

Federal GIS Conference 2014

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ArcGIS Enterprise Systems: Performance and Scalability

Andrew Sakowicz

Introductions

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

Agenda

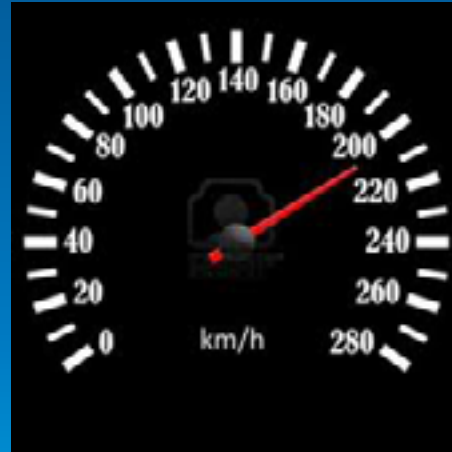
- **Definitions**
- **Process**
- **Requirements**
- **Performance Factors – Software**
- **Performance Factors - Hardware**
- **Performance Tuning**
- **Performance Testing**
- **Monitoring**
- **Capacity Planning**

Definitions

Definitions

Performance

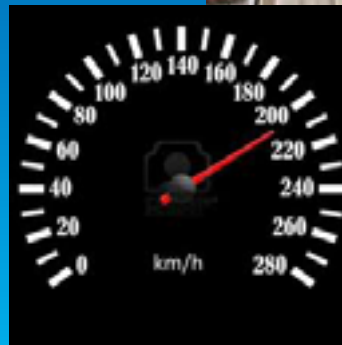
- The speed at which a given operation occurs
- E.g. Request response time measured in seconds



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 speed 55 mph**



Definitions

Capacity

- The maximum level of output the system can produce

At capacity



capa



Definitions

Bottleneck

- Resource(s) limiting the performance or capacity

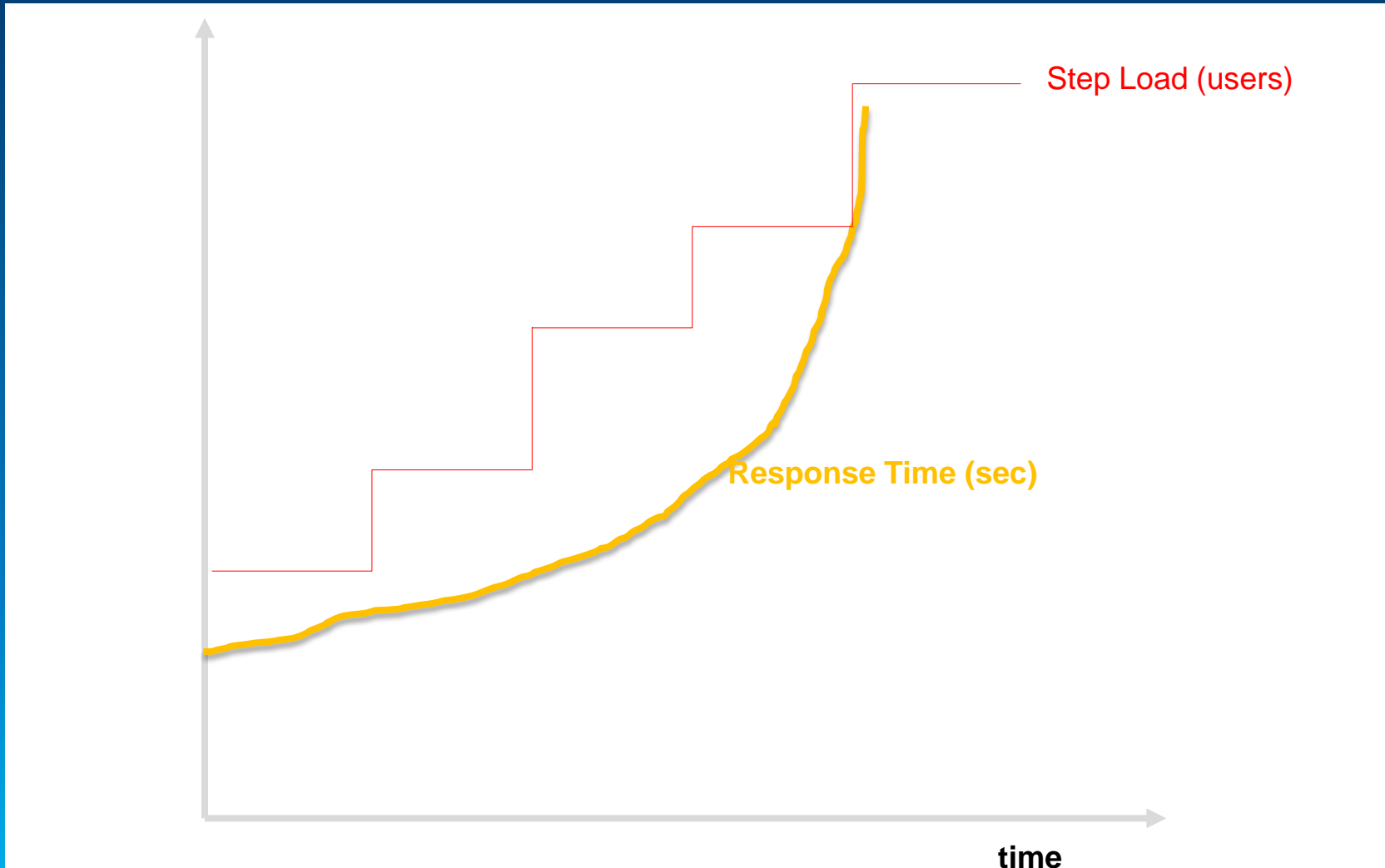


Low load

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

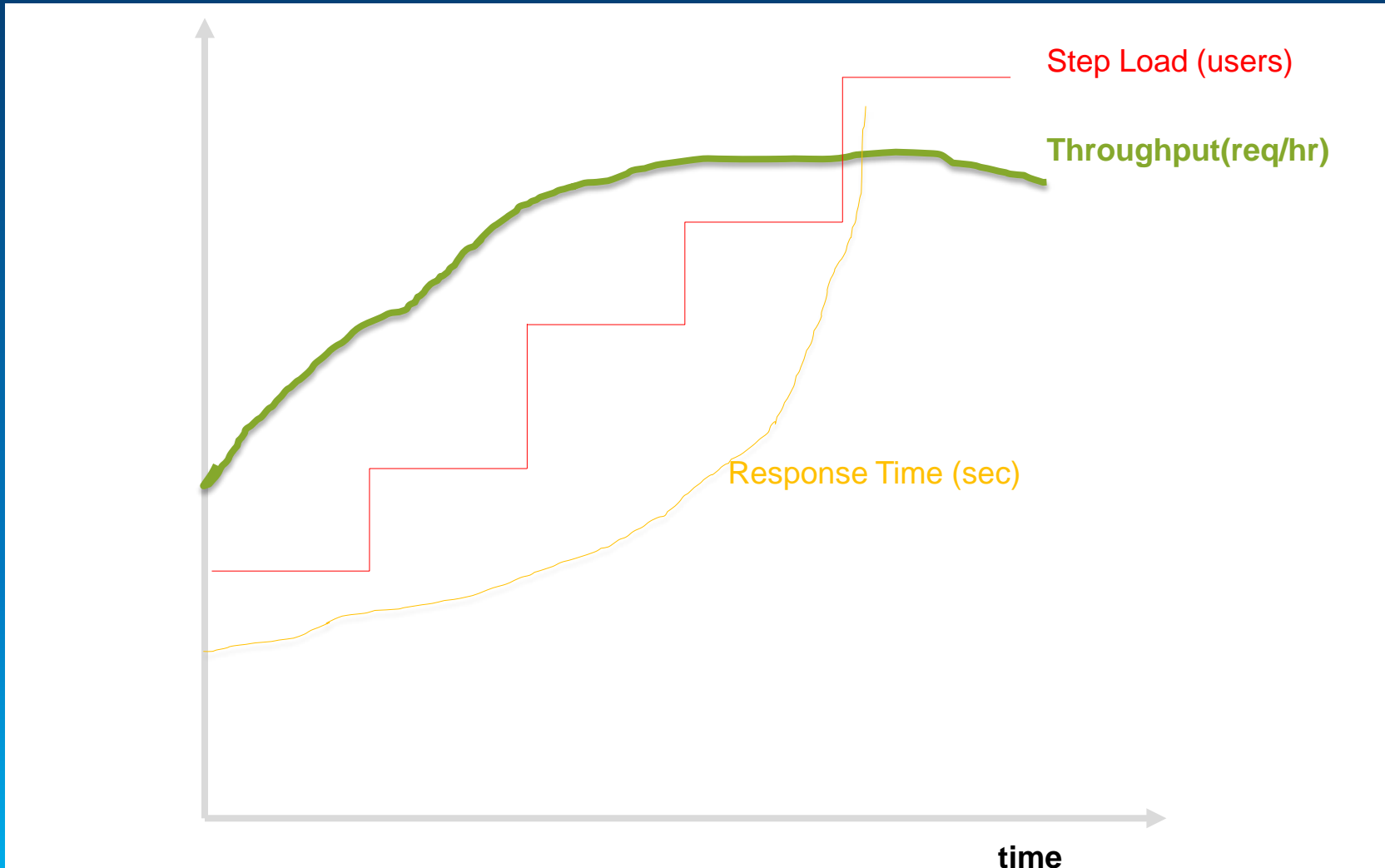
Definitions

Step Load and Response Time



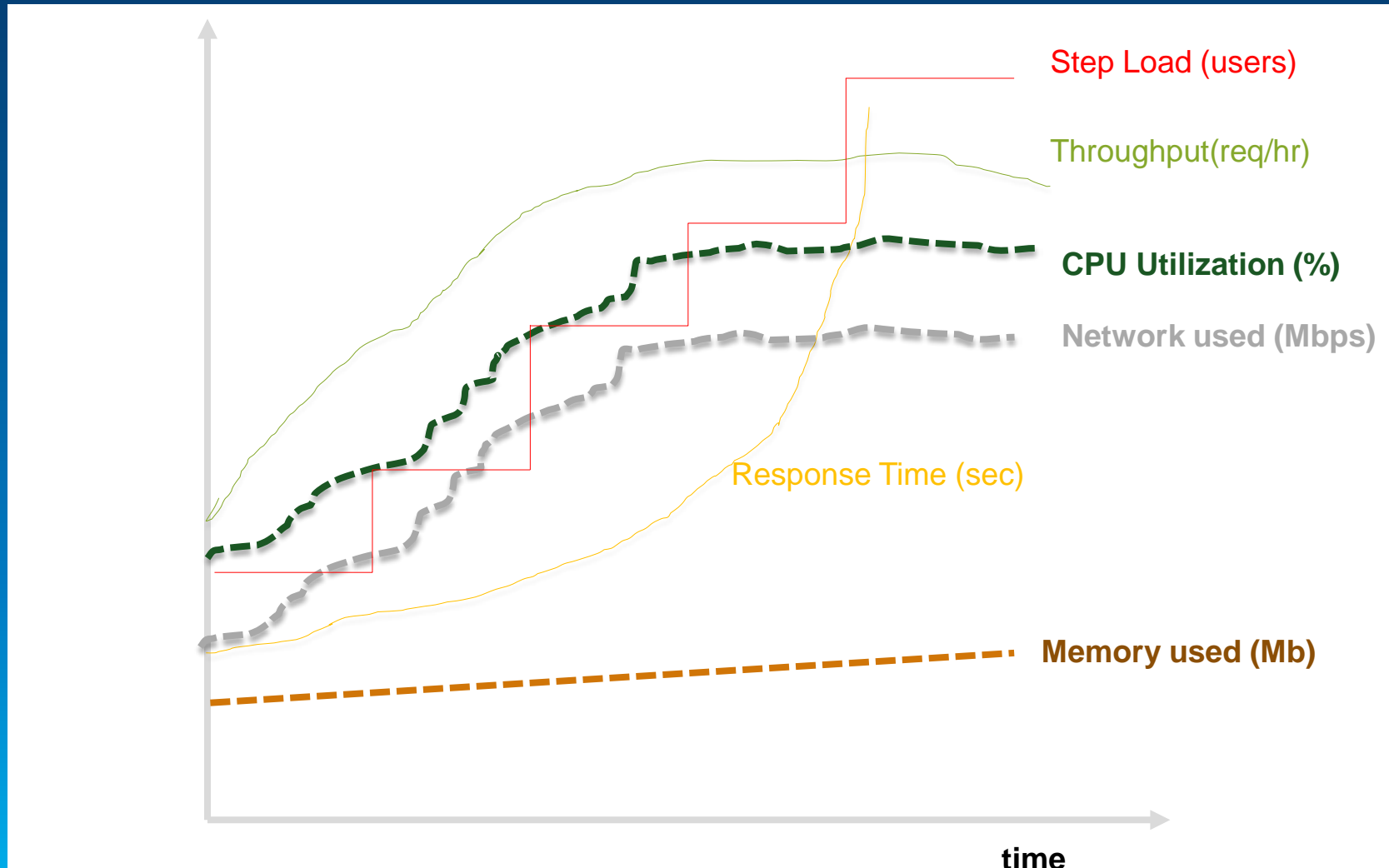
Definitions

Throughput (request/hr)



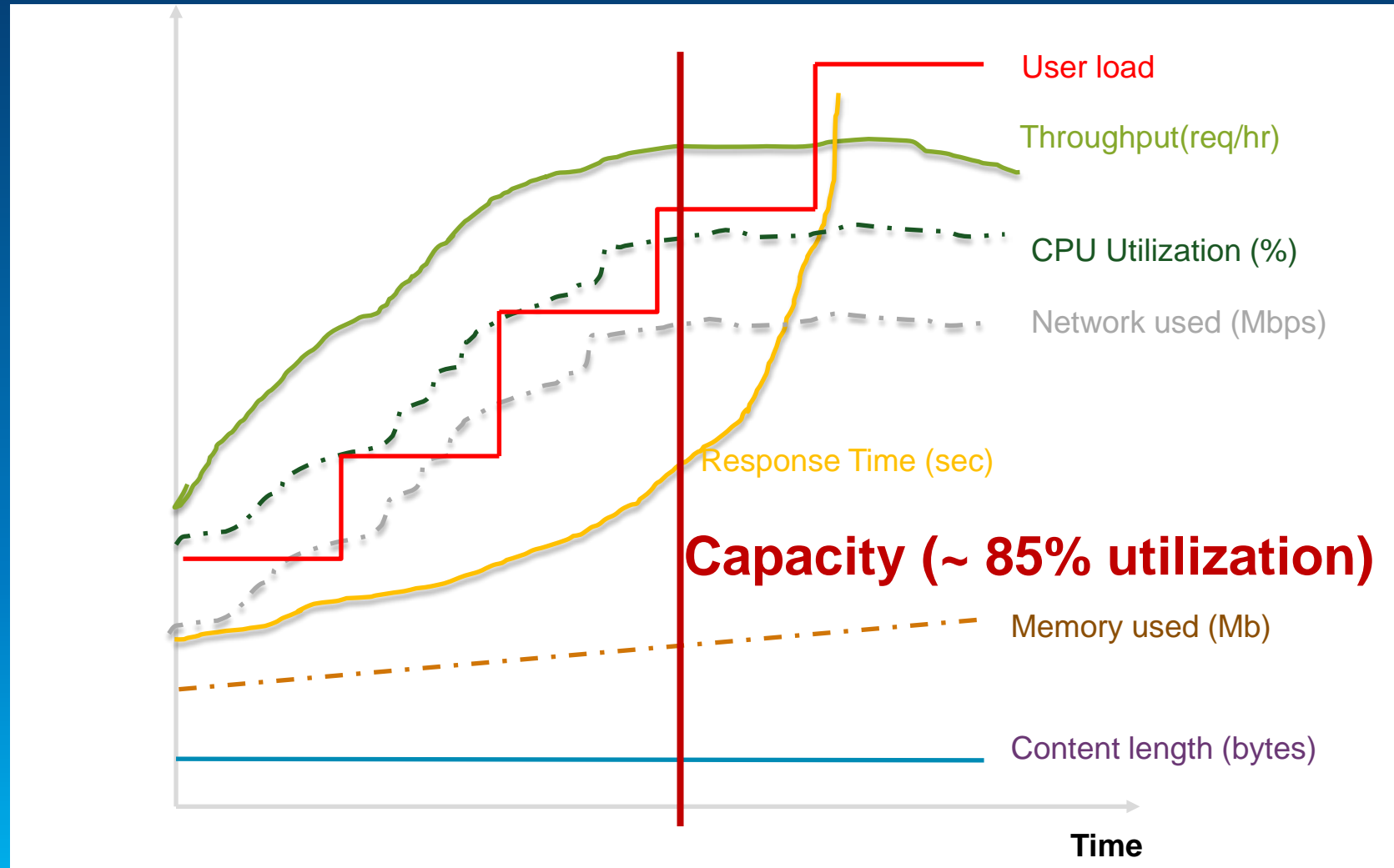
Definitions

Resource utilization: CPU, Memory, Network



Definitions

Capacity



Process

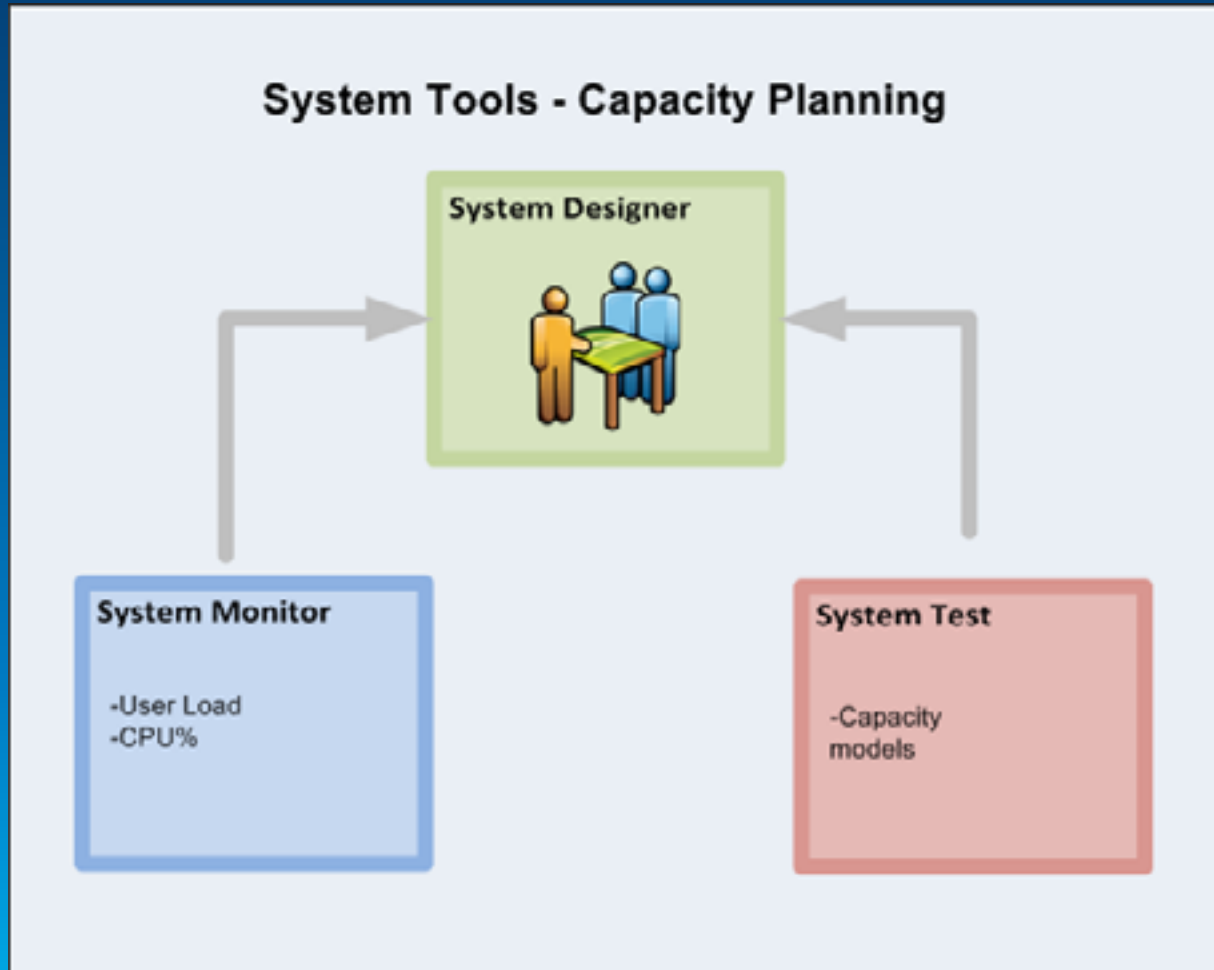
Esri Process and Tools

Holistic approach



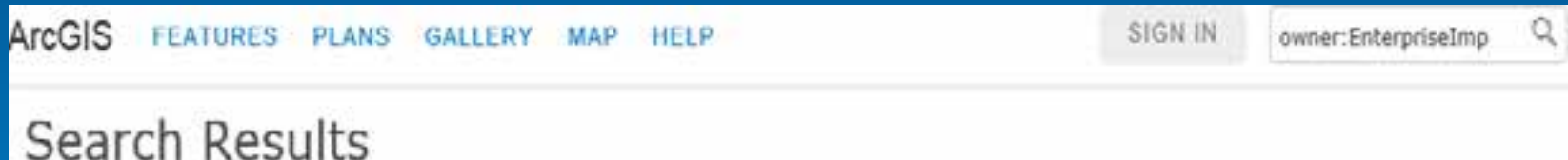
Capacity Planning

Tools



Tools

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



Show 10 results

[Relevance](#) [Title](#) [Owner](#) [Rating](#) [Views](#) [Date](#)

All Results

- Maps
- Layers
- Apps
- Tools
- Files

Show ArcGIS Desktop Content

[Open](#) [Details](#)

System Designer

A comprehensive tool for planning & designing complete enterprise GIS solutions, including hardware, software, deployment strategy, and capacity forecast.

Desktop Application Template by EnterpriseImp
Last Modified: July 5, 2013

★★★★☆ (2 ratings, 3 comments, 1,186 downloads)

Tools

- **System Designer**
- <http://www.arcgis.com/home/item.html?id=8ff490eef2794f428bde25b561226bda>.
- <http://www.arcgis.com/home/item.html?id=8e655b38f2fc4b778d07dd34f436a978> (MS 2013)
- **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>
- **Network Test**
- <http://www.arcgis.com/home/item.html?id=2b8d4ac8b102453bb0437cdd7a07dd27>
- **Mxdperfstat**
- <http://www.arcgis.com/home/item.html?id=a269d03aa1c840638680e2902dadecac>
- **Database Trace Tools**
- <http://www.arcgis.com/home/item.html?id=24c7b251159149848acc9b81cccb8356>
- **ASlog**
- <http://www.arcgis.com/home/item.html?id=5dfe54f1e9fd48068c4ae0c2c4f459c9>

Performance Factors

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

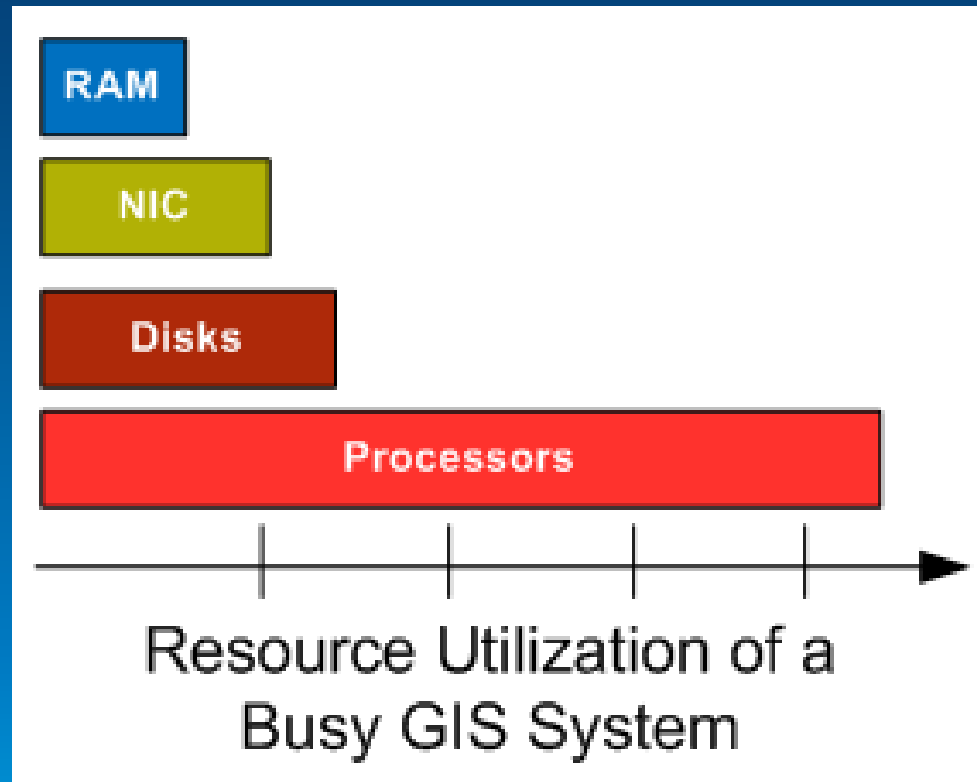
Geodatabase

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

Performance Factors - Hardware

Hardware Resources

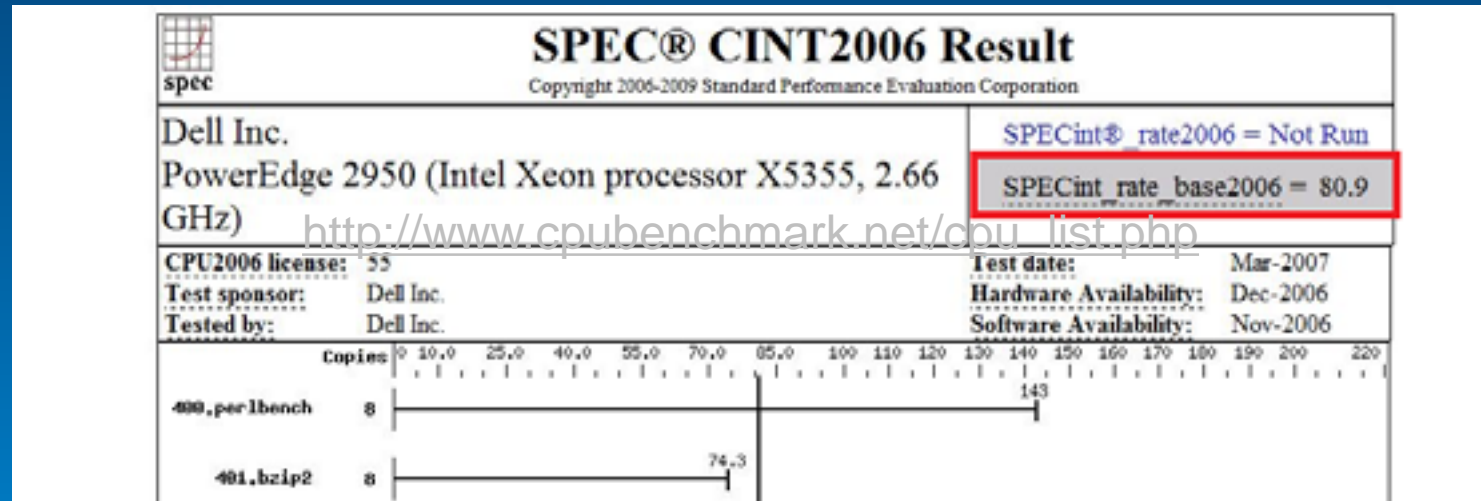
- CPU
- Network bandwidth
 - and latency
- Memory
- Disk



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

Performance Factors - Hardware

CPU Processor Speed – Specrate.org



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

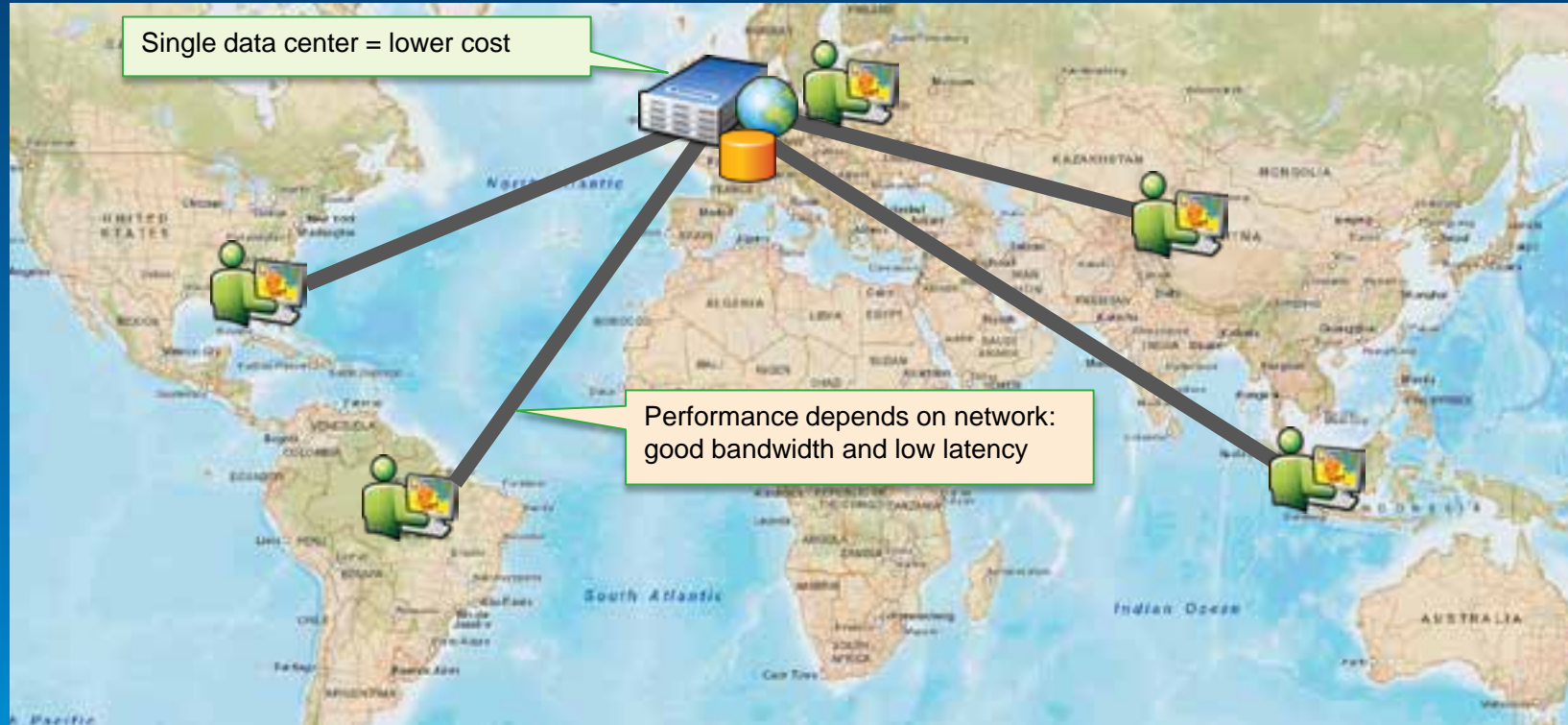
Virtualization

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

Overburdened VMs will incur significant performance degradation

Performance Factors

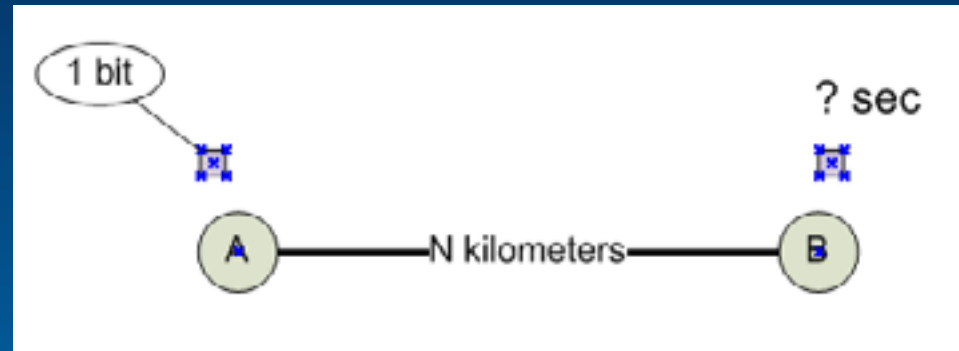
Network



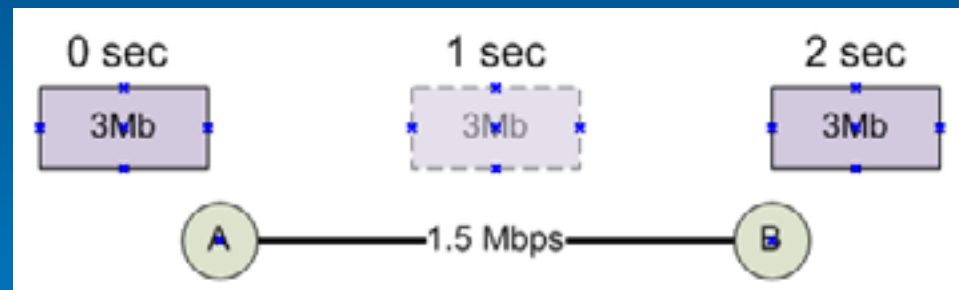
Performance Factors - Hardware

Network

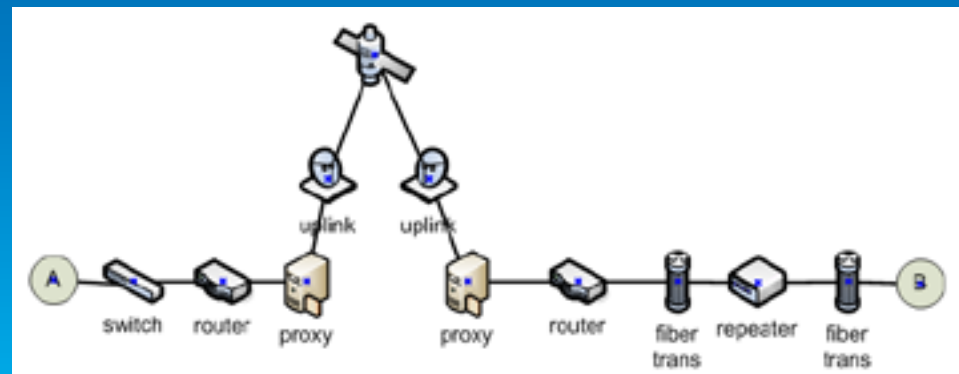
1. Distance



2. Payload



3. Infrastructure



Performance Factors - Hardware

Network transport time

- Required bandwidth
 - Response size
 - Number of transactions

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

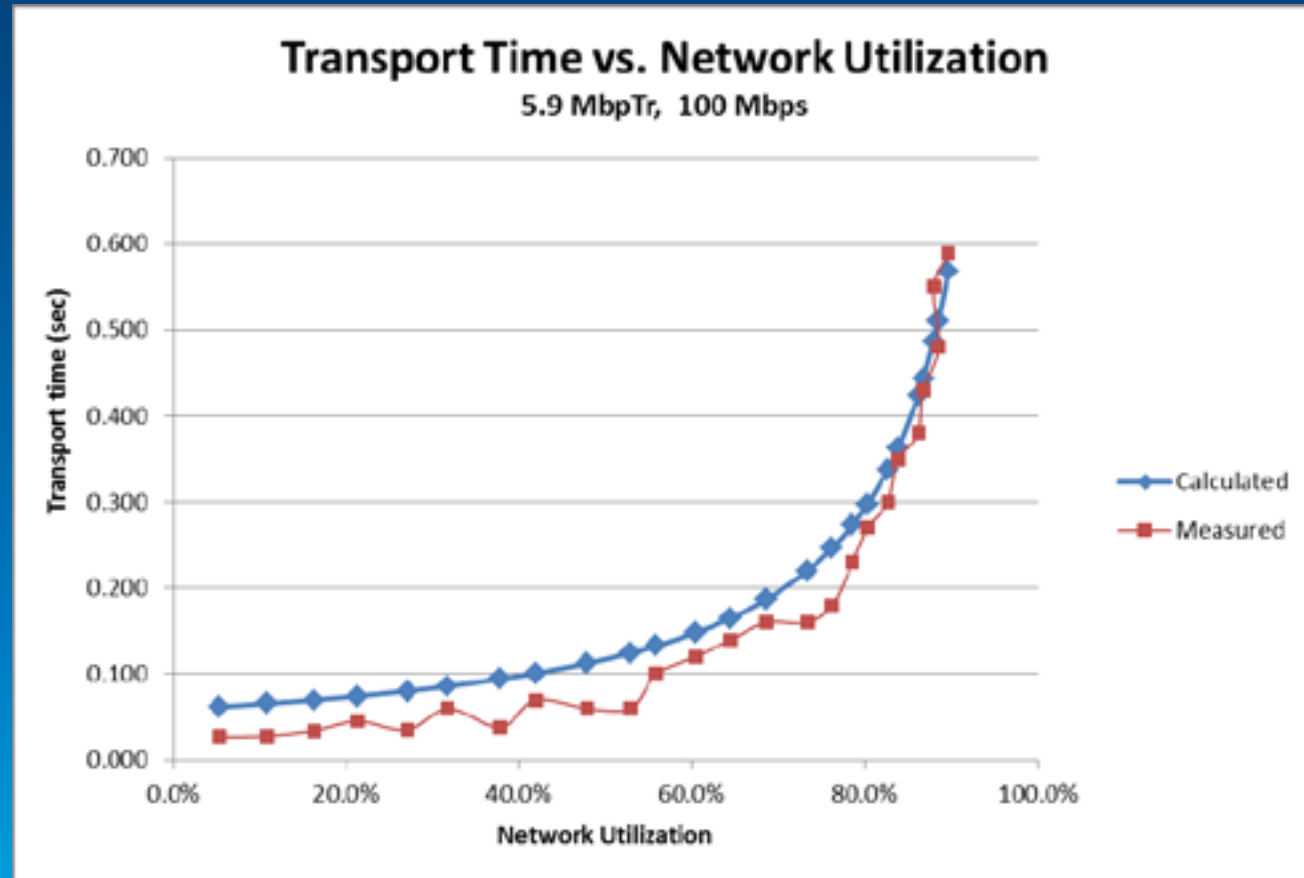
- Network transport time
 - Response size
 - Effective bandwidth

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

All built into System Designer

Performance Factors - Hardware

Network



Performance Factors - Hardware

Hardware Resources—Network

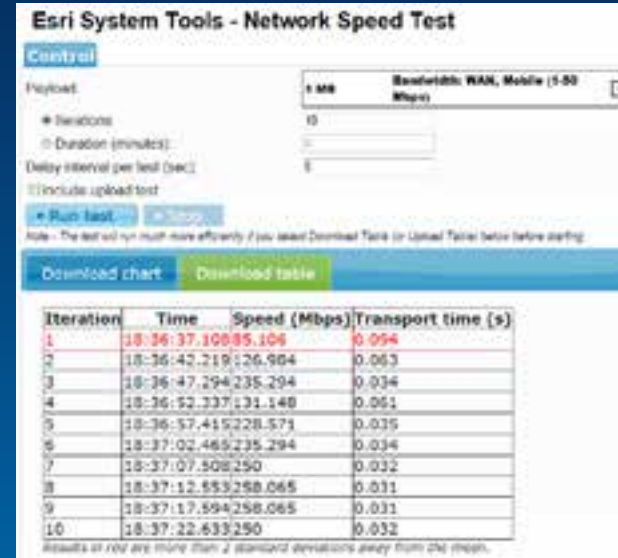
- **Impact of service and return type on network transport time**
 - **Compression**
 - **Content (e.g., Vector vs. Raster)**
 - **Return type (e.g., JPEG vs. PNG)**

					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	Vector+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

All built into System Designer

Demo

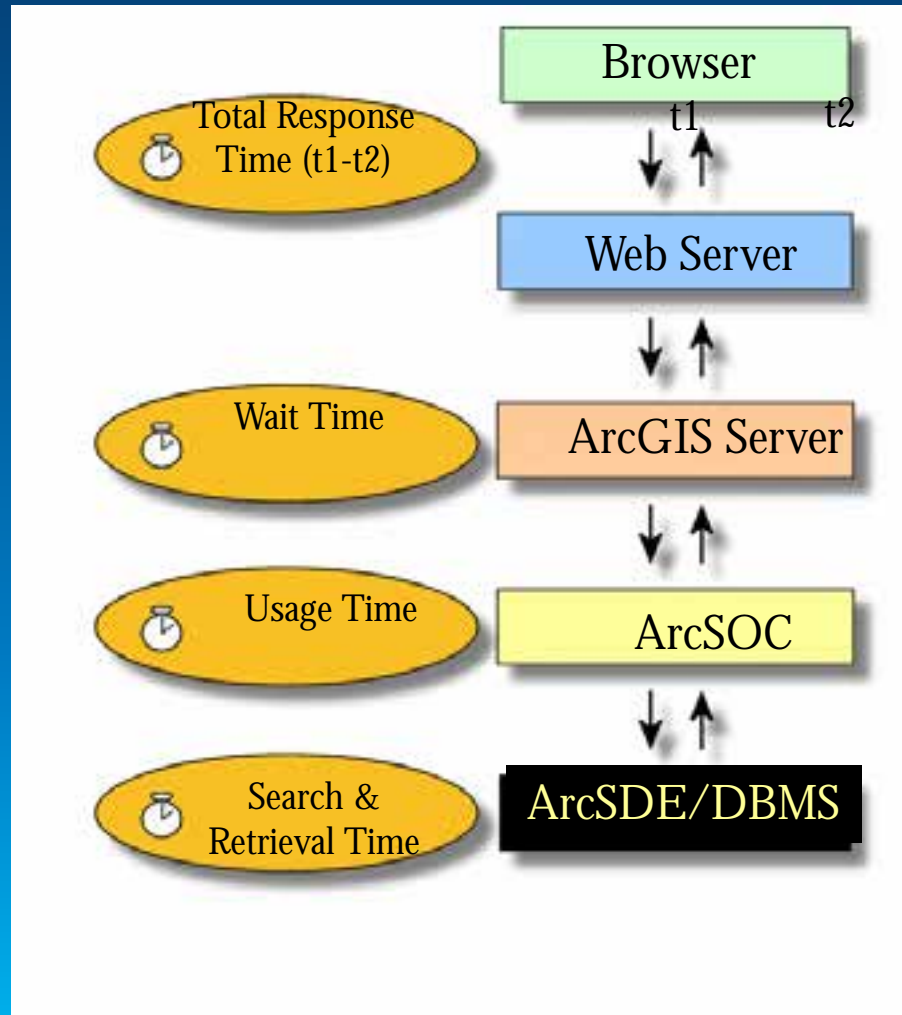
Network Speed Test Tool:



Tuning

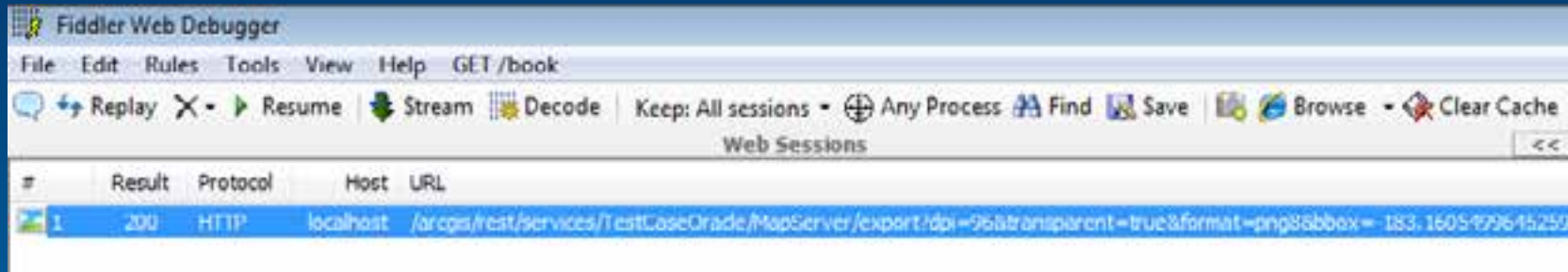
Tuning methodology

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:oracleSasakowicz:1521/gis2,sde	esriGeometryPoint	GCS_WGS_1984	ID<1000

Oracle Trace

Compare elapsed time

```
SQL ID: 6p20xry10fu4n Plan Hash: 569628948
SELECT U_45.st_SHAPE$, U_45.OID, U_45.st_points,U_45.st_numpts,
       U_45.st_entity,U_45.st_minx,U_45.st_miny,U_45.st_maxx,U_45.st_maxy,
       U_45.st_minz,U_45.st_maxz,U_45.st_minm,U_45.st_maxm,U_45.st_area$,
       U_45.st_len$,U_45.st_rowid
FROM
  (SELECT b.OID,b.GM,b.GY,b.ID,1 st_SHAPE$, 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.GM,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) U_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 pu=0 time=512477 us cost=8 size=45906 card=21)
1998	1998	1998	UNION-ALL (cr=131605 pr=0 pu=0 time=511682 us)
1998	1998	1998	FILTER (cr=131451 pr=0 pu=0 time=508349 us)
1998	1998	1998	TABLE ACCESS BY INDEX ROWID GRIDPOINT (cr=131451 pr=0 pu=0 time=4
129600	129600	129600	DOMAIN INDEX (Sel: Default - Undefined) A29_IX1 (cr=2017 pr=0 pu=
0	0	0	NESTED LOOPS (cr=0 pr=0 pu=0 time=4456 us cost=0 size=44 card=1)
0	0	0	INDEX RANGE SCAN D45_PK (cr=0 pr=0 pu=0 time=2101 us cost=0 size
0	0	0	INDEX UNIQUE SCAN LINEAGES_PK (cr=0 pr=0 pu=0 time=0 us cost=0 s
0	0	0	NESTED LOOPS ANTI (cr=154 pr=0 pu=0 time=2247 us cost=5 size=2367
0	0	0	NESTED LOOPS (cr=154 pr=0 pu=0 time=2243 us cost=5 size=2367 car
0	0	0	TABLE ACCESS BY INDEX ROWID A45 (cr=154 pr=0 pu=0 time=2242 us c
0	0	0	BITMAP CONVERSION TO ROWIDS (cr=154 pr=0 pu=0 time=2236 us)
0	0	0	BITMAP AND (cr=154 pr=0 pu=0 time=2232 us)
0	0	0	BITMAP CONVERSION FROM ROWIDS (cr=147 pr=0 pu=0 time=455 us)
0	0	0	SORT ORDER BY (cr=147 pr=0 pu=0 time=454 us)
0	0	0	INDEX RANGE SCAN A45_STATEID_IX1 (cr=147 pr=0 pu=0 time=439
0	0	0	BITMAP CONVERSION FROM ROWIDS (cr=7 pr=0 pu=0 time=1768 us)
0	0	0	SORT ORDER BY (cr=7 pr=0 pu=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 pu=0 time=0 us cost=0 s
0	0	0	VIEW PUSHED PREDICATE UW_NSO_1 (cr=0 pr=0 pu=0 time=0 us cost=0
0	0	0	FILTER (cr=0 pr=0 pu=0 time=0 us)
0	0	0	NESTED LOOPS (cr=0 pr=0 pu=0 time=0 us cost=0 size=44 card=1)
0	0	0	INDEX RANGE SCAN D45_PK (cr=0 pr=0 pu=0 time=0 us cost=0 size=
0	0	0	INDEX UNIQUE SCAN LINEAGES_PK (cr=0 pr=0 pu=0 time=0 us cost=0

Inefficient spatial index

Performance Testing

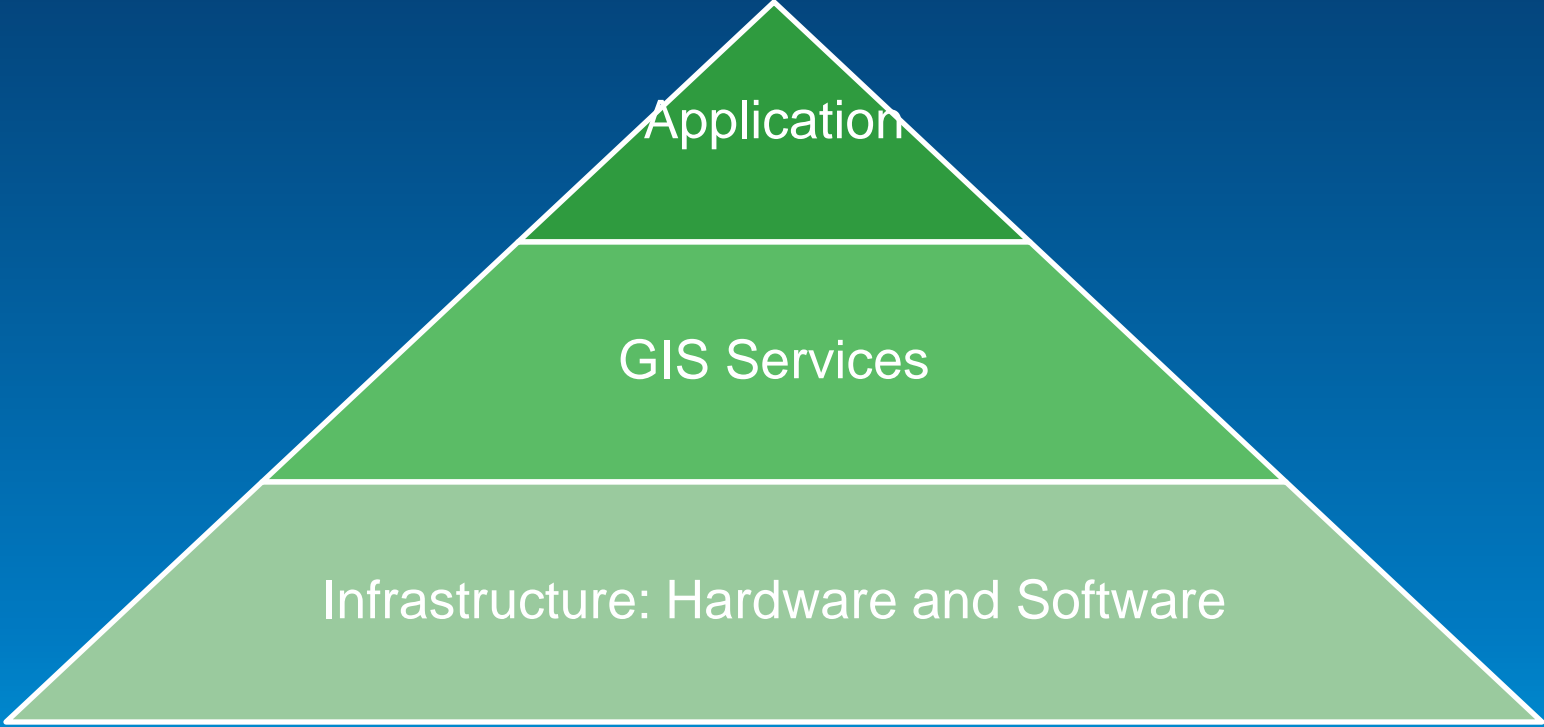
Testing Objectives

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

Testing Tools

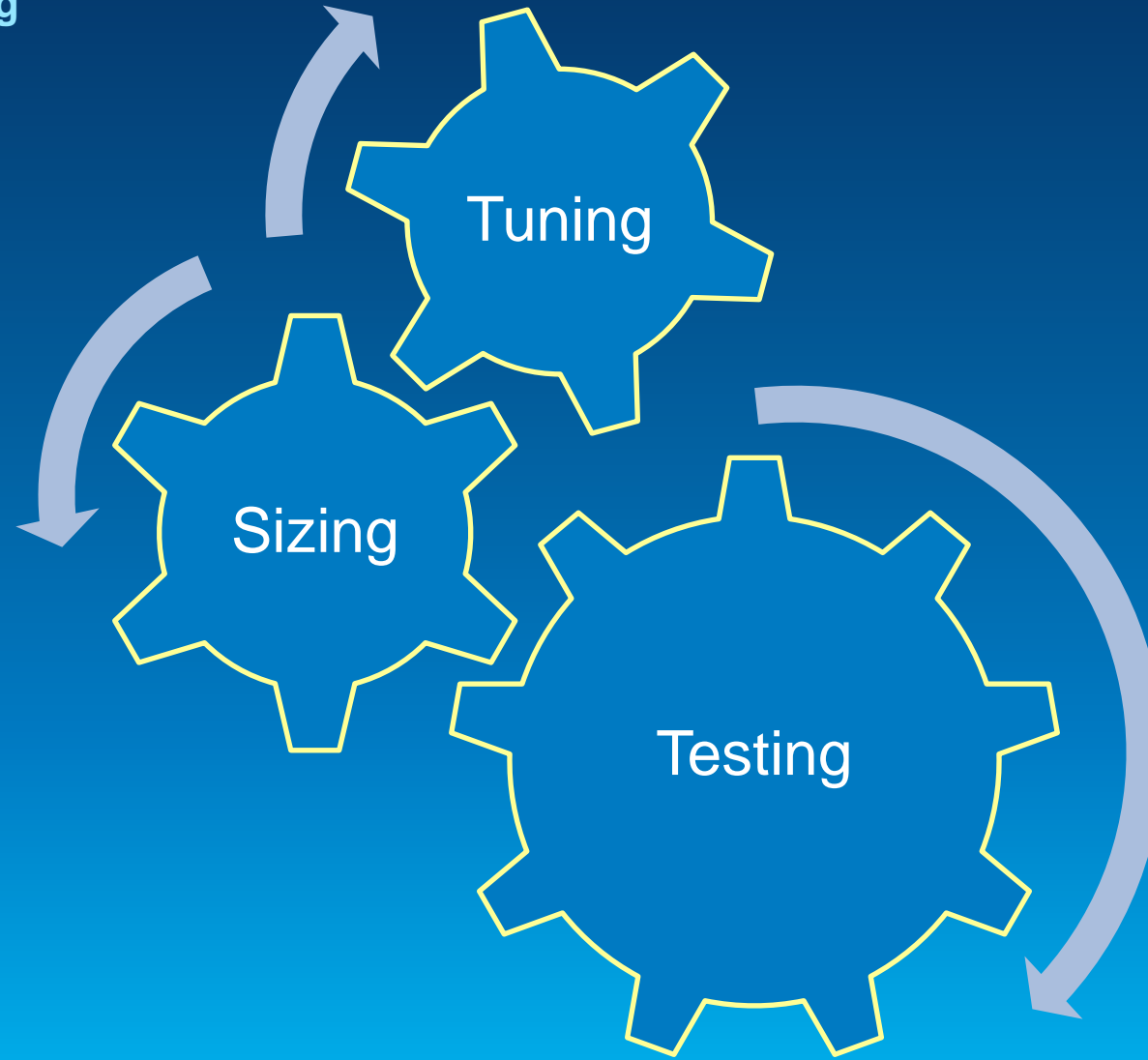
Test Tools	Open Source	Pros	Cons
LoadRunner	No	<ul style="list-style-type: none"> •Industry Leader •Automatic negative correlations identified with service-level agreements •HTTP web testing •Click and script •Very good tools for testing SOA •Test results stored in database •Thick client testing •Can be used for bottleneck analysis 	<ul style="list-style-type: none"> •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	<ul style="list-style-type: none"> •Good solution for testing Citrix •Wizard-driven interface guides the user •Can be used for bottleneck analysis 	<ul style="list-style-type: none"> •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	<ul style="list-style-type: none"> •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 	<ul style="list-style-type: none"> •No built-in support for AMF •No thick-client options •Moderate user community
JMeter	Yes	<ul style="list-style-type: none"> •Free •Tool 	<ul style="list-style-type: none"> •Provides only response times •Poor user community with few available examples

Testing process



Required skill set

Configuration, Tuning, Testing

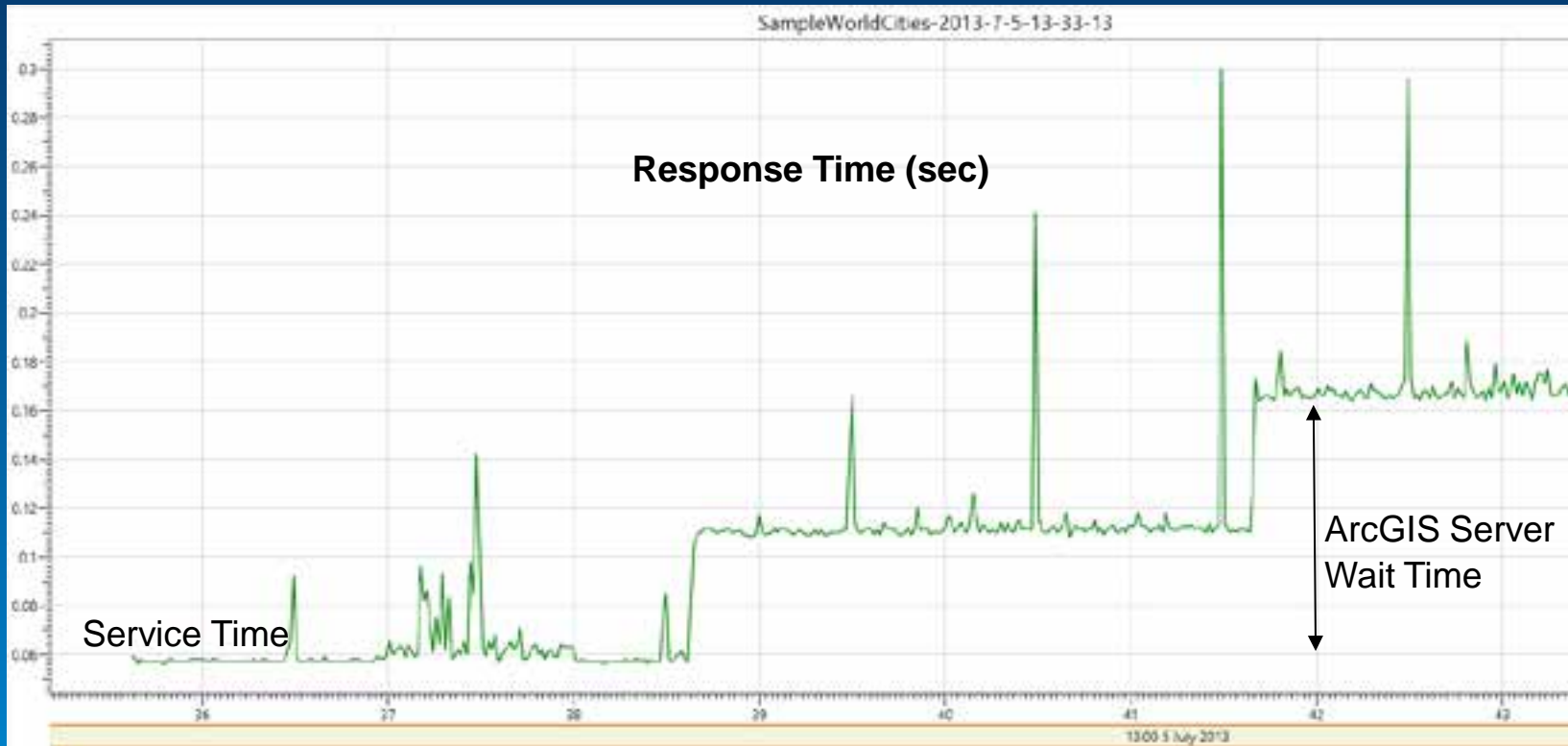


Demo

System Test –

Enterprise GIS testing tool

System Test Demo



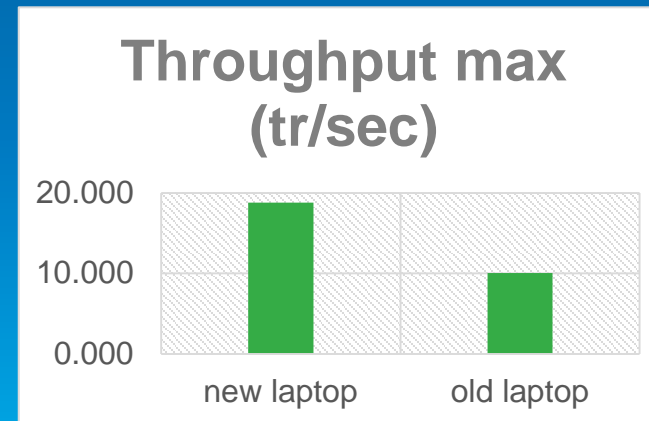
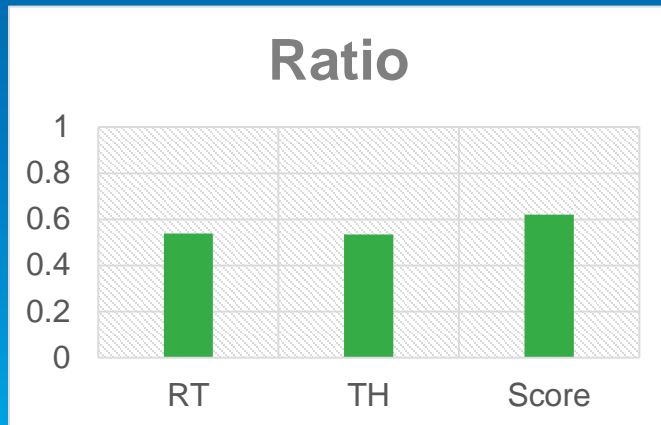
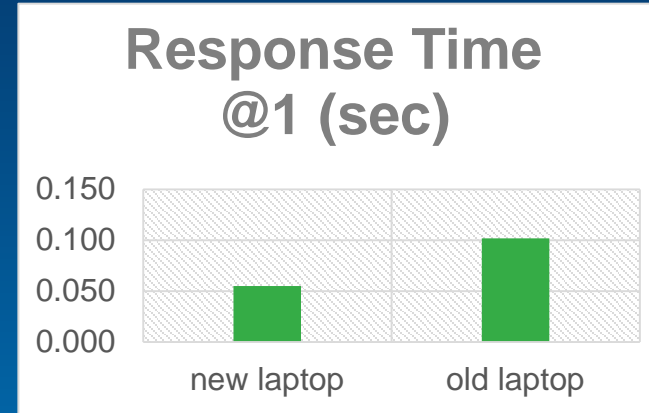
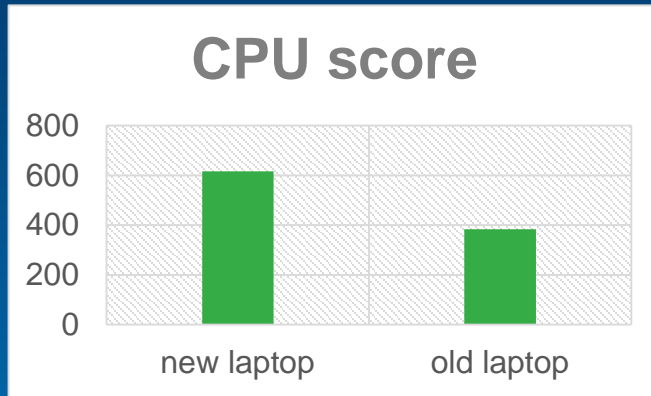
CPU ST/Tr @ ASAKOWICZ1

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

Impact of CPU speed



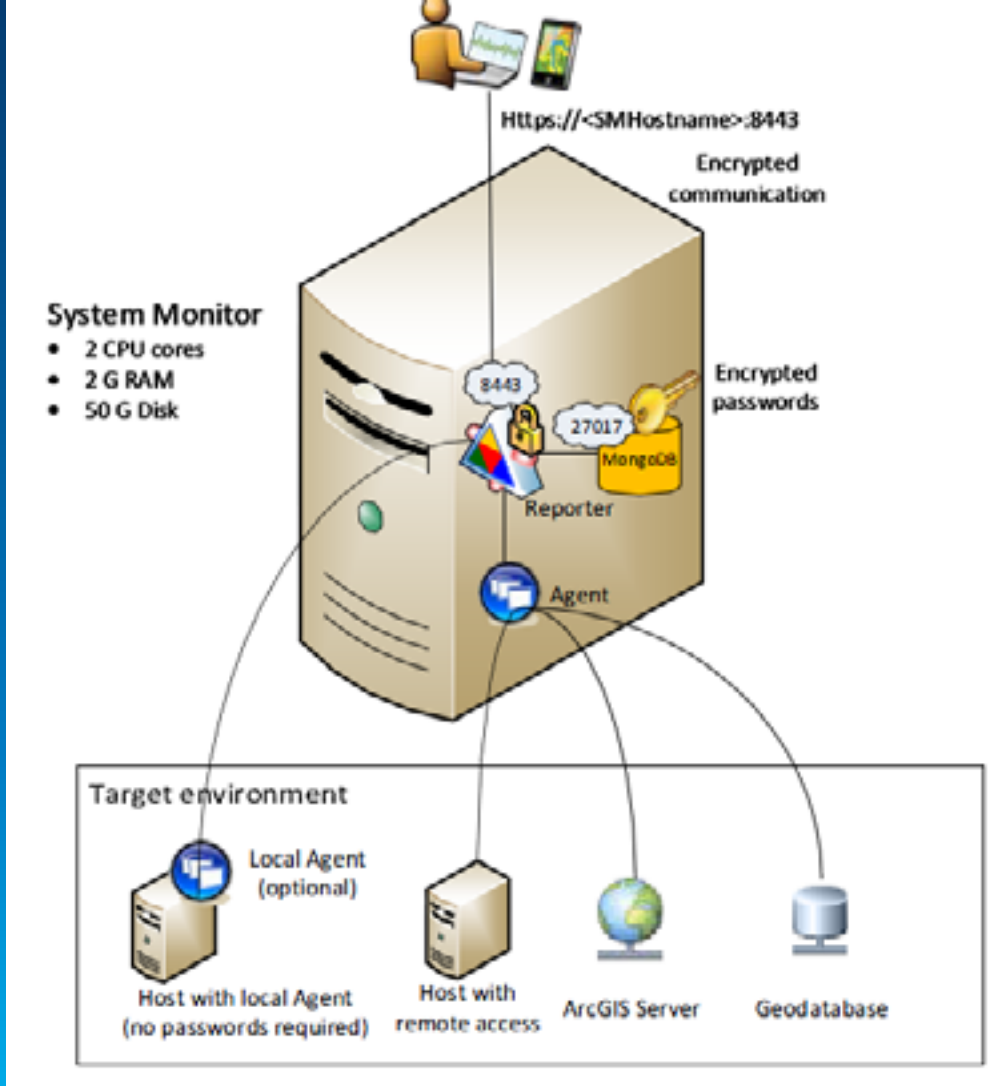
Monitoring

Demo

System Monitor –

Enterprise GIS monitoring tool

System Monitor



System Monitor

System Metrics

The screenshot displays a web-based system monitoring interface. At the top, there is a navigation bar with tabs for 'System Monitor', 'System', 'Process', 'ArcGIS', 'DB', 'Http', 'RDP', 'Amazon', and 'EXT'. Below this, there are sub-tabs for 'Alerts' and 'Reports'. A secondary navigation bar shows 'System: Group: All' with a dropdown menu, and icons for 'CPU', 'Disk', 'Memory', 'Network', and 'All'. A search box is located to the right of these icons. The main content area shows the host name 'ASAKOWICZ1' and the last update time 'Feb 9, 2014 11:50:49 AM'. Below this is a table of system metrics.

Chart	Name	Alerting	Value	Sample Interval
	Summary		None	60
	CPU % Total		4.22	60
	Available Memory GB		7.58	60
	Committed Memory GB		12.6	60
	Network Received mbps eth0		0.44	60
	Network Sent mbps eth0		0.020	60
	Network Received mbps eth1		0	60
	Network Sent mbps eth1		0	60
	Network Received mbps eth2		0	60
	Network Sent mbps eth2		0	60
	Disk % Used C		21	60

System Monitor

ArcGIS Server statistics

The screenshot displays the ArcGIS System Monitor interface. The top navigation bar includes tabs for System, Process, ArcGIS, DB, Http, RDP, Amazon, and EXT. Below this, there are sub-tabs for Alerts and Reports. The main content area shows the selected server: ASAKOWICZ1 ArcGIS Server, with a last update timestamp of Feb 9, 2014 11:43:14 AM. A search bar is present. Below the search bar, there are filters for Filter, Limit (set to Top 10), and Folder (set to All). The main data is presented in a table with columns for Chart, Name, Info, Folder, Alerting, Status, Type, Errors, Throughput (Tr/sec), Busy Time per Tr (sec), Transactions, Max, Busy, and Free.

Chart	Name	Info	Folder	Alerting	Status	Type	Errors	Throughput (Tr/sec)	Busy Time per Tr (sec)	Transactions	Max	Busy	Free
	Summary (1/1)		/		STARTED	Site	0	0	0	0	0	0	0
	SampleWorldCities		/		STOPPED	MapServer	0	0	0	0	0	0	0
	sqlserver		/		STOPPED	GeoDataServer	0	0	0	0	0	0	0
	CachingControllers		System		STOPPED	GPService	0	0	0	0	0	0	0

System Monitor

HTTP custom requests

System Monitor System Process ArcGIS DB Http RDP Amazon EXT


Alerts Reports

Http: Group: All Response Time Response Code Content Length All Refresh

Search:

asakowicz1_SampleWorldCitie Last Updated: Feb 9, 2014 11:55:52 AM

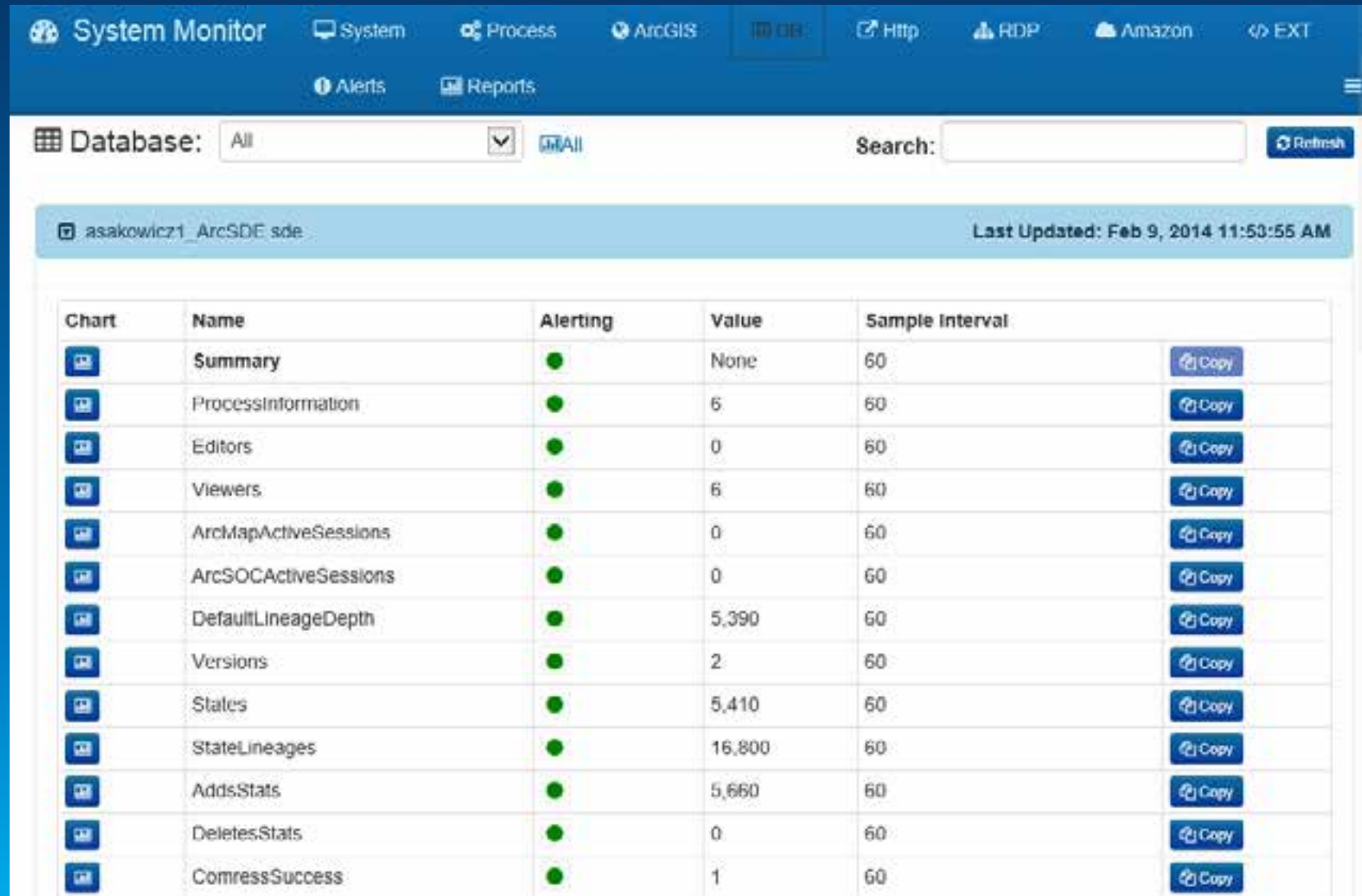
Chart	Name	Alerting	Value	Sample Interval
	Summary	●	None	60
	ResponseTime	●	1.3	60
	Content-Length	●	13,100	60
	Response-Code	●	200	60



Preview

System Monitor

Database statistics



System Monitor

Alerts

System Monitor Dashboards Alerts System Process ArcGIS DB Http RDP

Amazon EXT

Alerts: Host: Counter Type: All Home

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Sun Feb 9 12:51:31 PST 2014

ESLSRV1 (32) Start: - End:

Filter:

Host	Type	Counter	Measured Value	Alert	Validation Value	Last Update
ESLSRV1	Terminal Service Counter	Total Sessions	3.000	Less Than	6.00	Feb 9, 2014 4:45:00 PM
ESLSRV1	Terminal Service Counter	Active Sessions	1.000	Greater Than Equal To	1.00	Feb 9, 2014 4:45:00 PM
ESLSRV1	Terminal Service Counter	Total Sessions	3.000	Less Than	6.00	Feb 9, 2014 4:30:00 PM
ESLSRV1	Terminal Service Counter	Active Sessions	1.000	Greater Than	1.00	Feb 9, 2014

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

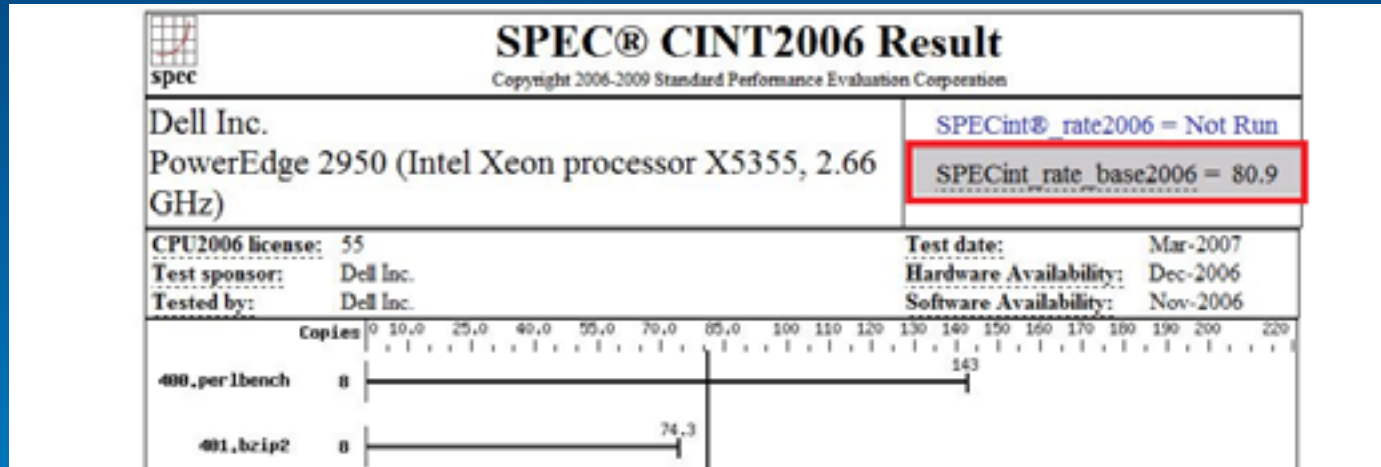
Test Results as Input into Capacity Planning

- Input from testing
 - #CPUs = 4 cores
 - %CPU = 20.8
 - TH = 14,004 requests/hour
 - SPEC per Core of machine tested = 35
- $ST = (4 * 3600 * 20.8) / (14,004 * 100) = 0.2138 \text{ sec}$
 - Note Service Time is very close to Average response time of 0.25

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

Target values

1. Server SpecRate/core=10.1



2. User load=30,000 req/hr

3. Network=45 Mbps

Target values

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

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

- No need to calculate it manually, System Designer Tool does it for you.

Target values

Target network calculation

- **Input to Capacity Planning:**

- Mb/req=1.25
- TH = 30,000 request/hour

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

- **Output**

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

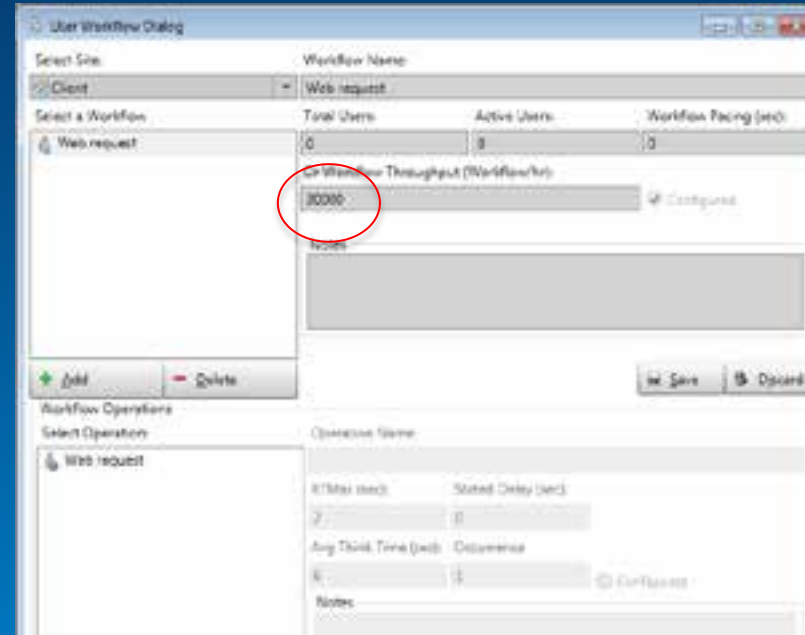
$$Transport(sec) = \frac{Mbits / req}{Mbps - Mbps_{used}}$$

No need to calculate it manually, System Designer Tool does it for you.

Sizing using System Designer

- **Input:**

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



Model 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	M
✓	Client	Client	☺		0.000	0.00	☺	1.250	
✓	WebService	Web Services	☑	0.210	0.004	1.01	☑	1.250	

Sizing using System Designer

- Input
 - Hardware=80.9 Spec

Hardware Dialog

Site: Server Role: WebServer Category: Server

Switch: Switch0 Vendor: Dell Inc. Processor: Processor Operating System: Windows Server 2008 R2 64-bit

Select Hardware Item: [Cores] [SPEC/Core] Hardware

Desktop
WebServer

[8] [10.11] PowerEdge 2950 (Intel Xeon processor X5355, 2.66 GHz)

Processor Name:	Processor Speed (MHz):	CPU Cores:
Intel Xeon X5355	2666.00	8
SPEC int rate per Core:	SPEC int rate:	%Max Utilization:
10.11	80.90	80
RAM (GB):	Storage (GB):	
0	0	

Platform Virtualization

Virtual Environment Vendor: CPU Cores Allocated:

Notes

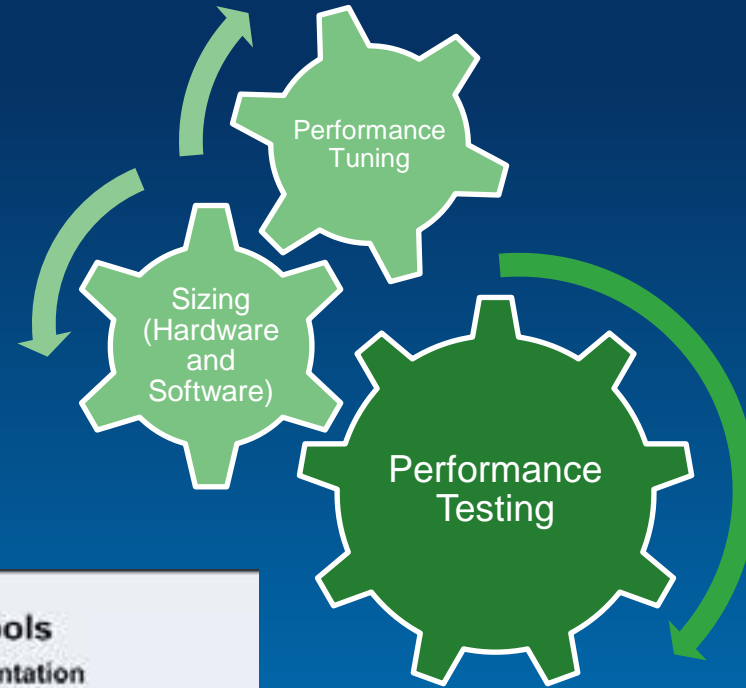
+ Add - Delete Configured Save Discard Close

Demo

**System Designer –
Enterprise GIS planning and
design tool**

Summary

- Process
- Skills
- Tools



Thank you!

Questions?

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