



Executive Workshop on Enterprise Geospatial Systems

Geospatial Infrastructure Demands

Dave Peters

July 15, 2004



What is the challenge?

Develop Enterprise support for GIS Operations

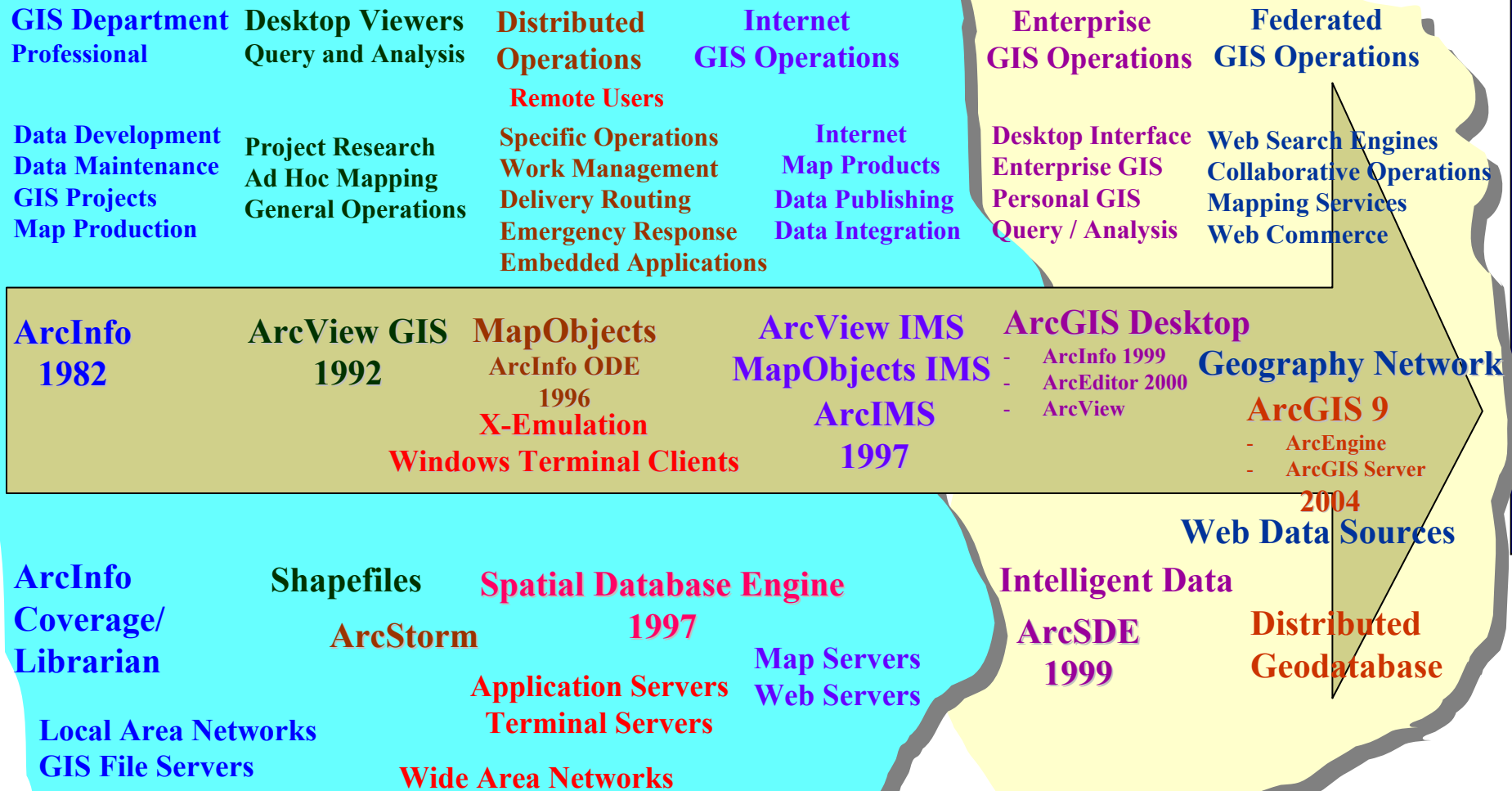
Important Business Drivers:

- Mature and growing GIS Operations
- Rapidly expanding GIS Data Infrastructure
- Evolving IT Infrastructure

DOI Enterprise GIS Challenges

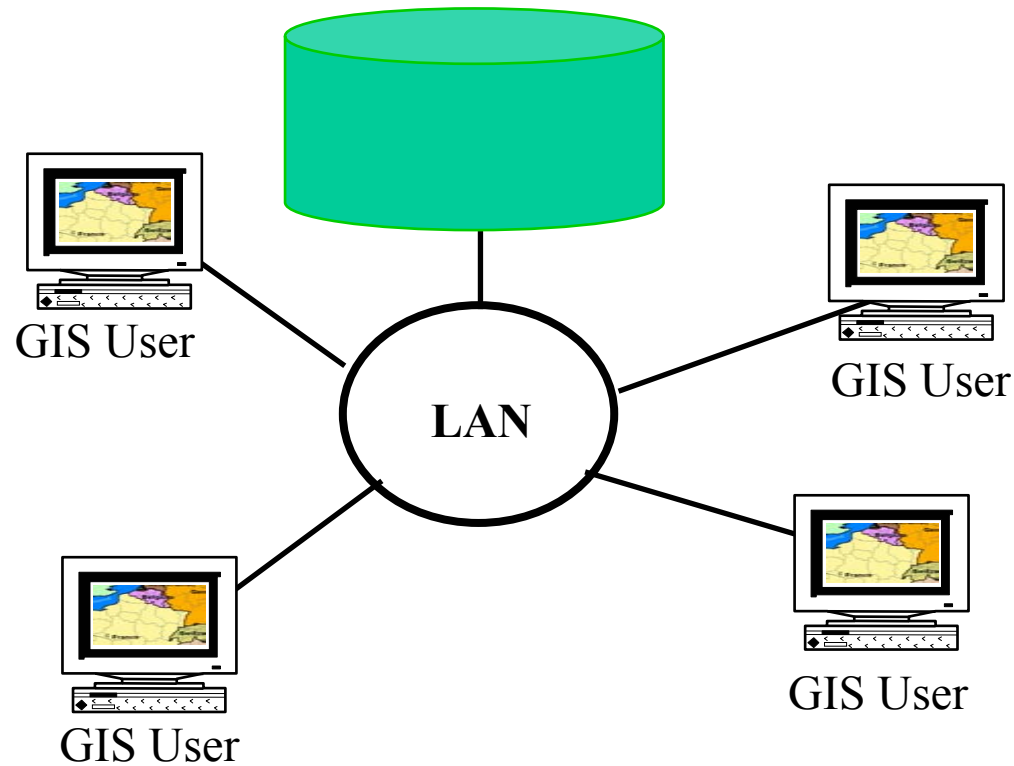
- Define requirements for a scalable architecture
 - Connecting User Applications with Data Sources
- GIS: Understand the proper architecture strategy
- IT: Establish an Actionable Infrastructure Blueprint that supports business needs (GIS Operational Requirements)

GIS Software Evolution Overview

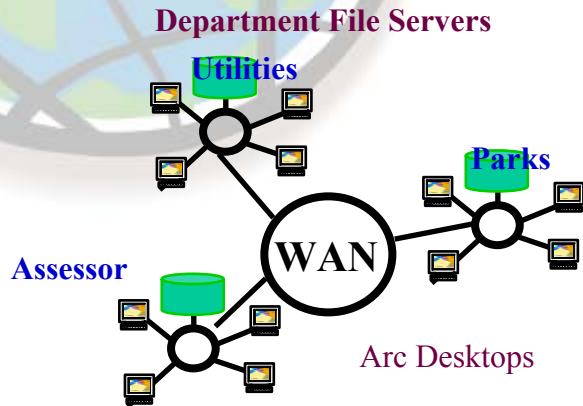


Department GIS

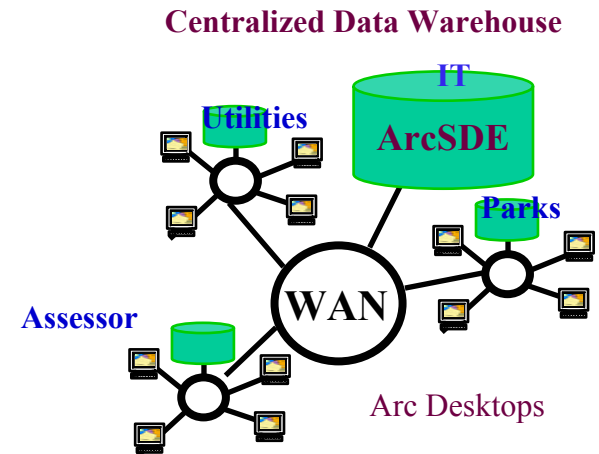
Department File Servers



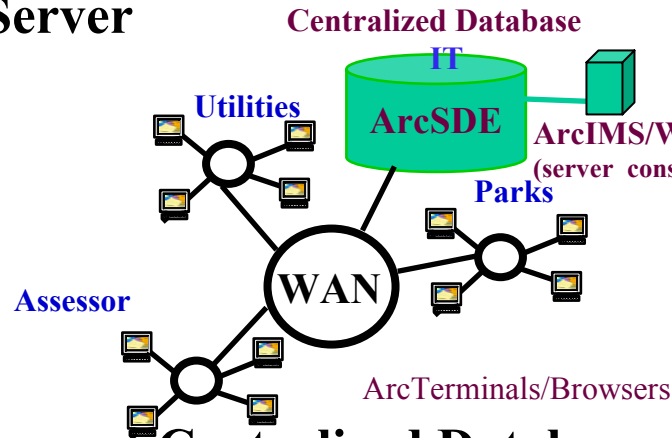
Organizational GIS



Distributed Client/Server
Departmental GIS



Data Warehouse
Departmental GIS Operations
Centralized Data Sharing

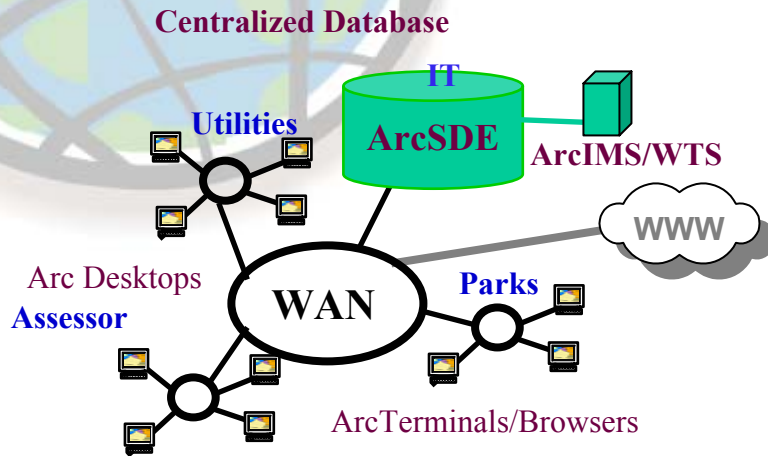


Centralized Database
Enterprise GIS Operations
Centralized Data Administration

Community GIS

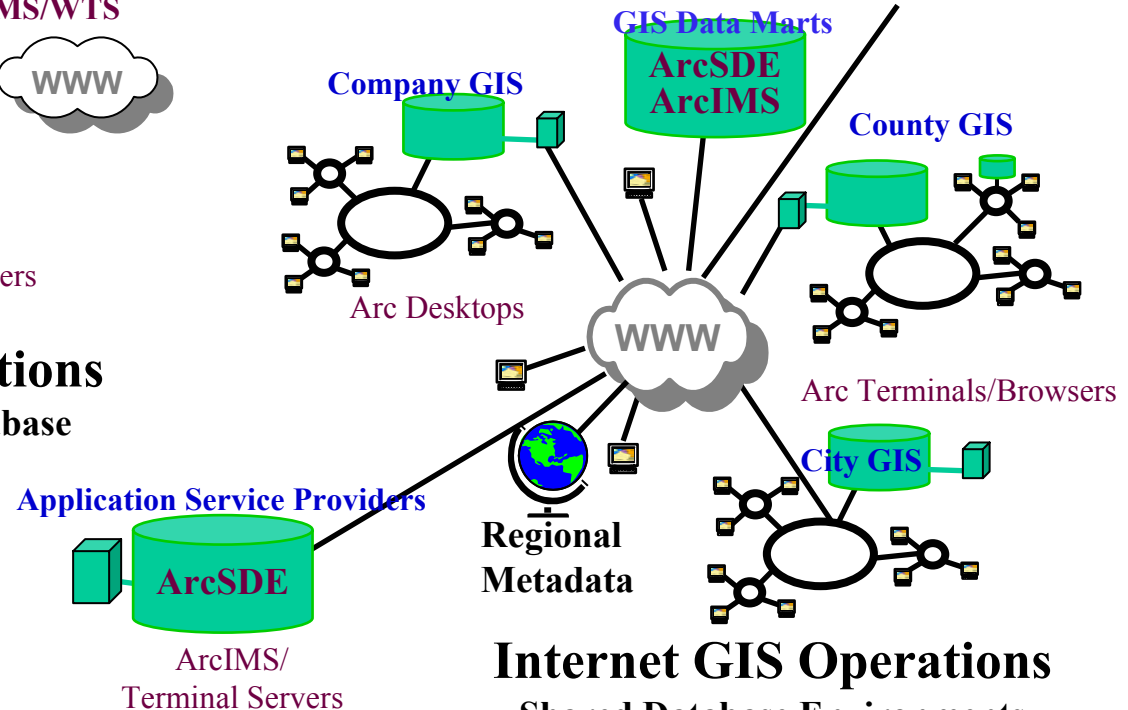


Geography Network



Enterprise GIS Operations

Department and Central Database
Data Integration



Internet GIS Operations

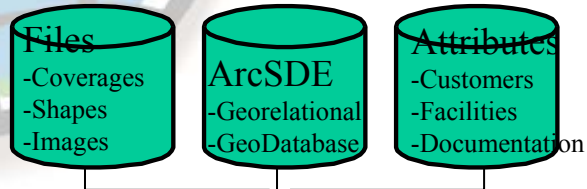
Shared Database Environments
Data Integration

Federated GIS

System Architecture Options

G.NET Architecture

Data Resources



Storage Area Network

File/Image Server



ArcSDE Server



DBMS Server



WTS



ArcIMS



100 Mbps Ethernet

Arc Desktops
-Analysis
-Maintenance
-Operations
-Studies



Arc Browsers
-Map Products
-Analysis
-Operations
-Studies



ArcGIS Architecture

Regional Metadata



Web



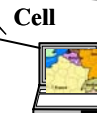
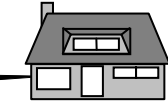
www



Geography Network



Remote Sites



Web Browsers
-Data Download
-Maps on Demand
-Data Shipping

WAN

Arc Terminals
-Analysis
-Maintenance
-Operations
-Studies



Arc 8 Laptops
-Data Updates
-Analysis



Arc 8 Mobile Users
-Data Updates
-Analysis

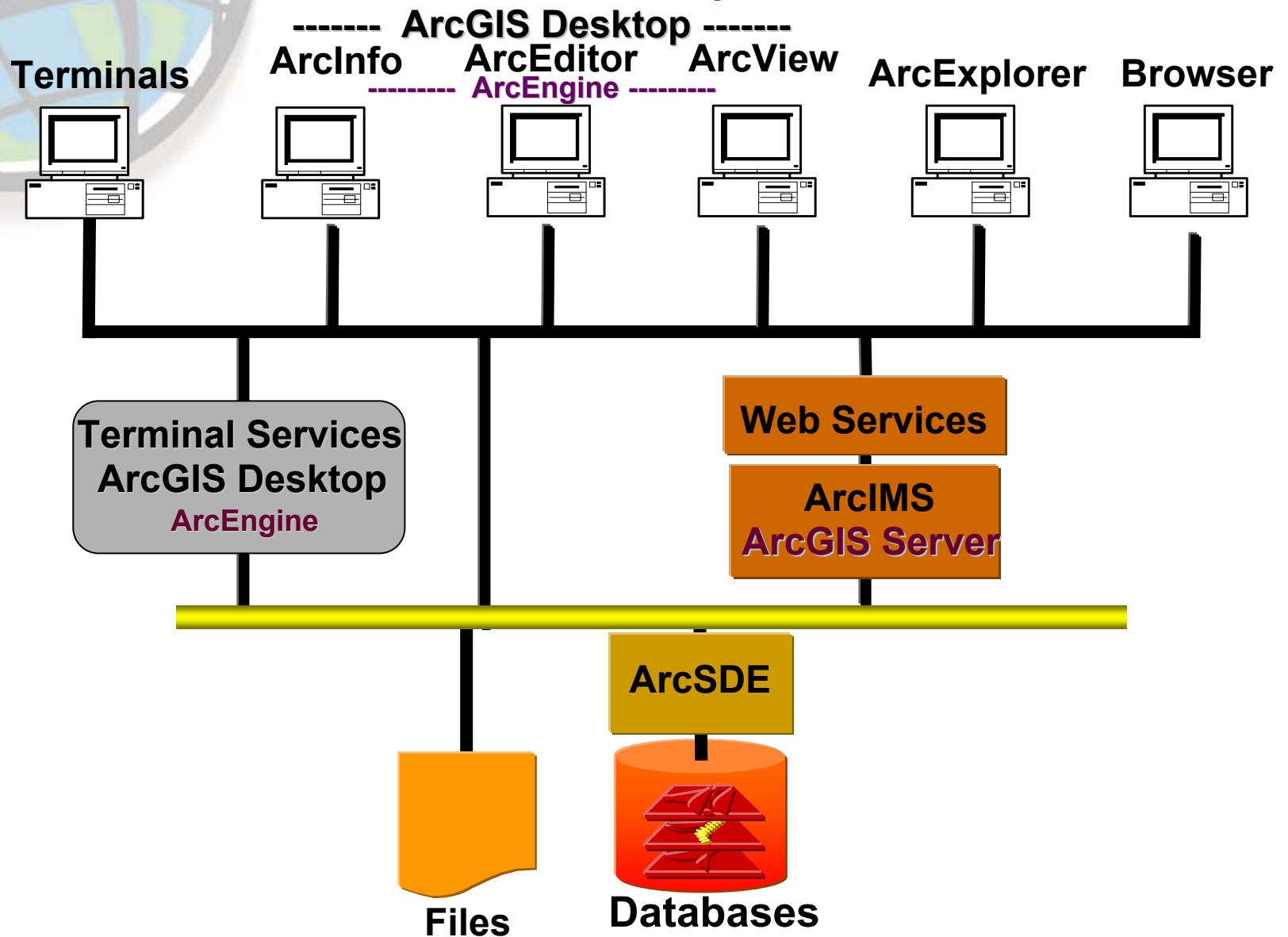


System Design Strategies

GIS Product Architecture



ArcGIS System



System Design Strategies

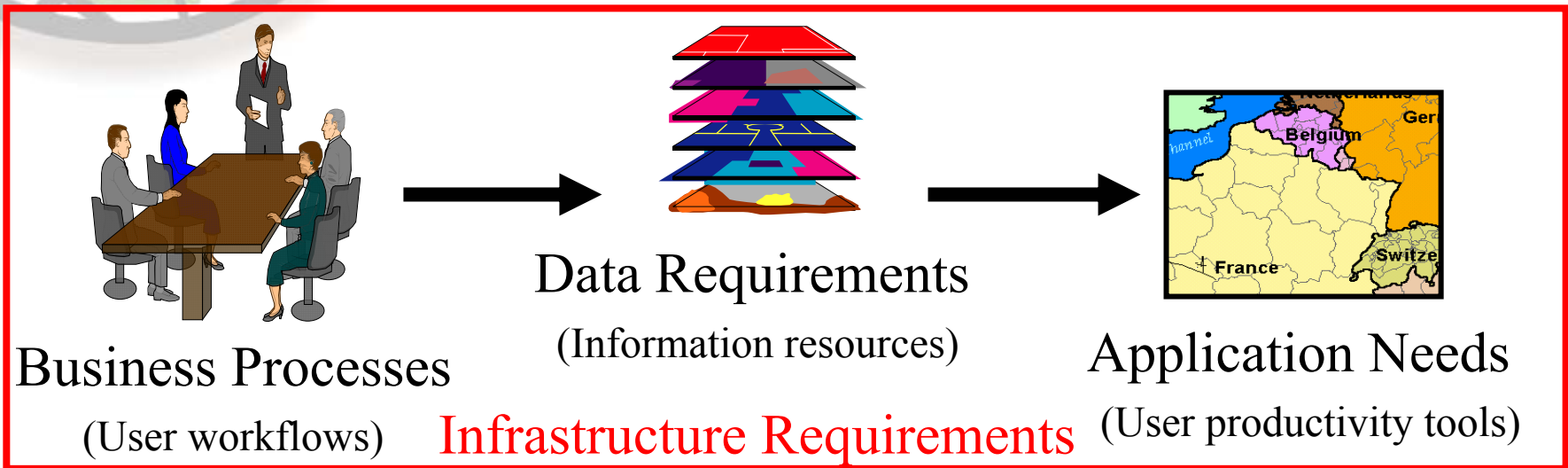
GIS User Needs



GIS Business Planning

Optimizing your Benefits

(Prerequisite for purchasing hardware)



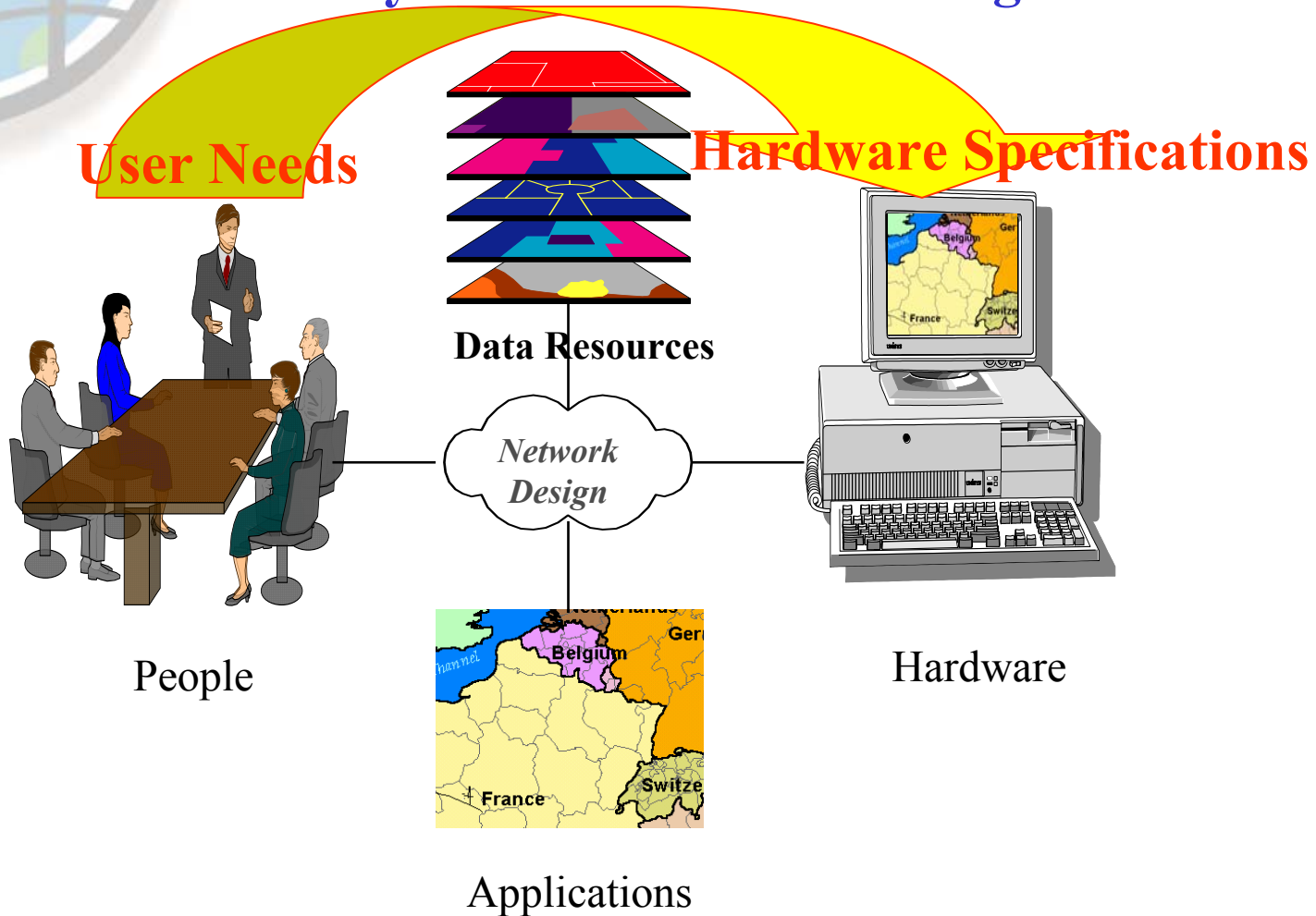
System Design Strategic Deployment Plan

GIS Deployment Strategy	2003				2004				2005			
	QTR 1	QTR 2	QTR 3	QTR 4	QTR 1	QTR 2	QTR 3	QTR 4	QTR 1	QTR 2	QTR 3	QTR 4
	J F M A M J J A S O N D	J F M A M J J A S O N D	J F M A M J J A S O N D	J F M A M J J A S O N D	J F M A M J J A S O N D	J F M A M J J A S O N D	J F M A M J J A S O N D	J F M A M J J A S O N D	J F M A M J J A S O N D	J F M A M J J A S O N D	J F M A M J J A S O N D	J F M A M J J A S O N D
User Requirements Analysis	Planning				Planning				Planning			
Data Migration												
Database Design												
Application Development												
Application Deployment												

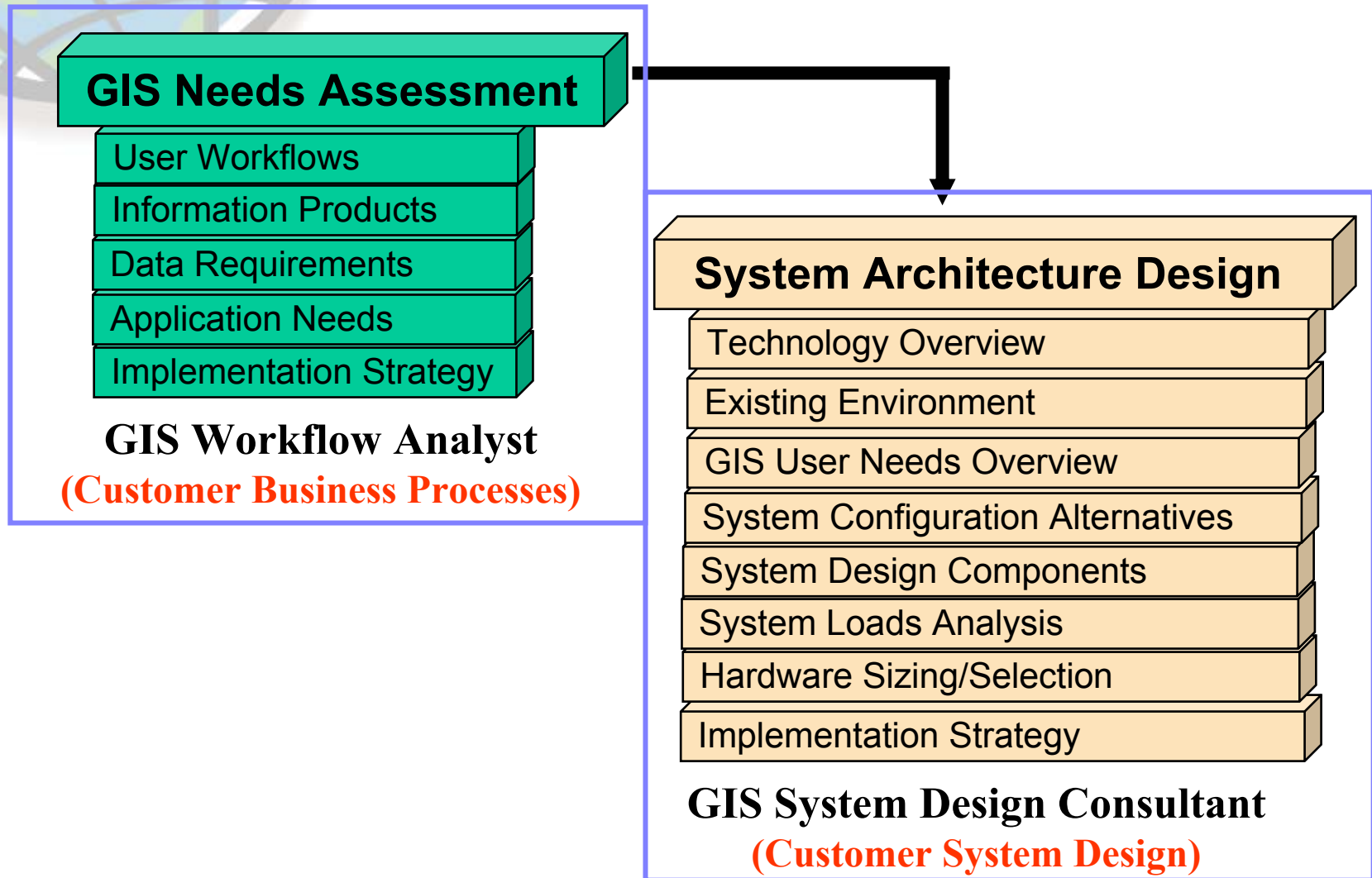
Planning with regular commitments leads to success

System Architecture Design

What Is System Architecture Design?



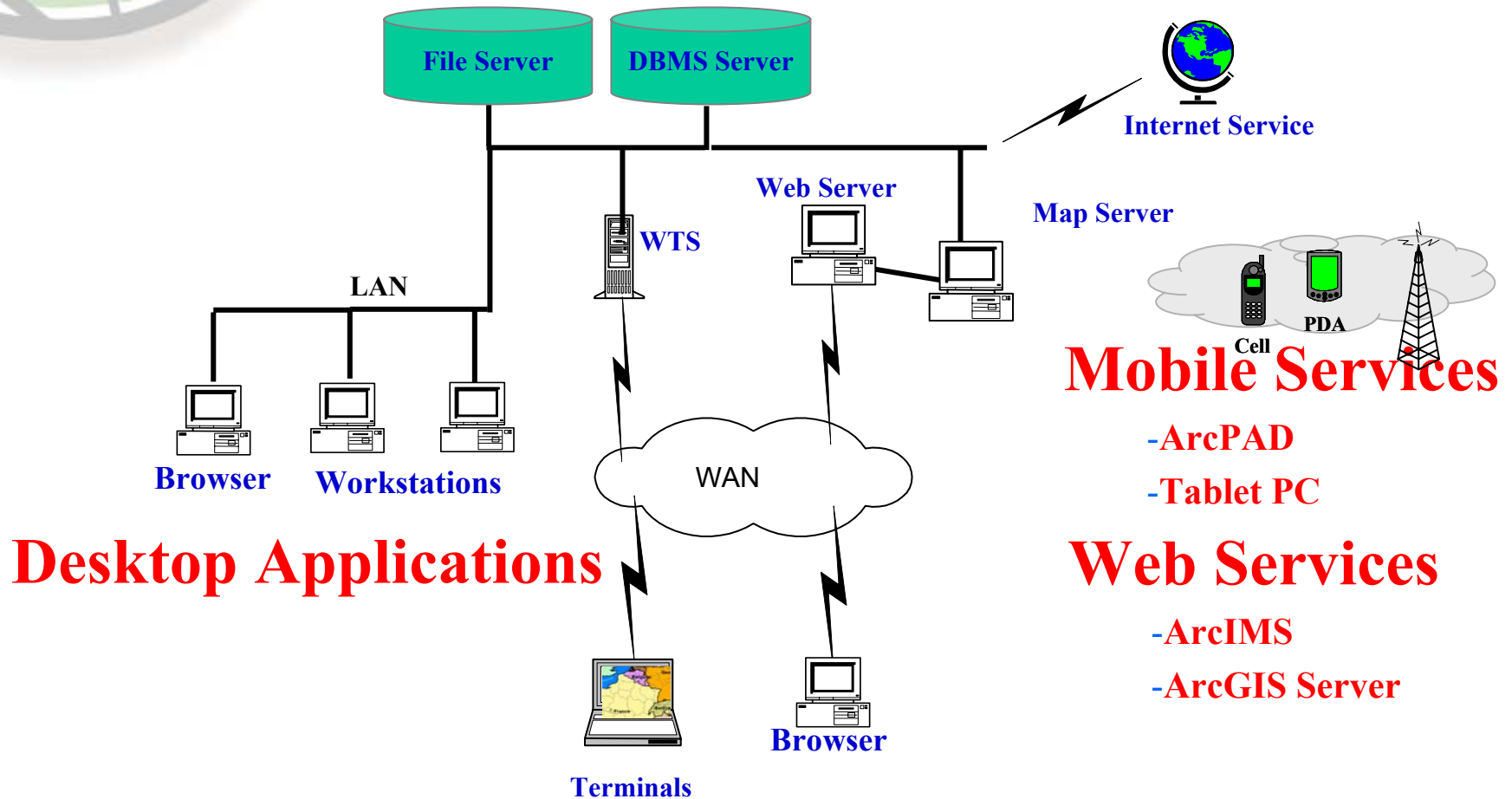
System Design Process



Software Technology Options

Desktop Applications or Web Services?

GIS Data Source



City of Rome Planning

Work Flow Analysis – Year 1

City of Rome January 1, 2004				Total Users	Peak Usage			
Department	Workflow	Info. Product	User Type		ArcGIS Desktop			Web Req/Hr
Site 1 - City Hall								
Planning	Zoning	1.0	Planner	20			8	
		1.1	Web Service					2,600
	Permits	1.2	Inspector	20			10	
		1.3	Appraiser	15	8			
		1.4	Supervisor	2			2	
		1.5	Web Service					600
Engineering	Sewer Backup	2.1	Engineer	4			3	
		2.2	Web Service					800
	Elec. Breaks	2.3	Electrician	13	6			
		2.4	Supervisor	2	1			
		2.5	Web Service					600
	Hwy Repair	2.6	Field Eng.	10			4	
2.7		Contracts	4			4		
IT Department	Public	5.0	Web Service					5,000
Subtotal City Hall				90	15		31	9,600
Site 2 - Operations Facility								
Operations	Clean-up Prog.	3.1	Op. Staff	4			2	
Subtotal Operations				4			2	
Remote Field Offices (WAN)								
Site 3 Freeberg	Inspection	4.1	Field Engineer	40			35	
Site 4 Willsberg	Inspection	4.1	Field Engineer	30			20	
Field Offices	Inspection	4.2	Web Service					1,200
Subtotal Field Offices				70			55	1,200
CITY TOTALS				164	15		88	10,800

User Needs Templates – Year 1

City of Rome Planning

Work Flow Analysis – Year 2

City of Rome January 1, 2005				Total Users	Peak Usage			Web Req/Hr
Department	Workflow	Info. Product	User Type		ArcInfo	ArcEditor	ArcView	
Site 1 - City Hall Network								
Planning	Zoning	1.0	Planner	25			15	2,600
		1.1	Web Service					
	Permits	1.2	Inspector	25			15	
		1.3	Appraiser	20	10			
		1.4	Supervisor	5	2			
		1.5	Web Service				900	
Engineering	Sewer Backup	2.1	Engineer	5			3	1,000
		2.2	Web Service					
	Elec. Breaks	2.3	Electrician	13	6			
		2.4	Supervisor	2	1			
		2.5	Web Service				1,900	
	Hwy Repair	2.6	Field Eng.	11			7	
2.7		Contracts	4			4		
IT Department	Public	5.0	Web Service					10,000
Subtotal City Hall				110	19		44	16,400
Site 1 - Police Network								
Police (Firewall)	Patrol Sched.	5.1	Admin.	10			3	200
		5.4	Web Services					
	Crime Analysis	5.2	Detectives	10	5			
	Spec. Events	5.3	Traffic	10			3	
Subtotal Police				30	5		6	200
Site 2 - Operations Facility								
Operations	Clean-up Prog.	3.1	Op. Staff	4			2	
911	Response	3.2	Call Takers	50			40	4,000
		3.3	Web Services					
Remote Vehicles	Dispatch	3.4	Drivers	30			30	
Subtotal Operations				84			72	4,000
Remote Field Offices (WAN)								
Site 3 Freeberg	Inspection	4.1	Field Engineer	45			30	
Site 4 Willsberg	Inspection	4.1	Field Engineer	60			40	
WAN Field Office	Inspection	4.2	Web Services					1,200
Subtotal WAN Offices				105			70	1,200
Remote Field Offices (Internet VPN)								
Site 5 Perth	Inspection	4.3	Field Engineer	10			2	
Site 6 Wawash	Inspection	4.3	Field Engineer	50			40	
Site 7 Jackson	Inspection	4.3	Field Engineer	60			20	
Internet Field Offices	Inspection	4.2	Web Service					1,300
Subtotal Internet Offices				120			202	3,700
CITY TOTALS				449	24		394	25,500

User Needs Templates – Year 2

City of Rome

User Application Requirements

CITY OF ROME	January 1, 2004					January 1, 2005				
	Total	Peak Loads			Web	Total	Peak Loads			Web
	Users	AI	AE	AV	Req/Hr	Users	AI	AE	AV	Req/Hr
Site 1 - City Hall Network										
Planning	57	8		20	3,200	75	12		30	3,500
Engineering	33	7		11	1,400	35	7		14	2,900
IT Department (Public Web Services)					5,000					10,000
Subtotal City Hall	90	15		31	9,600	110	19		44	16,400
Site 1 - Police Network										
Police (Firewall)						30	5		6	200
Police totals						30	5		6	200
Site 2 - Operations Facility										
Operations	4			2		4			2	
911						50			40	4,000
Remote Vehicles						30			30	
Operations Totals	4			2		84			72	4,000
Remote Field Offices (WAN)										
Site 3 Freeberg	40			35	600	45			30	600
Site 4 Willsberg	30			20	600	60			40	600
Subtotal WAN Offices	70			55	1,200	105			70	1,200
Remote Field Offices (Internet VPN)										
Site 5 Perth						10			2	100
Site 6 Wawash						50			40	600
Site 7 Jackson						60			20	600
Subtotal Internet Offices						120			62	1,300
CITY TOTALS	164	15		88	10,800	449	24		254	23,100

Note: ArcGIS Desktop (AI = ArcInfo, AE = ArcEditor, AV = ArcView)

User Needs

System Architecture Design Overview

Database Configuration Options

Centralized Computing Environment

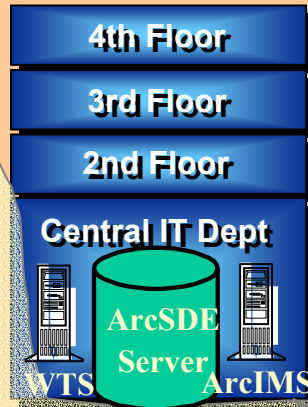
Phase 1

Site 1 City Hall

Police Dept

Office Staff

Firewall



T1

Internet

Browsers
PSAP

56 Kbps
Wireless

Police
Vehicles

56 Kbps
Wireless

Emergency
Vehicles

Phase 2

Site 2 Operations Facility

LAN



T1

T1

T1

Site 3
Freeberg

Site 4
Willsberg

Site 7
Jackson

Site 6
Wawash

Site 5
Perth

T1 = 1.54 Mbps

Roger Tomlinson,
Managing an GIS Seminar, July 2003

Platform Loads

Central Computing Environment

CITY OF ROME	January 1, 2004					January 1, 2005				
	Total	Peak Loads			Web	Total	Peak Loads			Web
	Users	AI	AE	AV	Req/Hr	Users	AI	AE	AV	Req/Hr
Site 1 - City Hall Network										
Planning	57	8		20	3,200	75	12		30	3,500
Engineering	33	7		11	1,400	35	7		14	2,900
IT Department (Public Web Services)					5,000					10,000
Subtotal City Hall	90	15		31	9,600	110	19		44	16,400
Site 1 - Police Network										
Police (Firewall)						30	5		6	200
Police totals						30	5		6	200
Site 2 - Operations Facility										
Operations	4			2		4			2	
911						50			40	4,000
Remote Vehicles						30			30	
Operations Totals	4			2		84			72	4,000
Remote Field Offices (WAN)										
Site 3 Freeberg	40			35	600	45			30	600
Site 4 Willsberg	30			20	600	60			40	600
Subtotal WAN Offices	70			55	1,200	105			70	1,200
Remote Field Offices (Internet VPN)										
Site 5 Perth						10			2	100
Site 6 Wawash						50			40	600
Site 7 Jackson						60			20	600
Subtotal Internet Offices						120			62	1,300
CITY TOTALS	164	15		88	10,800	449	24		254	23,100

Note: ArcGIS Desktop (AI = ArcInfo, AE = Arc Editor, AV = ArcView)

Server Platforms	January 1, 2004					January 1, 2005				
	Total Users	Peak Loads			Web Req/Hr	Total Users	Peak Loads			Web Req/Hr
		AI	AE	AV			AI	AE	AV	
City Hall Computer Room										
ArcSDE Geodatabase		15		88			24		254	
Windows Terminal Servers				57					204	
ArcIMS Web Server		Requests per hour			10,800		Requests per hour			23,100

Database Configuration Options

Distributed Computing Environment

Site 1 City Hall

Police Dept



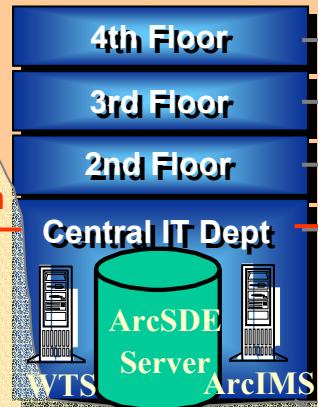
Replication



ArcIMS

56 Kbps Wireless

Police Vehicles



Firewall

Phase 2

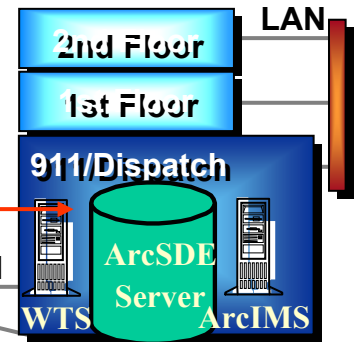


Internet

56 Kbps Wireless

Emergency Vehicles

Phase 1 Site 2 Operations Facility



Replication

WAN

Site 3
Freeberg

Site 4
Willsberg

Site 7
Jackson

Site 6
Wawash

Site 5
Perth

T1 = 1.54 Mbps

Roger Tomlinson,
Managing an GIS Seminar, July 2003

Platform Loads

Distributed Computing Environment

CITY OF ROME	January 1, 2004					January 1, 2005				
	Total Users	Peak Loads			Web Req/Hr	Total Users	Peak Loads			Web Req/Hr
	AI	AE	AV			AI	AE	AV		
Site 1 - City Hall Network										
Planning	57	8		20	3,200	75	12		30	3,500
Engineering	33	7		11	1,400	35	7		14	2,900
IT Department (Public Web Services)					5,000					10,000
Subtotal City Hall	90	15		31	9,600	110	19		44	16,400
Site 1 - Police Network										
Police (Firewall)						30	5		6	200
Police totals						30	5		6	200
Site 2 - Operations Facility										
Operations	4			2		4			2	
911						50			40	4,000
Remote Vehicles						30			30	
Operations Totals	4			2		84			72	4,000
Remote Field Offices (WAN)										
Site 3 Freeberg	40			35	600	45			30	600
Site 4 Willsberg	30			20	600	60			40	600
Subtotal WAN Offices	70			55	1,200	105			70	1,200
Remote Field Offices (Internet VPN)										
Site 5 Perth						10			2	100
Site 6 Wawash						50			40	600
Site 7 Jackson						60			20	600
Subtotal Internet Offices						120			62	1,300
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Note: ArcGIS Desktop (AI = ArcInfo, AE = ArcEditor, AV = ArcView)

Server Platforms	January 1, 2004					January 1, 2005				
	Total	Peak Loads			Web	Total	Peak Loads			Web
	Users	AI	AE	AV	Req/Hr	Users	AI	AE	AV	Req/Hr
City Hall Computer Room										
ArcSDE Geodatabase		15		86			19		176	
Windows Terminal Servers				55					132	
ArcIMS Web Server		Requests per hour			10,800		Requests per hour			18,900
Police Computer Room										
ArcSDE Server							5		6	
ArcIMS Web Server		Requests per hour					Requests per hour			200
Operations Facility										
ArcSDE Geodatabase		2					72			
Windows Terminal Servers							30			
ArcIMS Web Server		Requests per hour					Requests per hour			4,000

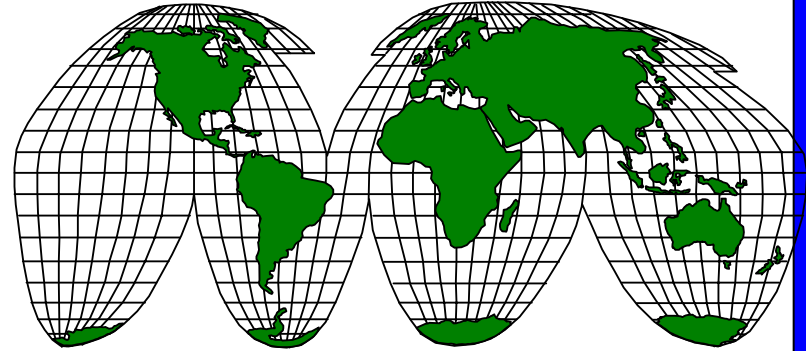
Platform
Loads
Analysis

System Design Strategies

Network Communications



GIS Applications Network Impact



What GIS Does ...

- Graphic Data Representation (Maps)
- Large Quantity of Data Analysis
- Lots of Network Traffic

Network Design Guidelines

Local Area Networks		Concurrent Client Loads			
Bandwidth	File Servers	SDE Servers	Windows Terminals	Web Products	
10 Mbps LAN	2-4	10-20	350-700		150-300
16 Mbps LAN	3-6	16-32	550-1100		250-500
100 Mbps LAN	20-40	100-200	3,500-7,000		1,500-3,000
1 Gbps LAN	200-400	1,000-2,000	35,000-70,000		15,000-30,000
Wide Area Networks		Concurrent Client Loads			
Bandwidth	File Servers	SDE Servers	Windows Terminals	Web Products	
56 Kbps Modem	NR	NR	2-4		1-2
128 Kbps ISDN	NR	NR	5-10		2-4
256 Kbps DSL	NR	NR	10-20		5-10
512 Kbps	NR	NR	20-40		10-20
1.54 Mbps T-1	NR	1-2	50-100		25-50
2 Mbps E-1	NR	1-3	75-150		40-80
6.16 Mbps T-2	1-2	6-12	200-400		100-200
45 Mbps T-3	10-20	50-100	1,500-3,000		700-1500
155 Mbps ATM	30-60	150-300	5,000-10,000		2,500-5,000

ArcIMS Network Performance

Wide Area Network Bandwidth	Peak ArcIMS Requests/Hour (based on Average Image Size)					
	10 KB	30 KB	50 KB	75 KB	100 KB	400 KB
56 Kbps Modem	2,016	672	403	269	202	50
1.54 Mbps T-1	55,440	18,480	11,088	7,392	5,544	1,386
6.16 Mbps T-2	221,760	73,920	44,352	29,568	22,176	5,544
45 Mbps T-3	1,620,000	540,000	324,000	216,000	162,000	40,500
155 Mbps ATM	5,580,000	1,860,000	1,116,000	744,000	558,000	139,500

Note: 1 KB = 10 Kb HTTP traffic

Wide Area Network Bandwidth	Image Transfer Time (sec) based on Average Image Size					
	10 KB	30 KB	50 KB	75 KB	100 KB	400 KB
19 Kbps Modem	5.3	15.8	26.3	39.5	52.6	210.5
28 Kbps Modem	3.6	10.7	17.9	26.8	35.7	142.9
56 Kbps Modem	1.8	5.4	8.9	13.4	17.9	71.4
256 Kbps	0.4	1.2	2.0	2.9	3.9	15.6
512 Kbps	0.2	0.6	1.0	1.5	2.0	7.8
1.54 Mbps T-1	0.1	0.2	0.3	0.5	0.6	2.6
6.16 Mbps T-2	0.0	0.0	0.1	0.1	0.2	0.6
45 Mbps T-3	0.0	0.0	0.0	0.0	0.0	0.1
155 Mbps ATM	0.0	0.0	0.0	0.0	0.0	0.0

Data Download Performance

Wide Area Network Bandwidth	Peak FTP Downloads/Hour (based on Average File Size)				
	1 MB	5 MB	10 MB	20 MB	50 MB
56 Kbps Modem	17	3	2	1	0
1.54 Mbps T-1	462	92	46	23	9
6.16 Mbps T-2	1,848	370	185	92	37
45 Mbps T-3	13,500	2,700	1,350	675	270
155 Mbps ATM	46,500	9,300	4,650	2,325	930

Note: 1 KB = 10 Kb FTP traffic

Wide Area Network Bandwidth	File Transfer Time (sec) based on Average File Size				
	1 MB	5 MB	10 MB	20 MB	50 MB
19 Kbps Modem	526	2,632	5,263	10,526	26,316
28 Kbps Modem	357	1,786	3,571	7,143	17,857
56 Kbps Modem	179	893	1,786	3,571	8,929
128 Kbps	78	391	781	1,563	3,906
256 Kbps	39	195	391	781	1,953
1.54 Mbps T-1	6	32	65	130	325
6.16 Mbps T-2	2	8	16	32	81
45 Mbps T-3	0	1	2	4	11
155 Mbps ATM	0	0	1	1	3



ArcGIS Desktop Network Design Planning Factors

Client Platform	Data per Query		Traffic per query	Bandwidth per user
	KBpq	Compressed KBpq	Kbpq	Kbps
ArcSDE Client	1,000	500	5,000	500
File Server Client	1,000	5,000	50,000	5,000
Terminal Client	100	28	280	28
ArcIMS Browser Client	50	50	500	50
ArcIMS ArcMap client	200	200	2000	200

Network Loads

Central Computing Environment

CITY OF ROME	January 1, 2004					January 1, 2005				
	Total	Peak Loads			Web	Total	Peak Loads			Web
	Users	AI	AE	AV	Req/Hr	Users	AI	AE	AV	Req/Hr
Site 1 - City Hall Network	ArcSDE /ArcIMS for all offices and Public									
Planning	57	8		20	3,200	75	12		30	3,500
Engineering	33	7		11	1,400	35	7		14	2,900
IT Department (Public Web Services)					5,000					10,000
Subtotal City Hall	90	15		31	9,600	110	19		44	16,400
Site 1 - Police Network	ArcSDE for local clients / dialup for remote patrol cars									
Police (Firewall)						30	5		6	200
Police totals						30	5		6	200
Site 2 - Operations Facility	Terminal WAN access for local clients / Internet access for remote vehicles									
Operations	4			2		4			2	
911						50			40	4,000
Remote Vehicles						30			30	
Operations Totals	4			2		84			72	4,000
Remote Field Offices (WAN)	Terminal WAN access to City Hall									
Site 3 Freeberg	40			35	600	45			30	600
Site 4 Willsberg	30			20	600	60			40	600
Subtotal WAN Offices	70			55	1,200	105			70	1,200
Remote Field Offices (Internet VPN)	Terminal Internet VPN Internet access to City Hall									
Site 5 Perth						10			2	100
Site 6 Wawash						50			40	600
Site 7 Jackson						60			20	600
Subtotal Internet Offices						120			62	1,300
CITY TOTALS	164	15		88	10,800	449	24		254	23,100

Note: ArcGIS Desktop (AI = ArcInfo, AE = ArcEditor, AV = ArcView)

Network
Loads
Analysis

Network Suitability	January 1, 2004					January 1, 2005				
	Bandwidth	Peak Loads			Web	Total	Peak Loads			Web
	Mbps	AI	AE	AV	Req/Hr	Users	AI	AE	AV	Req/Hr
City Hall										
City WAN Connection	1.54			57	1,200	1.54			142	5,200
Internet Connection (T-1)	1.54				5,000	1.54			62	11,300
Operations Facility										
WAN Connection (T-1)	1.54			2		1.54			42	4,000
Remote Field Offices										
Site 3 Freeberg	1.54			35	600	1.54			30	600
Site 4 Willsberg	1.54			20	600	1.54			40	600
Site 5 Perth	1.54					1.54			2	100
Site 6 Wawash	1.54					1.54			40	600
Site 7 Jackson	1.54					1.54			20	600

Network Suitability Year 1

Centralized Computing Environment

Network Suitability	January 1, 2004					January 1, 2005				
	Bandwidth	Peak Loads			Web	Total	Peak Loads			Web
	Mbps	AI	AE	AV	Req/Hr	Users	AI	AE	AV	Req/Hr
City Hall										
City WAN Connection	1.54			57	1,200	1.54			142	5,200
Internet Connection (T-1)	1.54				5,000	1.54			62	11,300
Operations Facility										
WAN Connection (T-1)	1.54			2		1.54			42	4,000
Remote Field Offices										
Site 3 Freeberg	1.54			35	600	1.54			30	600
Site 4 Willsberg	1.54			20	600	1.54			40	600
Site 5 Perth	1.54					1.54			2	100
Site 6 Wawash	1.54					1.54			40	600
Site 7 Jackson	1.54					1.54			20	600

Combine

Convert

Network Suitability	January 1, 2004					
	Available Bandwidth Mbps	User Loads		Network Loads Mbps		
		ArcGIS Desktop	ArcIMS Req/Sec	ArcGIS Desktop	ArcIMS Req/Sec	Required Bandwidth
City Hall						
City WAN Connection	1.54	57	0.33	1.60	0.17	1.76
Internet Connection (T-1)	1.54		1.39		0.69	0.69
Operations Facility						
WAN Connection (T-1)	1.54	2		0.06		0.06
Remote Field Offices						
Site 3 Freeberg	1.54	35	0.17	0.98	0.08	1.06
Site 4 Willsberg	1.54	20	0.17	0.56	0.08	0.64
Site 5 Perth	1.54					
Site 6 Wawash	1.54					
Site 7 Jackson	1.54					

Design Factors: Workstation 0.500 Mbps, Terminal 0.028Mbps, Browser 0.500Mbps

Exceed

High

Network Suitability Year 2

Centralized Computing Environment

Network Suitability	January 1, 2004					January 1, 2005				
	Bandwidth	Peak Loads			Web	Total	Peak Loads			Web
	Mbps	AI	AE	AV	Req/Hr	Users	AI	AE	AV	Req/Hr
City Hall										
City WAN Connection	1.54			57	1,200	1.54			142	5,200
Internet Connection (T-1)	1.54				5,000	1.54			62	11,300
Operations Facility										
WAN Connection (T-1)	1.54			2		1.54			42	4,000
Remote Field Offices										
Site 3 Freeberg	1.54			35	600	1.54			30	600
Site 4 Willsberg	1.54			20	600	1.54			40	600
Site 5 Perth	1.54					1.54			2	100
Site 6 Wawash	1.54					1.54			40	600
Site 7 Jackson	1.54					1.54			20	600

Combine

Convert

Exceed

High

Network Suitability	January 1, 2005					
	Available Bandwidth Mbps	User Loads		Network Loads Mbps		Required Bandwidth
		ArcGIS Desktop	ArcIMS Req/Sec	ArcGIS Desktop	ArcIMS Req/Sec	
City Hall		Network Design Factors		(0.028)	(0.5)	TOTAL
City WAN Connection	1.54	142	1.44	3.98	0.72	4.70
Internet Connection (T-1)	1.54	62	3.14	1.74	1.57	3.31
Operations Facility		Network Design Factors		(0.028)	(0.5)	TOTAL
WAN Connection (T-1)	1.54	42	1.11	1.18	0.56	1.73
Remote Field Offices		Network Design Factors		(0.028)	(0.5)	TOTAL
Site 3 Freeberg	1.54	30	0.17	0.84	0.08	0.92
Site 4 Willsberg	1.54	40	0.17	1.12	0.08	1.20
Site 5 Perth	1.54	2	0.03	0.06	0.01	0.07
Site 6 Wawash	1.54	40	0.17	1.12	0.08	1.20
Site 7 Jackson	1.54	20	0.17	0.56	0.08	0.64

Design Factors: Workstation 0.500 Mbps, Terminal 0.028Mbps, Browser 0.500Mbps

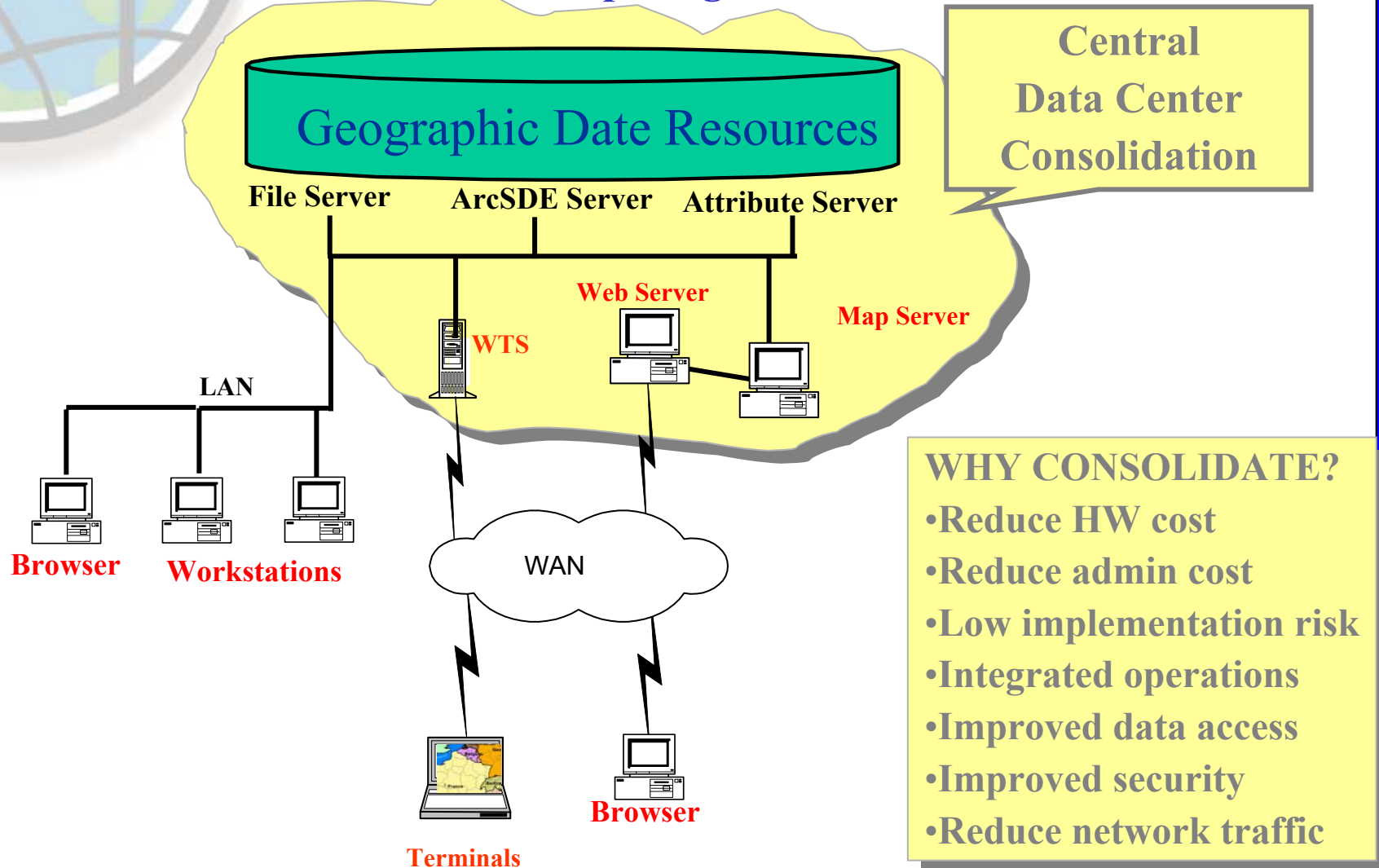
System Design Strategies

Data Administration



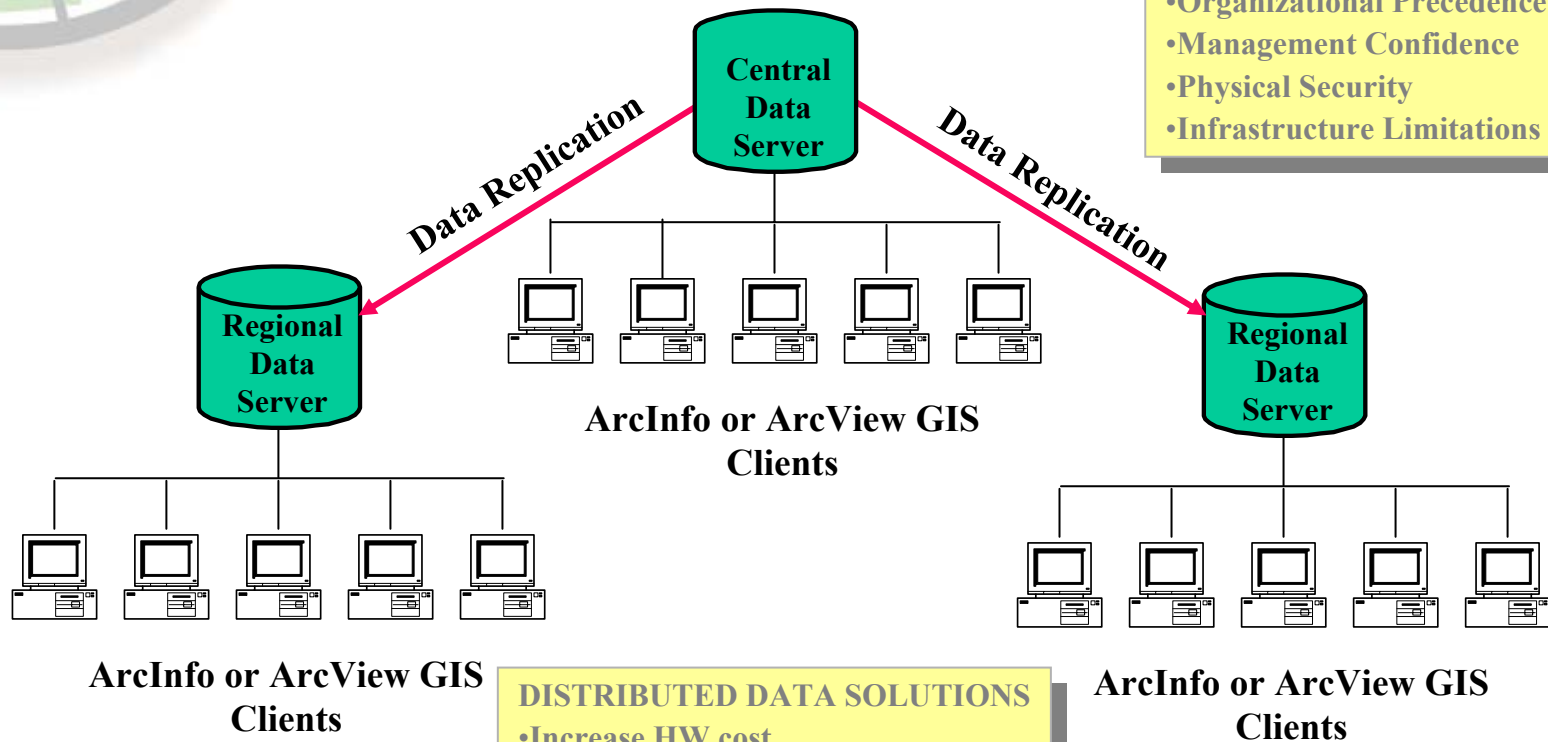
Database Configuration Options

Centralized Computing Environment



Database Configuration Options

Distributed Computing Environment



Why use distributed architecture?

- Organizational Precedence
- Management Confidence
- Physical Security
- Infrastructure Limitations

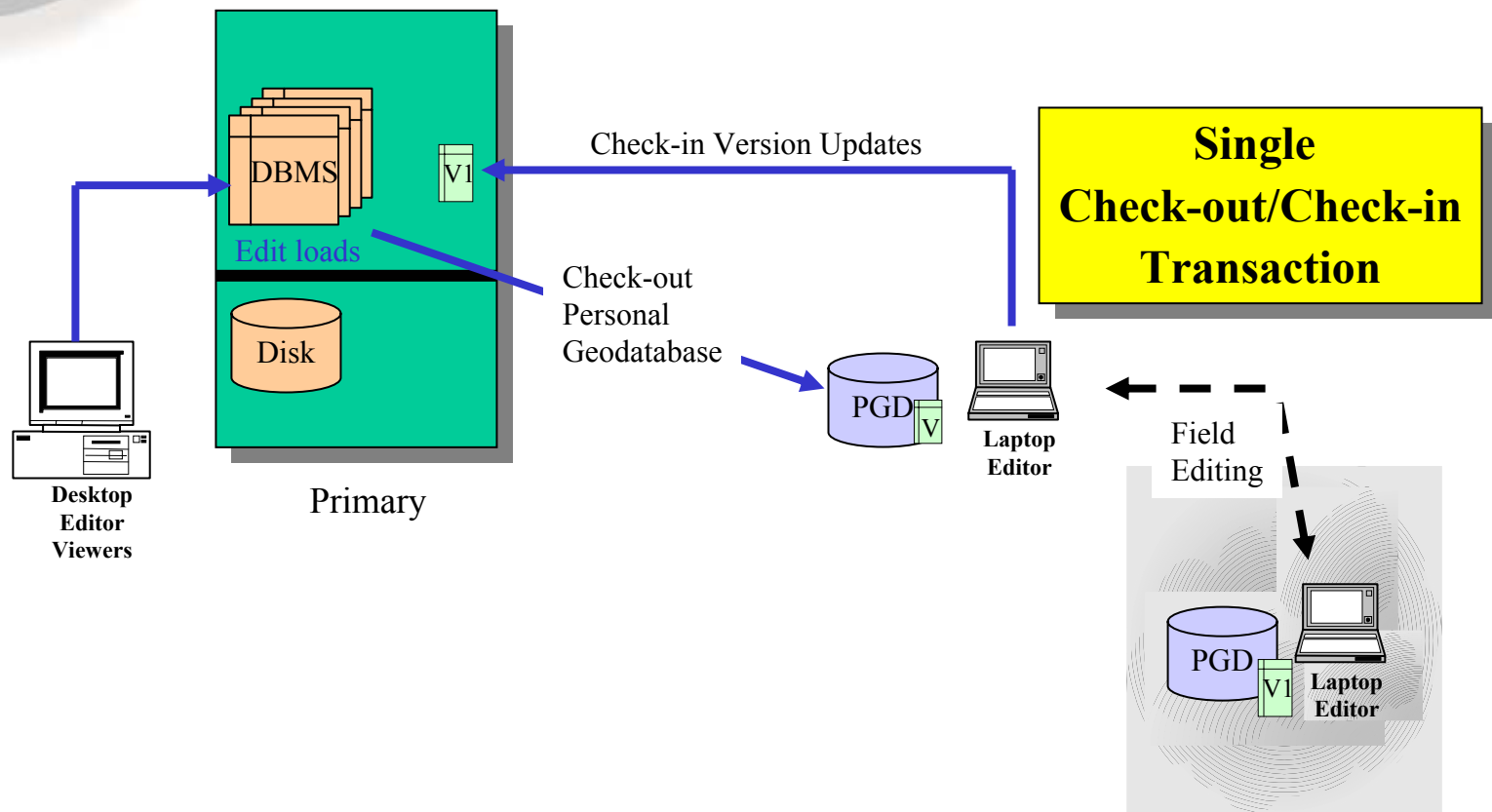
DISTRIBUTED DATA SOLUTIONS

- Increase HW cost
- Increase admin cost
- High implementation risk
- Disconnected operations
- Limited data access
- Reduced security
- Increased network traffic

ArcSDE Single-generation Replication

(Personal Geodatabase Checkout – ArcGIS 8.3+)

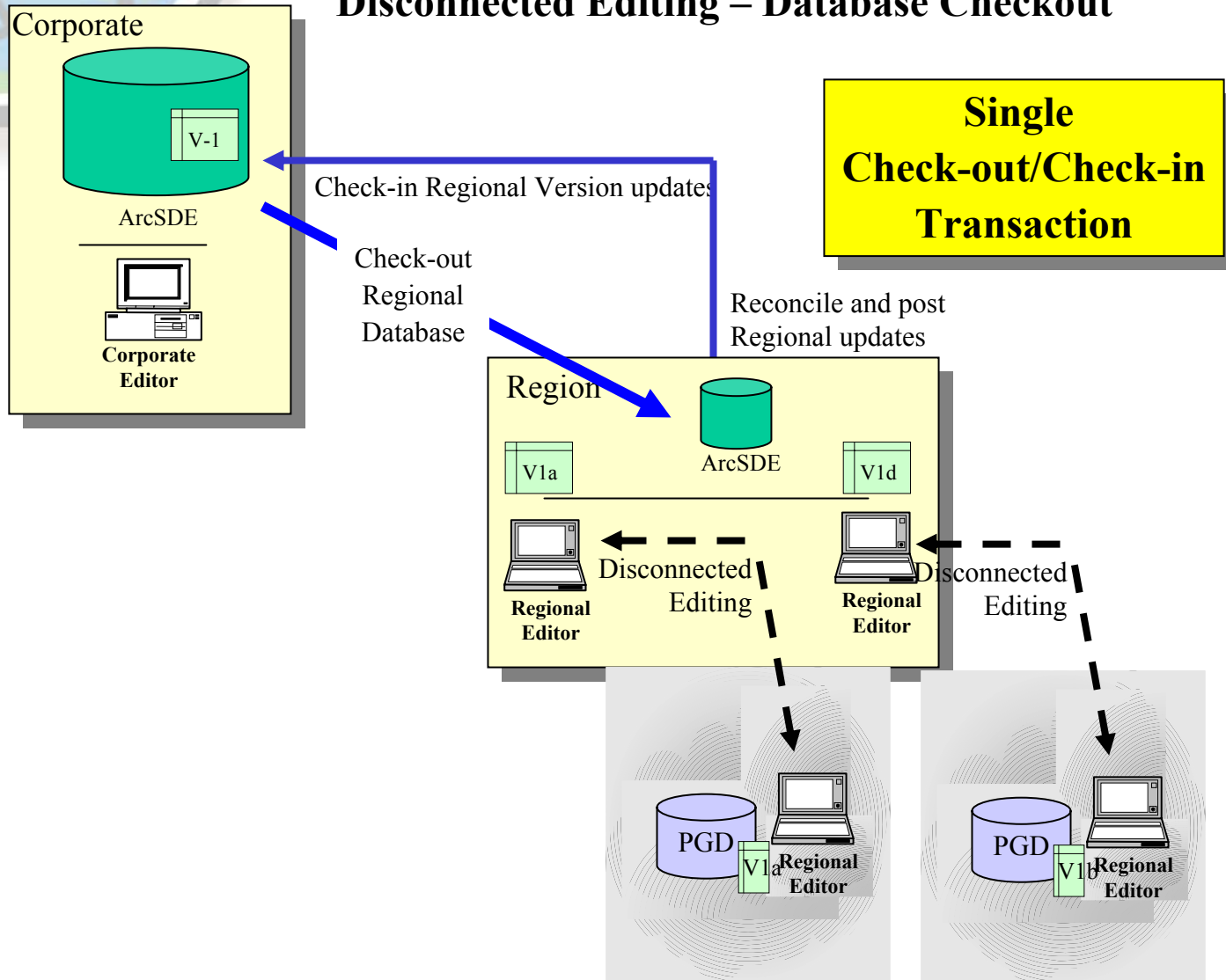
Disconnected Editing – Personal Geodatabase Checkout



Geodatabase Single-generation Replication

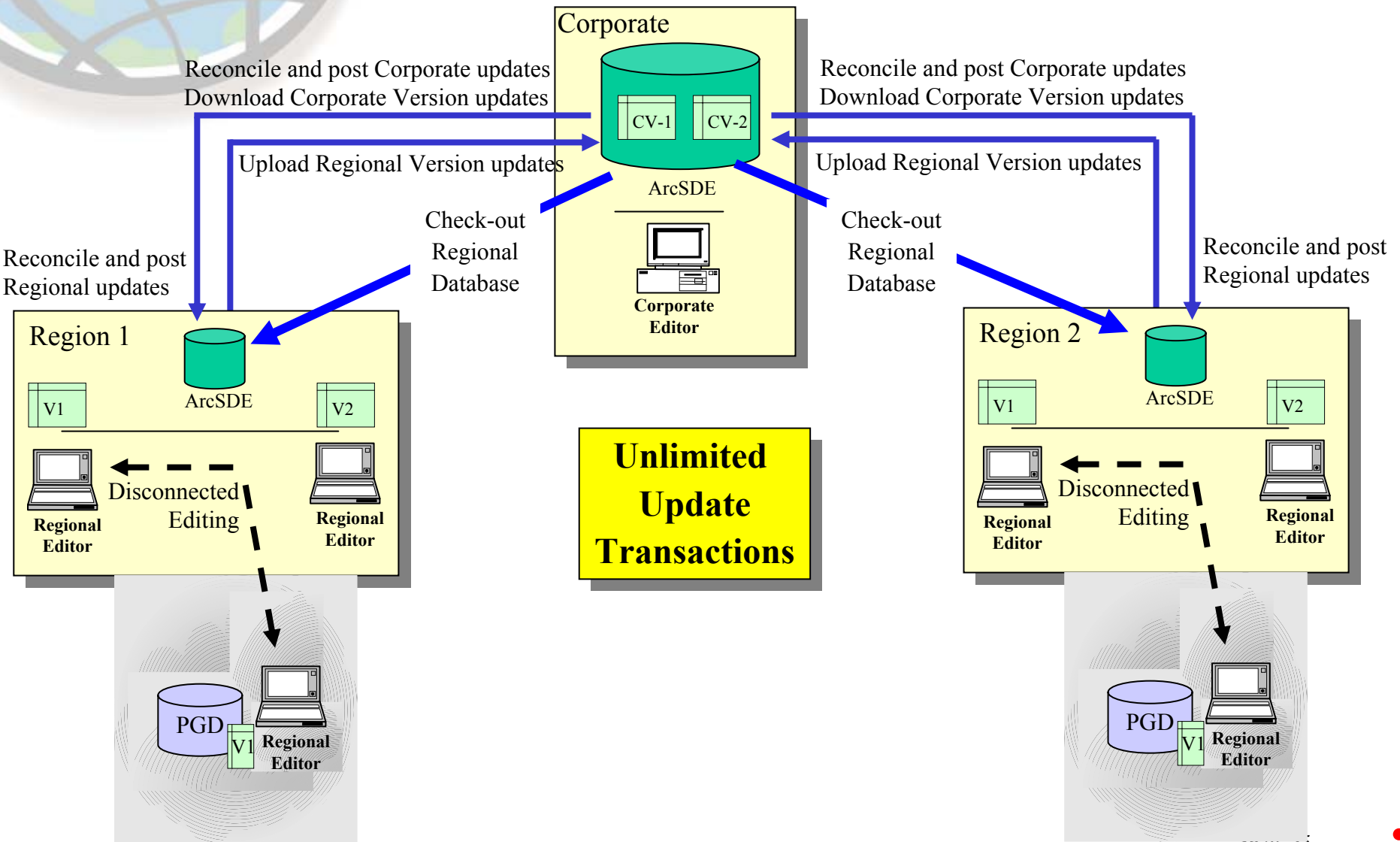
(Database Checkout – ArcGIS 8.3+)

Disconnected Editing – Database Checkout



Geodatabase Multi-generation Replication

(ArcGIS 9.1)



System Design Strategies

Performance Sizing Fundamentals



Planning for System Performance

Performance Chain

Reduce Cost

Improve Productivity

Balanced System Design

Servers

Network

DBMS

GeoDatabase

Storage

Clients

ArcSDE

Application

Hardware Infrastructure

Database Design

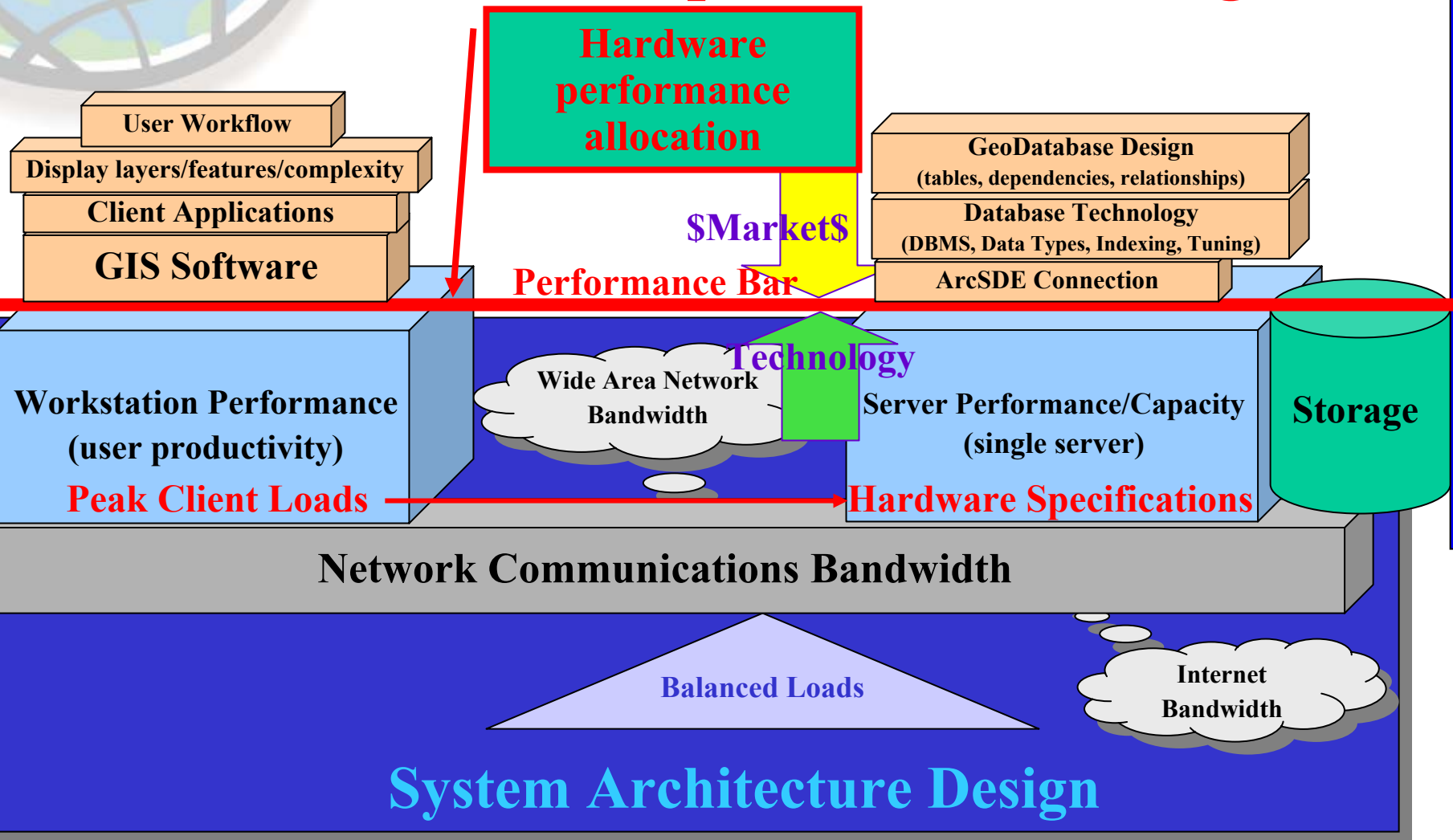
User Workflow

System Architecture Design
Framework for Productive Operations

Understanding the Technology

System Performance Factors

How do we address performance sizing?



System Design Strategies

System Sizing Tools



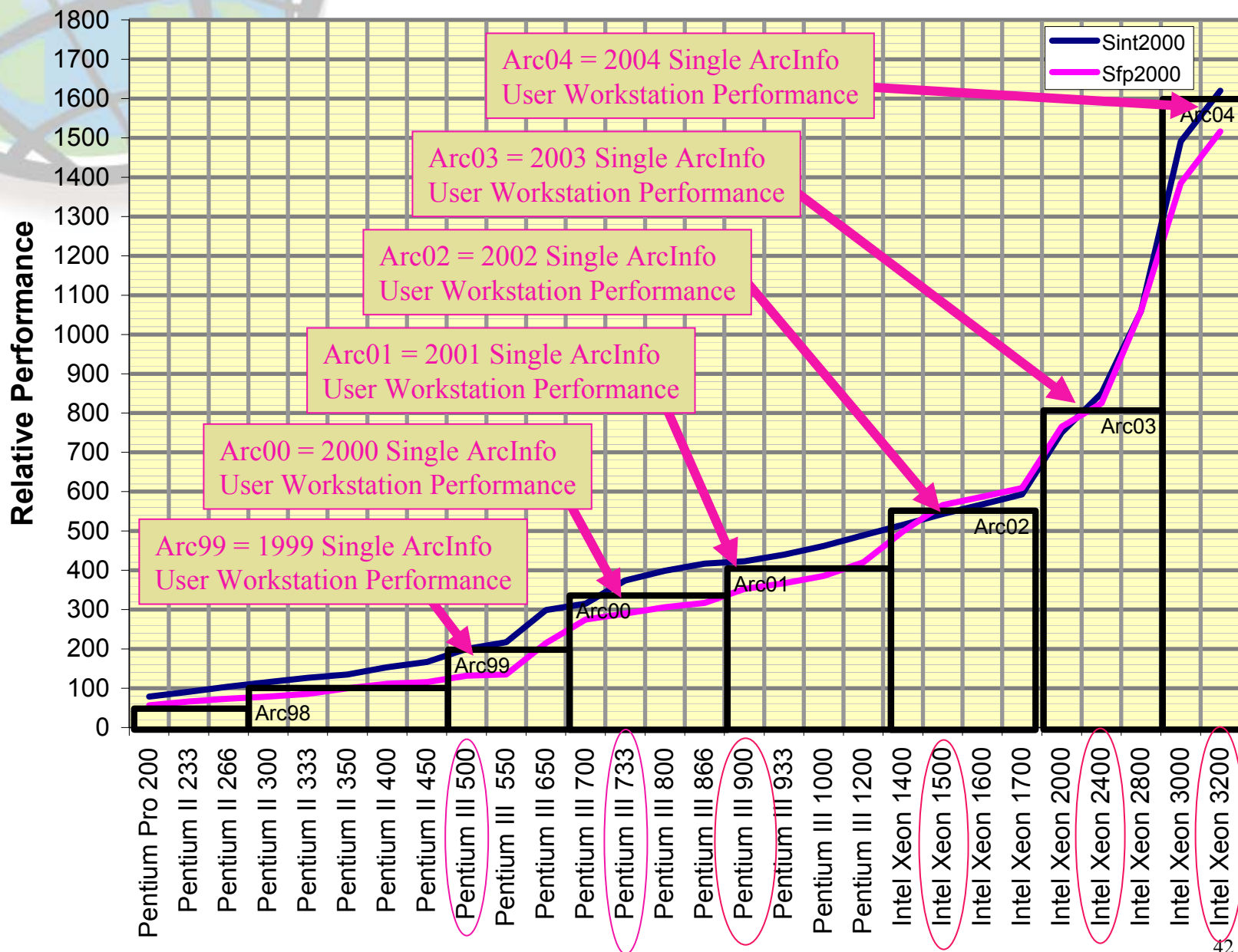


User Performance Expectations

ArcInfo Platform Selections

- **ArcInfo 7.0.2 (Sept. 1994)**
 - Sun SPARCstation 10 Model 40, 32 MB Memory
- **ArcInfo 7.0.4 (Feb. 1996)**
 - Sun SPARCstation 20 Model 71, 64 MB Memory
- **ArcInfo 7.1.1 (Feb. 1997)**
 - Pentium Pro 200 MHz, 64 MB Memory
- **ArcInfo 7.2.1 (April 1998)**
 - Pentium II 300 MHz, 128 MB Memory
- **ArcInfo 8 (July 1999)**
 - Pentium III 500 MHz, 128 MB Memory
- **ArcInfo 8.0.2 (July 2000)**
 - Pentium III 733 MHz, 256 MB Memory
- **ArcInfo 8.1 (July 2001)**
 - Pentium III 900 MHz, 256 MB Memory
- **ArcInfo 8.2 (July 2002)**
 - Pentium 4 1.5 GHz, 512 MB Memory
- **ArcInfo 8.3 (July 2003)**
 - Intel Pentium 2.4 GHz, 512 MB Memory
- **ArcInfo 9.0 (May 2004)**
 - Intel Xeon 3.2 GHz, 512 MB Memory

PC Intel Platform Performance





2003 Hardware Life Cycles

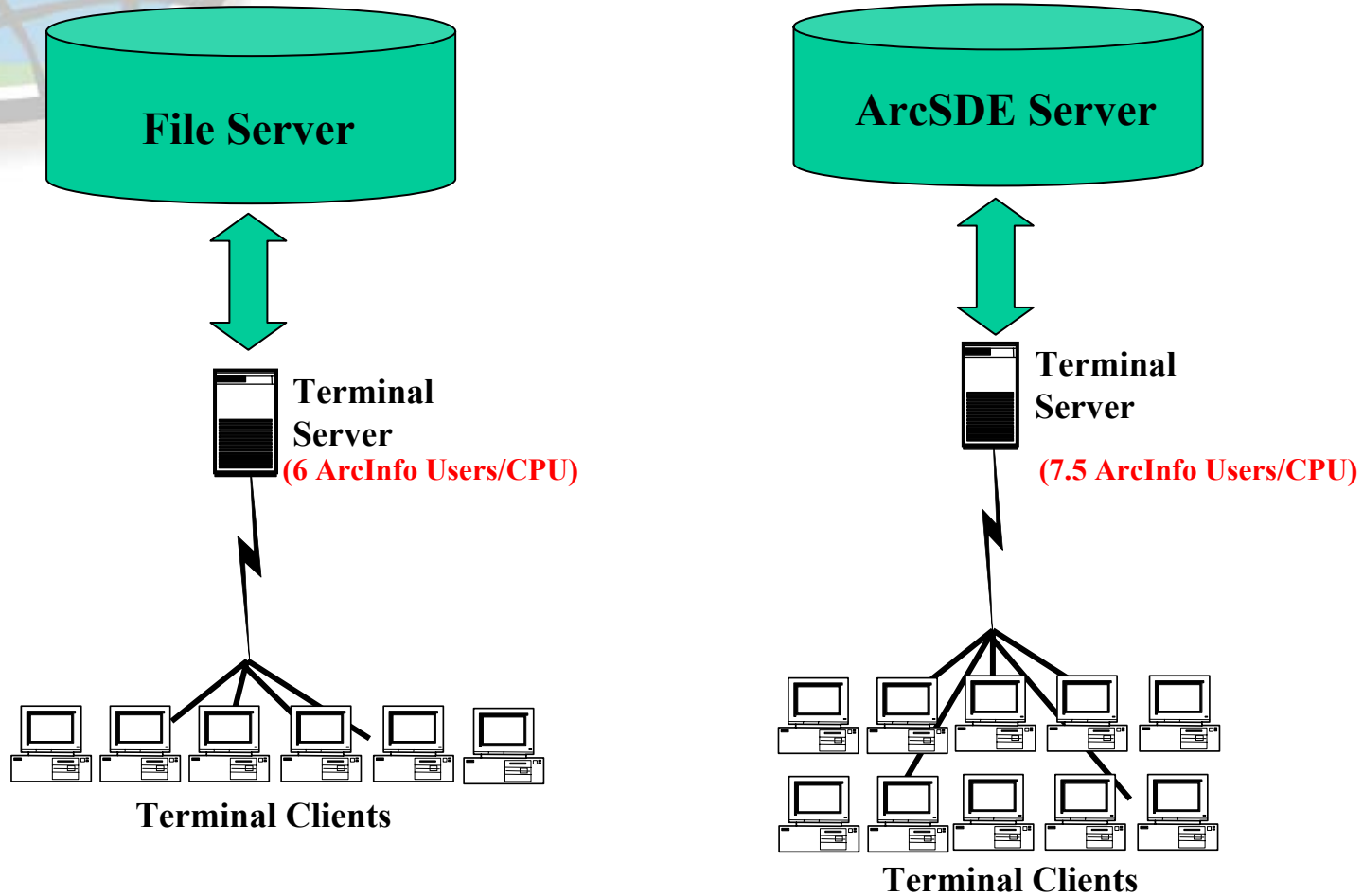
(Months)

Technology	Current	Useful	Obsolete	Non-functional
Network Infrastructure				
• Local area networks	24-36	37-84	85-120	120+
• Wide area networks*	12-24	25-60	61-84	84+
Computer Hardware				
• Data Servers	12-18	19-48	49-72	72+
• Application Servers	6-12	13-48	49-72	72+
• Desktop Workstations	6-12	13-36	37-60	60+
• Laptop Workstations	6-12	13-34	25-48	48+
• Terminal clients	24-36	37-60	61-72	72+

* Internet bandwidth increasing at 300% per year

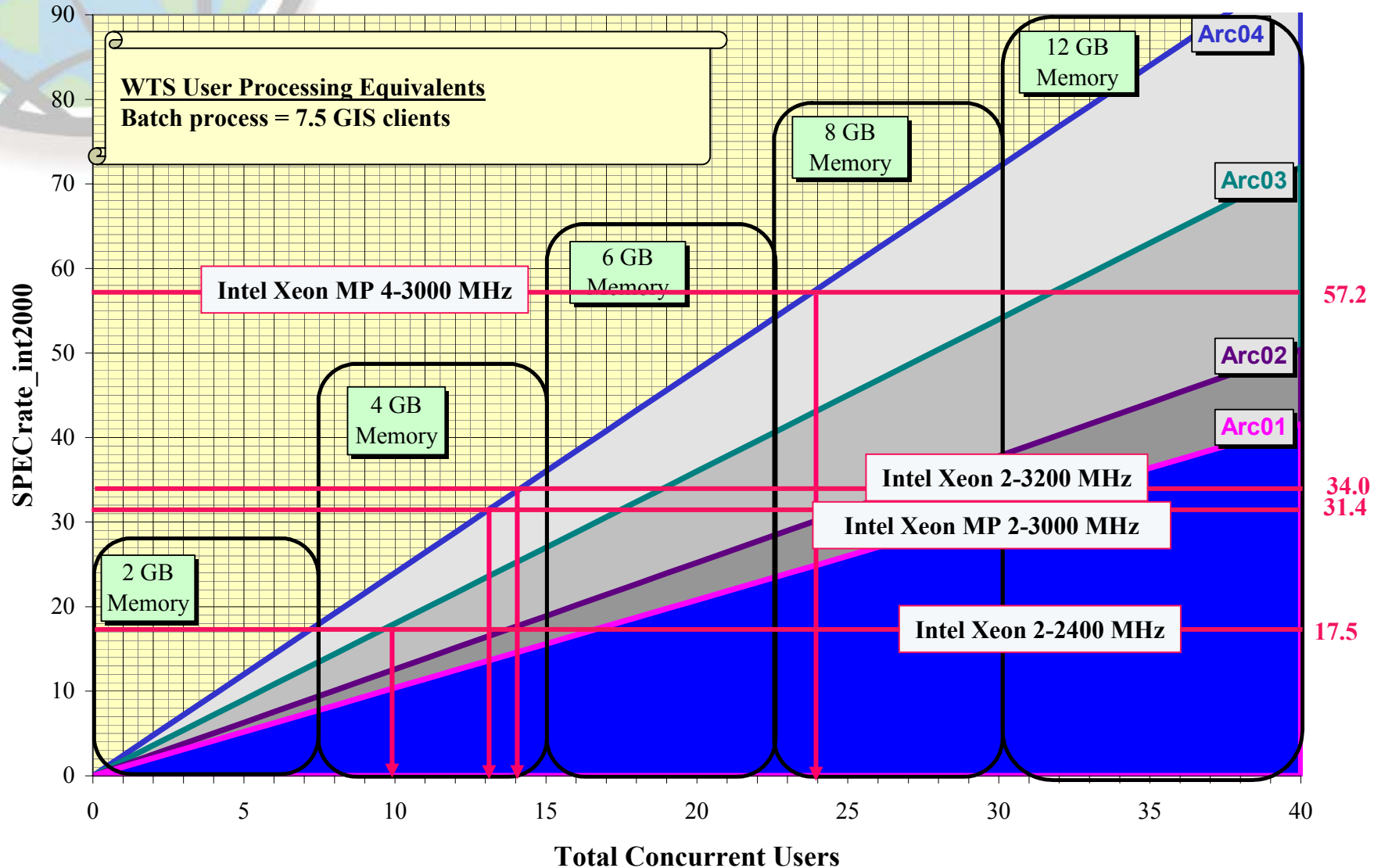
Terminal Server Performance

Terminal Server Performance Model

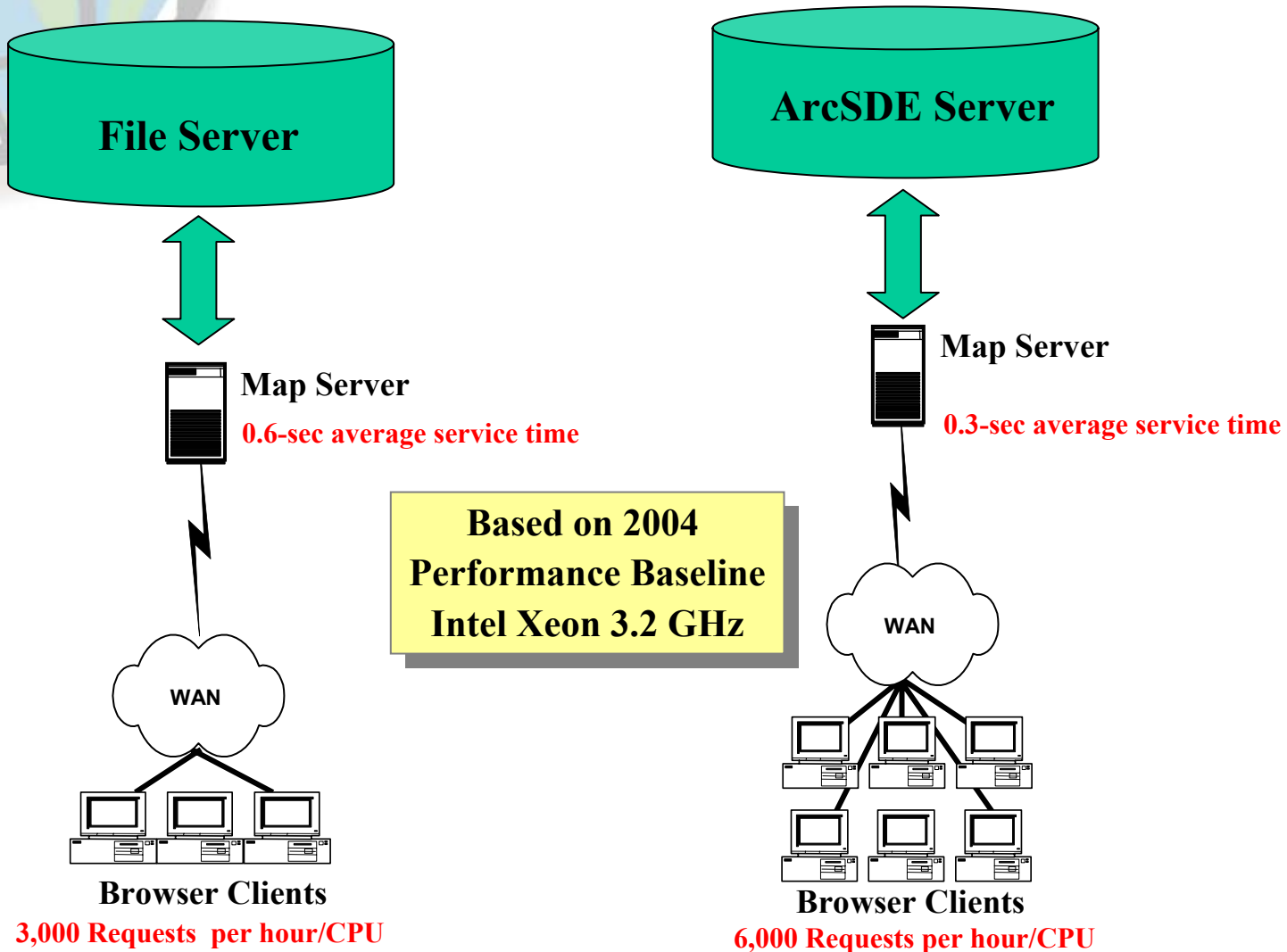


Windows Terminal Server

ArcSDE Server Data Source

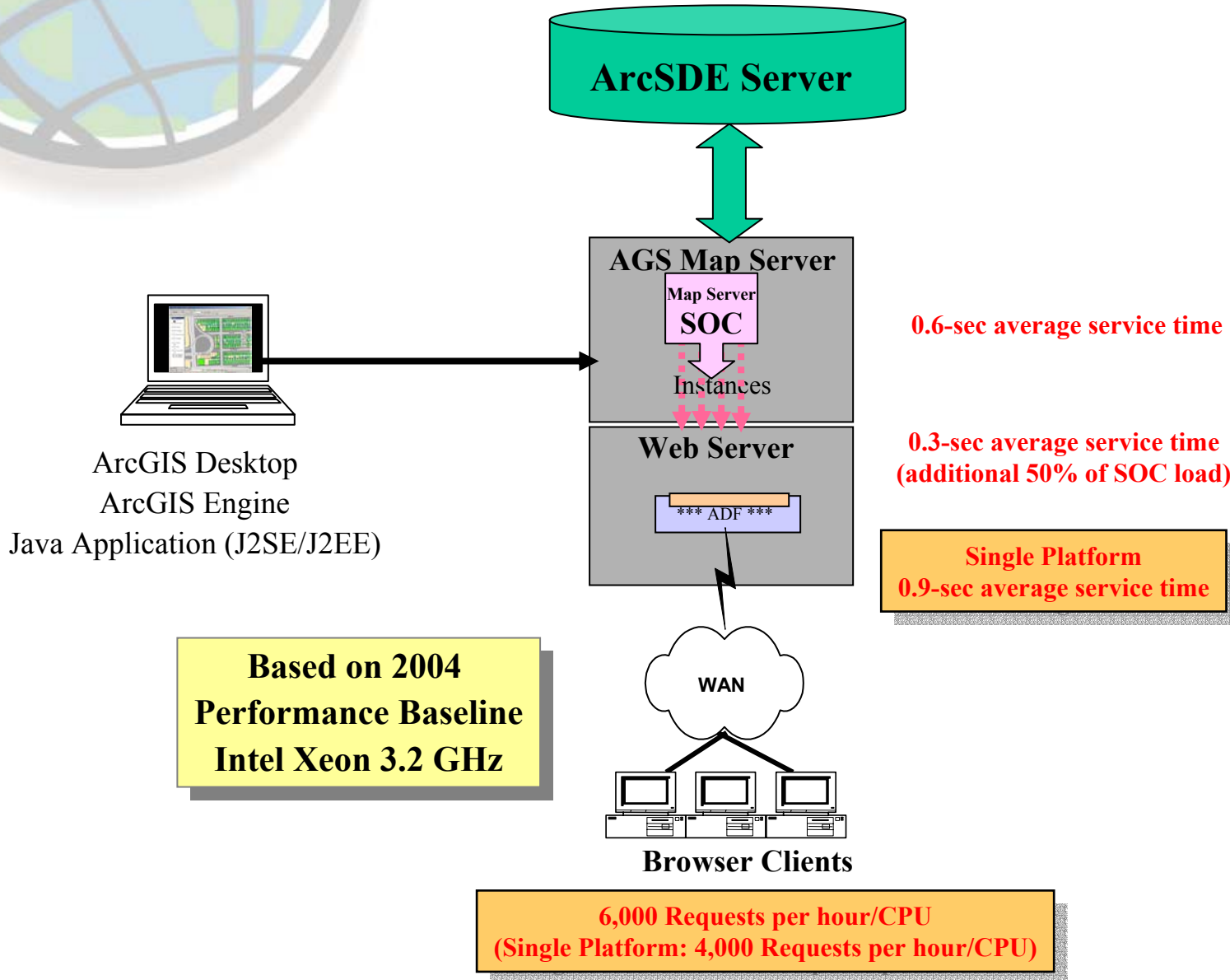


ArcIMS Server Performance



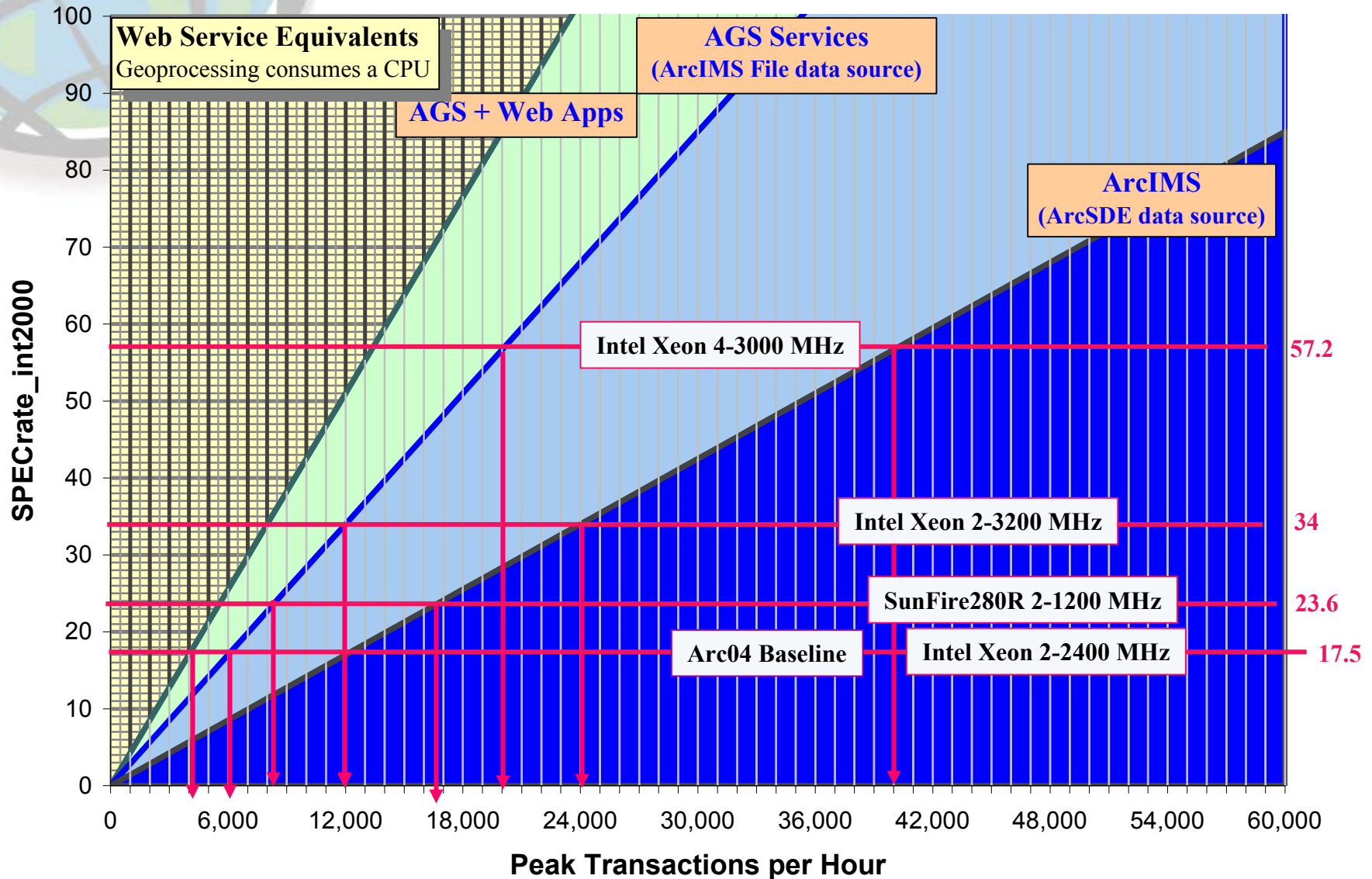
Web Application Transactions

(Simple 9.0 Map Server Application)

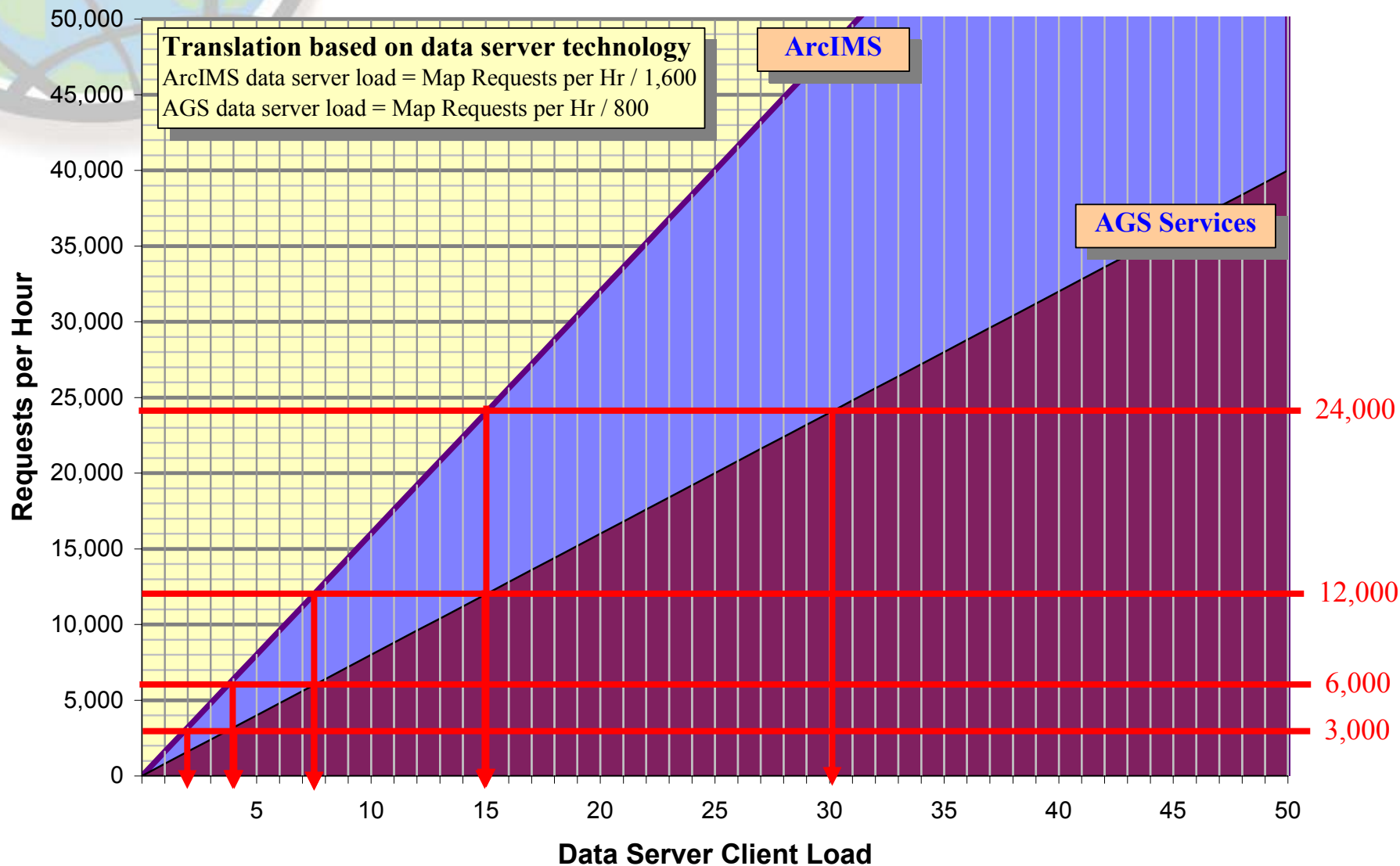


Internet Map Server Performance

ArcIMS Map Servers



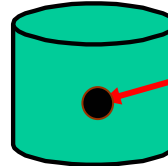
ArcIMS/AGS Data Server Loading



ArcSDE Server Performance

Server Loading Model

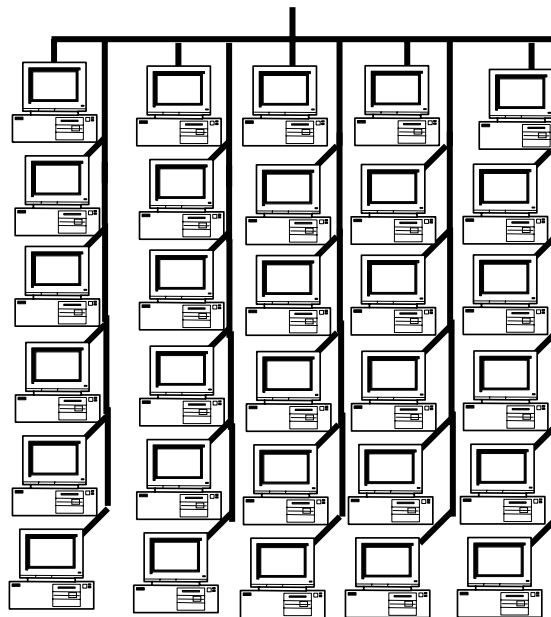
ArcSDE Servers



One server batch process
= 30 ArcSDE clients

ArcSDE Server

(30 ArcSDE Clients/CPU)

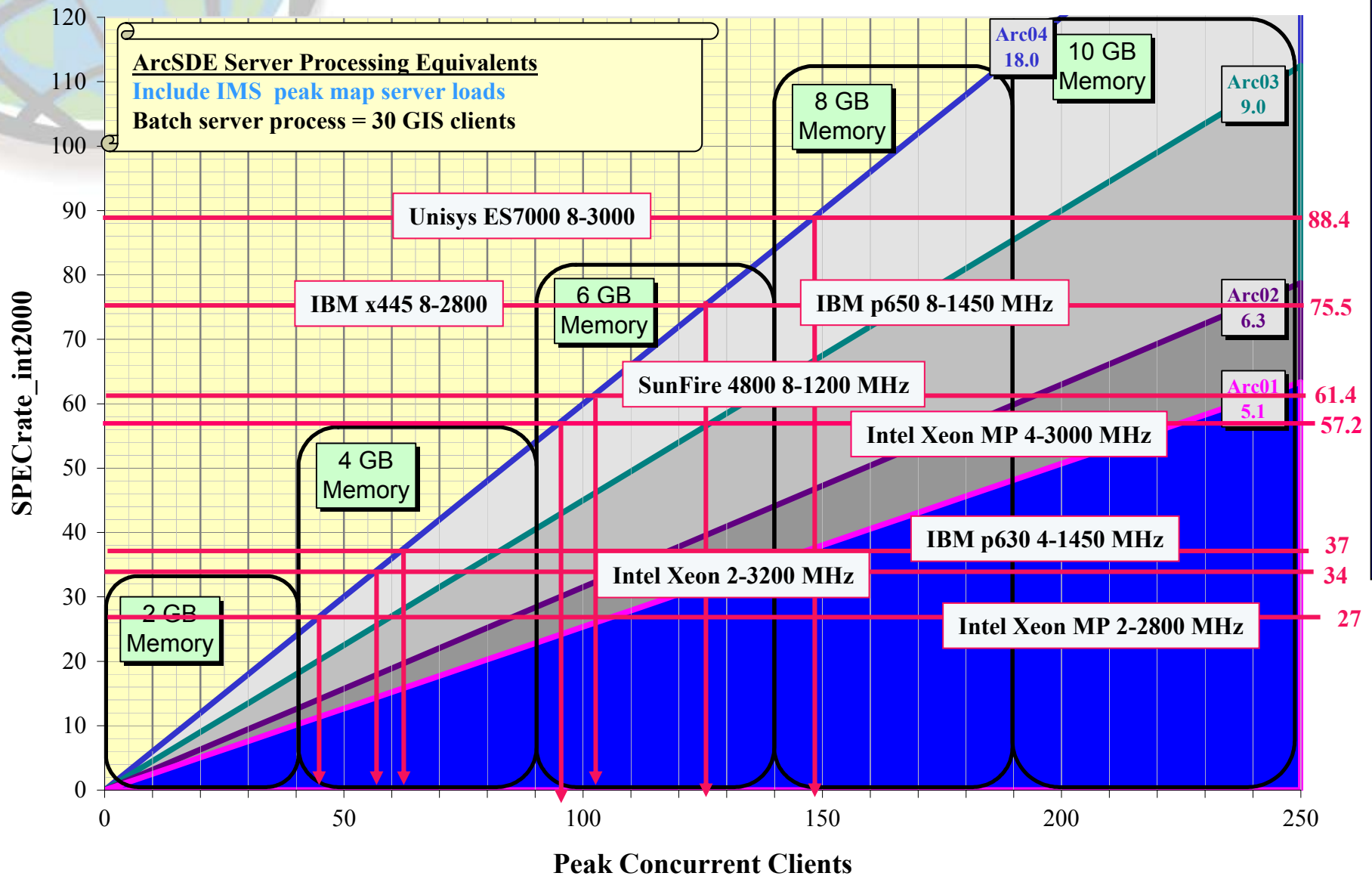


Workstations

● OR ●

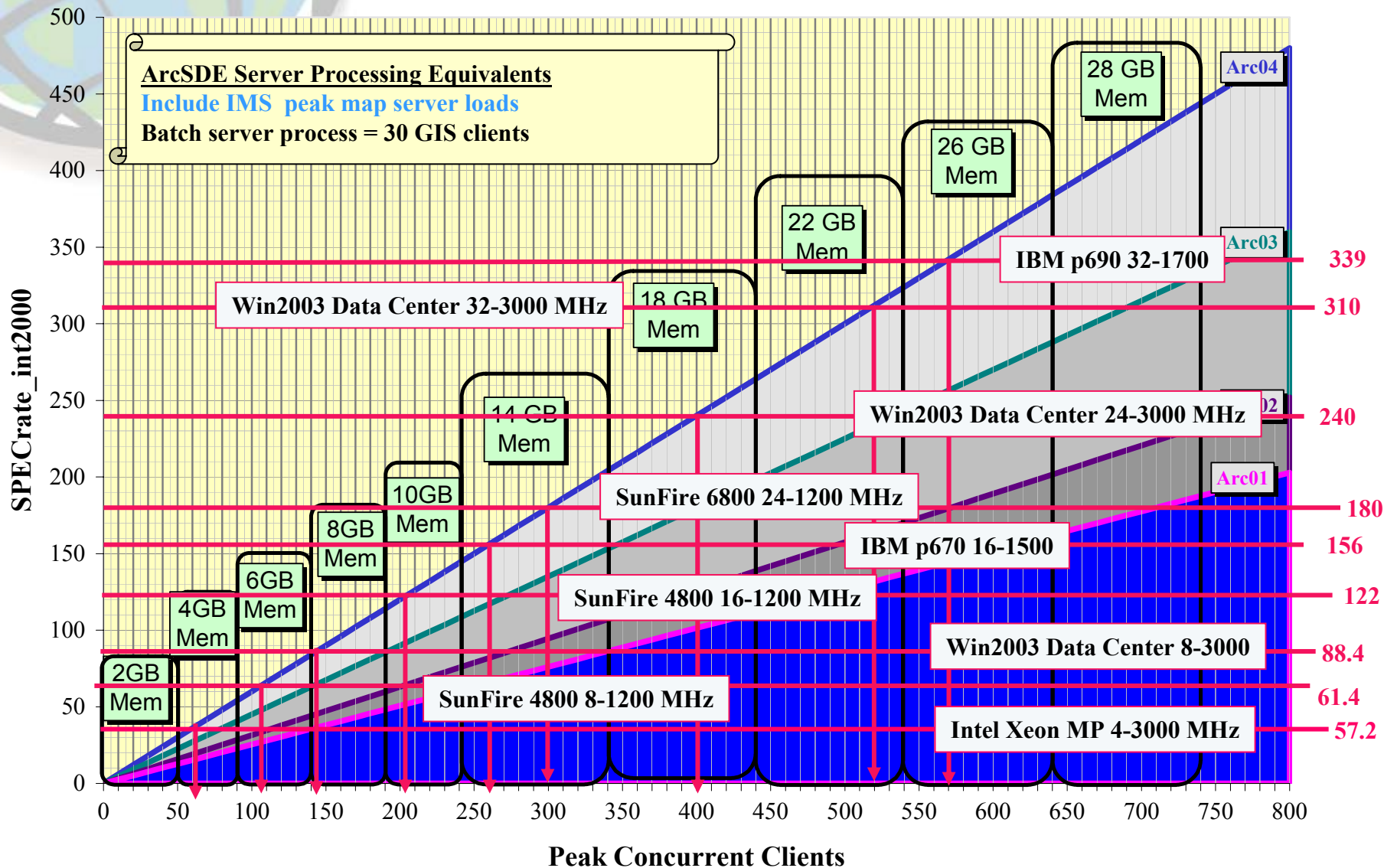
Workgroup GIS Data Server

(ArcSDE and File Server)



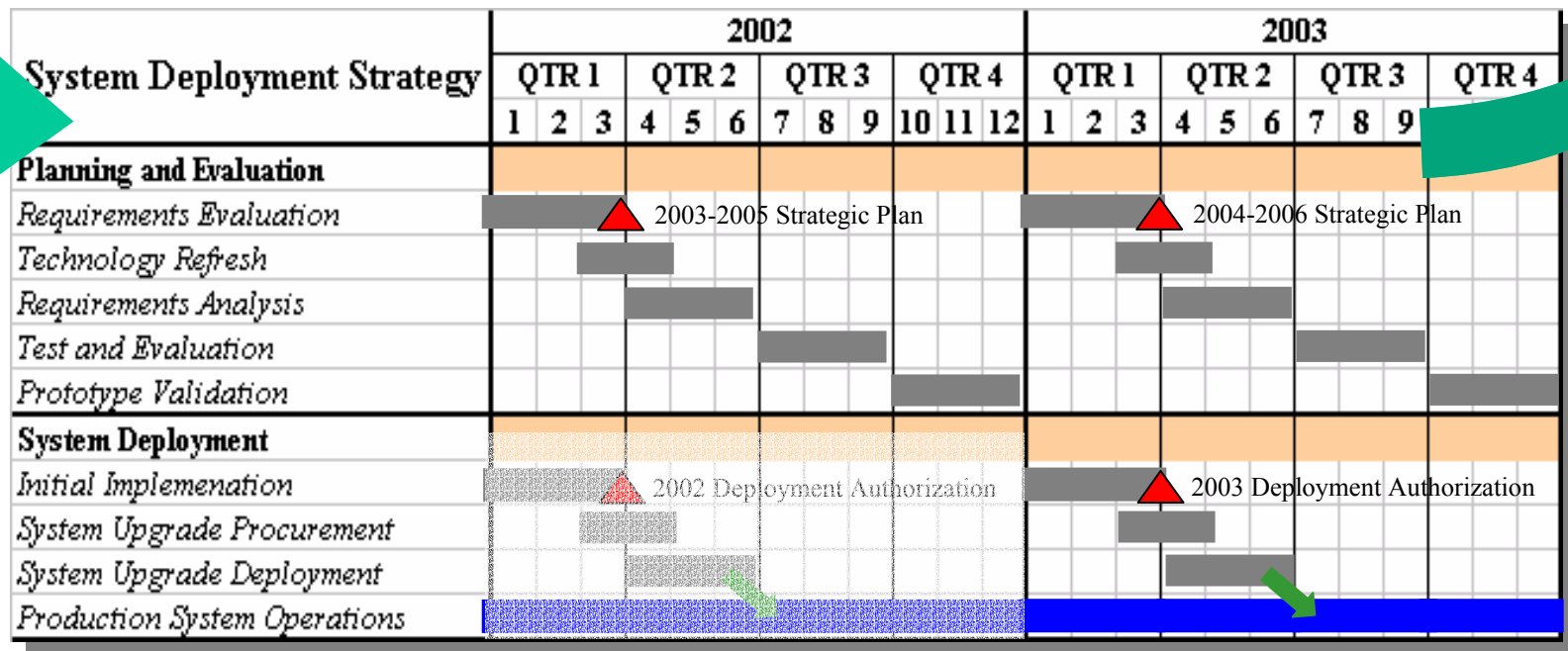
Enterprise GIS Data Server

(ArcSDE Server)



Phased Implementation Strategy

Managing Technology Change



Systems Integration Support Efforts

System Design Strategies White Paper

(<http://www.esri.com/library/whitepapers/pdfs/sysdesig.pdf>)

System Architecture Design Workbook

System Design Support

- Hardware Sales Support (sihelp@esri.com)
- Technical White Papers
- System Integration Test Reports
- System Installation Reports

System Architecture Design Training

(ESRI Training Class)

(Technology Exchange Workshops)

System Architecture Design Consulting

(Professional Consulting for Enterprise GIS)

Enterprise Systems Lab

(Internet Demonstration Site – (<http://eslims.esri.com>)

Performance Validation Testing)

ArcIMS Architecture Design Consulting

(Professional Consulting for ArcIMS Deployment)