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Performance and Scalability Best Practices in ArcGIS

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Introductions

- Target audience
  - GIS, DB, System administrators
  - Testers
  - Architects
  - Developers
  - Project managers
- Level
  - Intermediate

Objectives

Performance engineering—concepts and best practices

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

Agenda

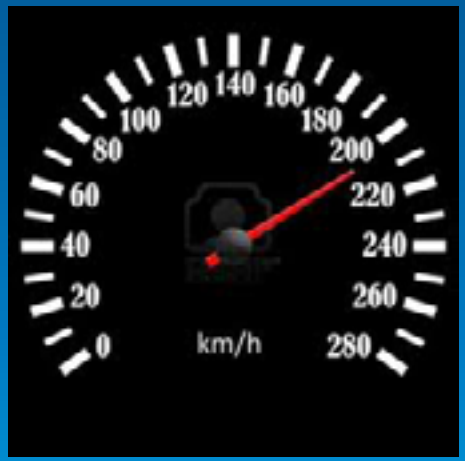
- Introduction
- Definitions
- Process
- Requirements
- Performance Factors – Software
- Performance Factors - Hardware
- Performance Tuning
- Performance Testing
- Monitoring
- Capacity Planning

Definitions

Definitions

Performance

- The speed at which a given operation occurs
- E.g. Request response time measured in seconds



Definitions

Scalability

- The ability to increase output and maintain acceptable performance
- Examples
  - Capacity 10 maps/sec and response time 1 second
  - Capacity 1000 cars/hrs and s

Definitions

Capacity

- The maximum level of output the system can produce

At capacity

Over capacity

Definitions

Bottleneck

- Resource(s) limiting the performance or capacity

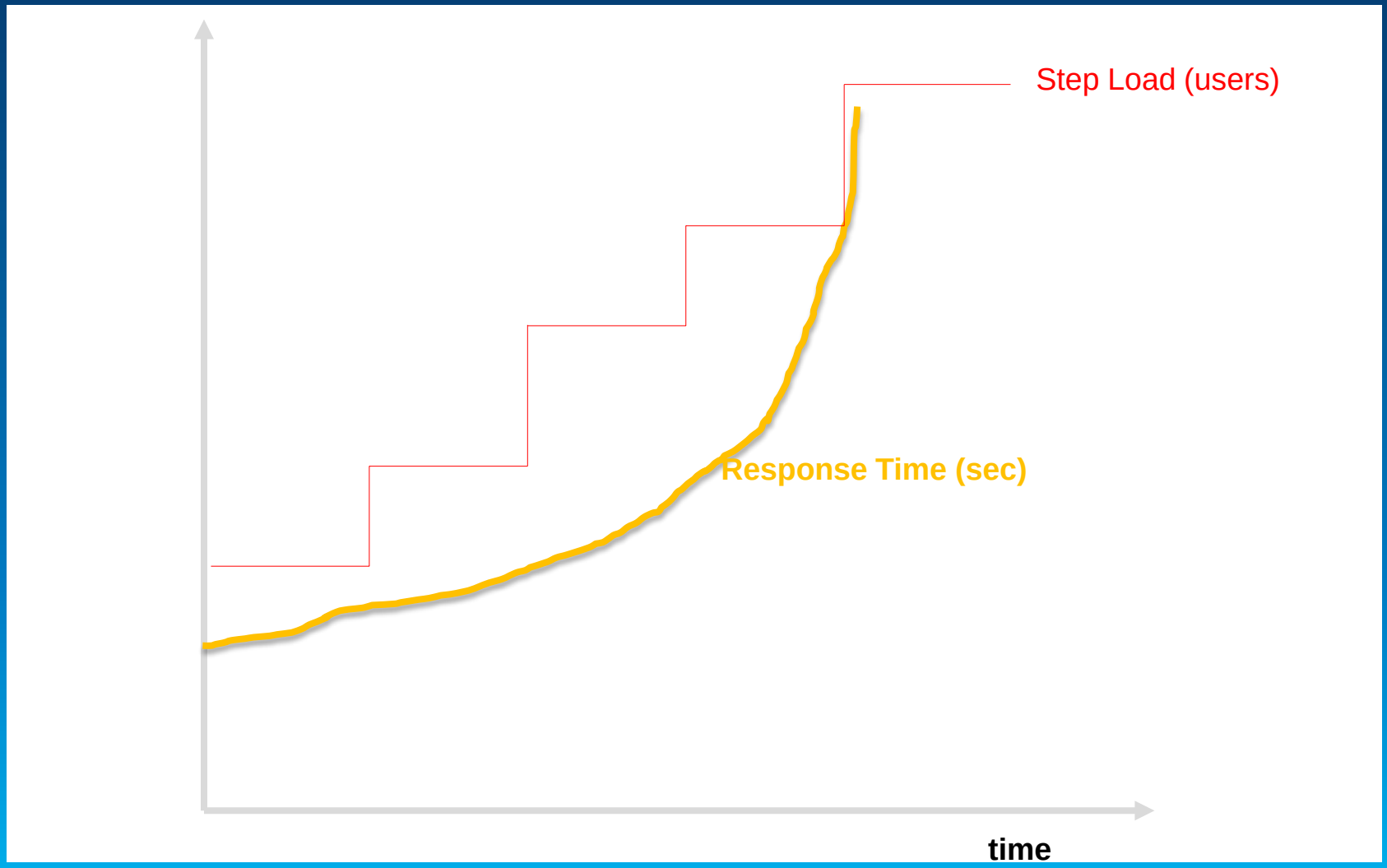
Think of :
lanes - as CPU processor
toll booths – as ArcGIS Server instances
cars - as map requests

Low load

High load

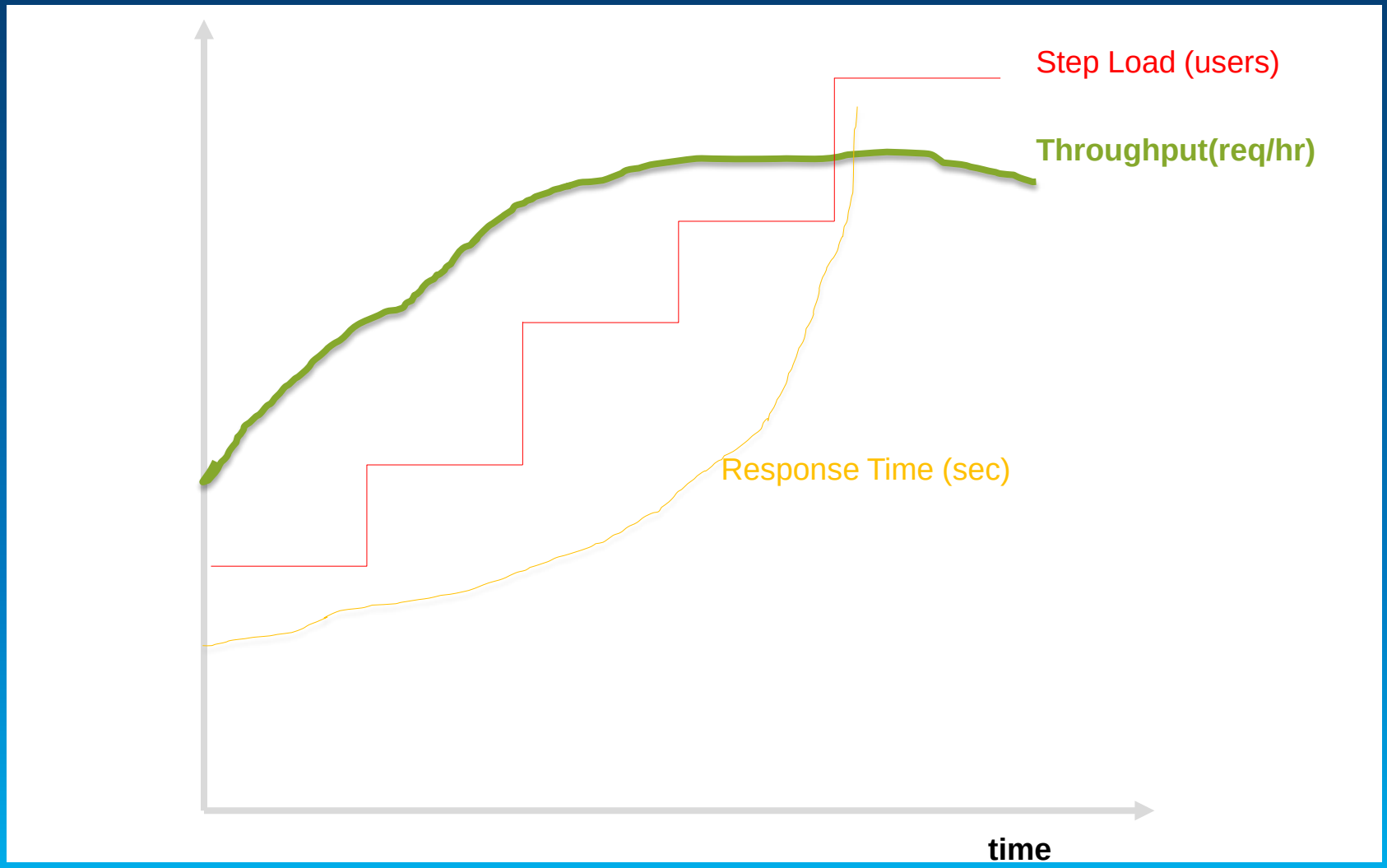
Definitions

Step Load and Response Time



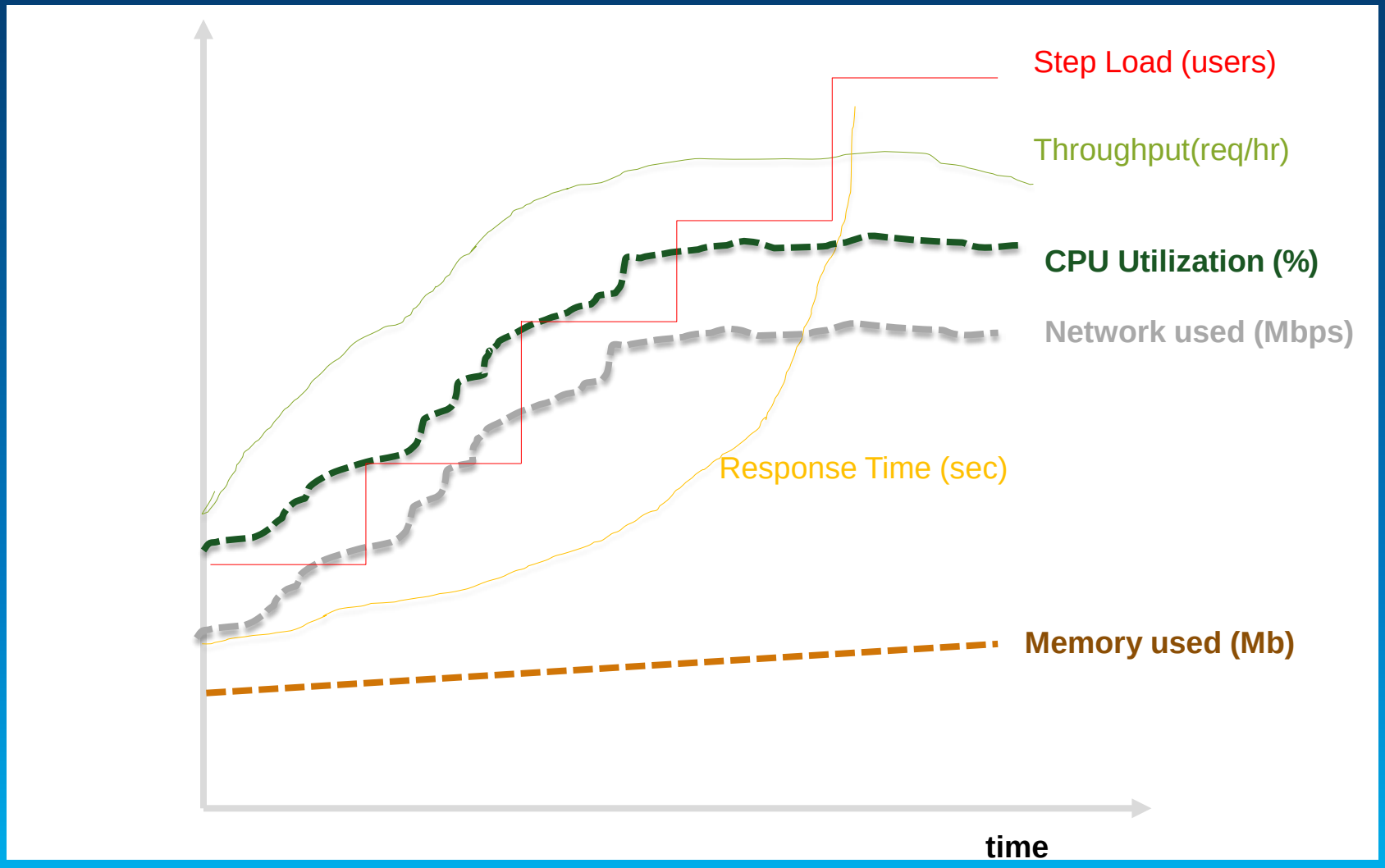
Definitions

Throughput (request/hr)



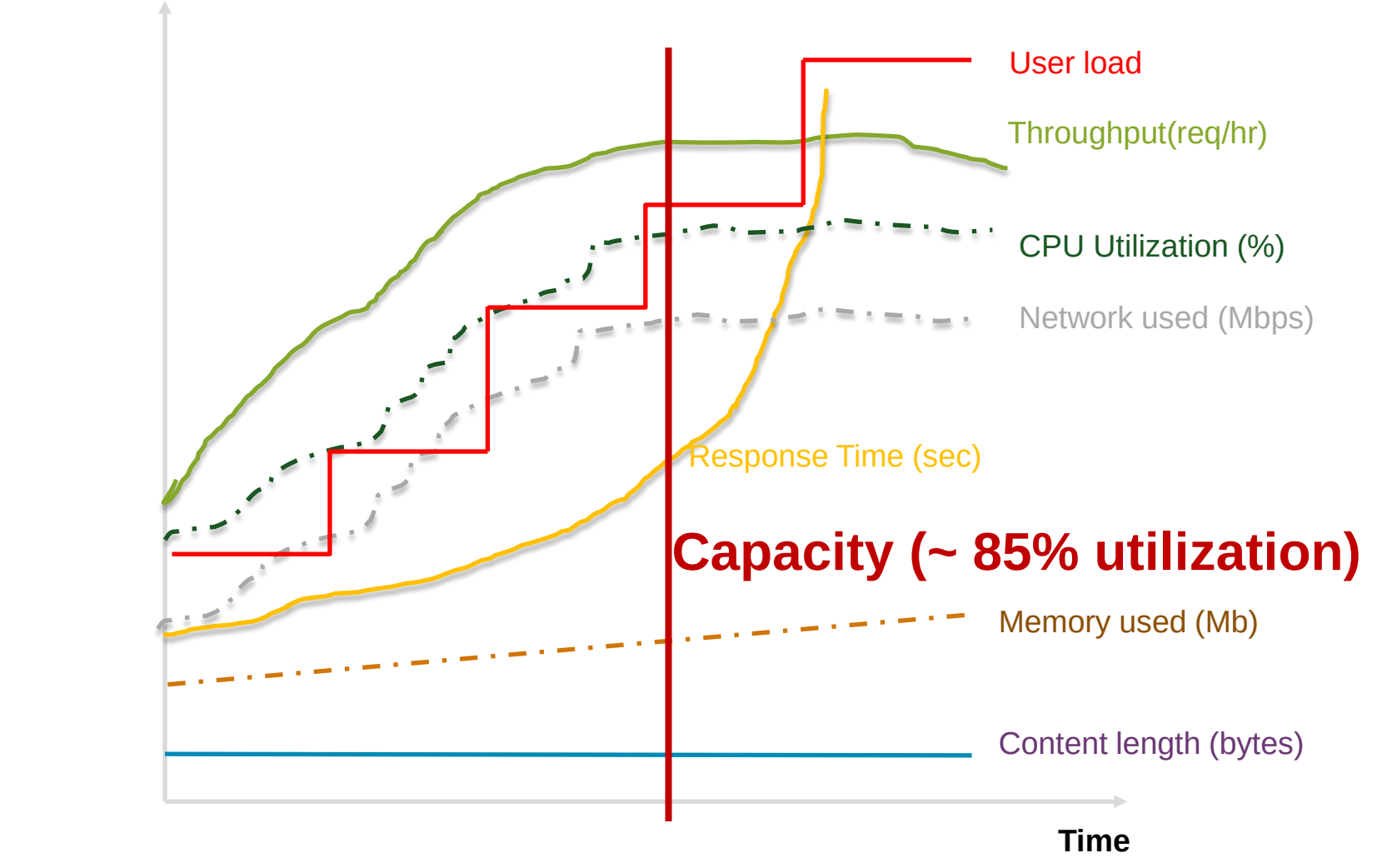
Definitions

Resource utilization: CPU, Memory, Network

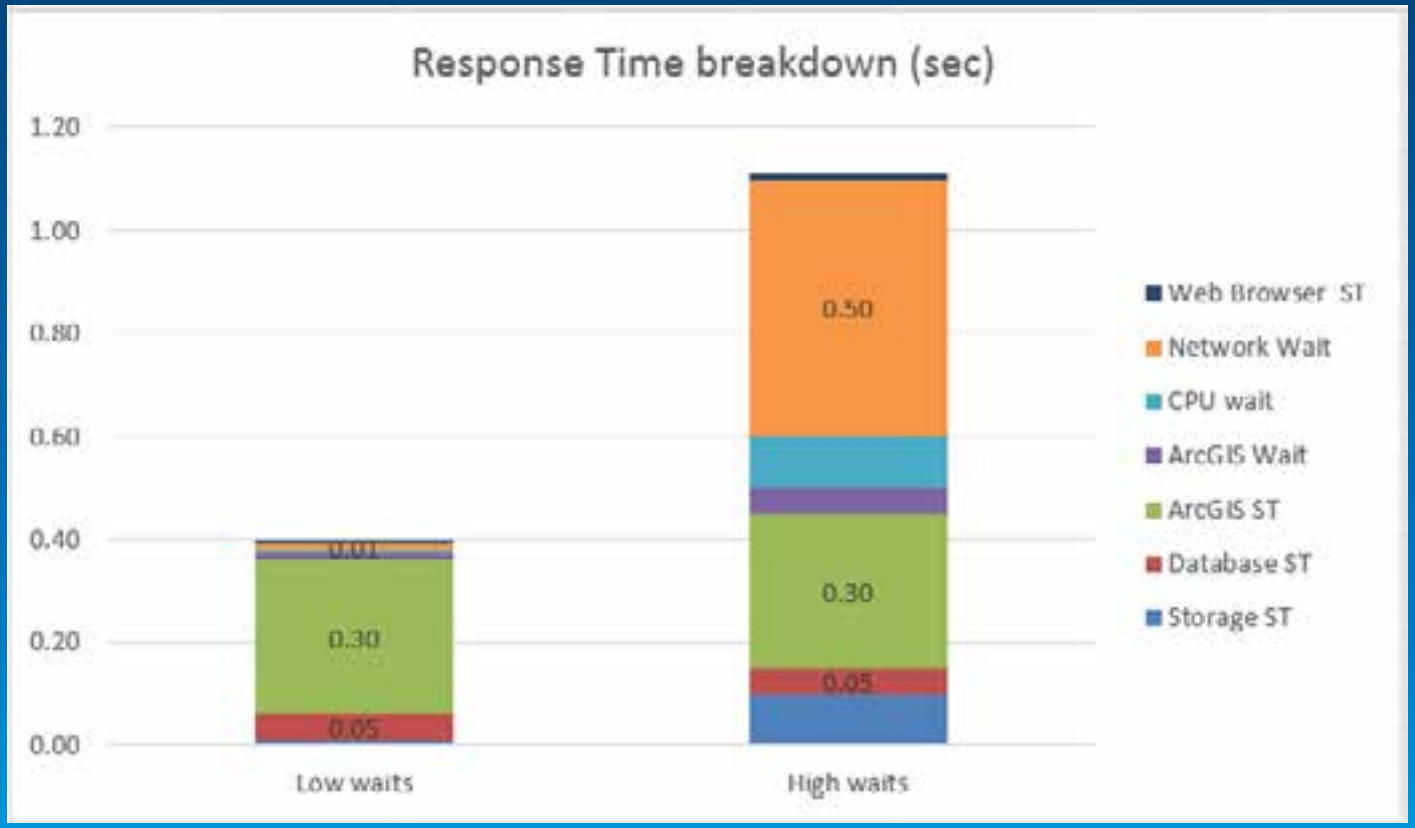


Definitions

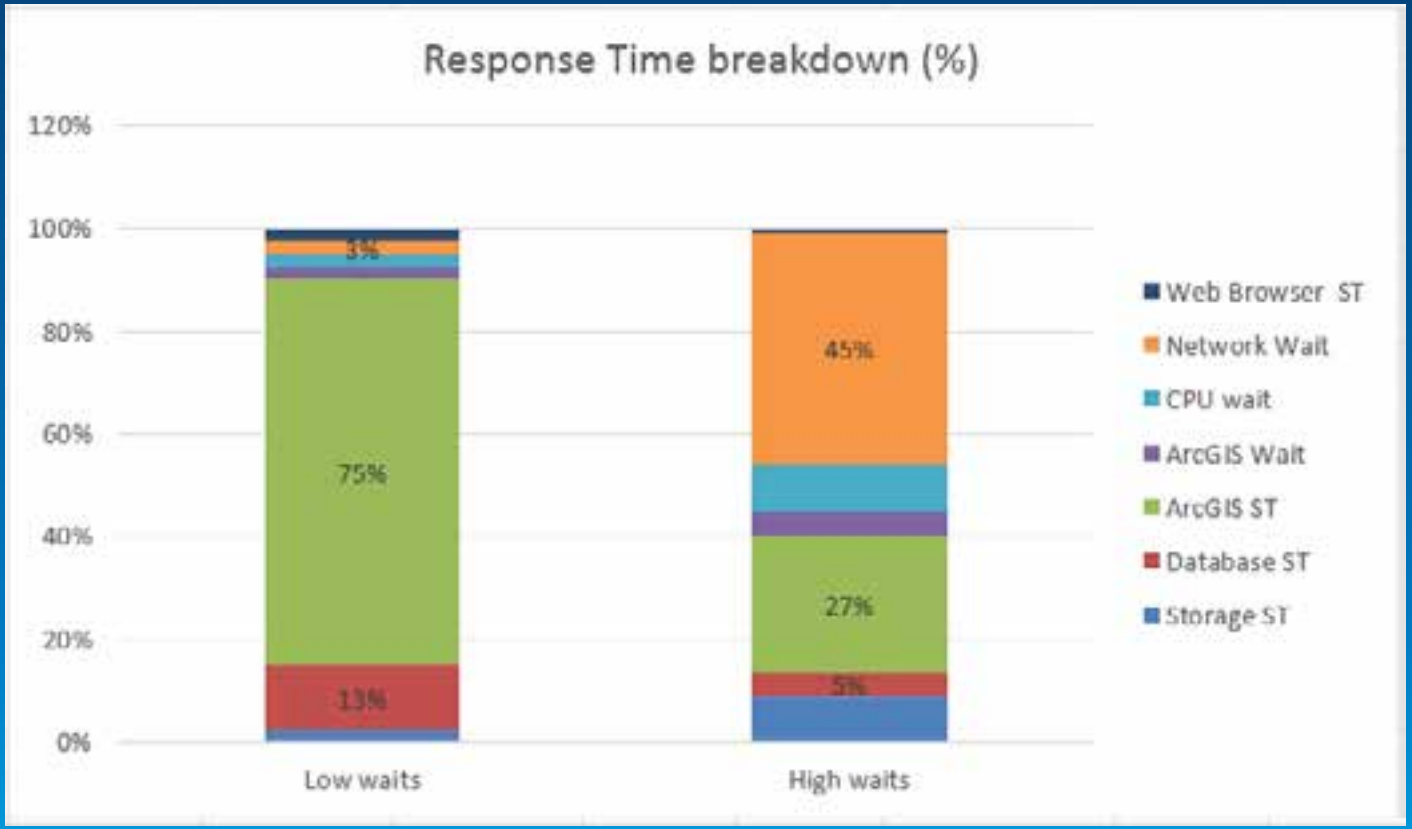
Capacity



Response time breakdown (sec)



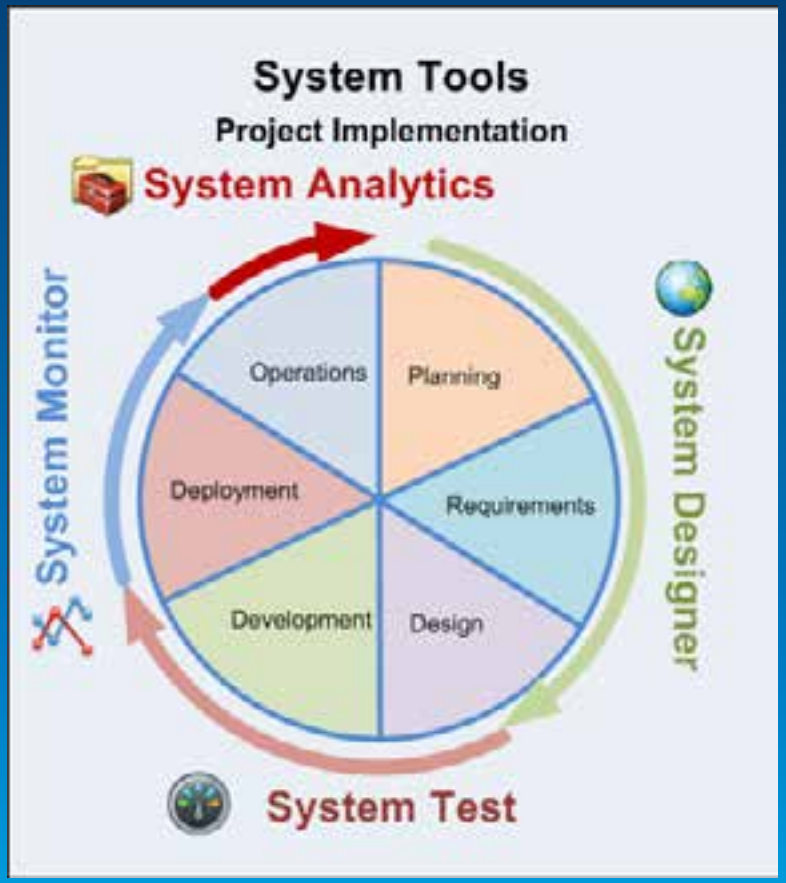
Response time breakdown (%)



Process

Esri Process and Tools

Holistic approach



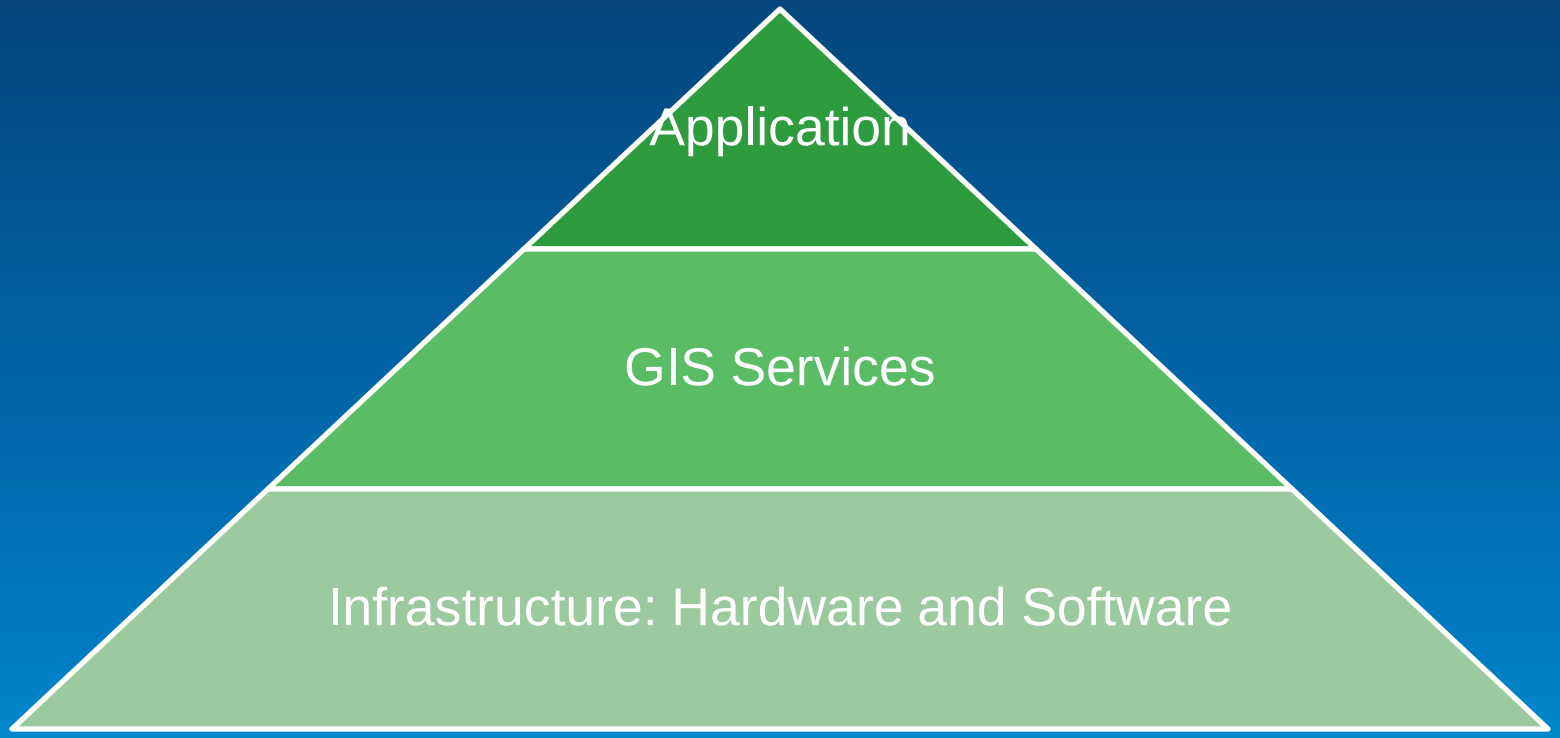
Tools

- http://www.arcgis.com
- owner:EnterpriseImp
- Show ArcGIS Desktop Content

Tools

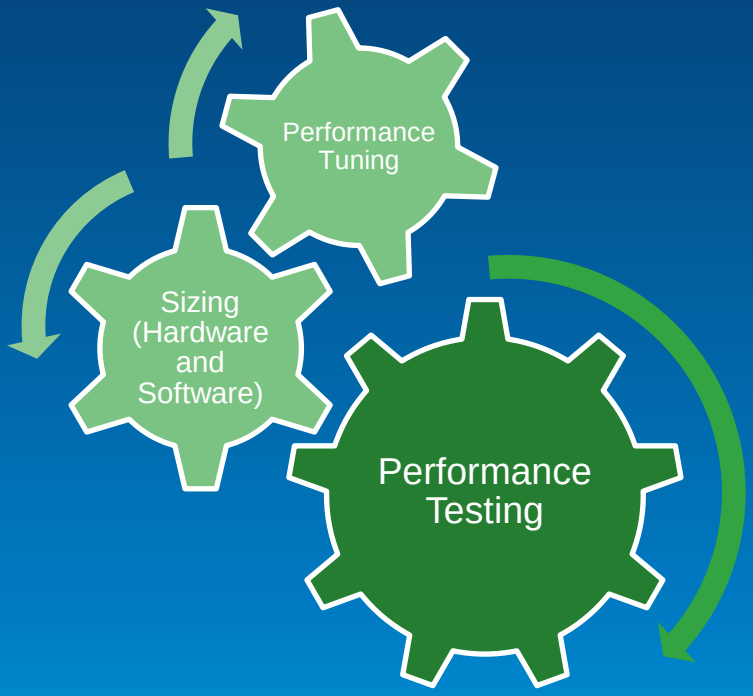
- System Designer
- http://www.arcgis.com/home/item.html?id=8ff490eef2794f428bde25b561226bda.
- System Test (Beta)
- http://www.arcgis.com/home/item.html?id=e8bac3559fd64352b799b6adf5721d81
- System Monitor (Beta)
- http://www.arcgis.com/home/item.html?id=848f48b0f88e4de7a036377197453efe
- System CPU
- http://www.arcgis.com/home/item.html?id=3e473b63a3254a6ab5f22e6f9608b209
- Mxdperfstat
- http://www.arcgis.com/home/item.html?id=a269d03aa1c840638680e2902dadecac
- Database Trace Tools
- http://www.arcgis.com/home/item.html?id=24c7b251159149848acc9b81cccb8356
-

Testing process



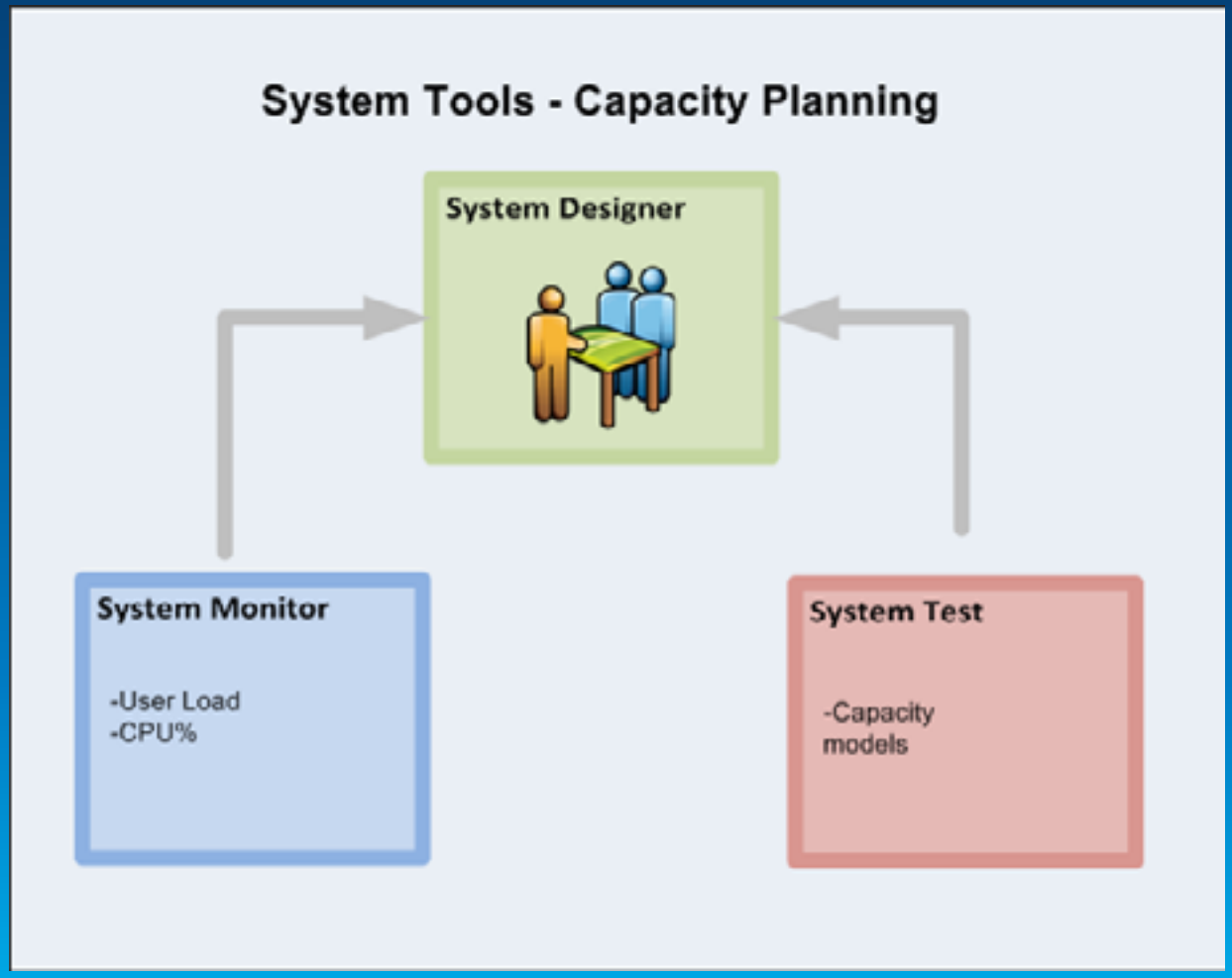
Required skill set

Configuration, Tuning, Testing



Capacity Planning

Tools



Requirements: Performance Service-Level Agreement

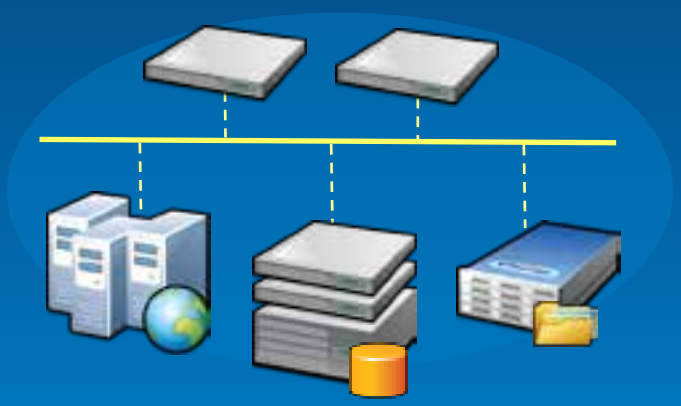
Requirements

Performance engineering addresses quality attributes

Functional Requirements

- Visualization
- Analysis
- Workflow Integration

Quality Attribute Requirements



- Availability
- Performance & Scalability
- Security

Requirements

- 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 Factors - Software

Performance Factors - Software

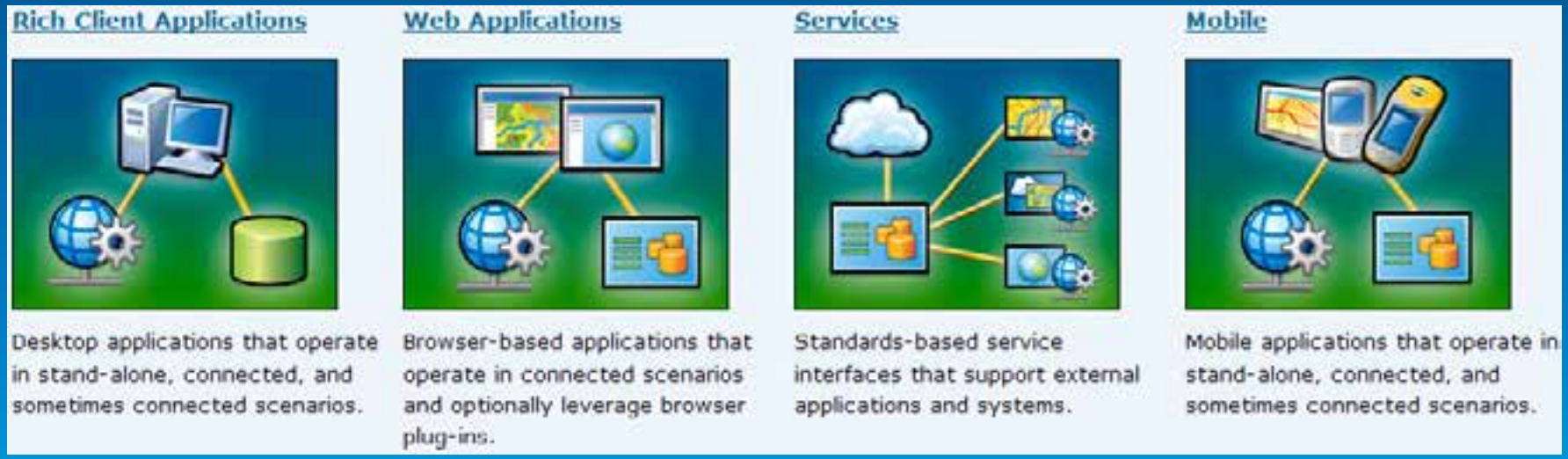
Application

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

Performance Factors - Software

Application Types

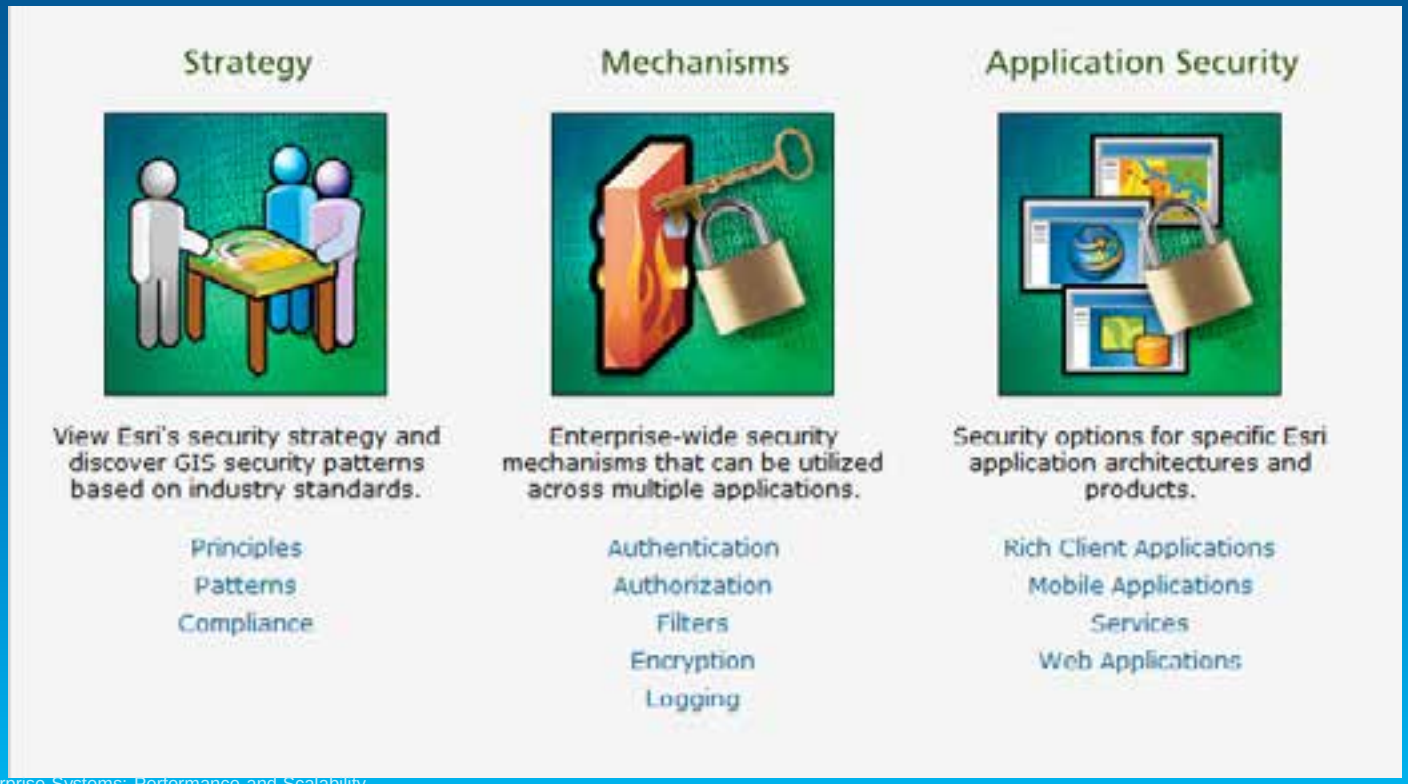
- http://resources.arcgis.com/en/communities/enterprise-gis/01n200000023000000.htm



Performance Factors - Software

Application Security

- http://resources.arcgis.com/en/communities/enterprise-gis/01n200000004000000.htm



Performance Factors - Software

GIS Services—ArcSOC instances

- Max Instances =~ #CPU Cores
- e.g. 2, 8 core machines, set max instance to 8

If max SOC instances are under configured, system will not scale.

Performance Factors - Software

GIS Services—Map Service

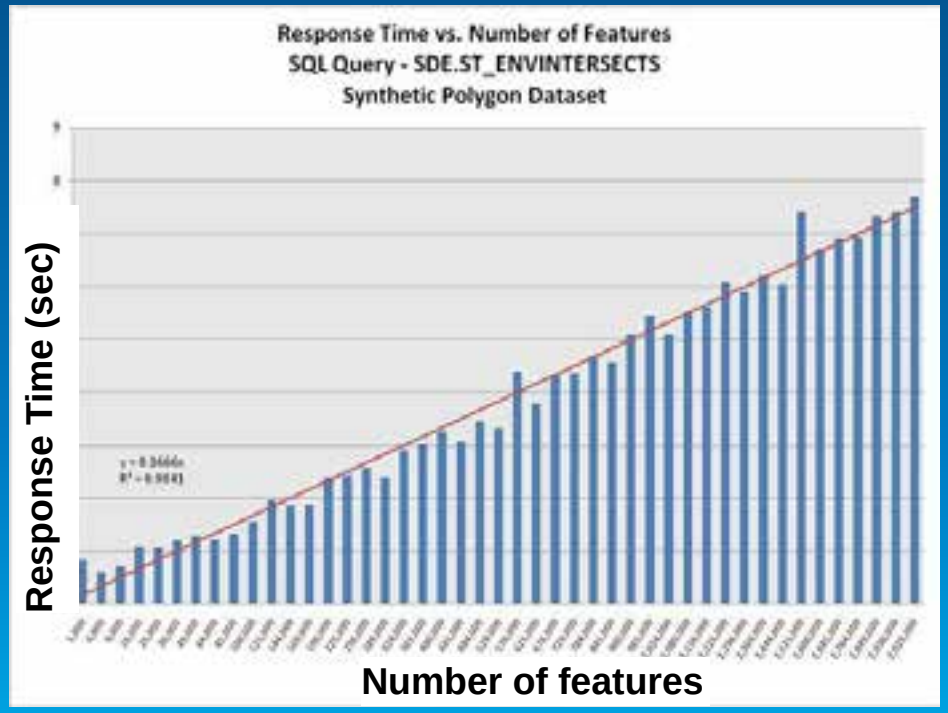
Source document (MXD) optimizations

- Keeping map symbols simple
  - Setting scale dependency
  - Avoiding multilayer, calculation-dependent symbols
  - Spatial index
  - Avoiding reprojections on the fly
  - Optimizing map text and labels for performance
    - Using annotations
    - Cost for Maplex and antialiasing
  - Using fast joins (no cross database joins)
  - Avoiding wavelet compression-based raster types (MrSid, JPEG 2000)

Performance Factors - Software

Map service

- Performance related to number of features and vertices



Performance Factors - Software

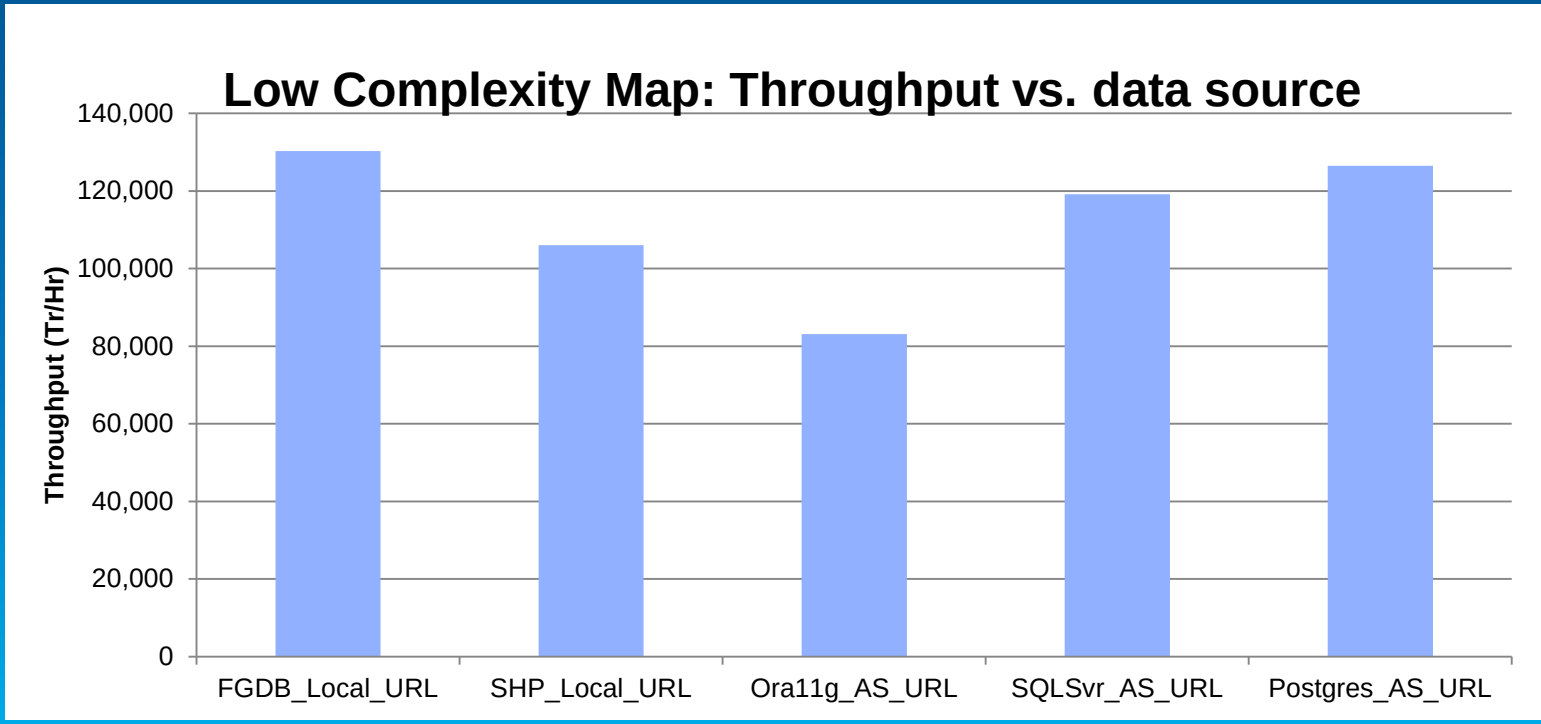
Geodatabase

- Keep delta tables and versioning tree small
  - Reconcile and post
  - Compress
  - Synchronize replicas
- Rebuild indexes
- Update statistics

Performance Factors - Software

Data storage

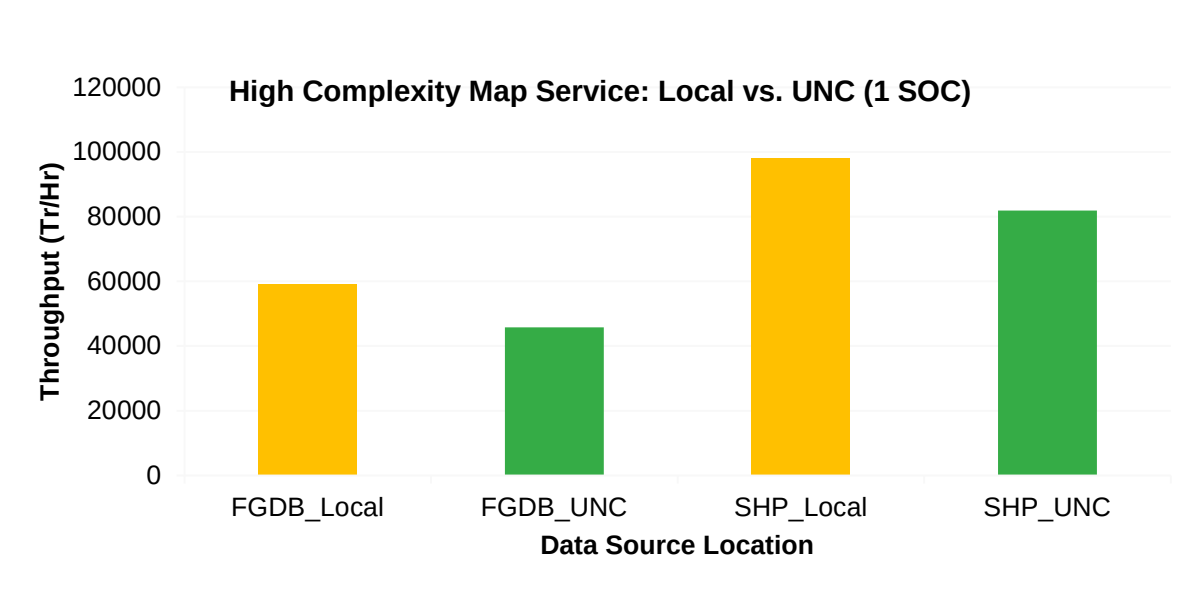
- Typically a low impact
- Small fraction (< 20%) of total response time



Performance Factors - Software

Data source location

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

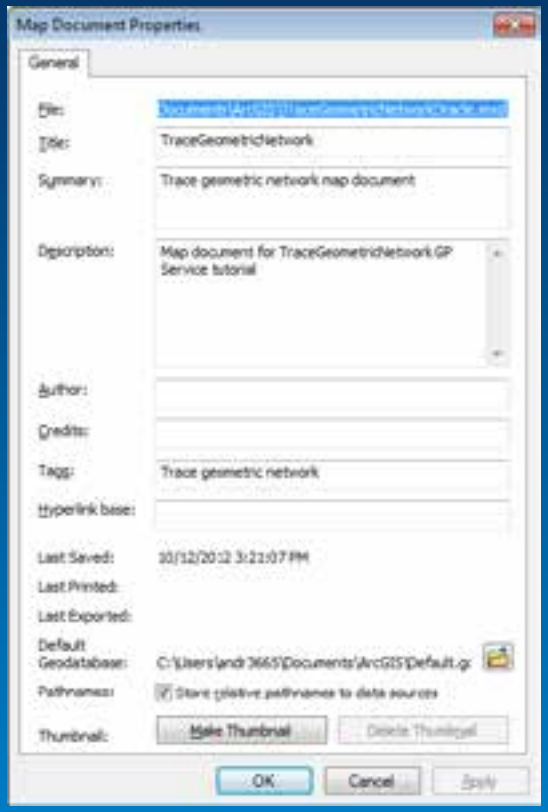


All disks being equal, locally sourced data results in better throughput.

Performance Factors - Software

ArcMap settings

- Default geodatabase
- Display cache
- Performance degradation
- when high network latency



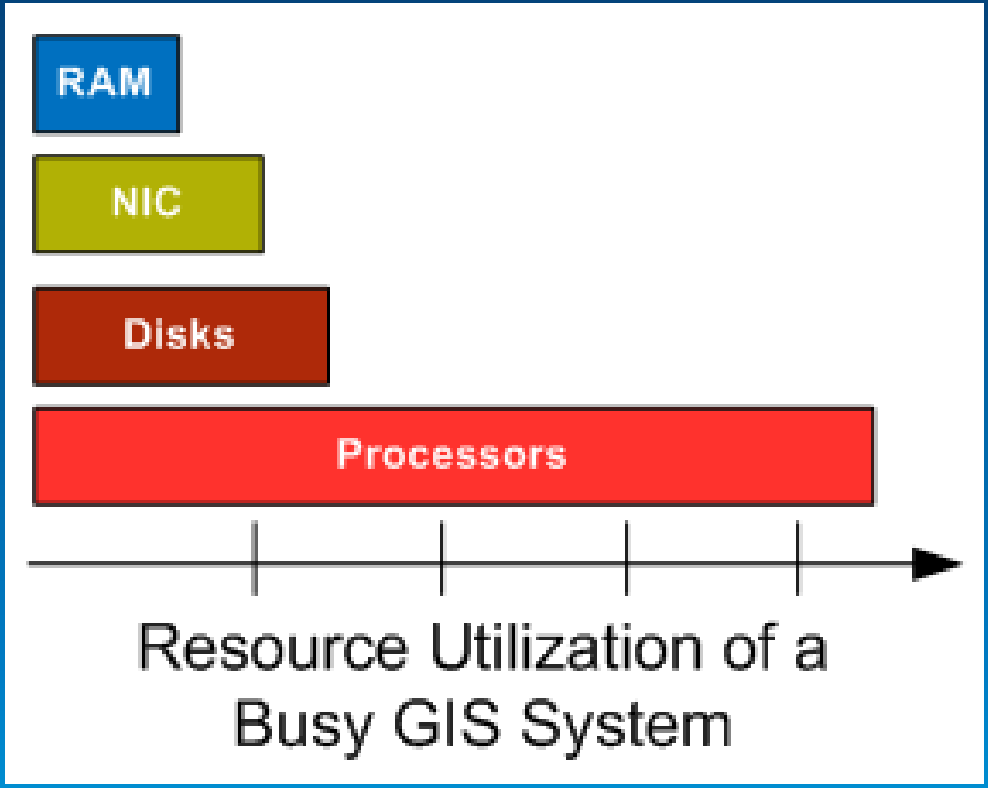
Typical case: global companies using roaming profile

Performance Factors - Hardware

Performance Factors - Hardware

Hardware Resources

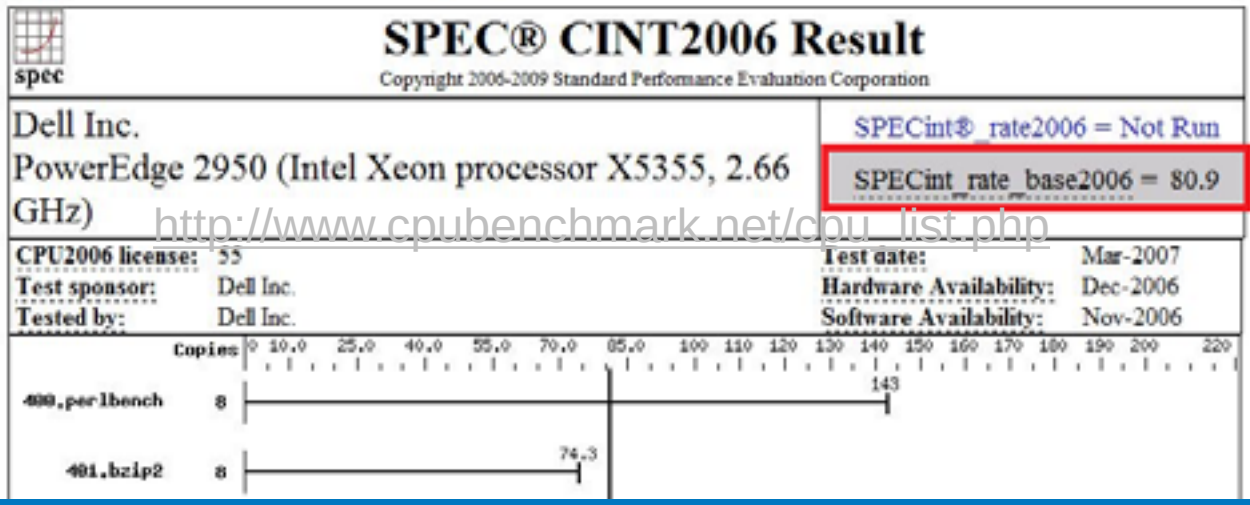
- CPU
- Network bandwidth
  - and latency
- Memory
- Disk



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

Performance Factors - Hardware

CPU Processor Speed – Specrate.org



SPEC® CINT2006 Result

Copyright 2006-2009 Standard Performance Evaluation Corporation

Dell Inc.

PowerEdge 2950 (Intel Xeon processor X5355, 2.66 GHz)

SPECint®_rate2006 = Not Run

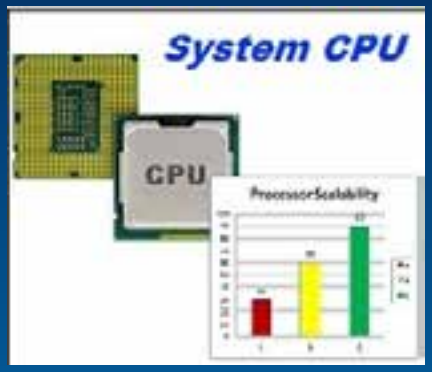
SPECint_rate_base2006 = 80.9

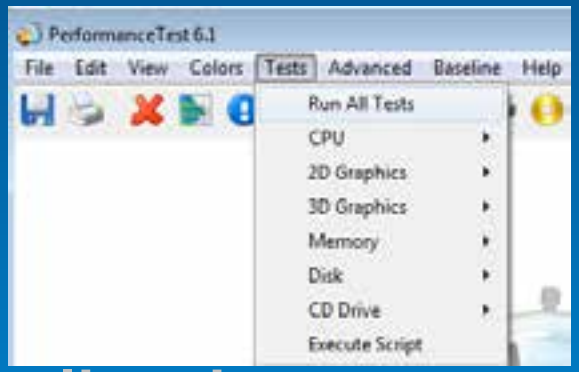
http://www.cpubenchmark.net/cpu_list.php

CPU2006 license:	55	Test date:	Mar-2007
Test sponsor:	Dell Inc.	Hardware Availability:	Dec-2006
Tested by:	Dell Inc.	Software Availability:	Nov-2006

Copies	0	10.0	25.0	40.0	55.0	70.0	85.0	100	110	120	130	140	150	160	170	180	190	200	220
400.perlbench 8													143						
401.bzip2 8							74.3												

Demo



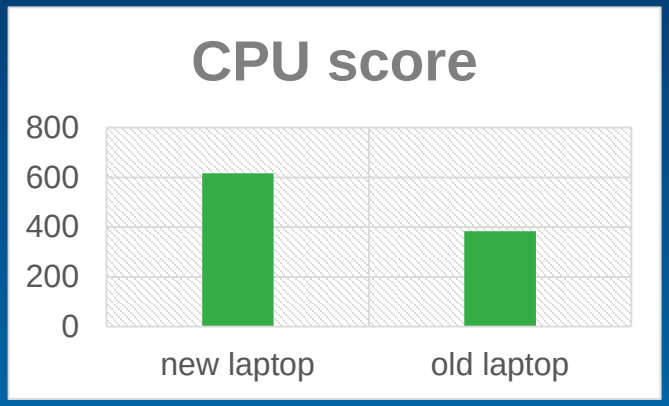


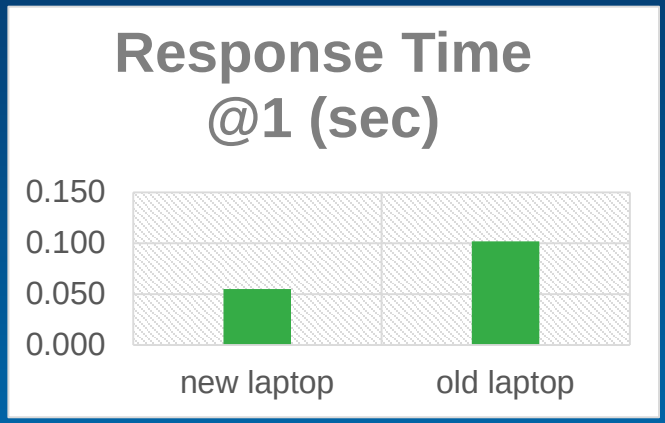
CPU Processor Speed

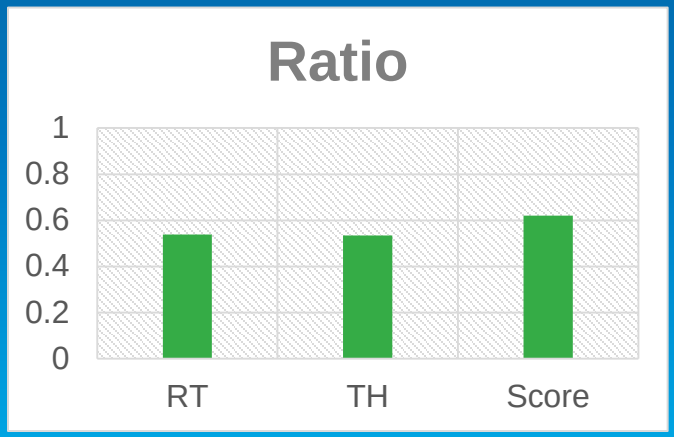
1. **System CPU**
2. **PassMark**

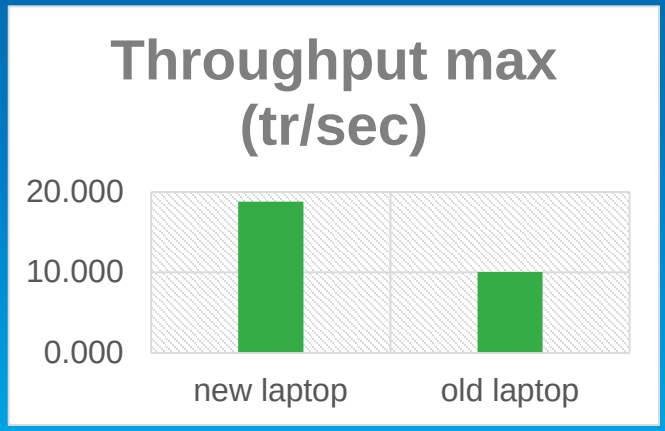
http://www.cpubenchmark.net/cpu_list.php

Impact of CPU speed









Performance Factors - Hardware

Capacity planning

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

$$\#CPU_t = \frac{ST_b \times TH_t \times 100}{3600 \times \%CPU_t} \times \frac{SpecRatePerCPU_b}{SpecRatePerCPU_t}$$

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

Design Phase—Performance Factors

Hardware Resources—Memory

Item	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 Factors - Hardware

Virtualization

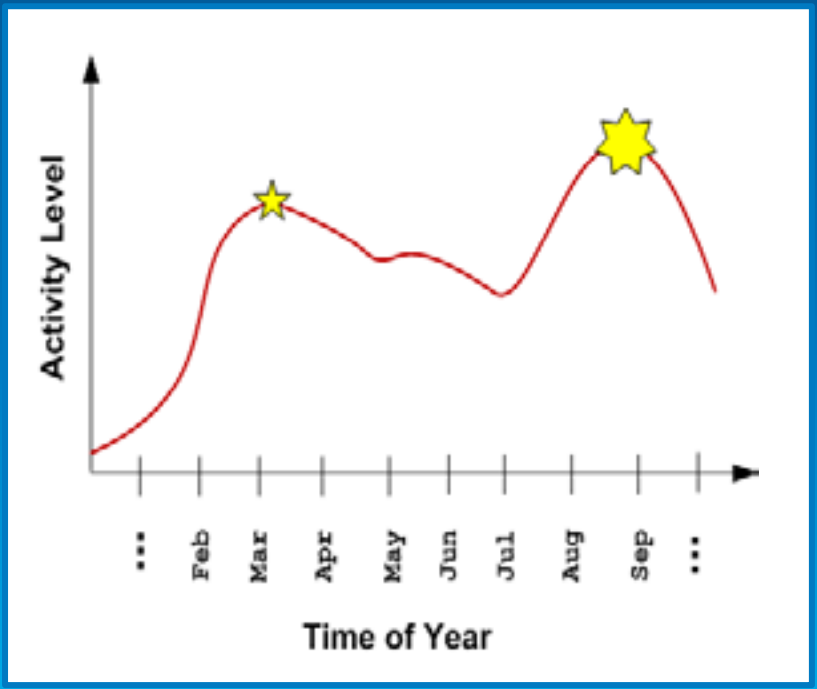
- Performance depends on configuration and implementation
  - 5-30%

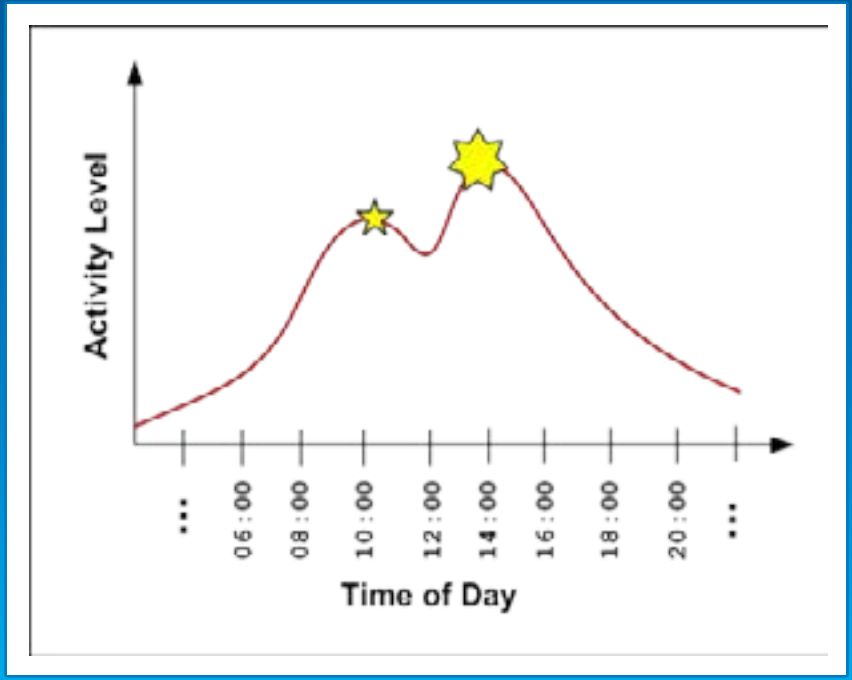
Overburdened VMs will incur significant performance degradation

Capacity Planning

Uncertainty of input information—Planning hour

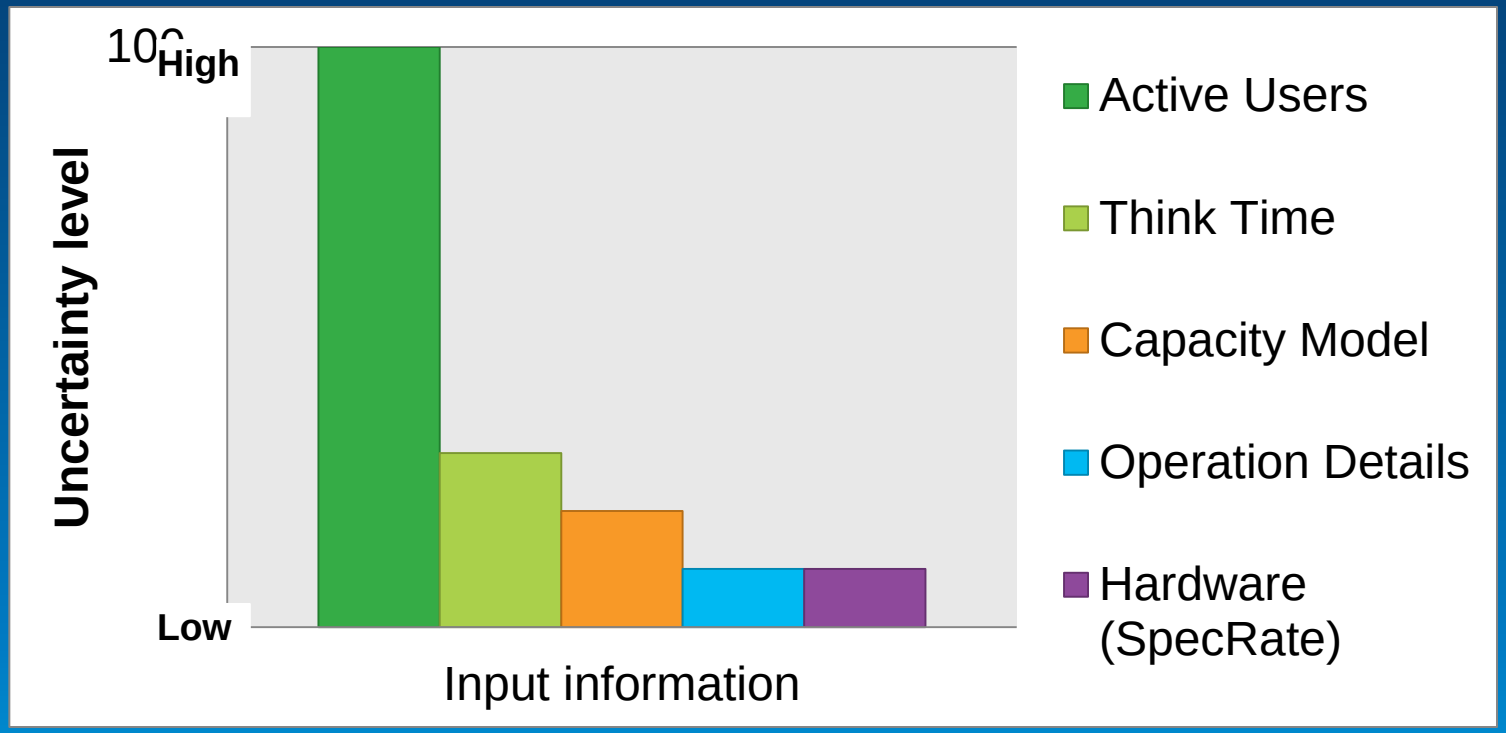
- Identify the Peak Planning Hour (most cases).





Capacity Planning

Uncertainty of input information

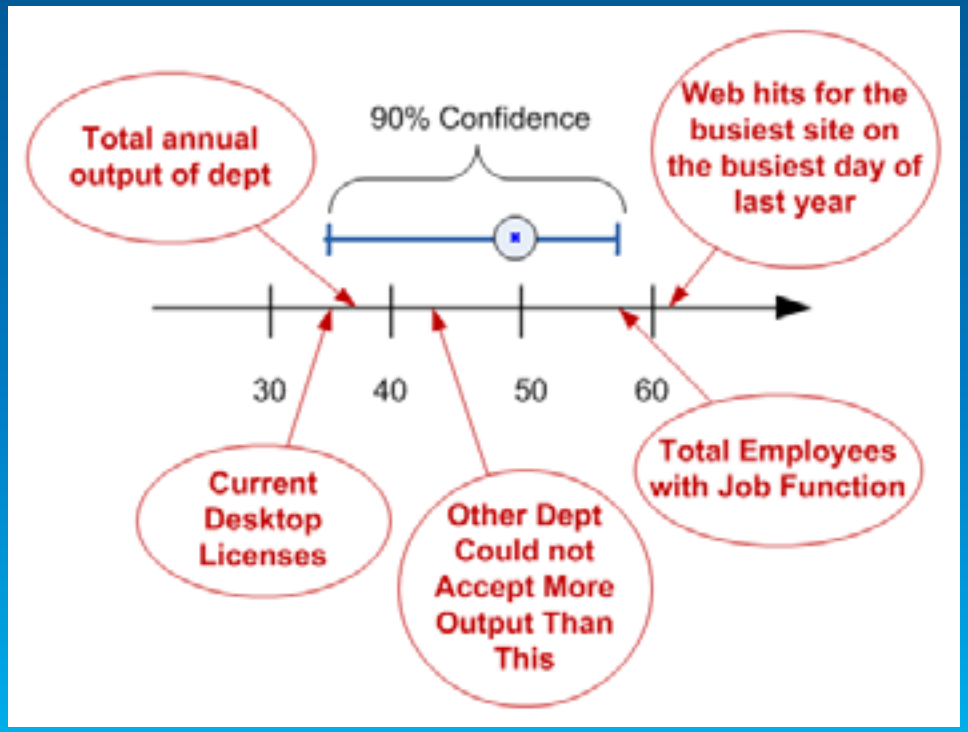


Define user load first.

Capacity Planning

Uncertainty of input information

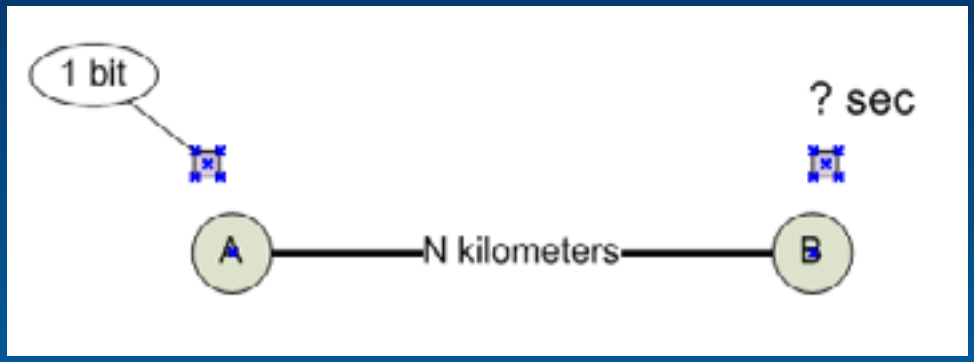
- License
- Total employees
- Usage logs



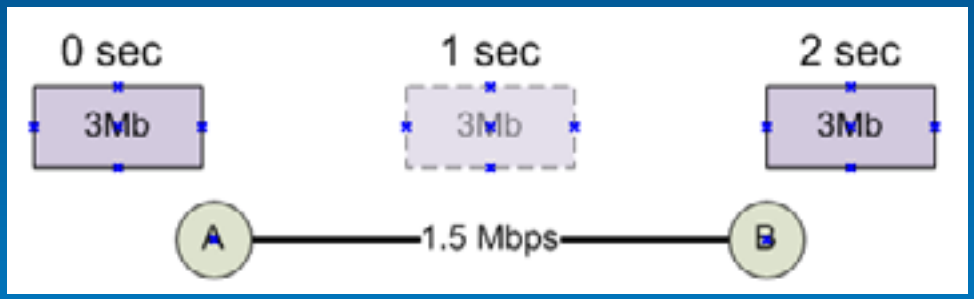
Performance Factors - Hardware

Network

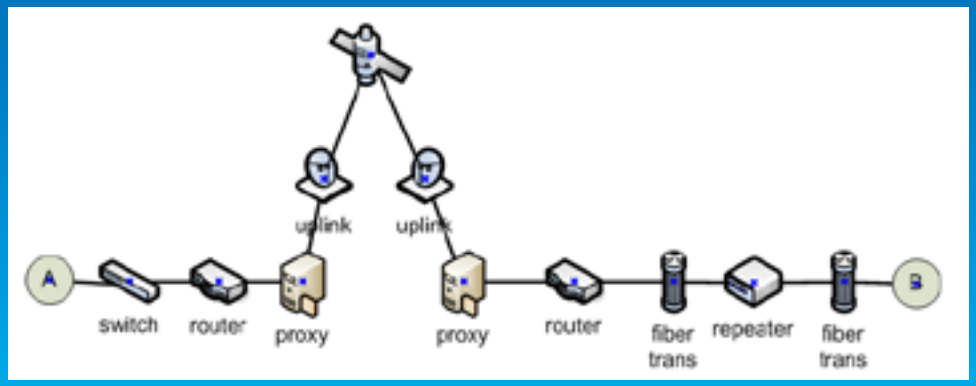
1. Distance



2. Payload



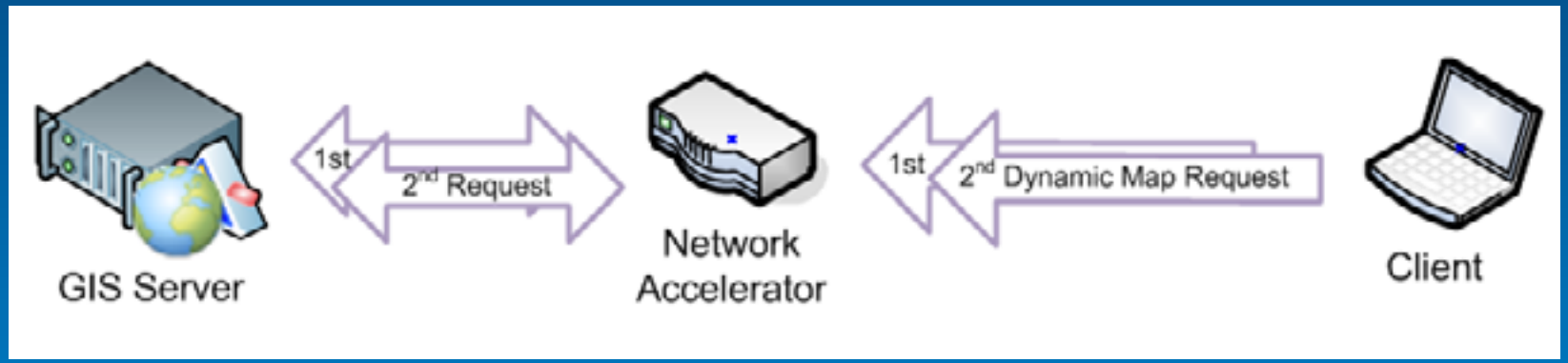
3. Infrastructure

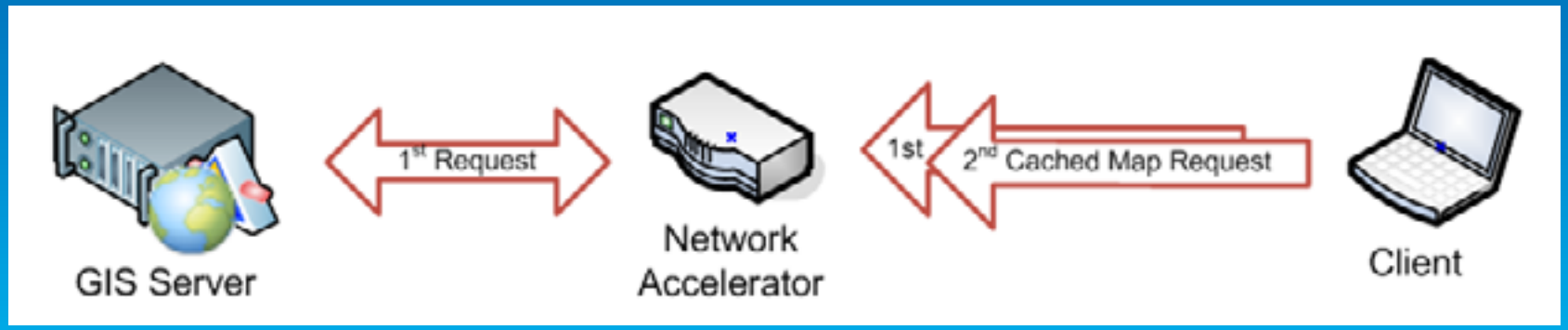


Performance Factors - Hardware

Network

- Network accelerator improves performance of repeated request.





Performance Factors - Hardware

Network transport time

- Required bandwidth
  - Response size
  - Number of transactions

$$Mbps = \frac{TH' \; Mbits/req}{3600}$$

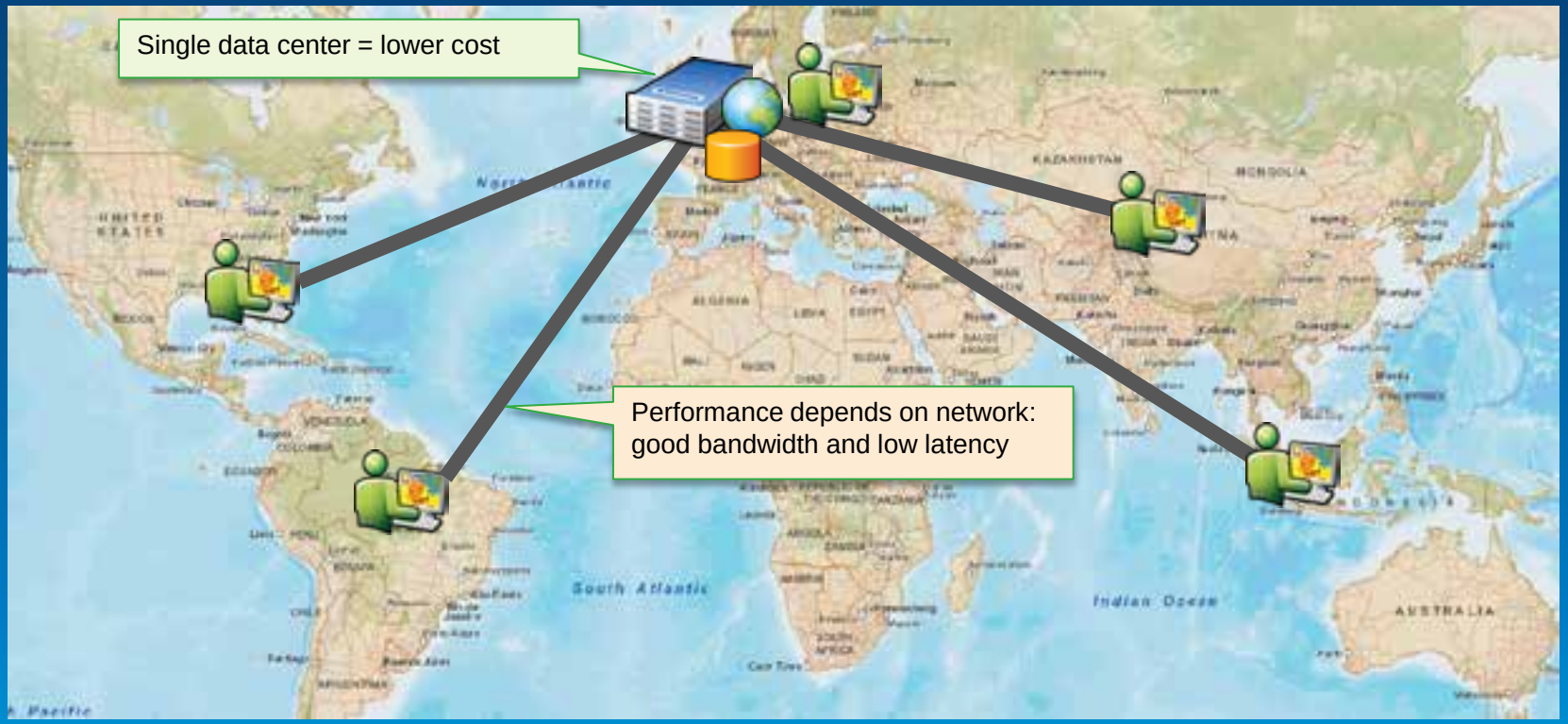
- Network transport time
  - Response size
  - Effective bandwidth

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

All Built into System Designer

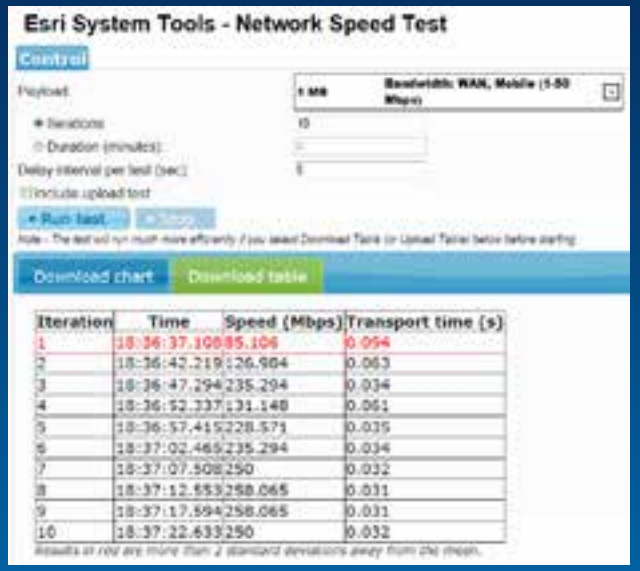
Network Testing

Important for cloud based solutions



Cloud vendors offer multiple location. Which one is the best for your global solution?

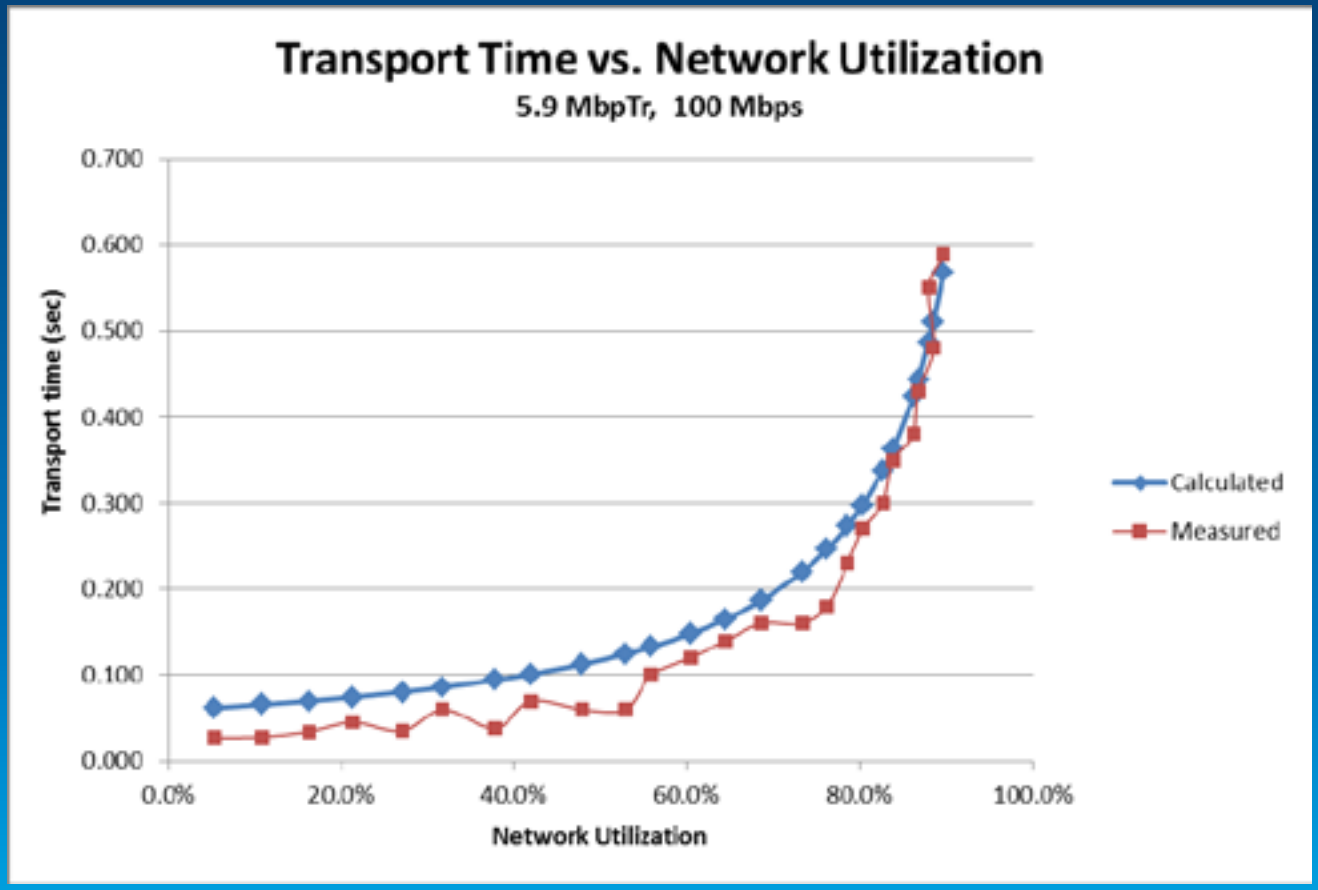
Demo



Network Speed Test Tool: http://localhost/speedtest/

Performance Factors - Hardware

Network



Performance Factors - Hardware

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	Map	Vector		10	178.571	6.494	1.000	0.222	0.100	0.010
Citrix/ArcGIS	Map	Vectror+Image	ICA Comp	1	17.857	0.649	0.100	0.022	0.010	0.001
Citrix/ArcGIS	Map	Vector	ICA Comp	0.3	5.357	0.195	0.030	0.007	0.003	0.000
ArcGIS Server	Map	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

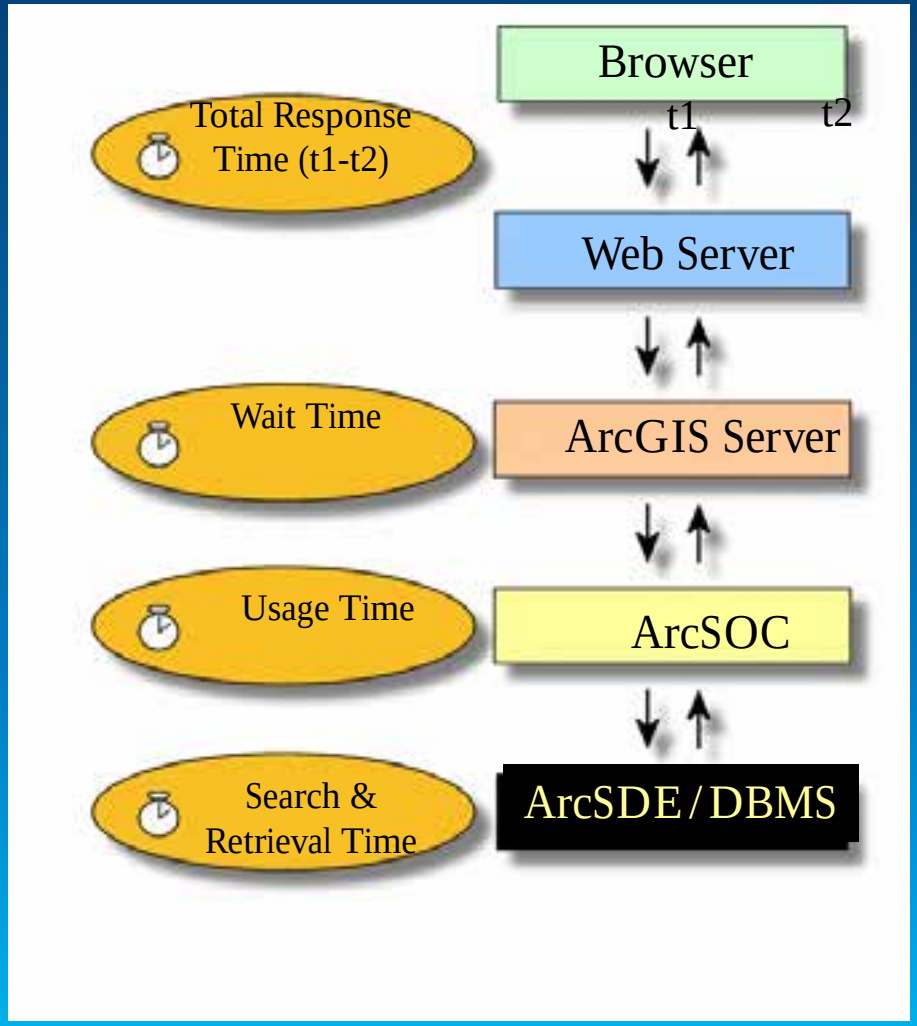
Demo

System Designer

Tuning:
A reproducible test cases

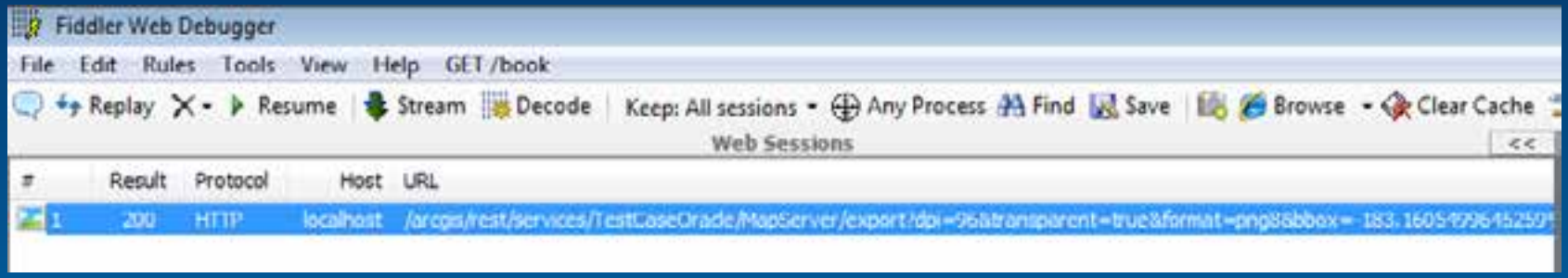
Tuning methodology

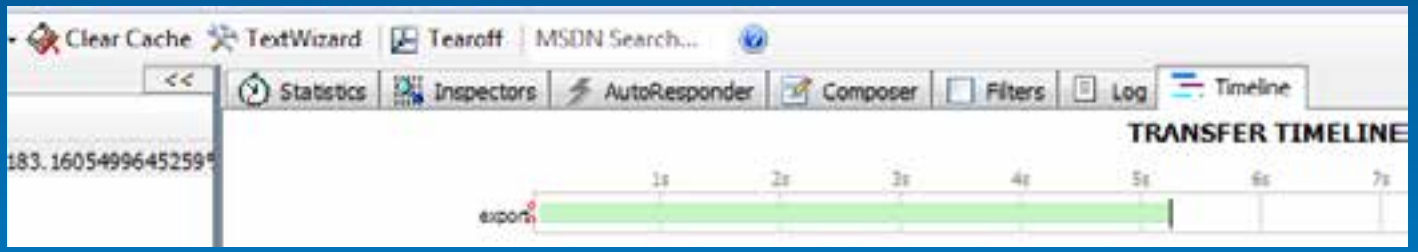
Profile each tier starting from the top



Fiddler

Fiddler measurement approximately 5.2 seconds



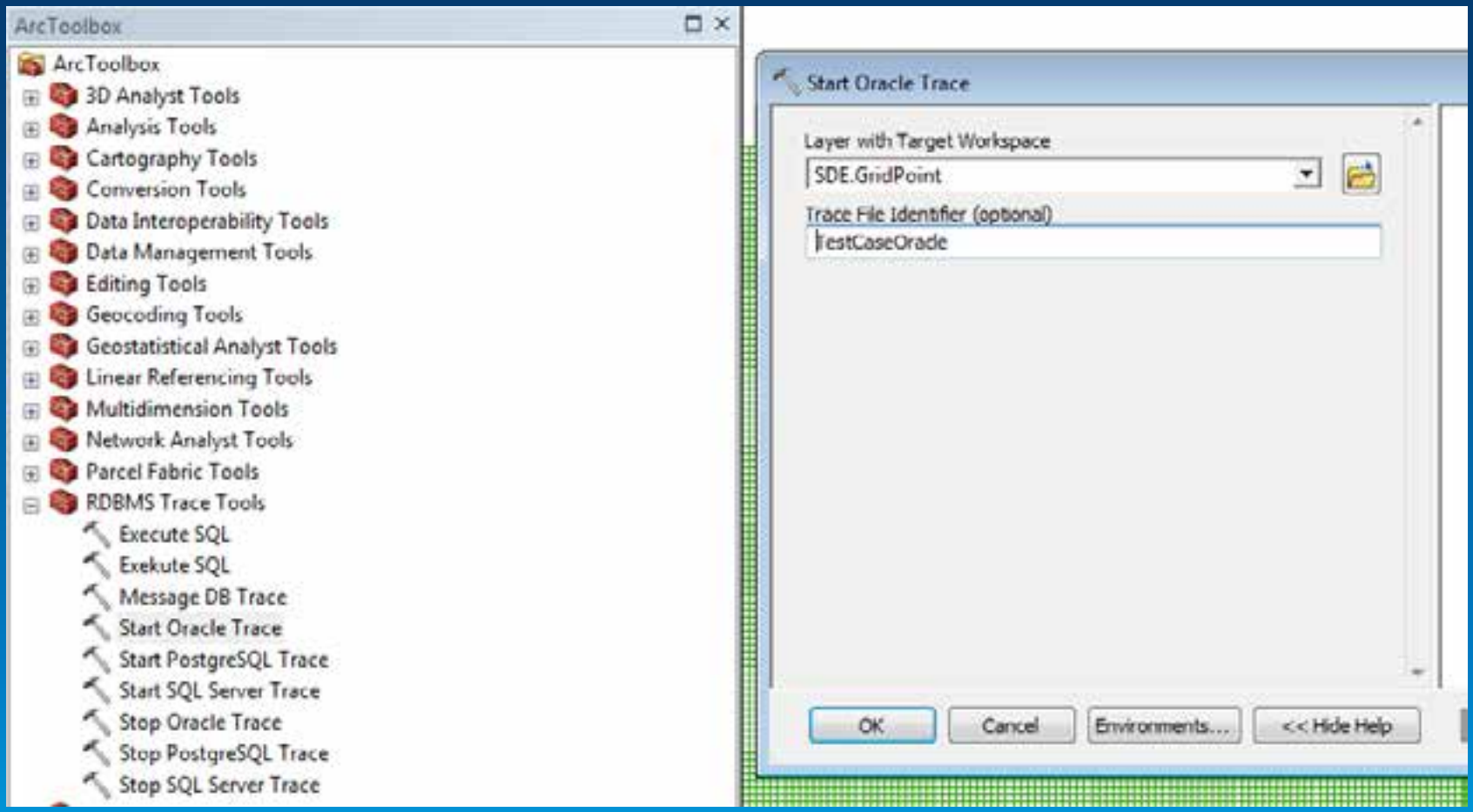


Mxdperfstat

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
1	167,935,665	SDE.GridPoint	4.75	run DBMS trace: oraCPU=4.74; run DBMS trace, check oracle execution plan: oraLIO=130936; check if index exist for query def attributes;	1,998		False	4.74	.00	4.56	4.74	130,936

DBMS LIO	DBMS PIO	Source	LayerType	Layer Spatial Reference	LayerQueryDef
130,936		esriDBMS_Oracle,asakowicz,sde:oracle$asakowicz:1521/gis2,sde	esriGeometryPoint	GCS_WGS_1984	ID<1000

DBMS Trace



http://www.arcgis.com/home/item.html?id=24c7b251159149848acc9b81cccb8356

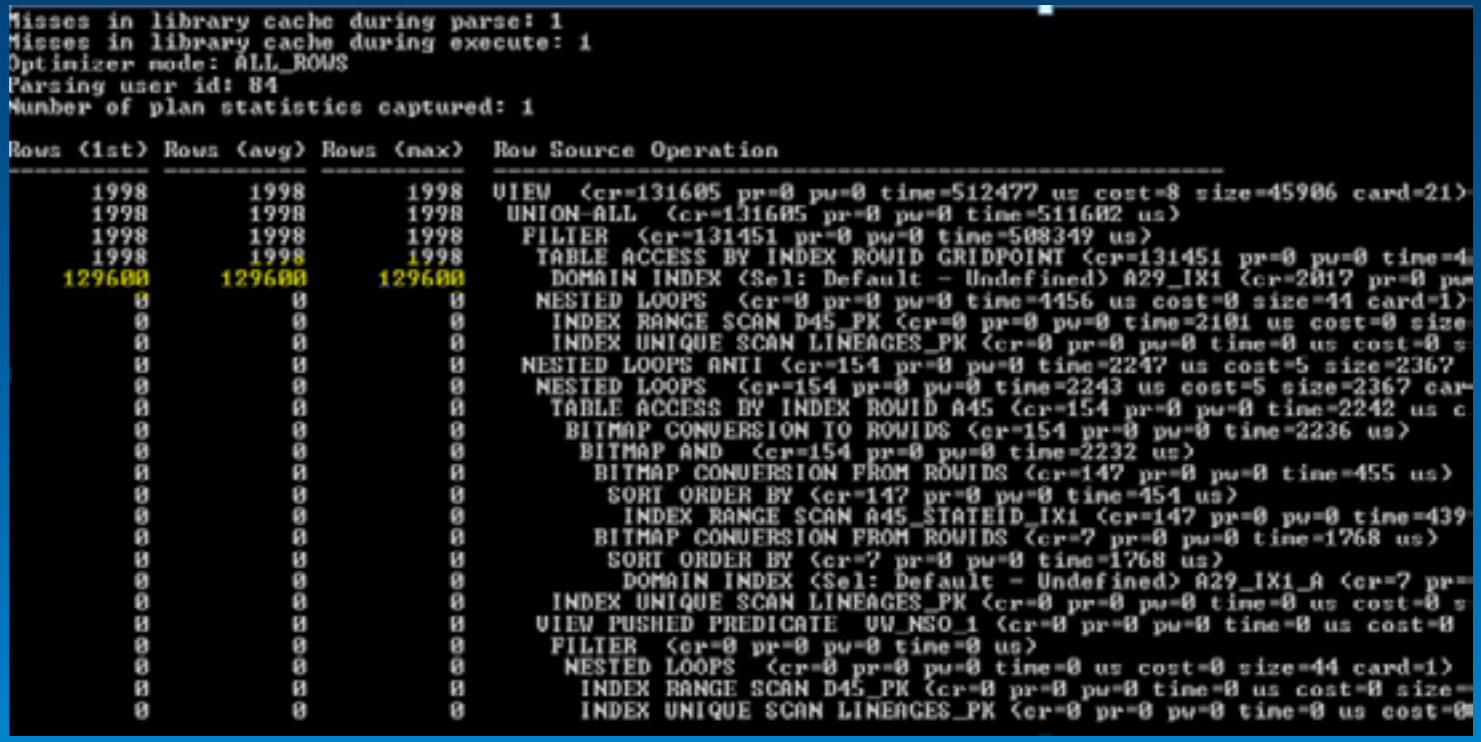
Oracle Trace

Compare elapsed time

```
SQL ID: 6p20xry10fw4n Plan Hash: 569628948

SELECT  V__45.st_SHAPE$, V__45.OID,  V__45.st_points,V__45.st_numpts,
  V__45.st_entity,V__45.st_minx,V__45.st_miny,V__45.st_maxx,V__45.st_maxy,
  V__45.st_minz,V__45.st_maxz,V__45.st_minm,V__45.st_maxm,V__45.st_area$,
  V__45.st_len$,V__45.st_rowid
FROM
 (SELECT b.OID,b.GX,b.GY,b.ID,1 st_SHAPE$ ,b.SHAPE.points as st_points,
  b.SHAPE.numpts as st_numpts,b.SHAPE.entity as st_entity,b.SHAPE.minx as
  st_minx,b.SHAPE.miny as st_miny,b.SHAPE.maxx as st_maxx,b.SHAPE.maxy as
  st_maxy,b.SHAPE.minz as st_minz,b.SHAPE.maxz as st_maxz,b.SHAPE.minm as
  st_minm,b.SHAPE.maxm as st_maxm,b.SHAPE.area as st_area$,b.SHAPE.len as
  st_len$,b.rowid as st_rowid FROM SDE.GridPoint b WHERE
  SDE.ST_EnvIntersects(b.SHAPE,:1,:2,:3,:4) = 1  AND b.OID NOT IN (SELECT /*+
  HASH_AJ */ SDE_DELETES_ROW_ID FROM SDE.D45 WHERE DELETED_AT IN (SELECT
  l.lineage_id FROM SDE.state_lineages l WHERE l.lineage_name =
  :lineage_name1 AND l.lineage_id <= :state_id1) AND SDE_STATE_ID = 0) UNION
  ALL SELECT a.OID,a.GX,a.GY,a.ID,2 st_SHAPE$ ,a.SHAPE.points as st_points,
  a.SHAPE.numpts as st_numpts,a.SHAPE.entity as st_entity,a.SHAPE.minx as
  st_minx,a.SHAPE.miny as st_miny,a.SHAPE.maxx as st_maxx,a.SHAPE.maxy as
  st_maxy,a.SHAPE.minz as st_minz,a.SHAPE.maxz as st_maxz,a.SHAPE.minm as
  st_minm,a.SHAPE.maxm as st_maxm,a.SHAPE.area as st_area$,a.SHAPE.len as
  st_len$,a.rowid as st_rowid FROM SDE.A45 a,SDE.state_lineages SL WHERE
  SDE.ST_EnvIntersects(a.SHAPE,:5,:6,:7,:8) = 1  AND (a.OID, a.SDE_STATE_ID)
  NOT IN (SELECT /*+ HASH_AJ */ SDE_DELETES_ROW_ID, SDE_STATE_ID FROM SDE.D45
  WHERE DELETED_AT IN (SELECT  l.lineage_id FROM SDE.state_lineages l WHERE
  l.lineage_name = :lineage_name2 AND l.lineage_id <= :state_id2) AND
  SDE_STATE_ID > 0) AND a.SDE_STATE_ID = SL.lineage_id AND SL.lineage_name =
  :lineage_name3 AND SL.lineage_id <= :state_id3) V__45 WHERE  (ID<1000)


call     count       cpu    elapsed       disk      query    current        rows
------- ------  -------- ---------- ---------- ---------- ----------  ----------
Parse        0      0.00       0.00          0          0          0           0
Execute      1      0.03       0.02          0          0          0           0
Fetch       20      9.67       9.64          0     129581          0        1998
------- ------  -------- ---------- ---------- ---------- ----------  ----------
total       21      9.70       9.66          0     129581          0        1998
```

Elapsed time slightly changed due to different test runs

Oracle Execution plan



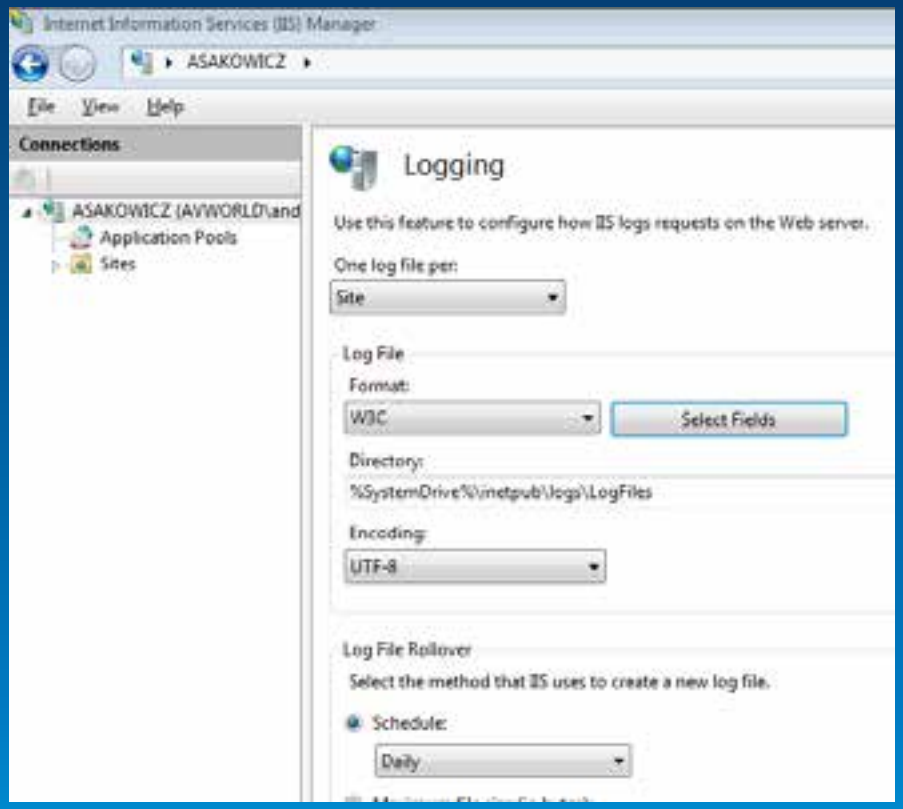
```
Misses in library cache during parse: 1
Misses in library cache during execute: 1
Optimizer mode: ALL_ROWS
Parsing user id: 84
Number of plan statistics captured: 1

Rows (1st) Rows (avg) Rows (max)  Row Source Operation
---------- ---------- ----------  ---------------------------------------------------
      1998       1998       1998  VIEW  (cr=131605 pr=0 pw=0 time=512477 us cost=8 size=45906 card=21)
      1998       1998       1998   UNION-ALL  (cr=131605 pr=0 pw=0 time=511602 us)
      1998       1998       1998    FILTER  (cr=131451 pr=0 pw=0 time=508349 us)
      1998       1998       1998     TABLE ACCESS BY INDEX ROWID GRIDPOINT (cr=131451 pr=0 pw=0 time=4
    129600     129600     129600      DOMAIN INDEX (Sel: Default - Undefined) A29_IX1 (cr=2017 pr=0 pw
         0          0          0     NESTED LOOPS  (cr=0 pr=0 pw=0 time=4456 us cost=0 size=44 card=1)
         0          0          0      INDEX RANGE SCAN D45_PK (cr=0 pr=0 pw=0 time=2101 us cost=0 size
         0          0          0      INDEX UNIQUE SCAN LINEAGES_PK (cr=0 pr=0 pw=0 time=0 us cost=0 s
         0          0          0    NESTED LOOPS ANTI (cr=154 pr=0 pw=0 time=2247 us cost=5 size=2367
         0          0          0     NESTED LOOPS  (cr=154 pr=0 pw=0 time=2243 us cost=5 size=2367 car
         0          0          0      TABLE ACCESS BY INDEX ROWID A45 (cr=154 pr=0 pw=0 time=2242 us c
         0          0          0       BITMAP CONVERSION TO ROWIDS (cr=154 pr=0 pw=0 time=2236 us)
         0          0          0        BITMAP AND  (cr=154 pr=0 pw=0 time=2232 us)
         0          0          0         BITMAP CONVERSION FROM ROWIDS (cr=147 pr=0 pw=0 time=455 us)
         0          0          0          SORT ORDER BY (cr=147 pr=0 pw=0 time=454 us)
         0          0          0           INDEX RANGE SCAN A45_STATEID_IX1 (cr=147 pr=0 pw=0 time=439
         0          0          0         BITMAP CONVERSION FROM ROWIDS (cr=7 pr=0 pw=0 time=1768 us)
         0          0          0          SORT ORDER BY (cr=7 pr=0 pw=0 time=1768 us)
         0          0          0           DOMAIN INDEX (Sel: Default - Undefined) A29_IX1_A (cr=7 pr=
         0          0          0      INDEX UNIQUE SCAN LINEAGES_PK (cr=0 pr=0 pw=0 time=0 us cost=0 s
         0          0          0     VIEW PUSHED PREDICATE  VW_NSO_1 (cr=0 pr=0 pw=0 time=0 us cost=0
         0          0          0      FILTER  (cr=0 pr=0 pw=0 time=0 us)
         0          0          0       NESTED LOOPS  (cr=0 pr=0 pw=0 time=0 us cost=0 size=44 card=1)
         0          0          0        INDEX RANGE SCAN D45_PK (cr=0 pr=0 pw=0 time=0 us cost=0 size=
         0          0          0        INDEX UNIQUE SCAN LINEAGES_PK (cr=0 pr=0 pw=0 time=0 us cost=0
```

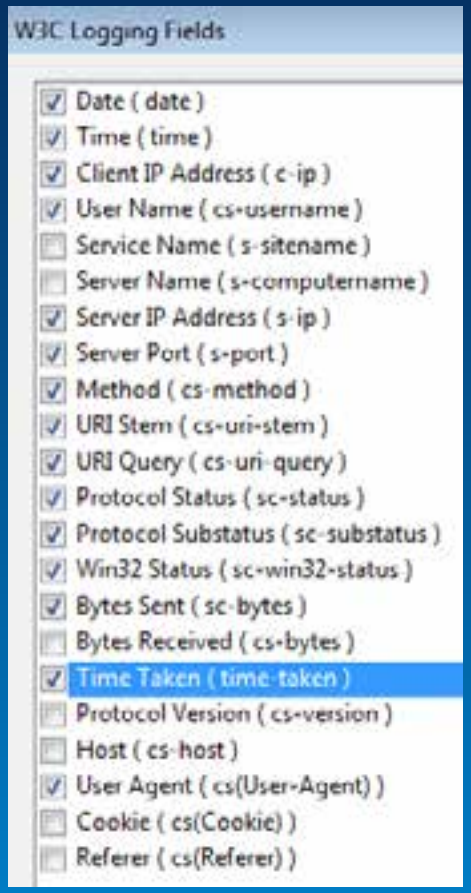
Inefficient spatial index

Tuning:
No-reproducible test cases

Analyze Web server Logs

IIS log measurement 5.256 seconds






```
2013-01-27 03:33:24 127.0.0.1 GET
/arcgis/rest/services/TestCaseOracle/MapServer/export
dpi=96&transparent=true&format=png8&bbox=-183.1605499645259%2C-
150.11246842655726%2C186.31768953052474%2C146.54329647921992&bboxSR=4326&imageSR
=4326&size=964%2C774&f=image 80 - 127.0.0.1 Mozilla/5.0+(compatible;+MSIE+9.0;
+Windows+NT+6.1;+WOW64;+Trident/5.0) 200 0 0 5256
```

ArcGIS Server logs

Analyzing lots of entries might be challenging

Monitoring

Demo

KPI Template

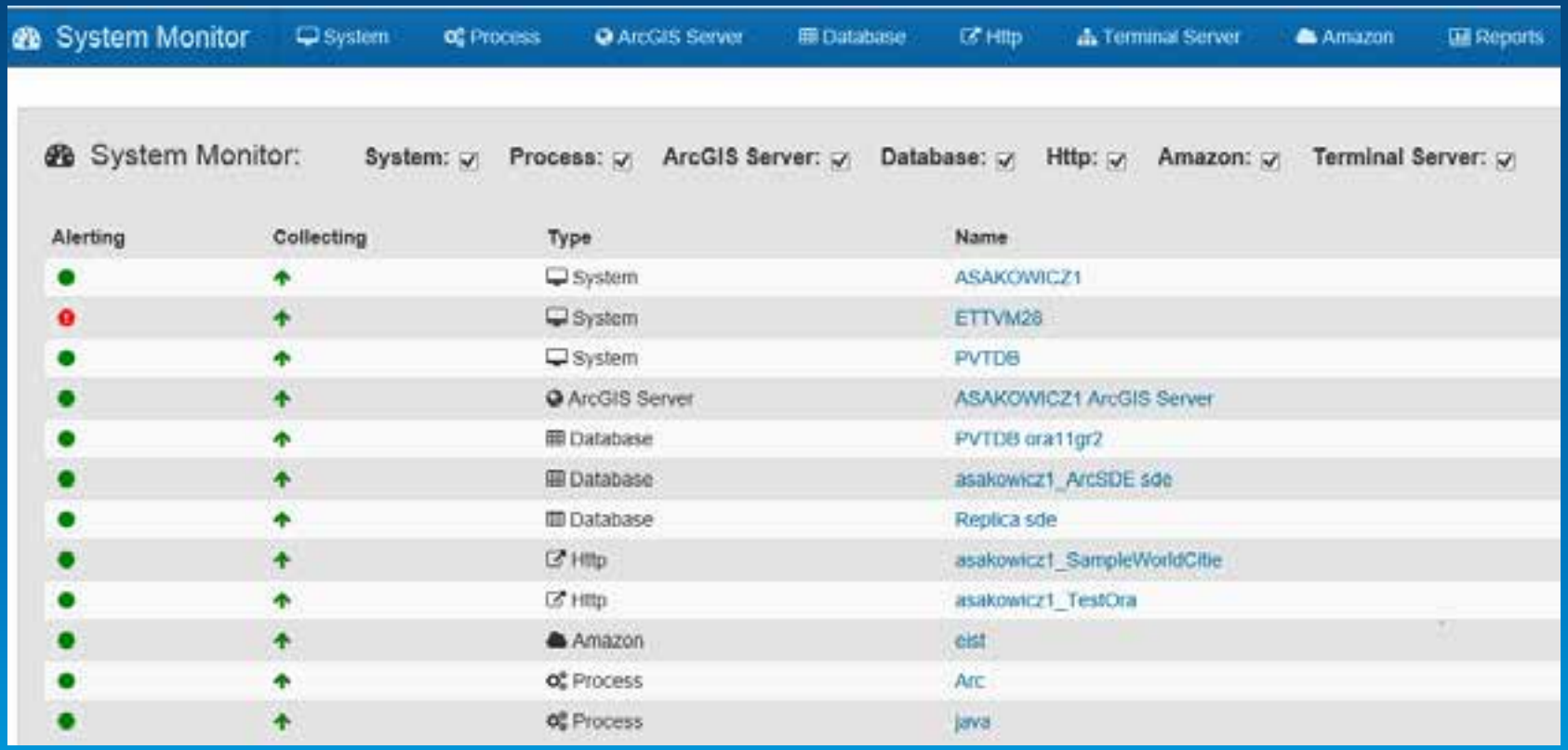
Key Performance Indicators:		
Period:	10/1/2013 to 11/1/2013	
	Indicator	
Category	Scope	Name
Usage		
	Applicatin log	Users
	Web log	Unique IP
	Web log	Hits
	AGS Service Name A	(Tr/s)
	Citrix Application Name	Terminal Server total sessions
		Terminal Server active sessions
	ArcGIS Desktop Application Name	Connections
Availability		
	Applicatin log	Error (%)
	Applicatin log	Error total
	Application URL A	Error (%)
	Application URL A	Error total
Performance		
	Application URL A	Url (s)
	Mxd A	Mxd (s)
	sql A	Sql (s)

Demo

System Monitor -Introduction

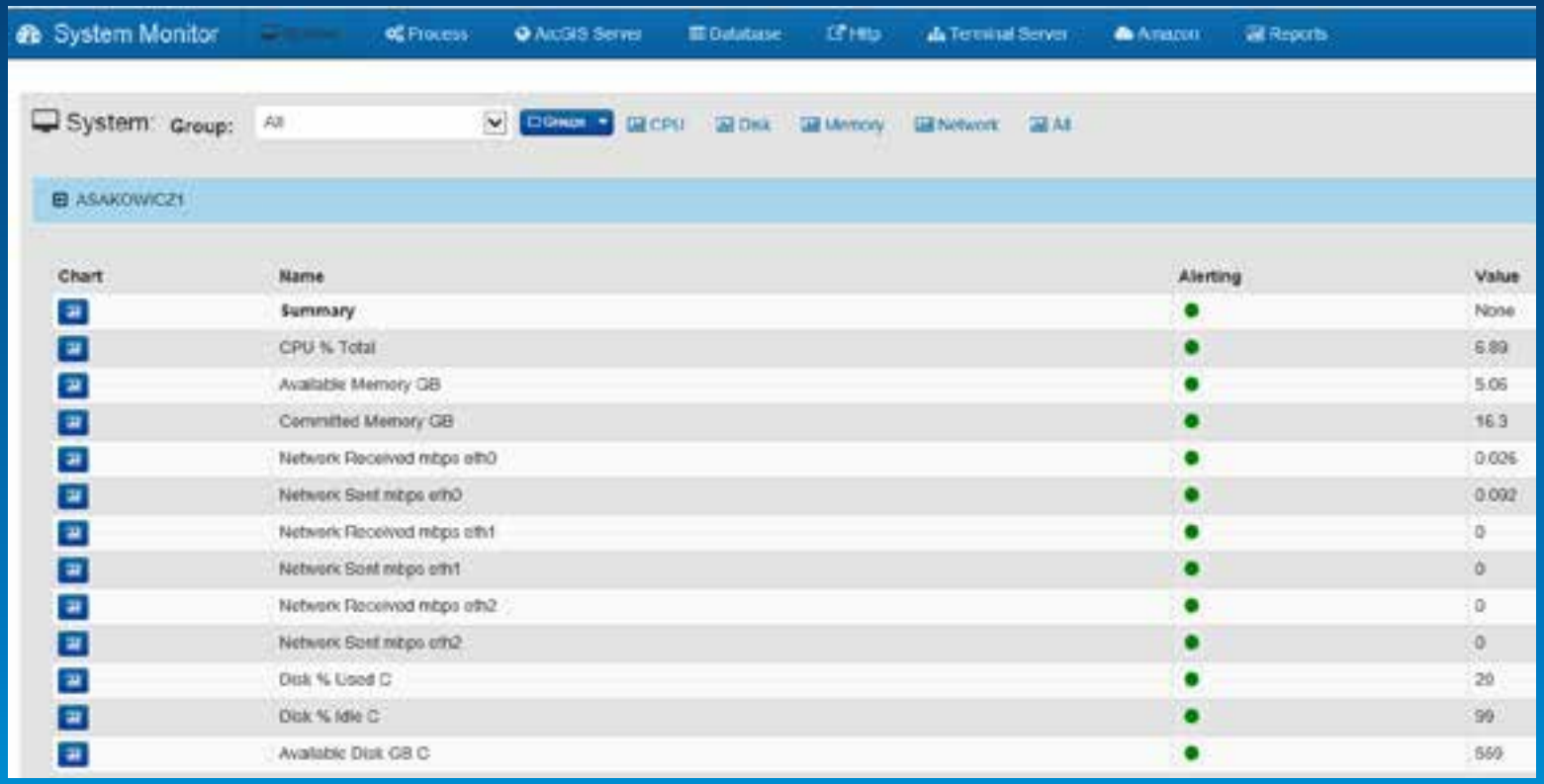
System Monitor

Overview



System Monitor

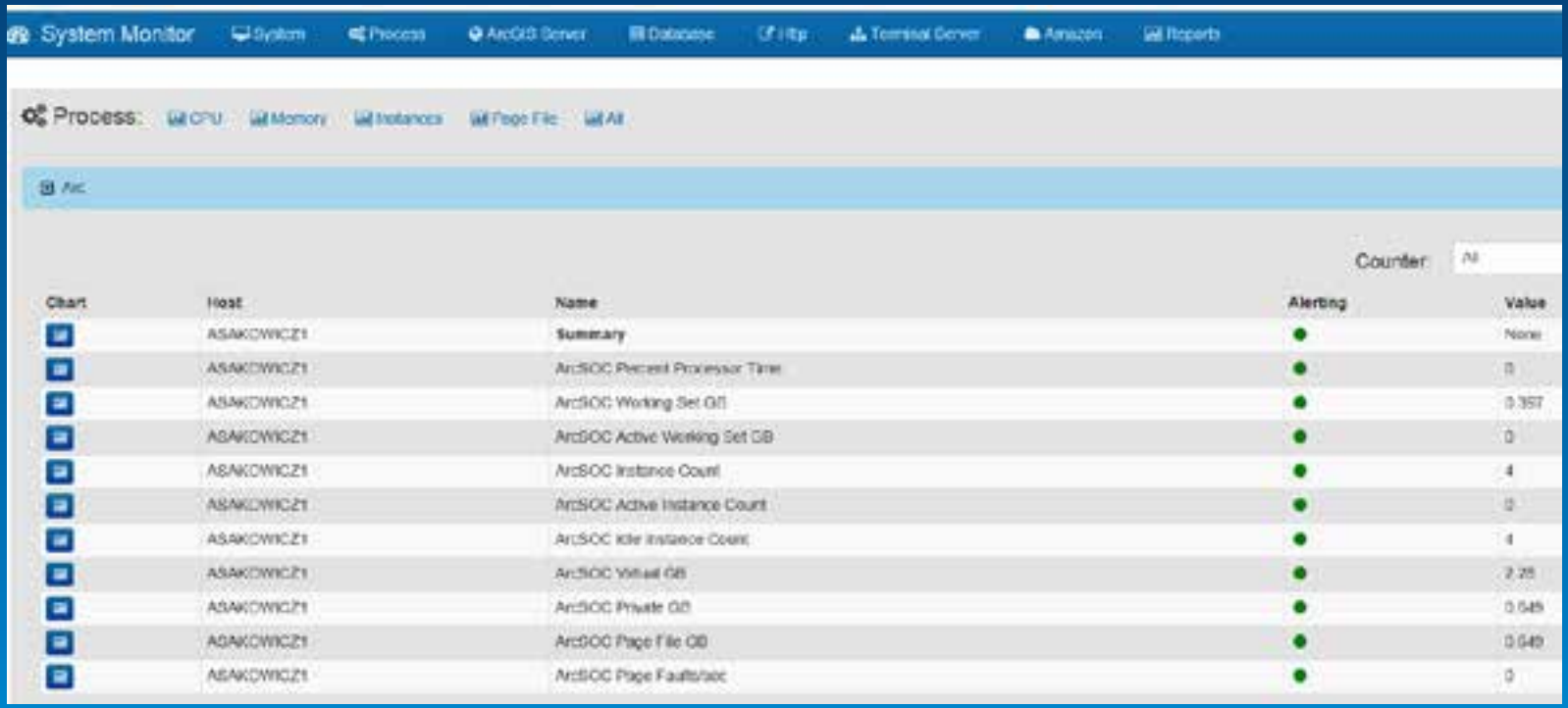
System Metrics



System Monitor tool

System Monitor

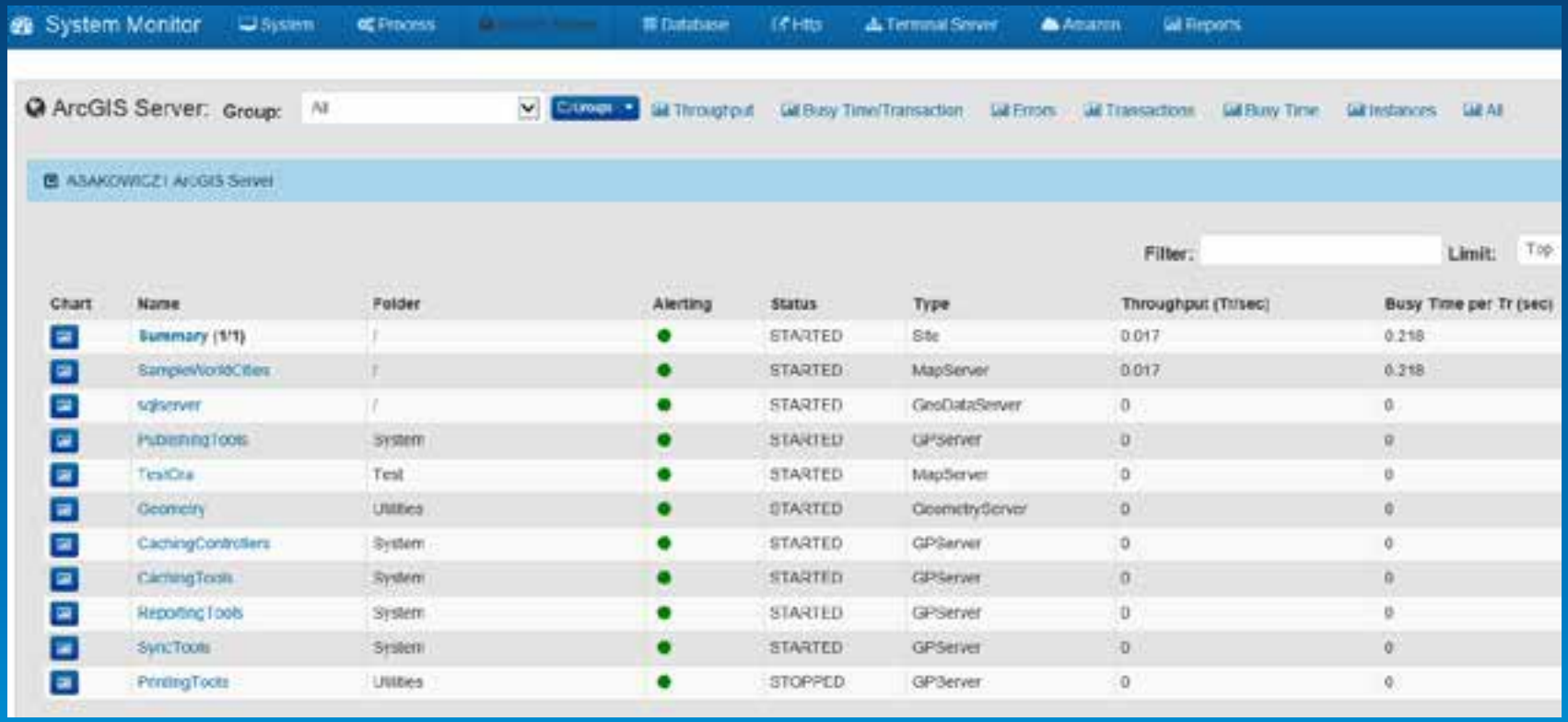
Process



System Monitor tool

System Monitor

ArcGIS Server statistics



System Monitor

HTTP custom requests

System Monitor

Geodatabase statistics

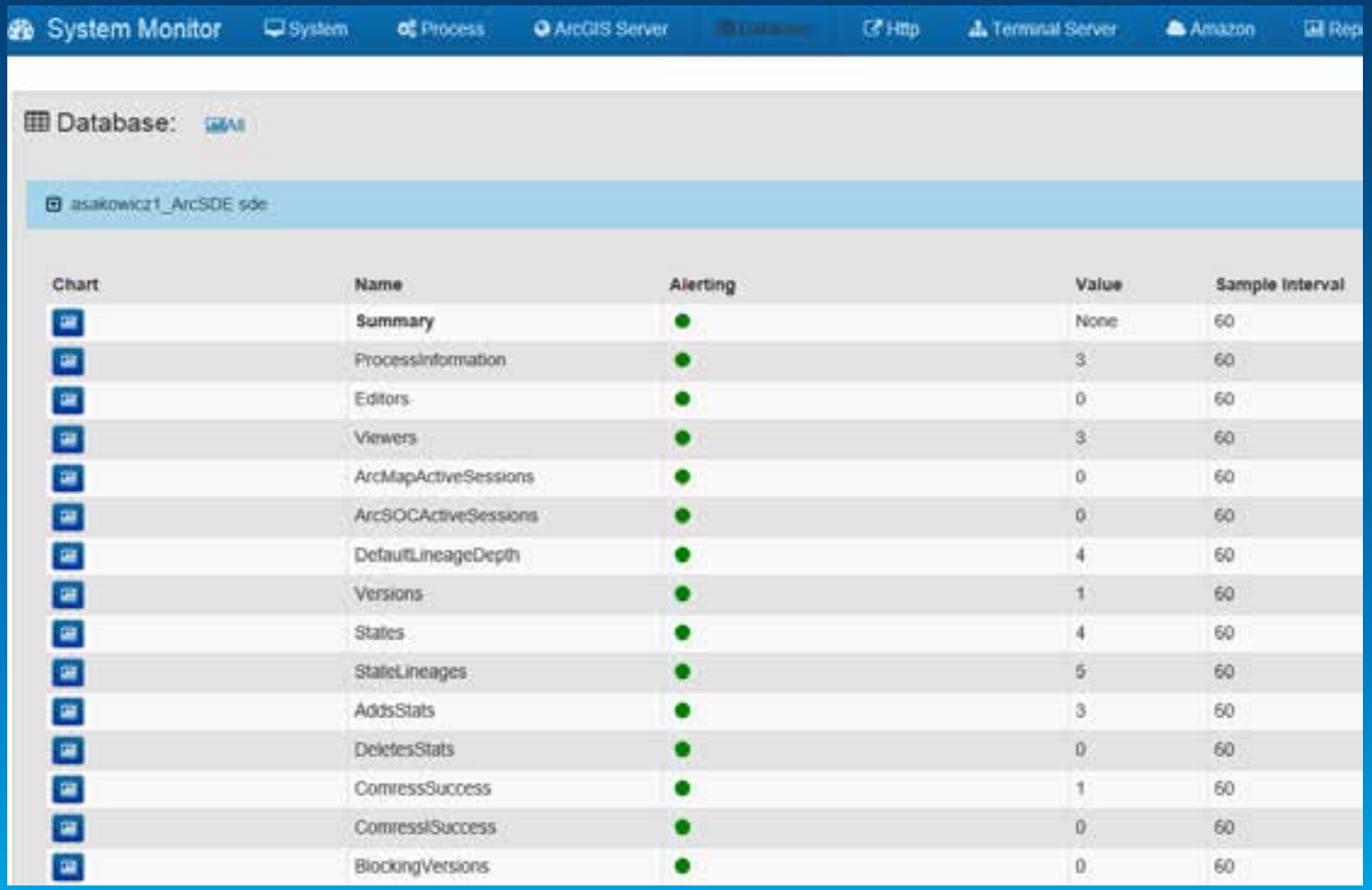
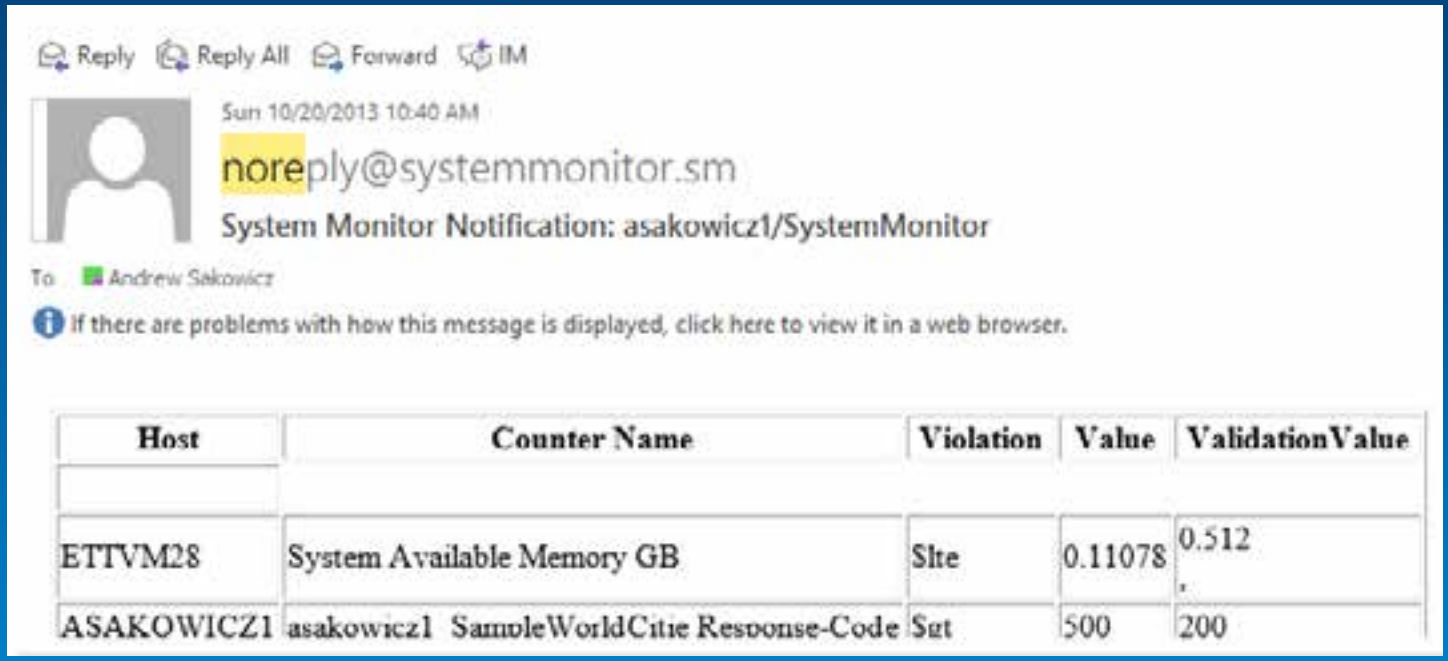


Chart	Name	Alerting	Value	Sample Interval
	Summary	●	None	60
	ProcessInformation	●	3	60
	Editors	●	0	60
	Viewers	●	3	60
	ArcMapActiveSessions	●	0	60
	ArcSOCActiveSessions	●	0	60
	DefaultLineageDepth	●	4	60
	Versions	●	1	60
	States	●	4	60
	StateLineages	●	5	60
	AddsStats	●	3	60
	DeletesStats	●	0	60
	ComressSuccess	●	1	60
	ComressISuccess	●	0	60
	BlockingVersions	●	0	60

Examples of versioned geodatabase stats

System Monitor

Email notification


Reply Reply All Forward IM

Sun 10/20/2013 10:40 AM

noreply@systemmonitor.sm

System Monitor Notification: asakowicz1/SystemMonitor

To Andrew Sakowicz

If there are problems with how this message is displayed, click here to view it in a web browser.

Host	Counter Name	Violation	Value	ValidationValue
ETTVM28	System Available Memory GB	Slte	0.11078	0.512
ASAKOWICZ1	asakowicz1 SampleWorldCitie Response-Code	Sgt	500	200

Define Key Performance Indicators (KPI)

Audience

- Administrators
- Management

Define Key Performance Indicators (KPI)

Management KPI

Usage

Performance

Availability

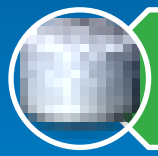
Define Key Performance Indicators (KPI)

Administrators


Hardware


Web Server


ArcGIS Server


Geodatabase


RDBMS

Performance Testing

Testing Objectives

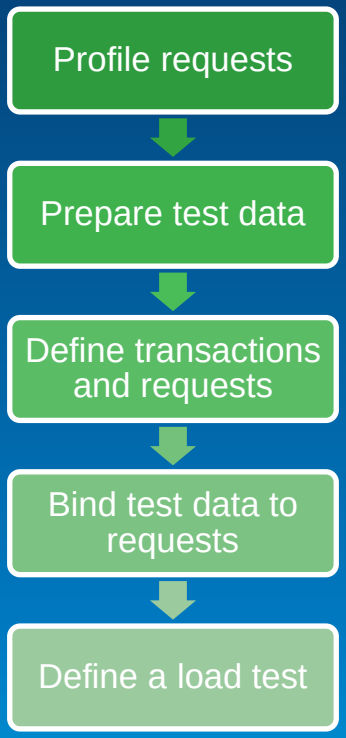
- Meet Service-Level Agreement (SLA)
- Bottlenecks analysis
- Capacity planning
- Benchmarking different alternatives

Testing Tools

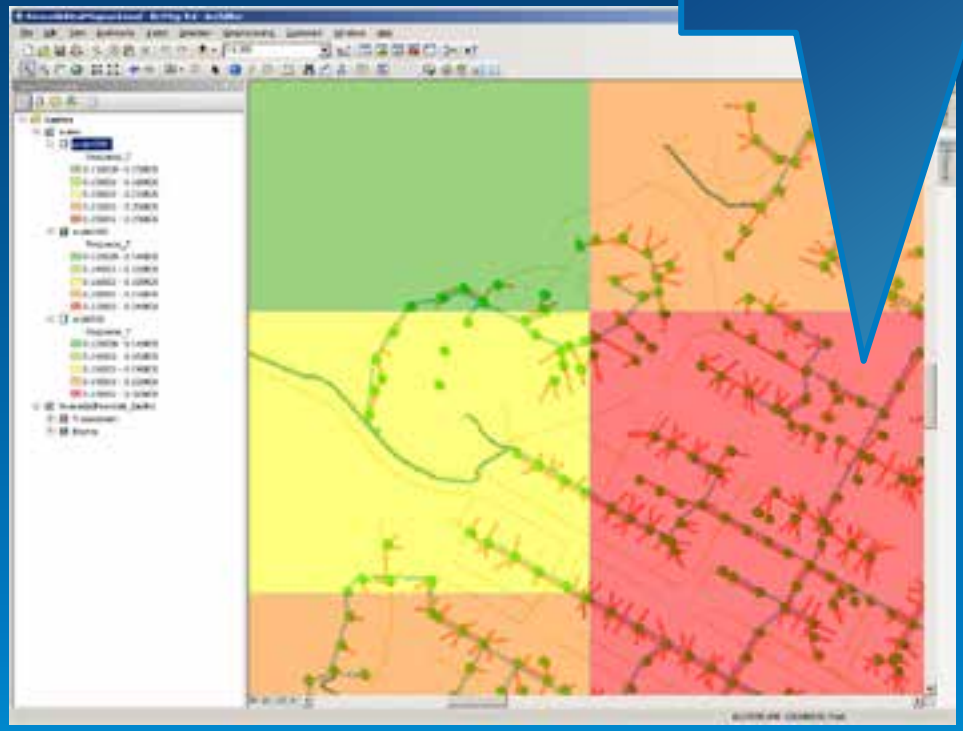
Test Tools	Open Source	Pros	Cons
LoadRunner	No	•Industry Leader •Automatic negative correlations identified with service-level agreements •HTTP web testing •Click and script •Very good tools for testing SOA •Test results stored in database •Thick client testing •Can be used for bottleneck analysis	•High 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

Testing steps

Designing test



Test data



Observe correlation between feature density and performance.

Demo

System Test - Introduction

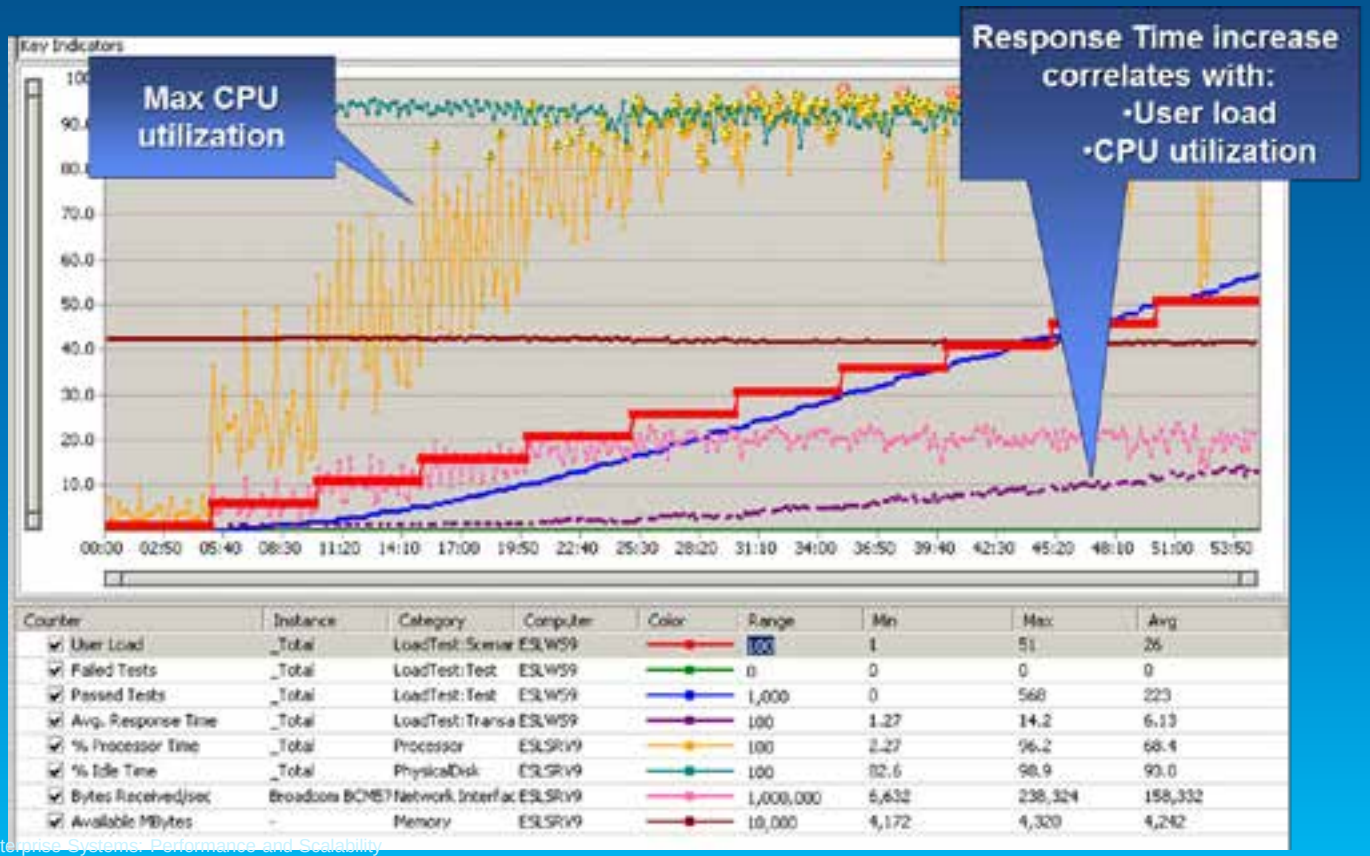
Analyze results

- Compare and correlate key measurements
  - Response Time Vs. Throughput
  - CPU, Network, Disk, and Memory on all tiers
  - Passed and Failed tests
- Validation
  - Lack of errors does not validate a test
  - Spot check request response content size

Analyze results

Valid

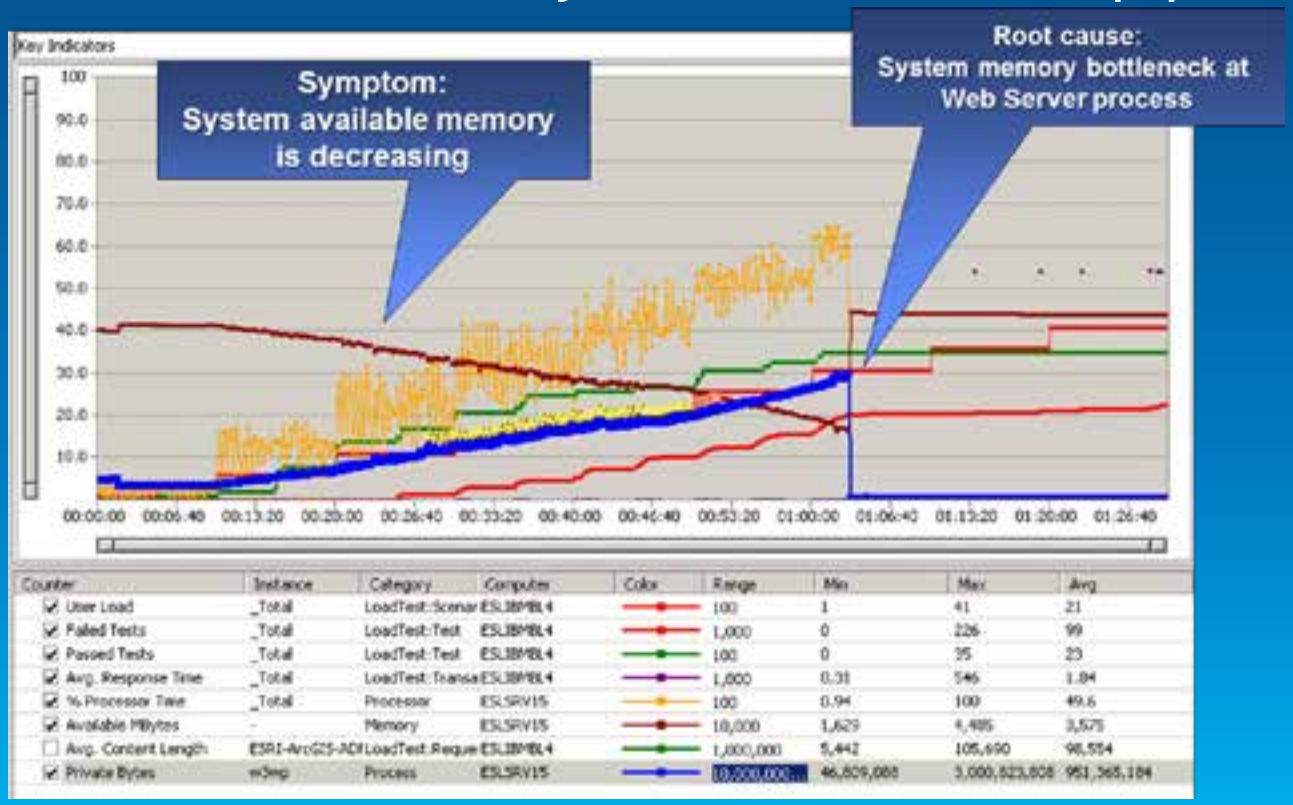
- *Expected* CPU and Response time correlation



Analyze results

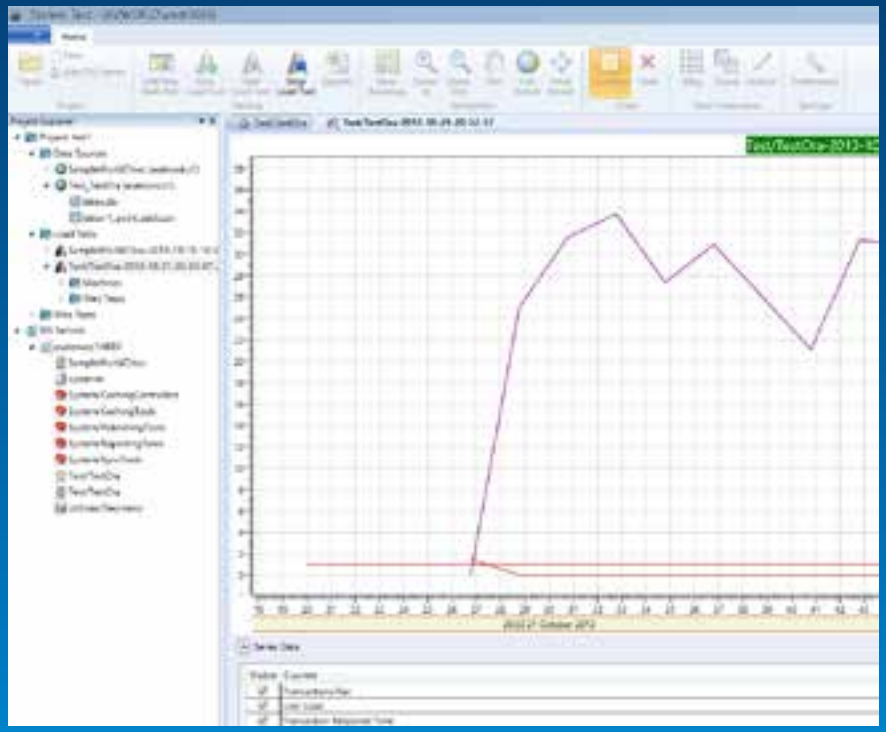
Invalid

- Validation Example
  - Test failure – memory bottleneck in w3wp process



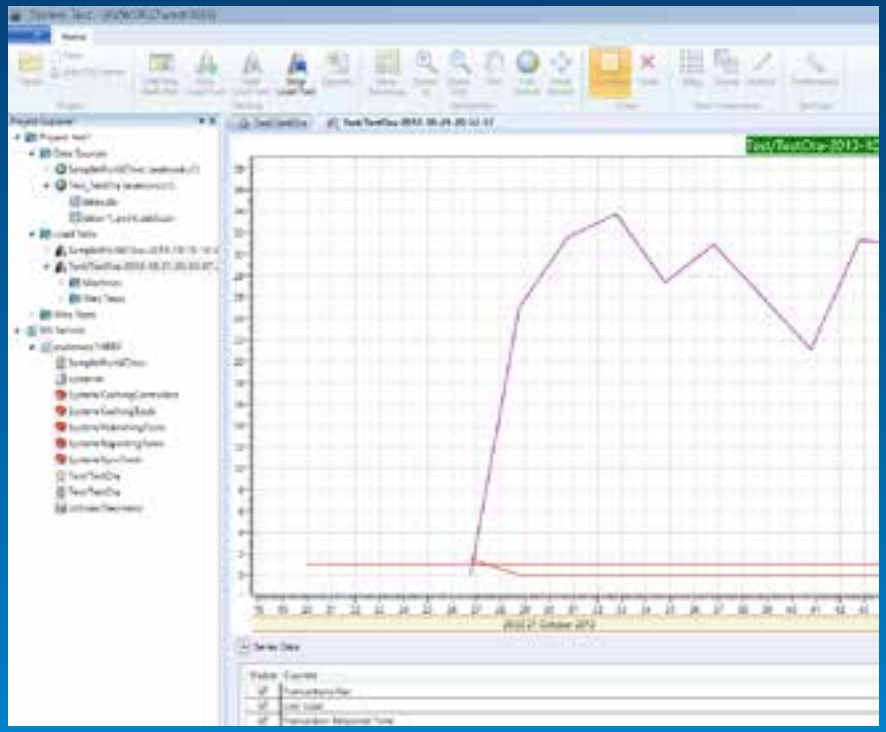
Demo

System Test (Oracle Edit)



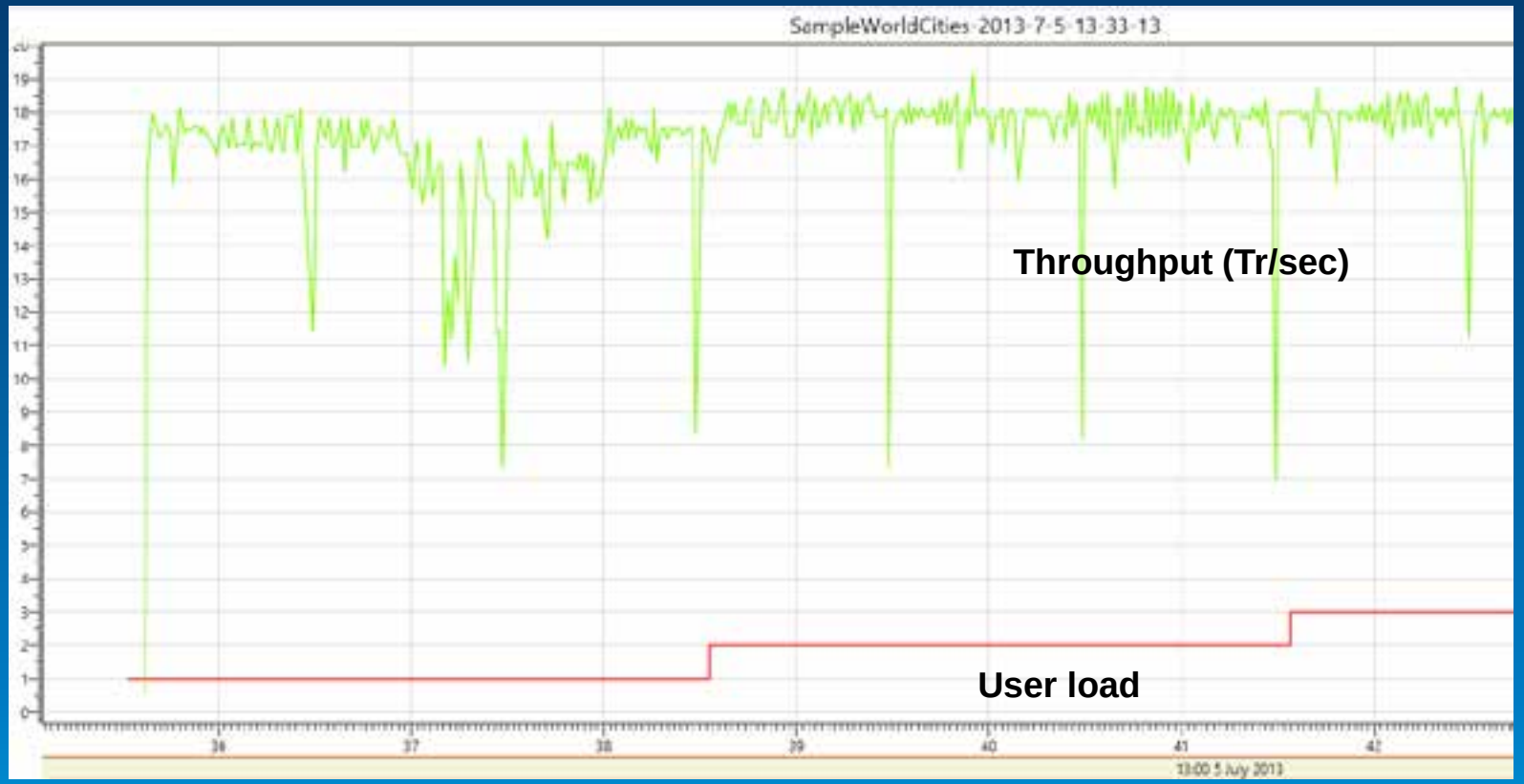
Demo

System Test (Oracle Edit)

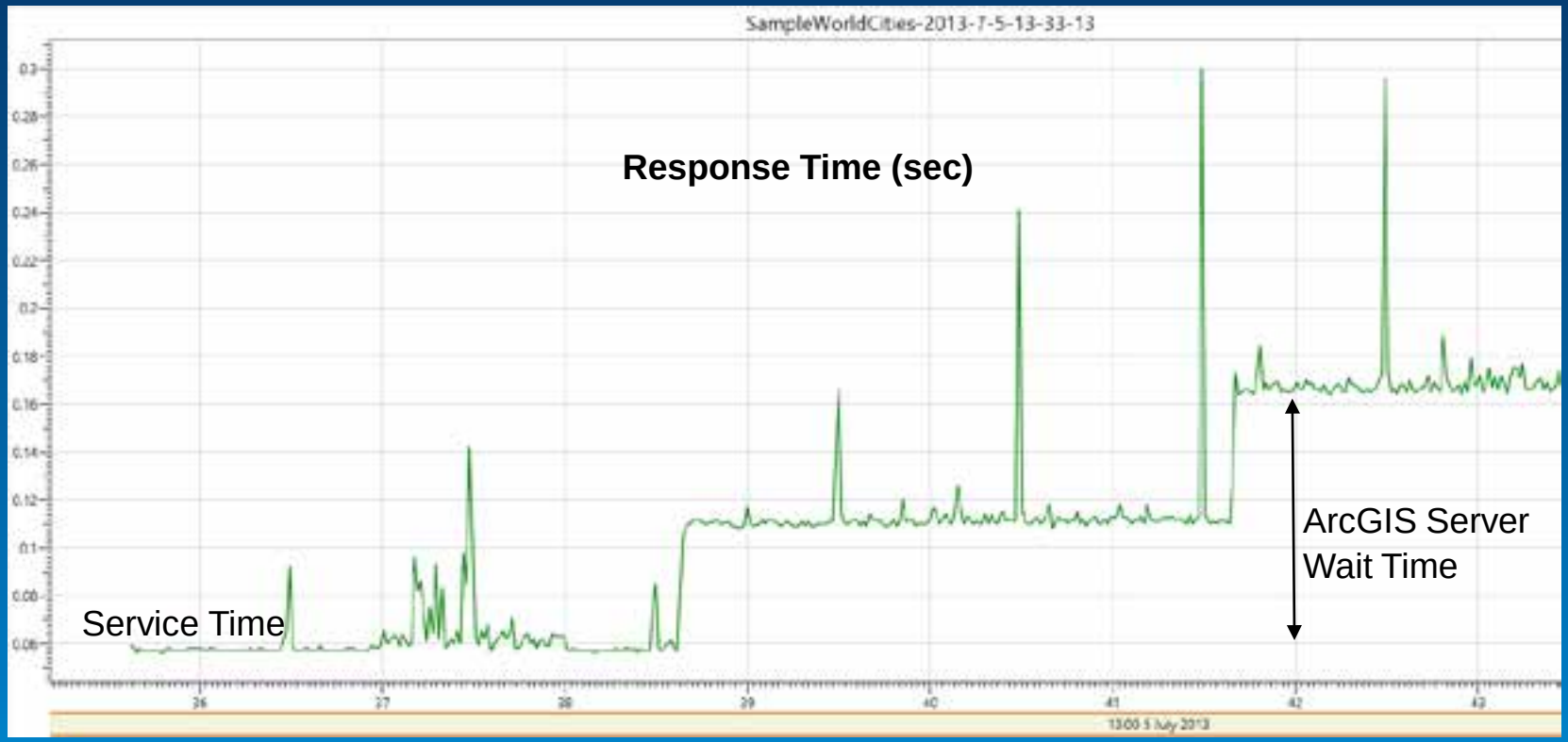


Demo

System Test (SampleWorldCities)



Transactions/Sec @ ASAKOWICZ1		
Step Load	Avg. Value	Std. Deviation
1	16.373	2.163
2	17.686	1.431
3	17.628	1.101



CPU ST/Tr @ ASAKOWICZ1		
Step Load	Avg. Value	Std. Deviation
1	0.054	0.018
2	0.048	0.009
3	0.045	0.009

Transaction Response Time @ ASAKOWICZ1		
Step Load	Avg. Value	Std. Deviation
1	0.060	0.023
2	0.111	0.023
3	0.168	0.026

Capacity planning: using test results

Test Results as Input into Capacity Planning

- Throughput = 3.89 request/sec (14,004 request/hour)
- Response time = 0.25 seconds
- Average CPU Utilization = 20.8%
- Mb/request = 1.25 Mb

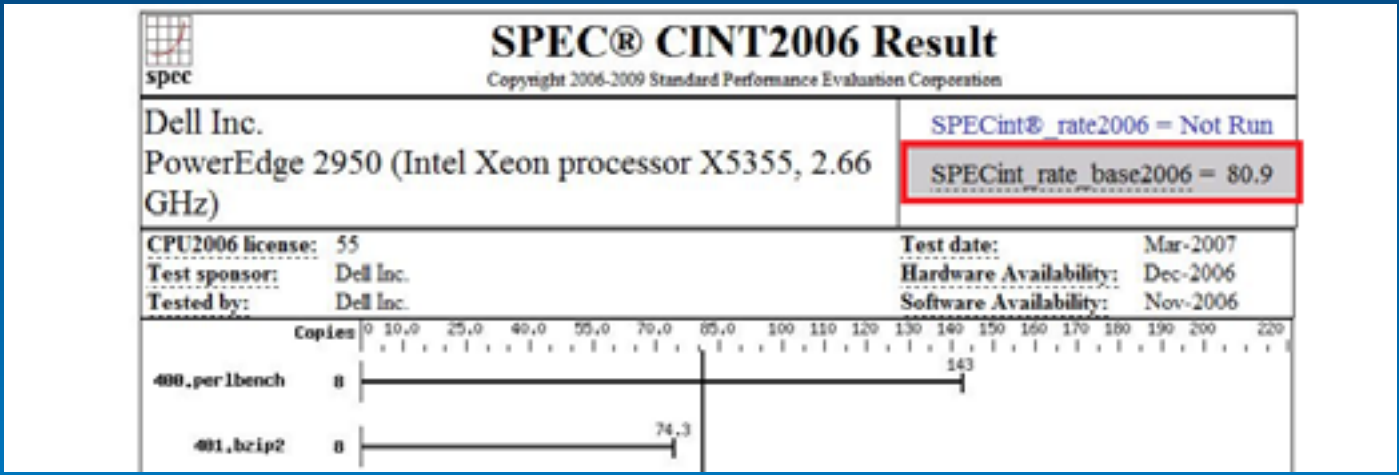
Test Results as Input into Capacity Planning

- 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 Service Time is very close to Average response time of 0.25

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

Target values

1. Server SpecRate/core=10.1



SPEC® CINT2006 Result

spec

Copyright 2006-2009 Standard Performance Evaluation Corporation

Dell Inc.
PowerEdge 2950 (Intel Xeon processor X5355, 2.66 GHz)

SPECint®_rate2006 = Not Run

SPECint_rate_base2006 = 80.9

CPU2006 license:	55	Test date:	Mar-2007
Test sponsor:	Dell Inc.	Hardware Availability:	Dec-2006
Tested by:	Dell Inc.	Software Availability:	Nov-2006

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

Target values

Target CPU cores calculation

$$\#CPU_t = \frac{ST_b \times TH_t \times 100}{3600 \times \%CPU_t} \times \frac{SpecRatePerCPU_b}{SpecRatePerCPU_t}$$

- 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

No need to calculate it manually, System Designer Tool does it for you:
http://www.arcgis.com/home/item.html?id=8ff490eef2794f428bde25b561226bda

Target values

Target network calculation

- Input to Capacity Planning:
  - Mb/req=1.25
  - TH = 30,000 request/hour

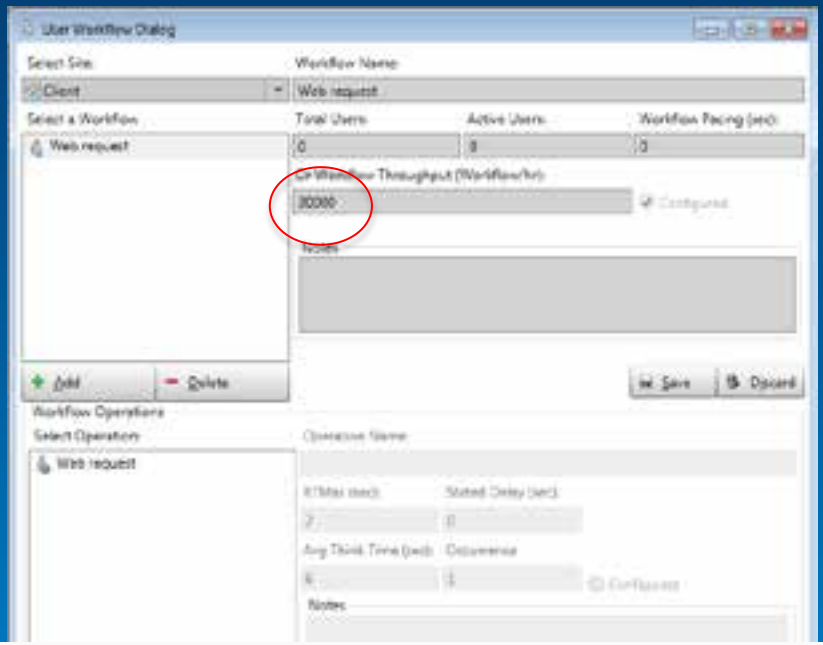
$$Mbps = \frac{TH\acute{}\ Mbits/req}{3600}$$

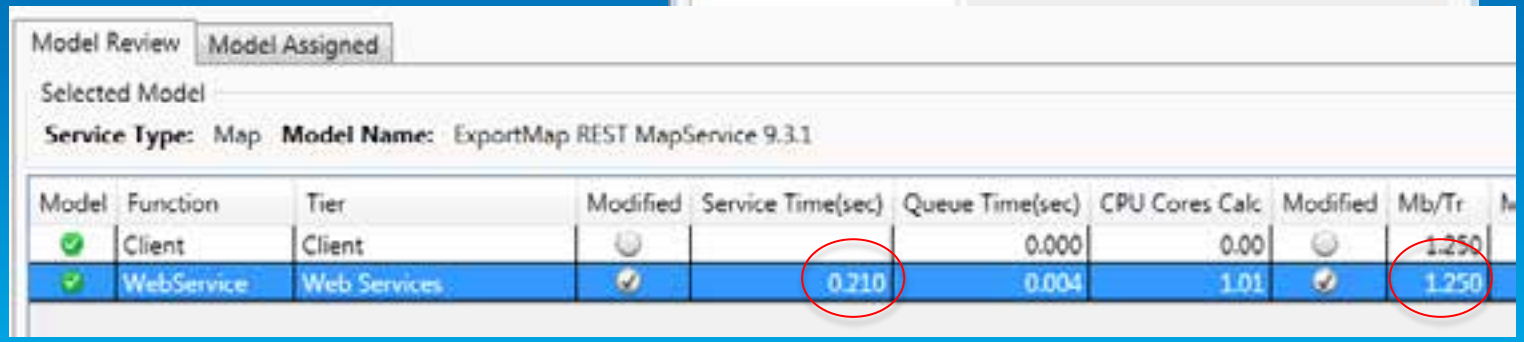
- Output
  - Network bandwidth required = 30000x1.25/3600
  - =10.4 Mbps < 45 Mbps available
  - Transport=1.25/(45-10.4)=0.036sec

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

Sizing using System Designer

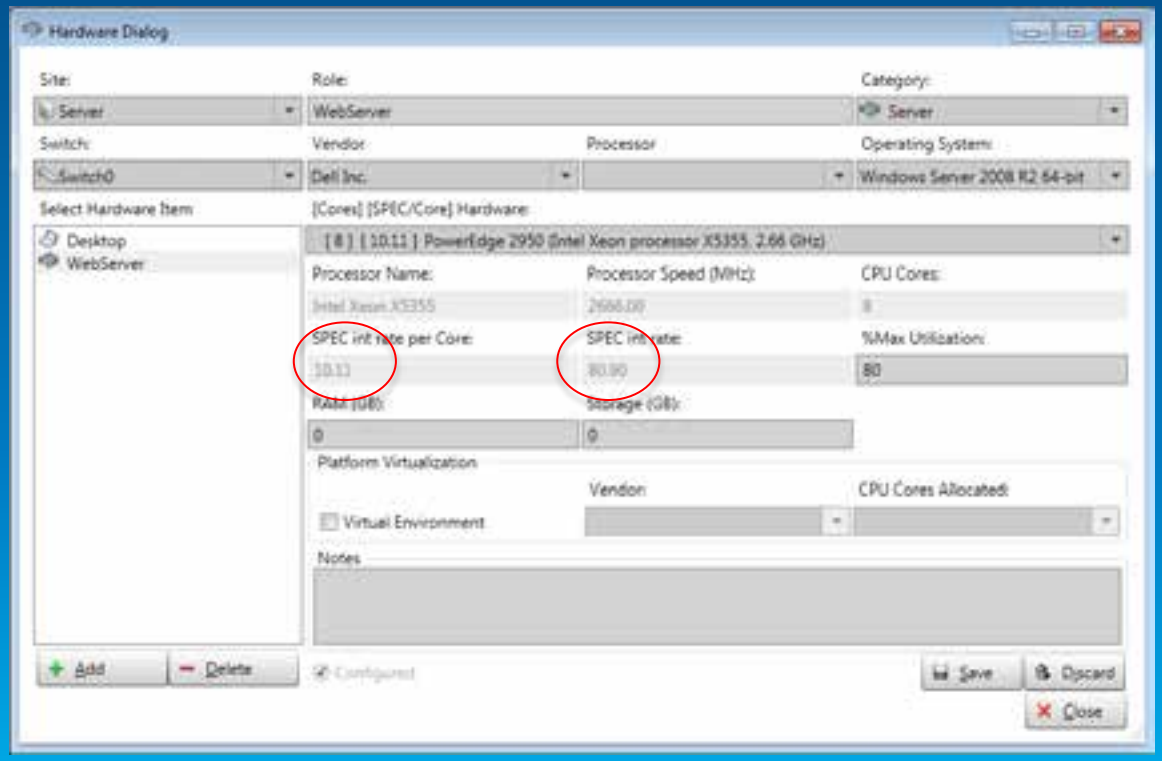
- Input:
  - Throughput=30000
  - ST=0.21
  - Mb/tr=1.25
  - Hardware=80.9 Spec





T Sizing using System Designer

- Input
  - Hardware=80.9 Spec



Summary

- Process
- Skills
- Tools