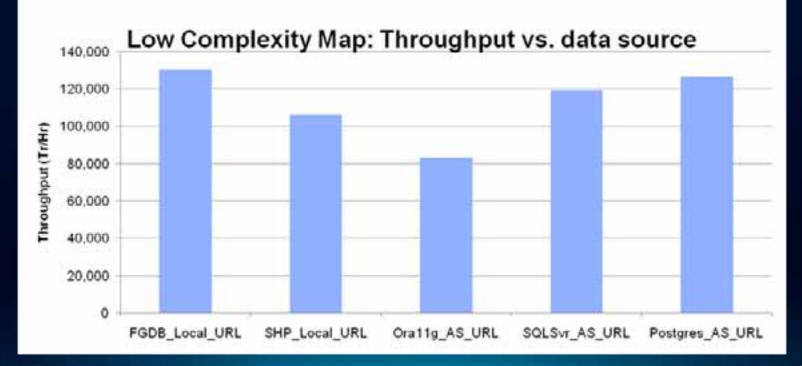
- Database Maintenance/Design
 - Keep versioning tree small, compress, schedule synchronizations, rebuild indexes and have a welldefined data model.
- Geodata Service Configuration
 - Server Object usage timeout (set larger than 10 min. default)
 - Upload/Download default IIS size limits (200 K upload/ 4 MB download)

GIS Services—Feature

 Trade-off between client-side rendering and sending large amounts of data over the wire

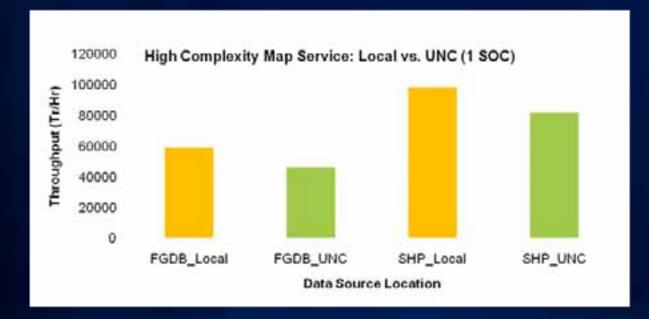
GIS Services—Data storage

- Typically a low impact
- Small fraction (< 20%) of total response time



GIS Services—Data source location

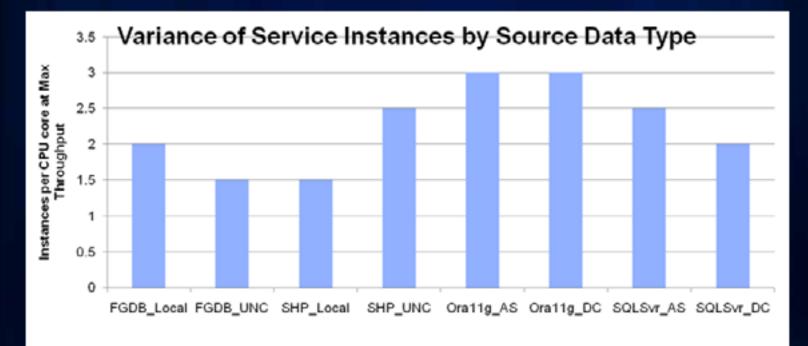
- Local to SOC machine
- UNC (protocol + network latency overhead)



All disks being equal, locally sourced data results in better throughput.

GIS Services—ArcSOC instances

ArcSOC Instances max = n * #CPU Cores n = 1 ... 4



If max SOC instances are underconfigured, system will not scale.

CPU Factors

- 1. User load: Concurrent users or throughput
- 2. Operation CPU service time (model)—performance
- 3. CPU SpecRate

$$\# CPU_{t} = \frac{ST_{b} \times TH_{t} \times 100}{3600 \times \% CPU_{t}} \times \frac{SpecRatePerCPU_{b}}{SpecRatePerCPU_{t}}$$

subscript t = target subscript b = benchmark ST = CPU service time TH = throughput %CPU = percent CPU

- Service time determined using a load test
- Capacity model expressed as Service Time



CPU

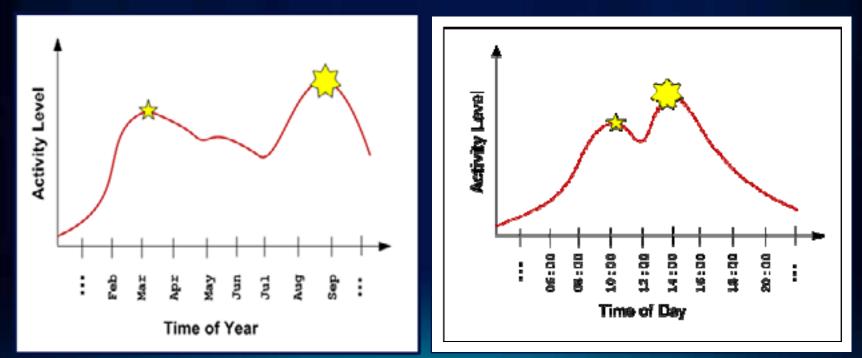
Dell Inc.	SPECint®_rate200	6 = Not Run	
PowerEdge 2950 (Intel Xeon processor X5355, 2.66 GHz)	SPECint_rate_base2006 = 80.9		
CPU2006 license: 55 Test sponsor: Dell Inc. Tested by: Dell Inc.	Test date: Hardware Availability: Software Availability:	Mar-2007 Dec-2006 Nov-2006	
Copies 0 10.0 25.0 40.0 55.0 70.0 85.0 100 110 120 400.perlbench 8 401.bzip2 8	130 140 150 160 170 180 143	190 200 22	

Additional Resources

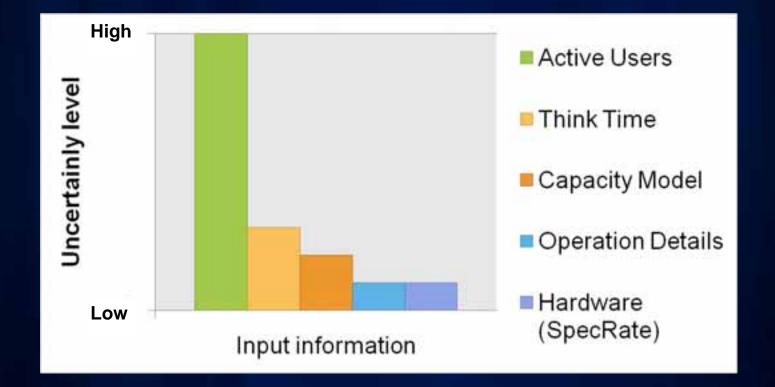
- System Designer
- Guide: Capacity Planning and Performance Benchmarks
 - resources.arcgis.com/gallery/file/enterprise-gis
 /details?entryID=6367F821-1422-2418-886F FCC43C8C8E22
- CPT
 - <u>http://www.wiki.gis.com/wiki/index.php</u>
 <u>/Capacity_Planning_Tool</u>

Uncertainty of input information—Planning hour

Identify the Peak Planning Hour (most cases)



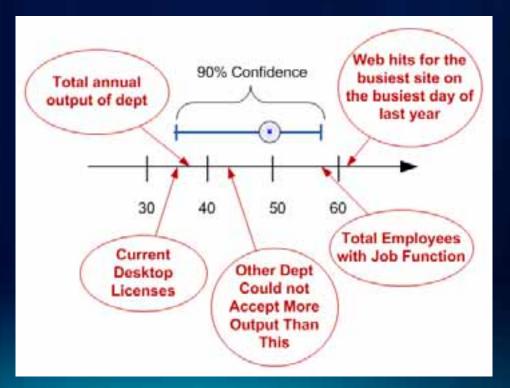
Uncertainty of input information



Define user load first

Uncertainty of input information

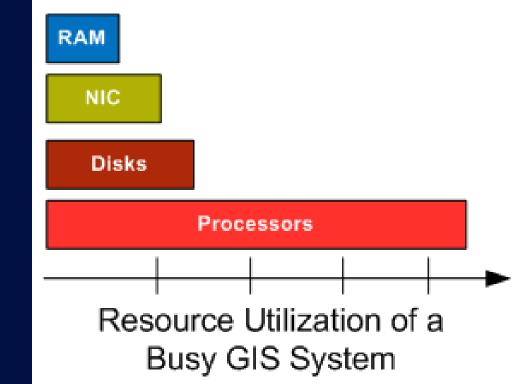
- License
- Total employees
- Usage logs



Hardware Resources

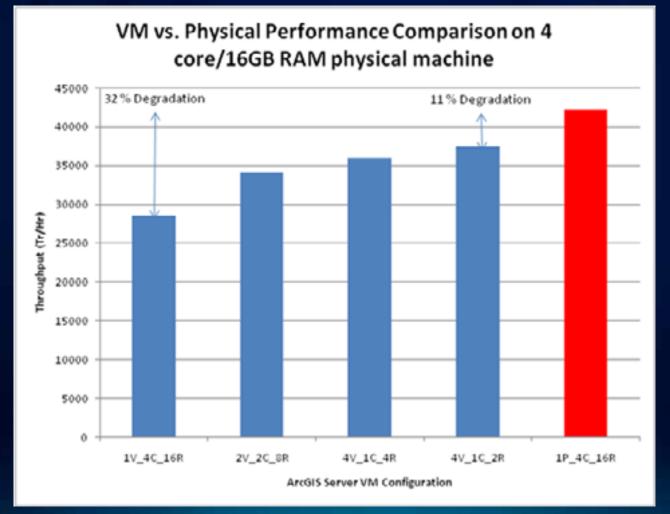
Hardware Resources

- CPU
- Network bandwidth and latency
- Memory
- Disk

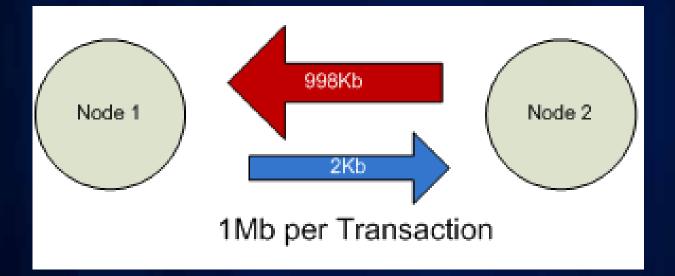


Most well-configured and tuned GIS systems are processor-bound.

Hardware Resources—Virtualization overhead



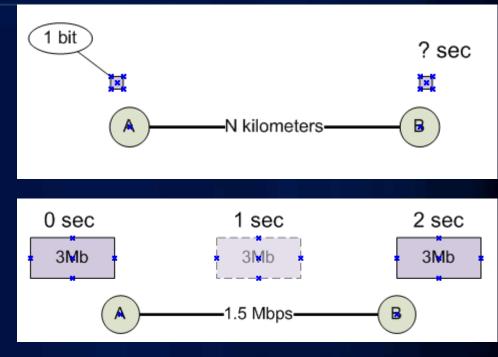
Hardware Resources—Network bandwidth directionality



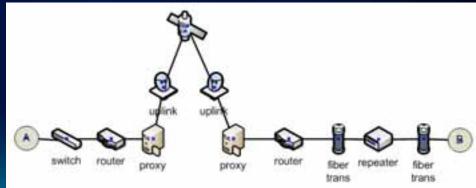
Hardware Resources—Network

1. Distance

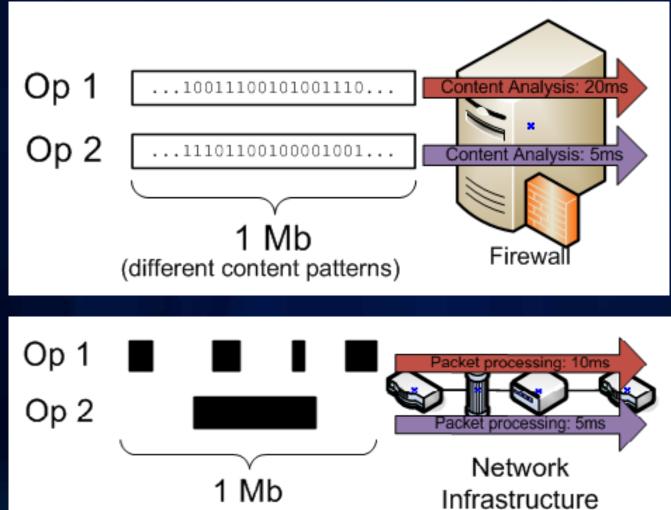
2. Payload



3. Infrastructure



Hardware Resources—Network

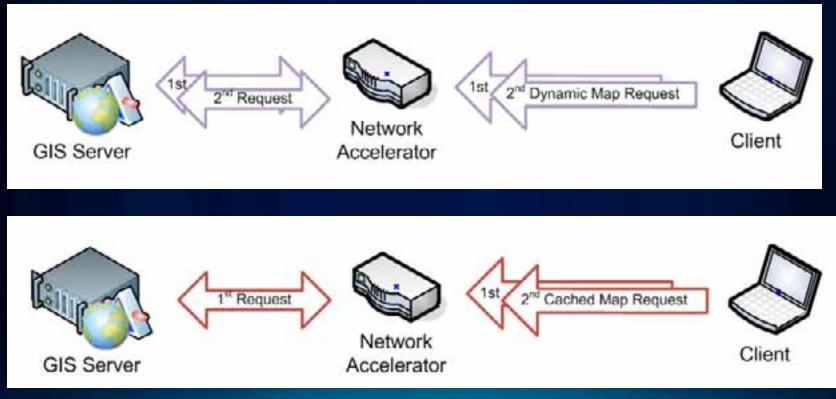


(different transmission sizes)

50

Hardware Resources—Network

 Network accelerator improves performance of repeated request



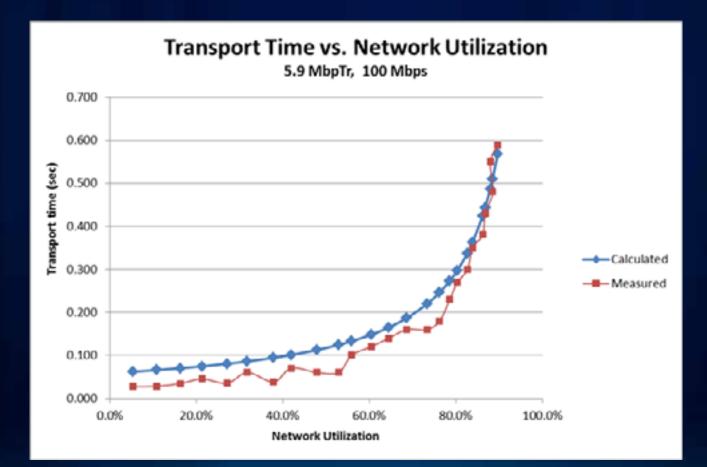
Hardware Resources—Network

 Impact of service and return type on network transport time

- Compression
- Content, e.g., Vector vs. Raster
- Return type, e.g., JPEG vs. PNG

					Network Traffic Transport Time (sec)					
					56 kbps	1.54 Mbps	10 Mbps	45 Mbps	100 Mbps	1 Gbps
Application Type	Service/Op	Content	Return Type	Mb/Tr	0.056	1.540	10.000	45.000	100.000	1000.000
ArcGIS Desktop	Мар	Vector		10	178.571	6.494	1.000	0.222	0.100	0.010
Citrix/ArcGIS	Мар	Vectror+Image	ICA Comp	1	17.857	0.649	0.100	0.022	0.010	0.001
Citrix/ArcGIS	Мар	Vector	ICA Comp	0.3	5.357	0.195	0.030	0.007	0.003	0.000
ArcGIS Server	Мар	Vector	PNG	1.5	26.786	0.974	0.150	0.033	0.015	0.002
ArcGIS Server	Image		JPG	0.3	5.357	0.195	0.030	0.007	0.003	0.000
ArcGIS Server	Map Cache	Vector	PNG	0.1	1.786	0.065	0.010	0.002	0.001	0.000
ArcGIS Server	Map Cache	Vector+Image	JPG	0.3	5.357	0.195	0.030	0.007	0.003	0.000

Hardware Resources—Network



Hardware Resources—Memory

ltem	Low	High	Delta
XenApp Session	500 MB	1.2 GB	140%
Database Session	10 MB	75 MB	650%
Database Cache	200 MB	200 GB	99,900%
SOC Process (Dynamic Map Service)	50 MB	500 MB	900%
SOC Process (Image Service)	20 MB	1,024 MB	5,020%
SOC Process (Geoprocessing Service)	100 MB	2,000 MB	1,900%
SOM	30 MB	70 MB	133%

Wide ranges of memory consumptions

Performance Engineering— Solution Development Phase

 Performance and load test early to validate that nonfunctional requirements can be met.

Performance Testing—Objectives

- Define Objectives
 - Contractual Service Level Agreement?
- Bottlenecks
- Capacity
- Benchmark

Performance Testing — Prerequisites

- Functional testing completed
- Performance tuning

Performance Testing—Test Plan

- Test Plan

- Workflows
 - Expected User Experience (Pass/Fail Criteria)
 - Single User Performance Evaluation (Baseline)
 - Think Times
 - Active User Load
 - Pacing
 - Valid Test Data and Test Areas
- Testing Environment
 - Scalability/Stability
 - IT Standards and Constraints
 - Configuration (GIS and Non-GIS)

Performance Testing—Test tools

Performance Testing — Test tools

- Tool selection depends on objective
 - Commercial tools all have system metrics and correlation tools.
 - Free tools typically provide response times and throughput, but leave system metrics to the tester to gather and report on.

Development Phase—Testing Tools

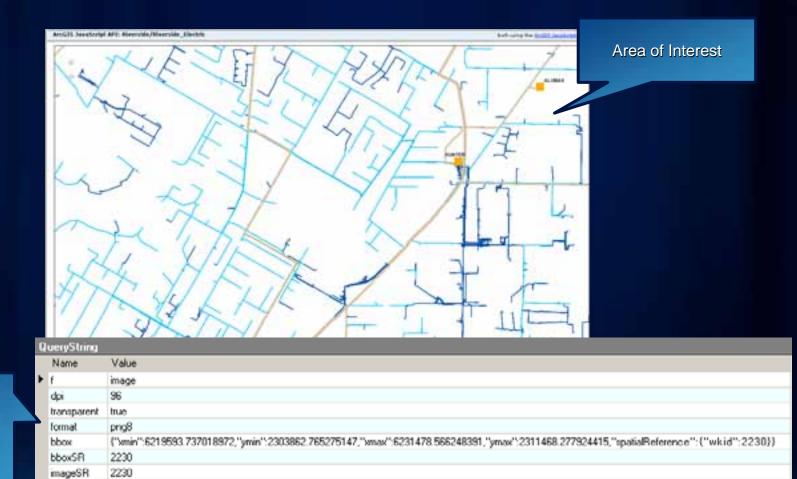
Test Tools	Open Source	Pros	Cons
LoadRunner	No	 Industry Leader Automatic negative correlations identified with service level agreements HTTP web testing Click and script Very good tools for testing SOA Test results stored in database Thick client testing Can be used for bottleneck analysis 	 High cost Test development in C programming language Test metrics difficult to manage and correlate Poor user community with few available examples
Silk Performer	No	 Good solution for testing Citrix Wizard driven interface guides the user Can be used for bottleneck analysis 	 Moderate to high cost Test metrics are poor Test development uses proprietary language Test metrics difficult to manage and correlate Poor user community with few available examples
Visual Studio Test Team	No	 Low to moderate cost Excellent test metric reporting Test scripting in C# or VB .NET Unit and web testing available Blog support with good examples Very good for bottleneck analysis 	 No built in support for AMF No thick client options Moderate user community
JMeter	Yes	•Free •Tool	 Provides only response times Poor user community with few available examples

Test Data

1222.782

size

Test Data



Selected Extent From HTTP Debugging Proxy

Attribute Data



Export Fi	eature Attribute to ASCII	
	ture Class	<u> </u>
Value Field	1	_
3	Export Feature Attribute to ASCII	_I_I_X
	Input Feature Class	<u> </u>
	C:\Data\Riverside\Riverside.gdb\Addresses	6
	Value Field	
Sek Delimitx Space Output	 □ OBJECTID □ ADPTNUMI ☑ STNAME ☑ ADDR 	
	Select All Unselect All	Add Field
	Comma	-
	Output Asci File	
	C:\Documents and Settings fran4944\Desktop TestData.csv	6
	OK Cancel Environments	Show Help >>

Test Data

Generate Bboxes

One simple example of Python script to generate Bboxes

Generate Booses from selected Flyerside estent from ... Mote: Deepe size:122,762 """ _____author___ = "" _____version___ = "0,1"

ingit readow

```
ief generateBoxs(fullExtent, (gridControl))
   hBoxs = []
   hBoxs.append(fullExtent)
   width = fullExtent[2]-fullExtent[0]
   height = fullExtent[5]-fullExtent[1]
   for grid in gridControl:
       nWidth = width/grid
       aMeight = height/grid
       the row to range (0, grid) i
           for column in range (0, grid) :
               minX=fullExtent[0]+(column*nWidth)
               minT=fullExtent[1]+(row*nHeight)
               maxX=minT+idth
               maxY=minT+nHelght
               bBuxs.append((minI, minT, muxI, maxT))
   intern blocks
```

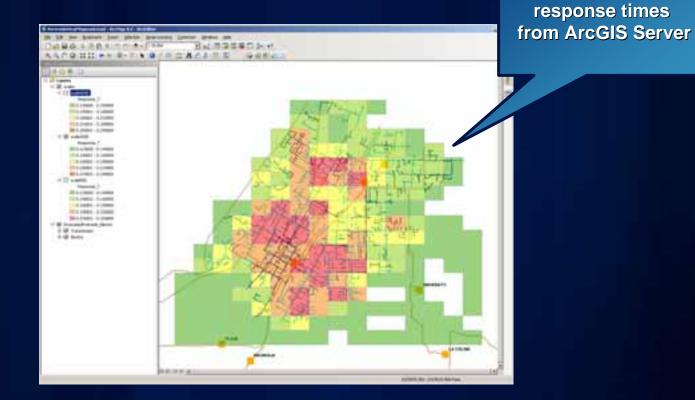
```
inf writeTuple(path, arr):
    trp:
    f = spen(path, "w")
    for item is arr;
```

```
f.write(",".join([str(s) for s in item])+"[s"]
f.close()
f.close()
f.close()
format path
print "writeTuple I/O error(tair tes" t (errno, strerror)
print "writeTuple Unespected error(", sys.exc_info()(0)
print"
```

17 BADE PRT MAIN TO

extent =(6219593,737018972,2303862.765275147,6231478.566248391,2311468.277924415)
grid = [2, 0, 16]
bBoxs = generateBoxs(extent, grid)
for item in bBoxs;
 print item
writeTuple("C:\\test.cov", bBoxs;

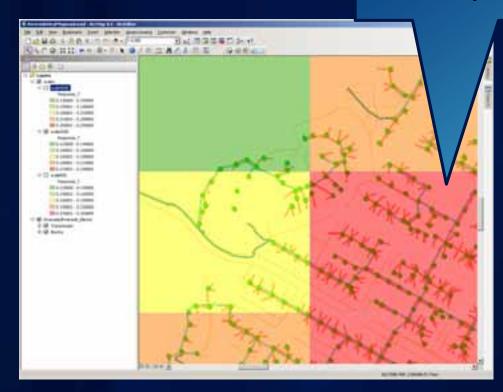
Test Data



Heat map based on

Test Data

Observe correlation between feature density and performance.



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ulton County Dept. of Health and Wellness(District 3) Unit 2

Demo

Discovering Capabilities using ArcGIS REST Discovering Test Data with System Test Tool



Add STT intro slide

Test Scripts—Request Profiling

- Sample selected functions
 - Observe response times with variable data.
 - Observe system resources while sampling.
 - Track changes over time if system is changing.
 - Example
 - Use Fiddler to record user workflows and find the expected single user response times for transactions.
 - Benefits
 - Low cost method for evaluating systems

Test Scripts

- Record user workflow based on application user requirements.
- Create single user web test.
 - Define transactions.
 - Set think time and pacing based on application user requirements.
 - Parameterize transaction inputs.
 - Verify test script with single user.

Test Scripts—Visual Studio Quick Introduction

Transaction



Data source

Query String parameter referencing data source

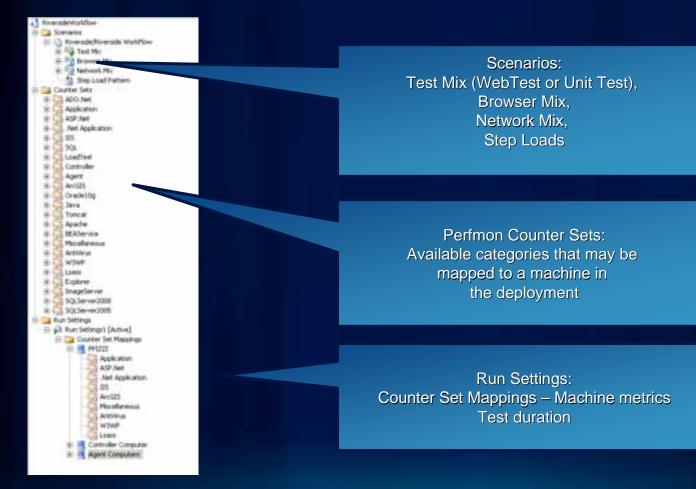
HTTP Request

Load Test

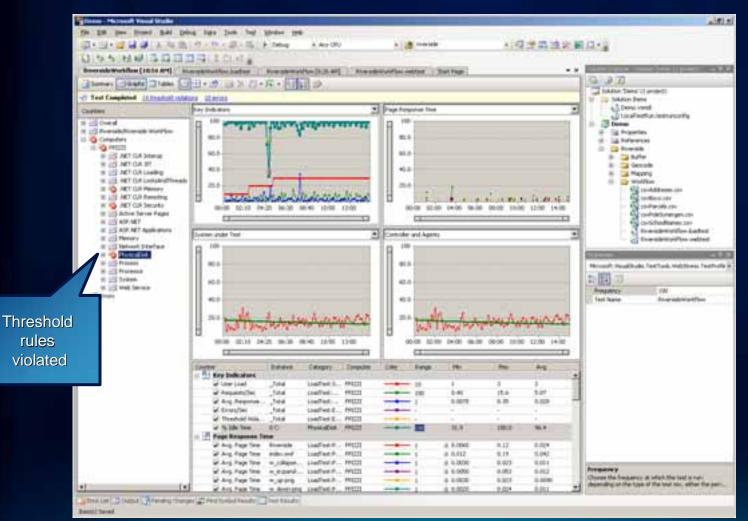
Load Test

- Create load test.
 - Define user load.
 - Max users
 - Step interval and duration
 - Create machine counters to gather raw data for analysis.
- Execute.

Load Test—Visual Studio Quick Introduction



Load Test-Visual Studio



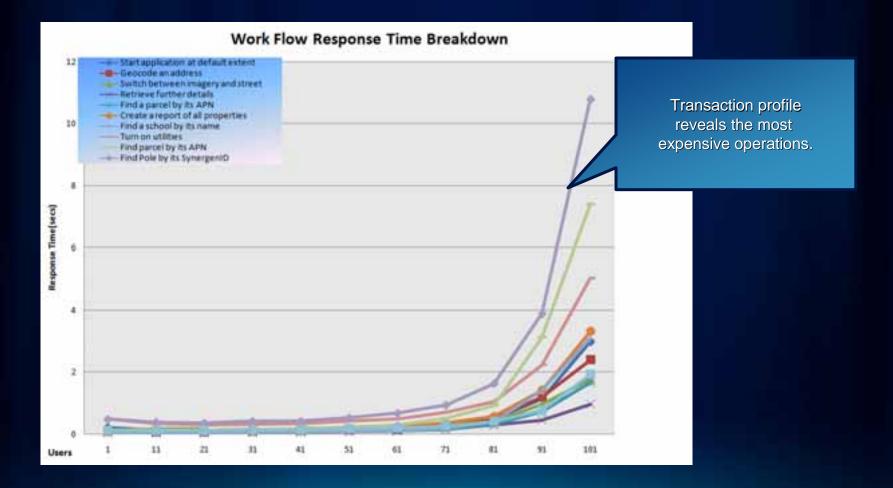
Execute

• Ensure

- Virus scan is off.
- Only target applications are running.
- Application data is in the same state for every test.
- Good configuration management is critical to getting consistent load test results.

Analysis

Analysis—Workflow response time breakdown

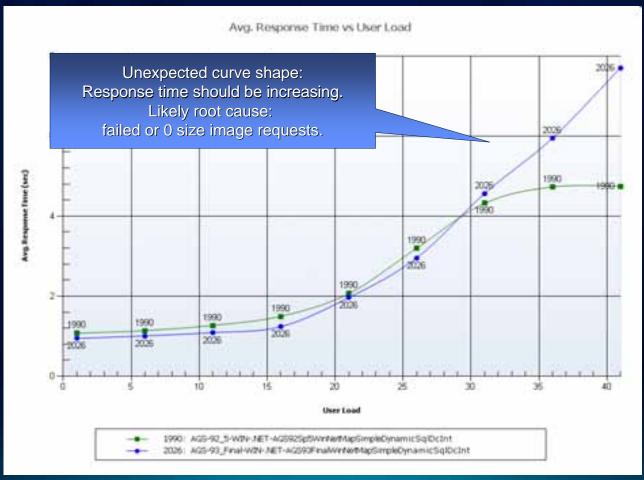


Analysis—Compare and correlate key measurements

- Most counters and utilization should be <u>increasing</u> with increased load:
 - Throughput
 - Response time
 - Metrics
 - CPU
 - Network
 - Disk
 - Memory
 - Errors

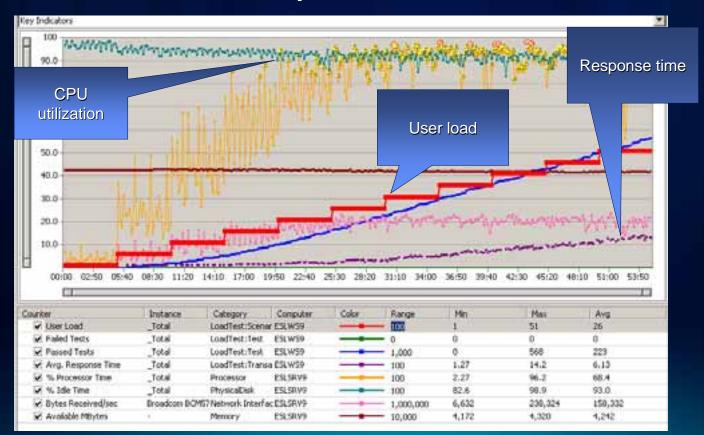
Analysis—Compare and correlate key measurements

Unexpected curve



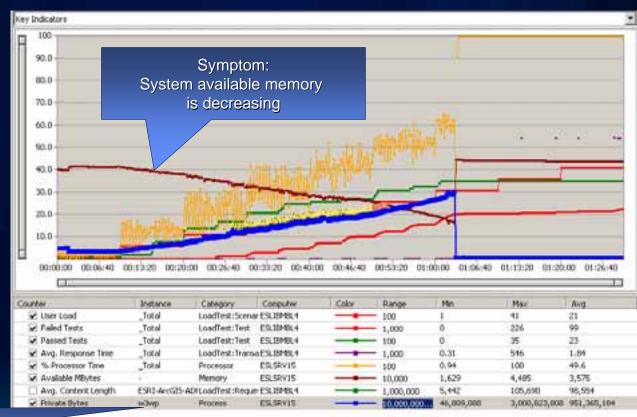
Analysis—Compare and correlate key measurements

 Expected counters correlation: increasing user load, CPU utilization, response time



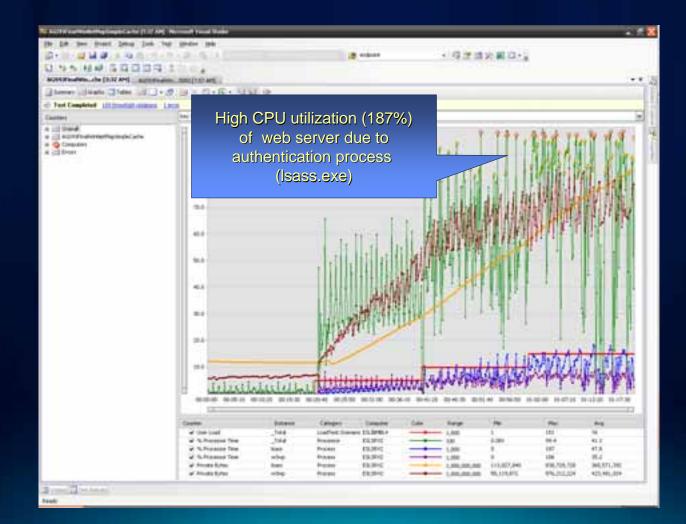
Analysis—Compare and correlate key measurements

Memory leak example



Root cause: Web Server process

Analysis—Unexpected CPU utilization for cached service



Analysis—Validate results

- Lack of errors does not validate a test.
 - Requests may succeed but return zero size image.
 - Spot check request response content size.

Analysis—Valid range

- Exclude failure range, e.g., failure rate > 5%, from the analysis.
- Exclude excessive resource utilization range.

Analysis—Determining capacity

- Maximum number of concurrent users corresponding to, for example:
 - Maximum acceptable response time
 - First failure or 5%
 - Resource utilization greater than 85%, for example, CPU
- Different ways of defining acceptance criteria (performance level of service), for example:
 - 95% of requests under 3 sec
 - Max request under 10 sec

Report

- Executive summary
- Test plan
 - Workflows
 - Work load
- Deployment documentation
- Results and charts
 - Key indicators, e.g., response time, throughput
 - System metrics, e.g., CPU %
 - Errors
- Summary and conclusions
 - Provide management recommendations for improvements.
- Appendix

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ulton County Dept. of Health and Wellness/District 3, Unit 2.

Demo

Fiddler Request Profiling Fiddler to Visual Studio Web Test Visual Studio Load Test



Performance Engineering —Deployment

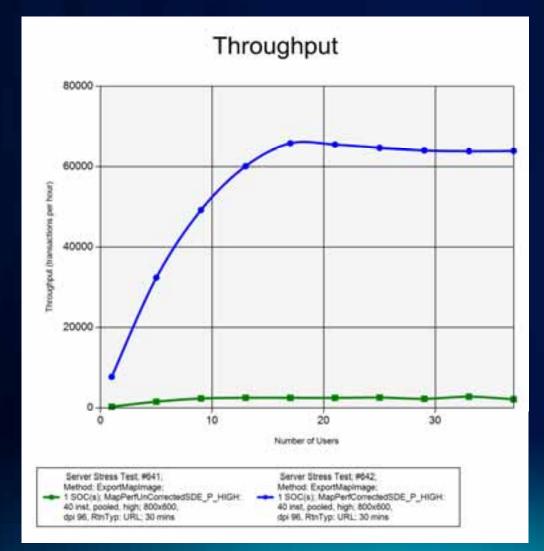
Deployment Phase

Performance engineering tasks

- Configuration management
- Performance tuning
- Performance and load testing

Deployment Phase

Configuration—**ArcSOC** max instances



Optimal (Unloaded TT: 0.34 sec) (2.1 Instances/core)

Nonoptimal (Unloaded TT: 11.97 sec) (1.6 Instances/core)

Deployment Phase

Performance tuning

Performance tuning

Benefits

- Improved performance—User experience
- Optimal resource utilization—Scalability
- Tools
 - Fiddler
 - Mxdperfstat, <u>resources.arcgis.com/gallery/file/enterprise-gis</u> /details?entryID=6391E988-1422-2418-88DE-3E052E78213C
 - Map Service Publishing Toolbar
 - DBMS trace

Process

- Optimize ArcGIS Services.
- Profile individual user operations and tune if needed.
- Drill down through software stack:
 - Application
 - Service
 - MXD
 - Layer
 - DBMS query
- <u>Correlate</u> your findings between tiers.
- Performance and <u>load test</u>.

Profile user transaction response time Browser **Total Response** P Time (t1-t2) Web Server Wait Time SOM 8 Usage Time 吊 SOC SDE/DBMS Search & 罚 **Retrieval Time**

A test is executed at the web browser.

It measures web browser call's elapsed time (roundtrip between browser and data source).

Web diagnostic tools: Fiddler, Tamperdata, Yslow

😵 Request Graph - Mozilla Firefox								X
Elle Edit Yew History Bookmarks Iools Help								\bigcirc
http://ocalhost/EditPooled/Default.aspx	200	892						^
http://localhost/EdiPooled/ESRLArcGIS ADF Web Mimelmage ashv?	200	410						
http://localhost.EditPooled.Default.aspx	200	1553						
http://localhost.EditPooled.Default.aspx	200	862						
http://localhost/EdiPooled/ESRI.ArcOIS.ADF.Web.Mimelmage.ashx?	200	30	1					
http://localhost.EditPooled.Default.aspx	200	581						
http://localhost/EdiPooled/ESRI.ArcOIS ADF.Web.Mimelmage.ashx?	200	20		1				
http://localhost/EditPooled/Default.aspx	200	5749						
http://localhost.EditPooled.Default.aspx	200	5048						
http://iocalhost/EditPooled/ESRI.ArcOIS.ADF.Web.Mimelmage.astu?	200	90						
http://localhost/EditPooled/Default.aspx	200	19399						
http://ocalhost.EditPooled.Default.aspx	200	18458						
http://iocalhost.EditPooled.Default.aspx	200	17737						
http://ocalhost.EditPooled.Default.aspx	200	17236						
http://localhost.EditPooled.Default.aspx	200	13149						
http://iocalhost.EditPooled.Default.aspx	200	12679						
http://ocalhost.EditPooled/Default.aspx	200	5759						
http://localhost/EditPooled/ESRLArcOIS ADF.Web.Mimelmage.ashx?	200	11050						
http://localhost/EditPooled/ESRLArcGIS ADF.Web.Mimelmage.ashv?	200	5128						
http://sb.google.com/safebrowsing/update?	200	110						
http://localhost/EditPooled/ESRLAccOIS ADF.Web.MimeImage.ashx?	200	1072						
http://localhost/EdiPooled/ESRLArcOIS ADF.Web.Mimelmage.ashx?	200	30						
			1	1	1	1	1	
URI	Status	Duration	15:26:00.086	15:26:09.028	15:26:17.970	15:26:26.911	15:26:35.853	~
¢								2

Web diagnostic tools: Fiddler validate image returned

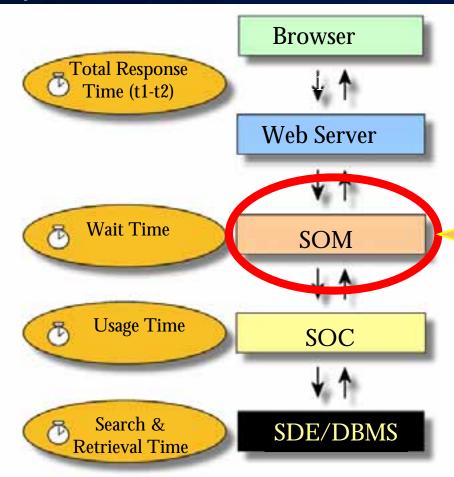
2 Fi	ddler - H	ITTP (Debuggir	ng Proxy	/	-				-	12				x
Eile	Edit	Bules	Loois	View	Help										
				Web Se	essions		<<	4	Request Build	er	Elb	5/5	3	Timeline	
*	Res	ult P	rotocol		Host	URL		Ó	Statistics	12	Inspectors		🗲 Auto	Responder	
5	20	-	TTP		marchena2k8		-	Headers	TextView	WebForms	HexView	Auth	Raw	XML	
	20	0 1	ITTP		marchena 2k8	/arcgisoutput/_ags_r	1ap2b117			man 26/1761	727746-024	Ros	v] (Head	ler Definitio	-
						Request Headers (Haw Header Desternance GET /aregisoutput/_ags_map2bf1761787746e08df3df1a785e373a.png HTTP/1. • • Client • • Accept: */* • • Accept: anguage: en-us • • UA-CPU: x86 • • User-Agent: Mozila/4.0 (compatible; MSIE 7.0; Windows NT 6.0; SLCC1; • Miscellaneous • Referer: http://marchena2k8/ArcGIS/rest/services/Portland/MapServer// • Transport • Connection: Keep-Alive • Transformer Headers • The second to the seco							SLCC1; .NET Server/expor		
•							,	10,573 byt 400w x 40 Format: Pit Autoshrink	on and a second	naw Ar),			
III a	opturing	Ŧ	All Proce	sses	1/2	http://marchena	2k8/arcgi	soutput/_ags	_map2bf1761	7877f46e08d	lf3df1a785e37	3a.png		_	

Web diagnostic tools: Fiddler

- Understand each request URL.
- Verify cache requests are from virtual directory, not dynamic map service.
- Validate host origin (reverse proxy).
- Profile each transaction response time.

Hig Fi	ddler - HTT	P Debuggi	ng Proxy		-			-	
<u>F</u> ile	<u>E</u> dit <u>R</u> ul	es <u>T</u> ools	View Help Web Sessions		Г				
=	Result	Protocol	WCD Sessions	Host	URL	~~	Statistics Request Builder	Inspectors Filters	AutoResponder
5	200	HTTP		k8	/ArcGIS/rest/services/Po			TRANSFER	TIMELINE
26	200	HTTP	marche	ena2k8	/arcgisoutput/_ags_map	52bf17		/export	1s 2s
•						÷	•		Þ
iii Ca	apturing	👻 All Proce	3903	1/2	http://marchena2k	8/ArcGI	[5/rest/services/Portland/M	lapServer/exp	ort?bbox=7610148.5

Analyze SOM/SOC statistics



Analyze ArcGIS context server statistics using ArcCatalog, Workflow Manager, or logs. They provide aggregate and detailed information to help reveal the cause of the performance problem.

Analyze SOM/SOC statistics

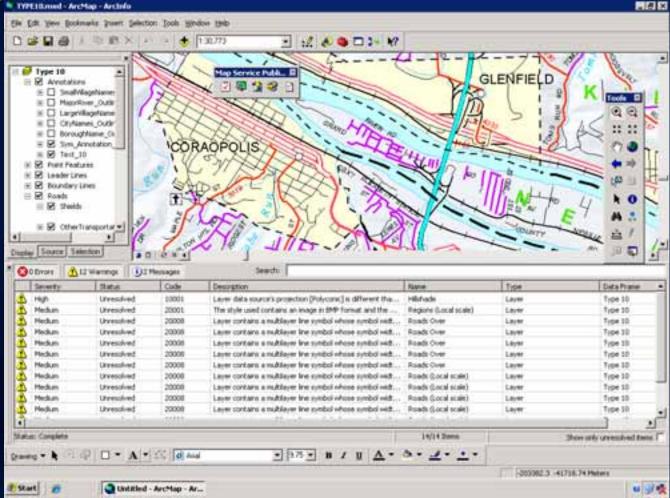
ArcGIS Server Properties	
General Hosts Directories Statistics T Service(s): Portland Host(s): <al> Type: Service Usage Time Interval: Since server startut</al>	Service Name: Portland Service Type: MapServer Service Usage Time: Total number of requests: 3
Show Statistics Statistics Time Range Start Time: 2009-03-16T12:18:16 End Time: 2009-03-16T13:21:54	Number of requests succeeded: 3 Number of requests timed out: 0 Avg usage time: 1.181000 Seconds Min usage time: 0.813000 Seconds Max usage time: 1.799000 Seconds Sum usage time: 3.542999 Seconds

<Msg time="2009-03-16T12:23:22" type="INFO3" code="103021" target="Portland.MapServer"
methodName="FeatureLayer.Draw" machine="myWebServer" process="2836" thread="3916" elapsed="0.05221">Executing
query.</Msg>

<Msg time="2009-03-16T12:23:23" type="INFO3" code="103019" target="Portland.MapServer"
methodName="SimpleRenderer.Draw" machine="myWebServer" process="2836" thread="3916">Feature count: 27590</Msg>

<Msg time="2009-03-16T12:23:23" type="INFO3" code="103001" target="Portland.MapServer" methodName="Map.Draw" machine="myWebServer" process="2836" thread="3916" elapsed="0.67125">End of layer draw: STREETS</Msg>

ArcMap 9.3.1/10 Analvze Tool



mxdperfstat

http://resources.arcgis.com/gallery/file/enterprise-gis/details?entryID=6391E988-1422-2418-88DE-3E052E78213C C:>mxdperfstat -mxd Portland_Dev09_Bad.mxd -xy 7655029;652614 -scale 8000

Item	At Scale	Layer Name	Refresh Time (sec)	Recommendations	Features	Vertices	Labeling	Geography Phase (sec)	Graphics Phase (sec)	Cursor Phase (sec)	DBMS CPU	DBMS LIO
18	8,000	Tax Lots	1.05	Simplify labeling, symbology: GraphicsPhase=.83;	2,226	33,872	True	.14	.83	20	,08	6,396
19	8,000	Tax Lots Query Def	.13		1	26	False	.03	.02	.06	.03	3,204
20	8,000	TaxlotDenseLabel		Simplify labeling, symbology: Graphics/Phase=1.03; simplify geometry and/or set label scale, convert polygon to polyline: vertices fetched=200001; simplify geometry and/or set label scale: vertices fetched=200001;	1	200,001	True	,73	1.03	.95	.01	266
21	8,000	TaxlotDenseNoLabel	10000	simplify geometry: vertices fetched=200001;	1	200,001	False	.47	.02	.97	.00	140

Issues discovered

- Large numbers of vertices on features
- Labeling of dense features expensive

Dekalb County Board of

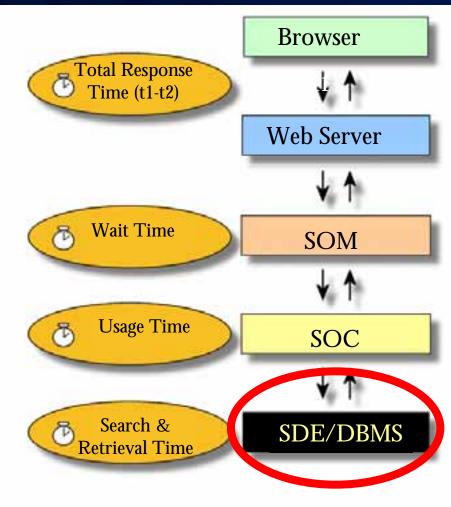
ulton County Dept. of Health and Weilness/District 3, Unit 7, 4

Demo



GIS Test Tool

Data sources



Data Sources—Oracle Trace

select username, sid, serial#, program, logon_time from v\$session where									
username='STUDENT';									
USERNAME SID SERIAL# PROGRAM LOGON_TIM									
STUDENT 132 31835 gsrvr.exe 23-OCT-06									
SQL> connect sys@gis1_andrews as sysdba									
Enter password:									
Connected.									
SQL> execute									

sys.dbms_system.set_ev(132,31835,10046,12,'');

DBMS trace is a very powerful diagnostic tool. 106

Starting Oracle trace using a custom ArcMap UIControl

Private Sub OracleTrace_Click()

```
. . .
Set pFeatCls = pFeatLyr.FeatureClass
Set pDS = pFeatCls
Set pWS = pDS.Workspace
sTraceName = InputBox("Enter <test_name><email>")
pWS.ExecuteSQL ("alter session set tracefile_identifier = '" &
sTraceName & "'")
pWS.ExecuteSQL ("ALTER SESSION SET events '10046 trace name context
forever, level 12'")
```

End Sub

Data Sources—Oracle Trace (continued)

SQL ID : 71py6481sj3xu

SELECT 1 SHAPE, TAXLOTS.OBJECTID, TAXLOTS.SHAPE.points,TAXLOTS.SHAPE.numpts, TAXLOTS.SHAPE.entity,TAXLOTS.SHAPE.minx,TAXLOTS.SHAPE.miny,

TAXLOTS.SHAPE.maxx,TAXLOTS.SHAPE.maxy,TAXLOTS.rowid

FROM SDE.TAXLOTS TAXLOTS WHERE SDE.ST_EnvIntersects(TAXLOTS.SHAPE,:1,:2,:3,:4) = 1

call	count	cpu	elapsed	disk	query	current	rows
Parse	0	0.00	0.00	0	0	0	0
Execute	1	0.07	0.59	115	1734	0	0
Fetch	242	0.78	12.42	2291	26820	0	24175
total	243	0.85	13.02	2406	28554	0	24175

Elapsed times include waiting on following events:

Event waited on	Times	Max. Wait	Total Waited	
	Waited			
SQL*Net message to client	242	0.00	0.00	
db file sequential read	2291	0.39	11.69	
SQL*Net more data to client	355	0.00	0.02	
SQL*Net message from client	242	0.03	0.54	

Data Sources—Oracle Trace (continued)

- Definitions
 - Elapsed time [sec] = (CPU + wait event)
 - CPU [sec]
 - Query (Oracle blocks, e.g., 8 K read from memory)
 - Disk (Oracle blocks read from disk)
 - Wait event [sec], e.g., db file sequential read
 - Rows fetched

Data Sources—Oracle Trace (continued)

- Example (cost of physical reads):
 - Elapsed time = 13.02 sec
 - CPU = 0.85 sec
 - Disk = 2291 blocks
 - Wait event (db file sequential read) = 11.69 sec
 - Rows fetched = 24175

Data Sources—SQL Profiler

ArcSDE_trace (ANDREWS2)										
	EventClass	Login	Application	TextData	CPU	Duration	RowCounts	Reads		
	Trace Start			(
	showplan >ML statistics P	sde	SDE:5932	<showplanml http:="" schemas<="" td="" xmlns="http://schemas</td><td></td><td></td><td></td><td></td></tr><tr><td></td><td>SP:StmtCompleted</td><td>sde</td><td>\$0615932</td><td>SELECT state_id, owner, creation_time</td><td>10</td><td>0</td><td>1</td><td>2</td></tr><tr><td></td><td>Showplan XML Statistics P</td><td>sde</td><td>SDE: 5932</td><td><ShowPlanDML xmlns="><td></td><td></td><td></td><td></td></showplanml>						
	SP:StmtCompleted	sde	SDE:5932	SELECT lineage_name, time_last_modi	0	0	1	2		
	Shouplan >ML Statistics P	sde	\$0615932	<showplanml http:="" schemas<="" td="" xmlns="http://schemas</td><td></td><td></td><td></td><td></td></tr><tr><td></td><td>SP:StmtCompleted</td><td>sde</td><td>SOE: 5932</td><td>SELECT Seminx, Seminy, Semaxx, S</td><td>0</td><td>0</td><td>0</td><td>0</td></tr><tr><td></td><td>Showplan >ML Statistics P</td><td>sde</td><td>SOE:5932</td><td><ShowPlanDML xmlns="><td></td><td>I T</td><td></td><td>11 71</td></showplanml>		I T		11 71		
<	SF:StmtCompleted	sde	506:5932	SELECT Seminx,Seminy,Sempx,S	\$21	2624	36251	11		

0	24	000	
(Date Join) Cast: 0 K	Distinct Sort) [SDE]. [SDE]	Index Scat]+[s2]+[s2_%2] [SP_] Costs &3 #	
1	Clustered Index Seek	Index Scan Scan a nondustered index, entire range.	
	[son].[son].[f2].[f2]p1] [soore]	Physical Operation	Index Scan
		Logical Operation	Index Scan
		Actual Number of Rows	51629
		Estimated I/U Cost	1.11424
		Estimated CPU Cost	0.183394
		Estimated Operator Cost	1.29763 (63%)
		Estimated Subtree Cost	1.29763
		Estimated Number of Rows	21.77
		Estimated Row Size	59.6
		Actual Rebinds	0
		Actual Rewinds	
		Ordered	False
		Node ID	3

Summary

- Optimize ArcGIS Services.
- Profile individual user operations and tune if needed.
- Drill down through software stack:
 - Application
 - Service
 - MXD
 - Layer
 - DBMS query
- Correlate your findings between tiers.
- Performance and load test.

Operation and Maintenance

Operation and Maintenance—Monitoring

- Baselines
- Trends
 - Used for growth estimation and variance
- Capacity models calibration
- Thresholds alerts

View Test Result

Calculate Service Time

Project Service Time to Production Hardware

Calculate Capacity

Load Test Results - Riverside Electric

- Baseline Test with Single Thread
 - Note* Service Time is Load Independent
- Think Time=0
- Evaluate Key Metrics
 - Throughput
 - Response Time
 - QA Check
- Evaluate System Under Test
 - CPU, Network, Memory, and Disk

Load Test Results - Key Indicators

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RiversideElectricRandomData [12:34 PM]	RiversideElectricRandomDa	ata.loadtest	Riverside_M	lulti_Service.we	ebtest Ri	iversideElectri	c.webtest			-
📳 Summary 🖂 Graphs 📰 Tables 💡	Detail 🔣 🗆 + 🦪 🖄	X 🛛 - 🛛	222	🗟 🖬 - 🔤	193					
Test Completed <u>2 threshold violatio</u>	<u>ns</u>									
Counters	Key Indicators									٣
 Overall Page Request Avg. Connection Wait Time Avg. Content Length Avg. First Byte Time Avg. Response Time Avg. Response Time Cached Requests Failed Requests Failed Requests Failed Requests Passed Requests/Sec Requests/Sec Requests/Sec Requests/Sec Total Requests Scenario Test 					,	,	- 		∕∕ ∕∕	-
🗉 🖂 Transaction	Counter	Instance	Category	Computer	Color	Range	Min	Max	Avg	
	User Load	Total	LoadTest:S			1	1	1	1	
Computers Errors	Errors/Sec	Total	LoadTest:E	FPIZZ17		0	0	0	0	
	Requests/Sec	_Total	LoadTest:R	FPIZZ17		10	2.00	4.60	3.89	
	🖌 Avg. Response Time	Total	LoadTest:R	FPIZZ17		1	0.21	0.41	0.25	

Load Test Results - System Metrics



Load Test Results – input into capacity models

- Average throughput over the test duration
 - 3.89 request/sec ~ 14,004 request/hour
- Average response time over the test duration
 - .25 seconds
- Average CPU Utilization
 - 20.8%
 - Mb/request = 1.25 Mb

Post-Indiana distant (2218/24) in	Republication		Real Property lies	-	1944 Br	- militair		
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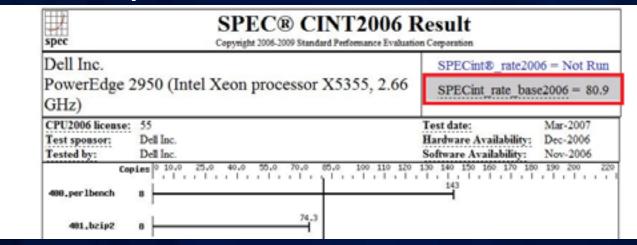
Load Test Results – input into CPU capacity model

- Input from testing
 - #CPUs = 4 cores
 - %CPU = 20.8
 - TH = 14,004 requests/hour
 - SPEC per Core of machine tested = 35
- ST = (4*3600*20.8)/(14,004 *100) = 0.2138 sec
 - Note* very close to Average response time of .25

$$ST = \frac{\#CPU \times 3600 \times \% CPU}{TH \times 100}$$

Target values

1. Server SpecRate/core=10.1



- 2. User load=30,000 req/hr
- 3. Network=45 Mbps

Target CPU cores calculation

- Input to Capacity Planning:
 - ST = Service Time = .2138 sec
 - TH = Throughput desired = 30,000 request/hour
 - %CPU = Max CPU Utilization = 80%
 - SpecRatePerCpuBase = 35
 - SpecRatePerCpuTarget = 10.1
- Output
 - #CPU required =([.2138*30,000*100]/3600*80]) *[35/10.1]
 - #CPU required = 7.7 cores ~ 8 cores

 $\# CPU_{t} = \frac{ST_{b} \times TH_{t} \times 100}{3600 \times \% CPU_{t}} \times \frac{SpecRatePerCPU_{b}}{SpecRatePerCPU_{t}}$

Target network calculation

- Input to Capacity Planning:
 - Mb/req=1.25
 - TH = 30,000 request/hour
- Output
 - Network bandwidth required = 30000x1.25/3600
 - =10.4 Mbps < 45 Mbps available
 - Transport=1.25/(45-10.4)=0.036sec

$$Transport(sec) = \frac{Mbits / req}{Mbps - Mbps_{used}}$$

Mbps =

 $\underline{TH \times Mbits} / req$

3600

System Designer

• Input:

Model Review

- Throughput=30000
- ST=0.21
- Mb/tr=1.25
- Hardware=80.9 Spec

				Shar Weddhow Dating			10 L = 1				
Input: - Throughput=30000 - ST=0.21 - Mb/tr=1.25 - Hardware=80.9 Spec				Select Site	Workflow Netw	Workflow Nerve					
				Class	- Web request						
				Select a Workflore	Total Upers:	Active Di	es .	Workflow Fe	ong (sed		
				2 Web request	3	aughput (Workfrom)		18			
						and the second	*G	R College	•		
				+ And - Del Workfrom Operations	area .			bi See	B Doord		
			ec Je	Select Operation:	Constitution Name	Operative Nation					
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					Withday Inech	Stated Delay	there				
					E.	(bid) Discourse					
					Programmer (199	theth restaura		1223			
					Notes						
electe	d Model	Assigned Model Name: ExportM	Map REST MapS	Service 9.3.1							
Nodel	Function	Tier	Modified	Service Time(se	c) Queue Time(se	ec) CPU Cor	res Calc	Modified	Mb/Tr		
0	Client	Client	0		0.0	00	0.00	0			
			Ø	0.21							

System Designer

Input

- Hardware=80.9 Spec

Hardware Dialog			
Site:	Role:		Category:
lą, Server	 WebServer 		Server *
Switch:	Vendor	Processor	Operating System:
Switch0	* Dell Inc.	· .	Windows Server 2008 R2 64-bit *
Select Hardware Item	[Cores] [SPEC/Core] Hardware:		
Desktop	[8] [10.11] PowerEdge 2950 (In	tel Xeon processor X5355, 2.66 GHz)	*
WebServer	Processor Name:	Processor Speed (MHz):	CPU Cores:
	Intel Xeon X5355	2666.00	8
	SPEC into the per Core:	SPEC in rate:	%Max Utilization:
	10.11	80.90	80
		3-590 (G8):	
	0	0	
	Platform Virtualization		
		Vendor:	CPU Cores Allocated:
	Virtual Environment		*
	Notes		
+ Add - Delete	@ Configured		E Save B Discard
T Dec Eren	Compres		
			× <u>C</u> lose

System Designer

Review results

Model R	del Review Model Assigned										
	Selected Model Service Type: Map Model Name: ExportMap REST MapService 9.3.1										
Model	Function	Tier	Modified	Service Time(sec)	Queue Time(sec)	CPU Cores Calc	Modified	Mb/Tr	Mbps Calc	Transpo	ort(sec)
S	Client	Client	0		0.000	0.00	0	1.250	10.42		0.00
0	WebService	Web Services	Ø	0.210	0.046	7.57	Ø	1.250	10.42		0.04

ulton County Dept. of Health and Wellness/District 3, Unit 2.

Demo System Designer

Calculate Capacity



System Designer evaluation and training

Contact us

 \bullet

- Chad Helm, <u>chelm@esri.com</u>
- Andrew Sakowicz, <u>asakowicz@esri.com</u>

Download free evaluation

- ftp://ftp.esri.com/
- Click the File menu and choose Login As
- username: eist
- password: eXwJkh9N

Related sessions

• Enterprise GIS Architecture Deployment Options

- Thu 08:30 AM

Session Evaluation

<u>http://events.esri.com/uc/2011/sessionEvals/index.cf</u> <u>m?fa=app_login_form</u>

Session Evaluations

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	International Characters
	Login
	w UC Account Forgot My Login

Questions?

Contact us

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