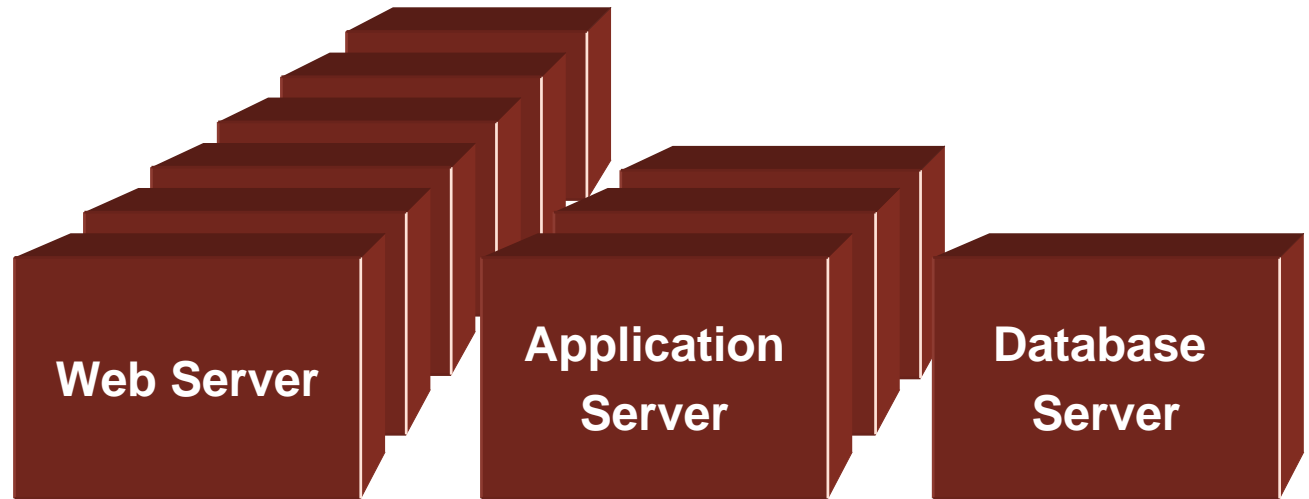
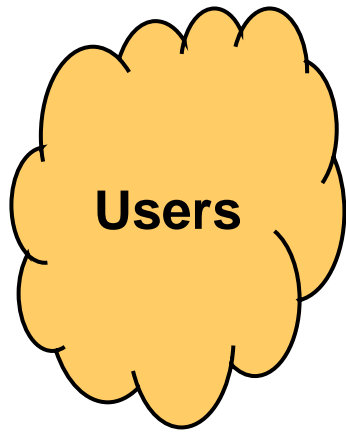
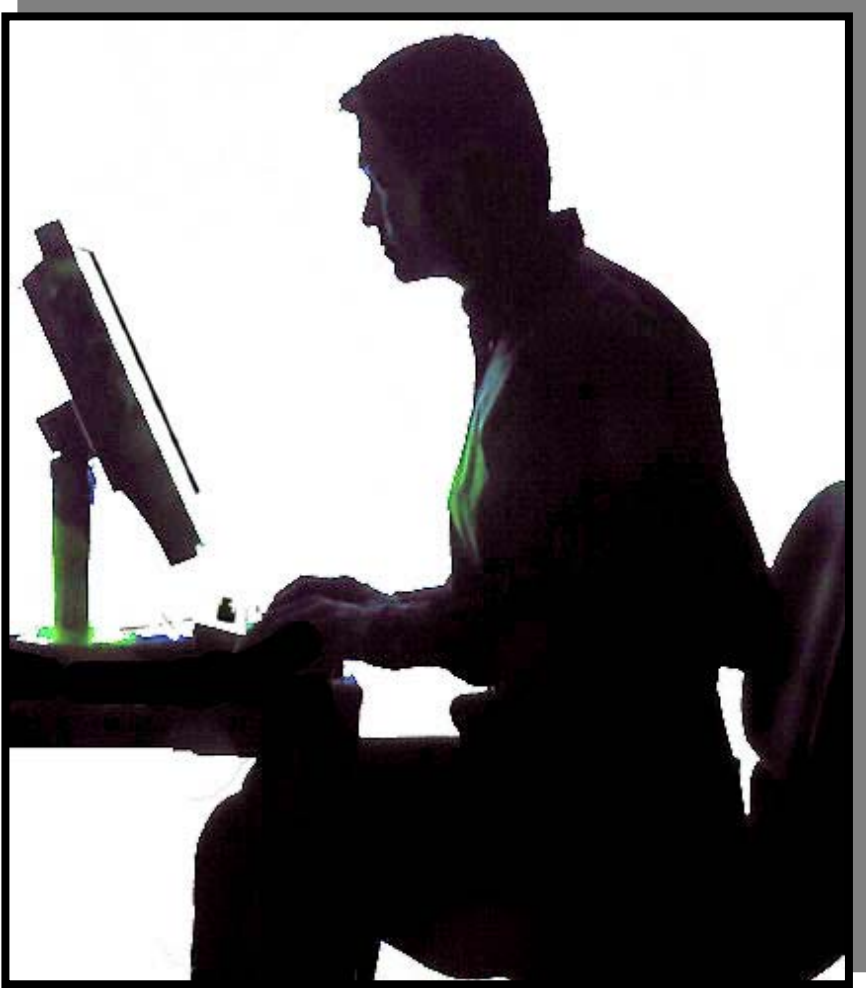


# Modeling Multi-Tiered Applications

*Joe Rich*  
*TeamQuest Corporation*

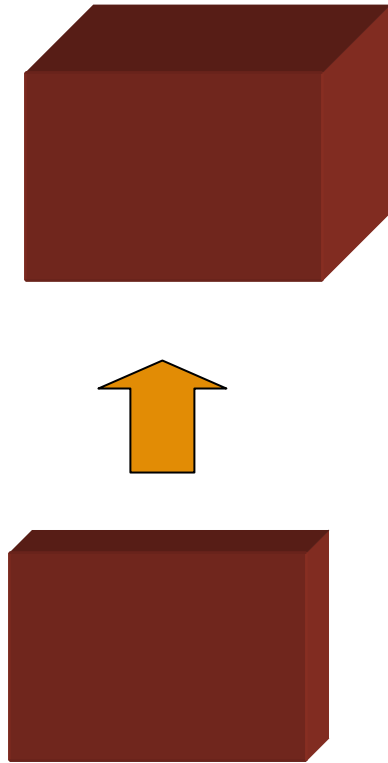
# What is a multi-tiered application?



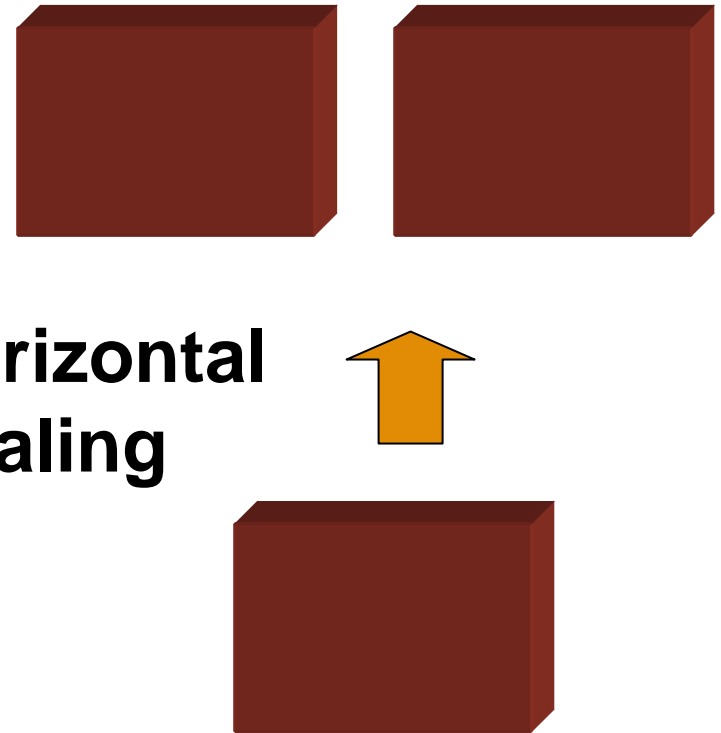


- How much growth can the enterprise handle?
- Which component runs out of capacity first?
- What happens if I get bigger servers?
- What happens if I get more servers?
- What happens if a server fails?

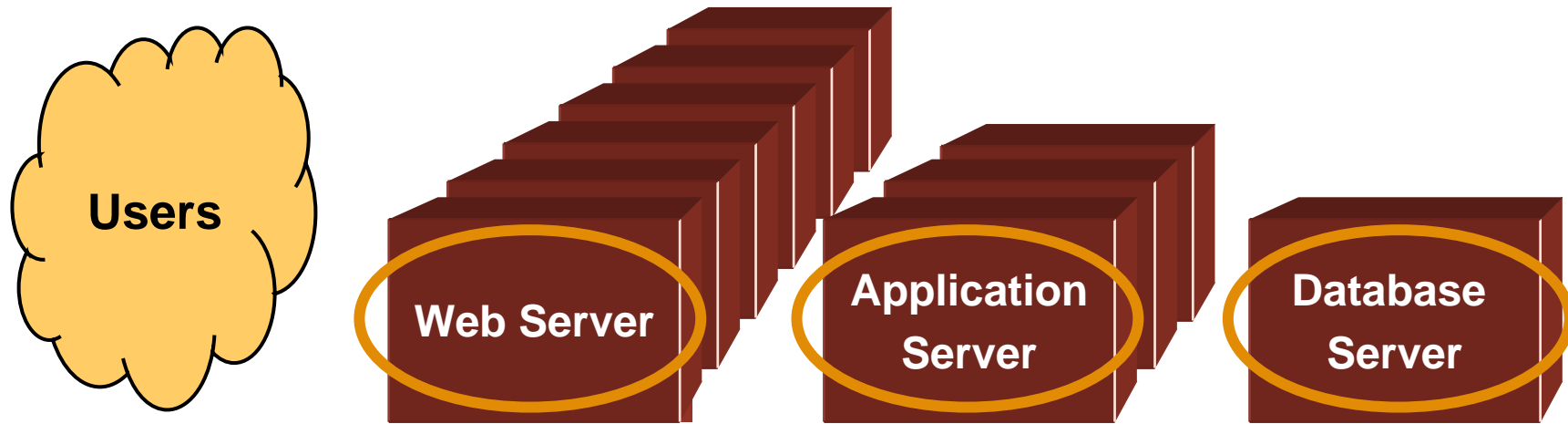
# Vertical vs Horizontal Scaling



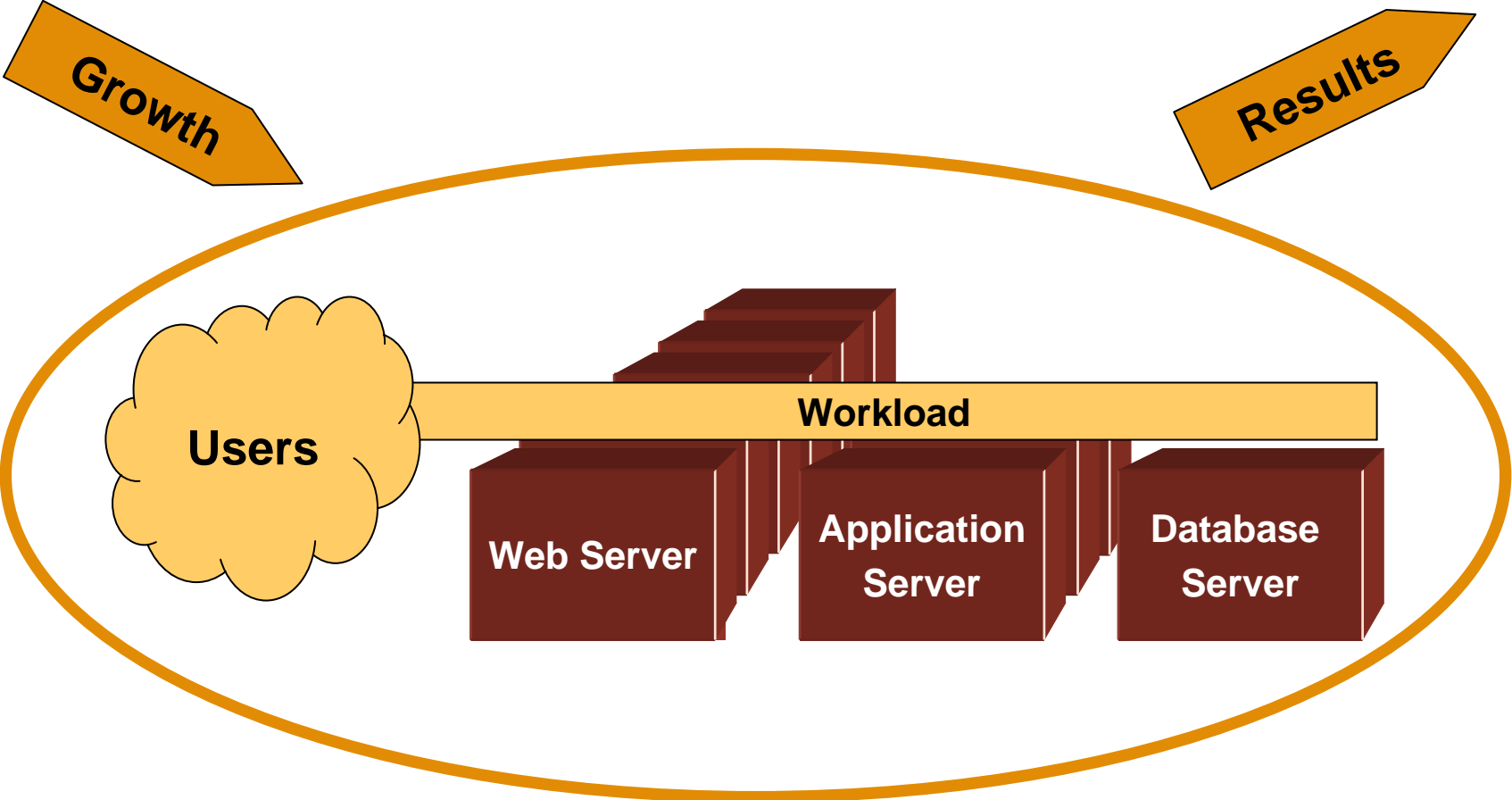
**Vertical  
Scaling**



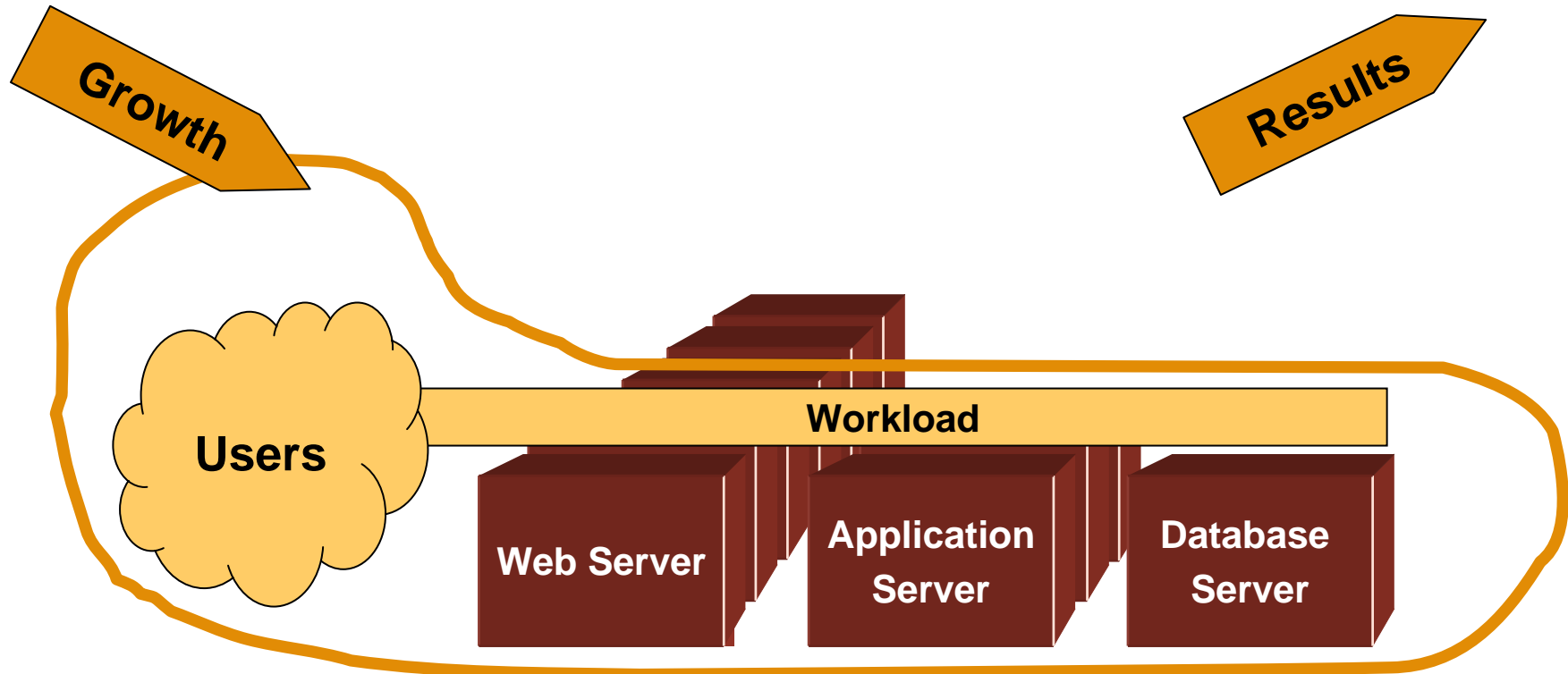
**Horizontal  
Scaling**



# Enterprise modeling approach

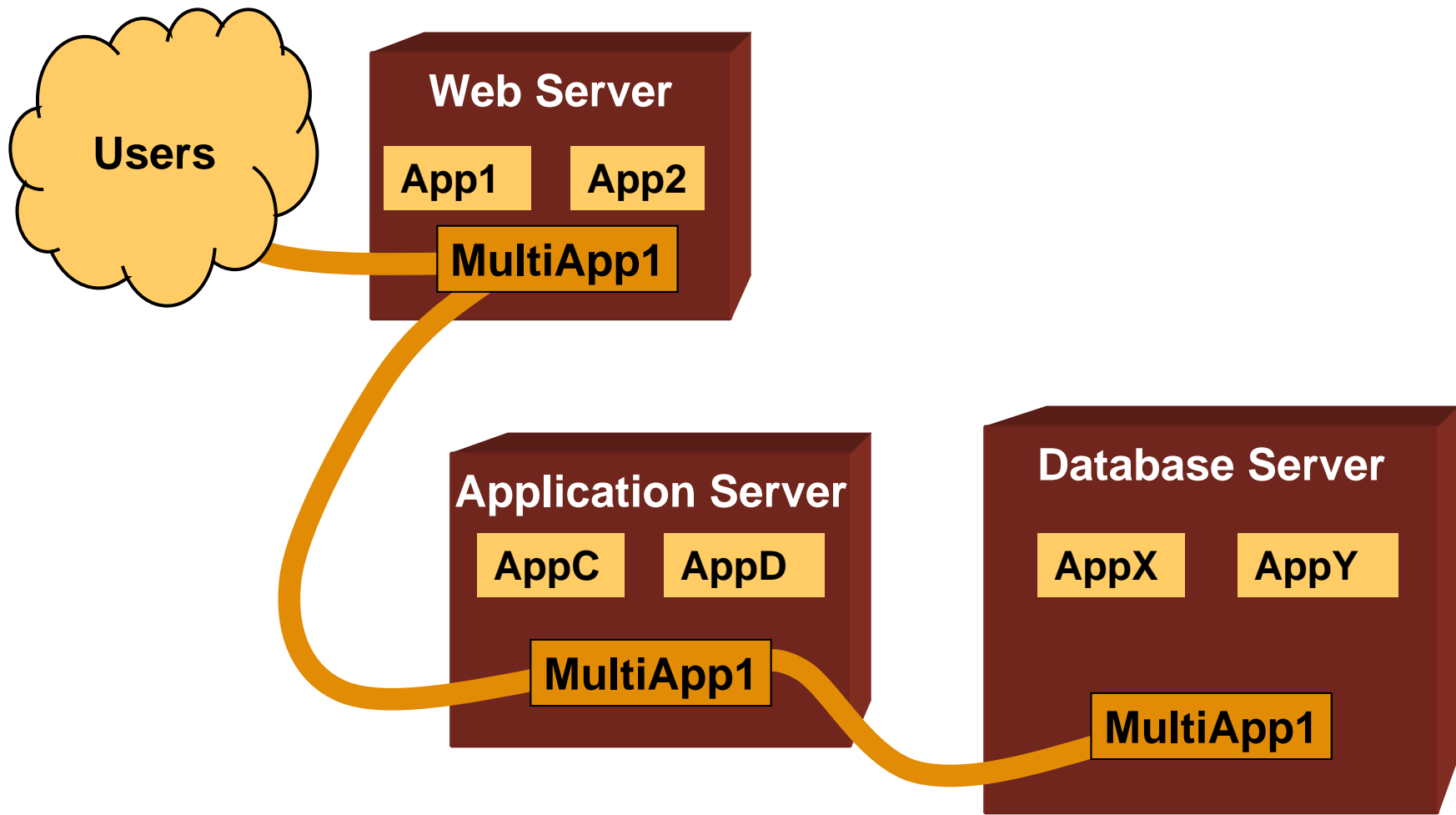


# Simplified enterprise modeling approach

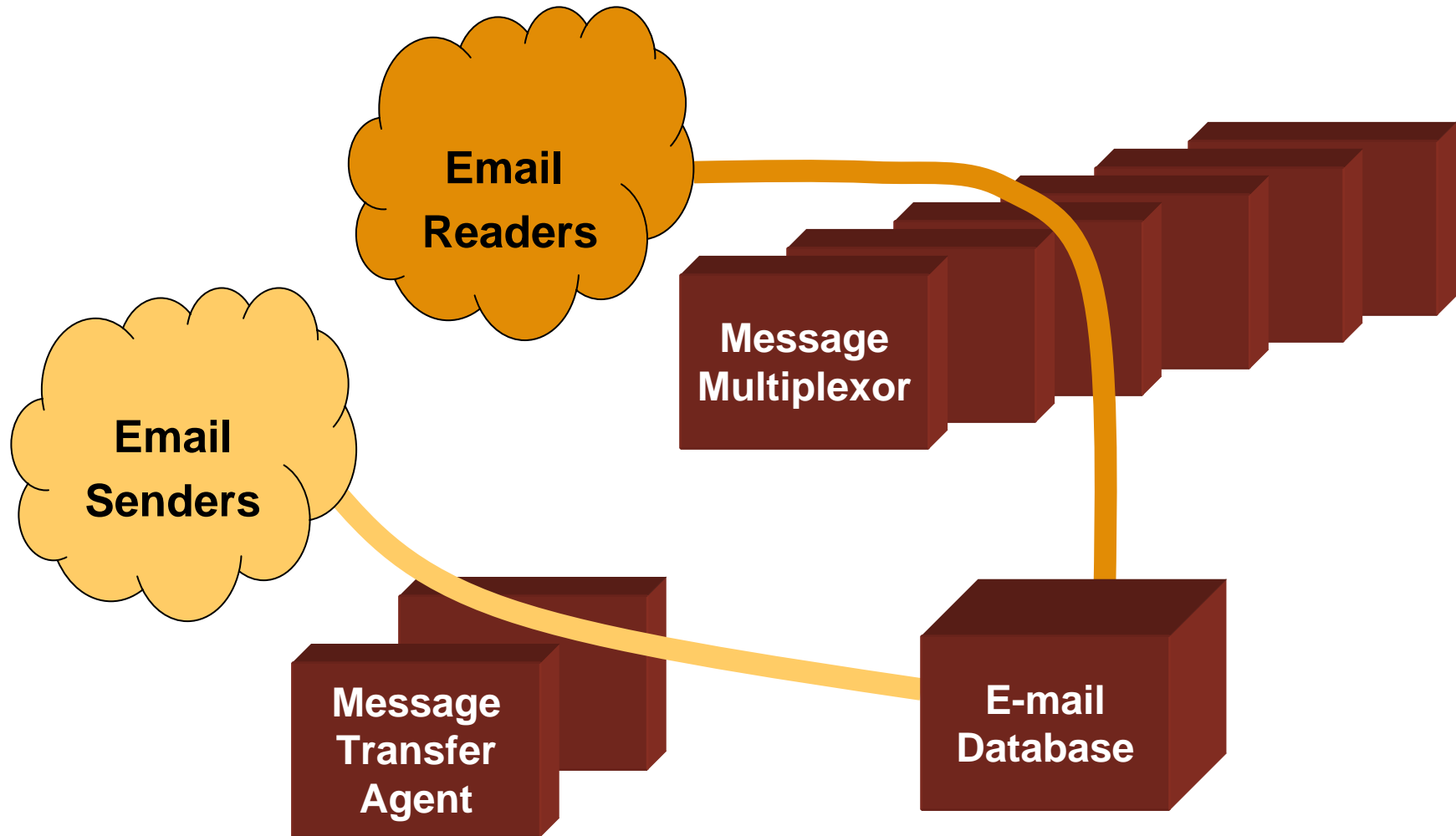




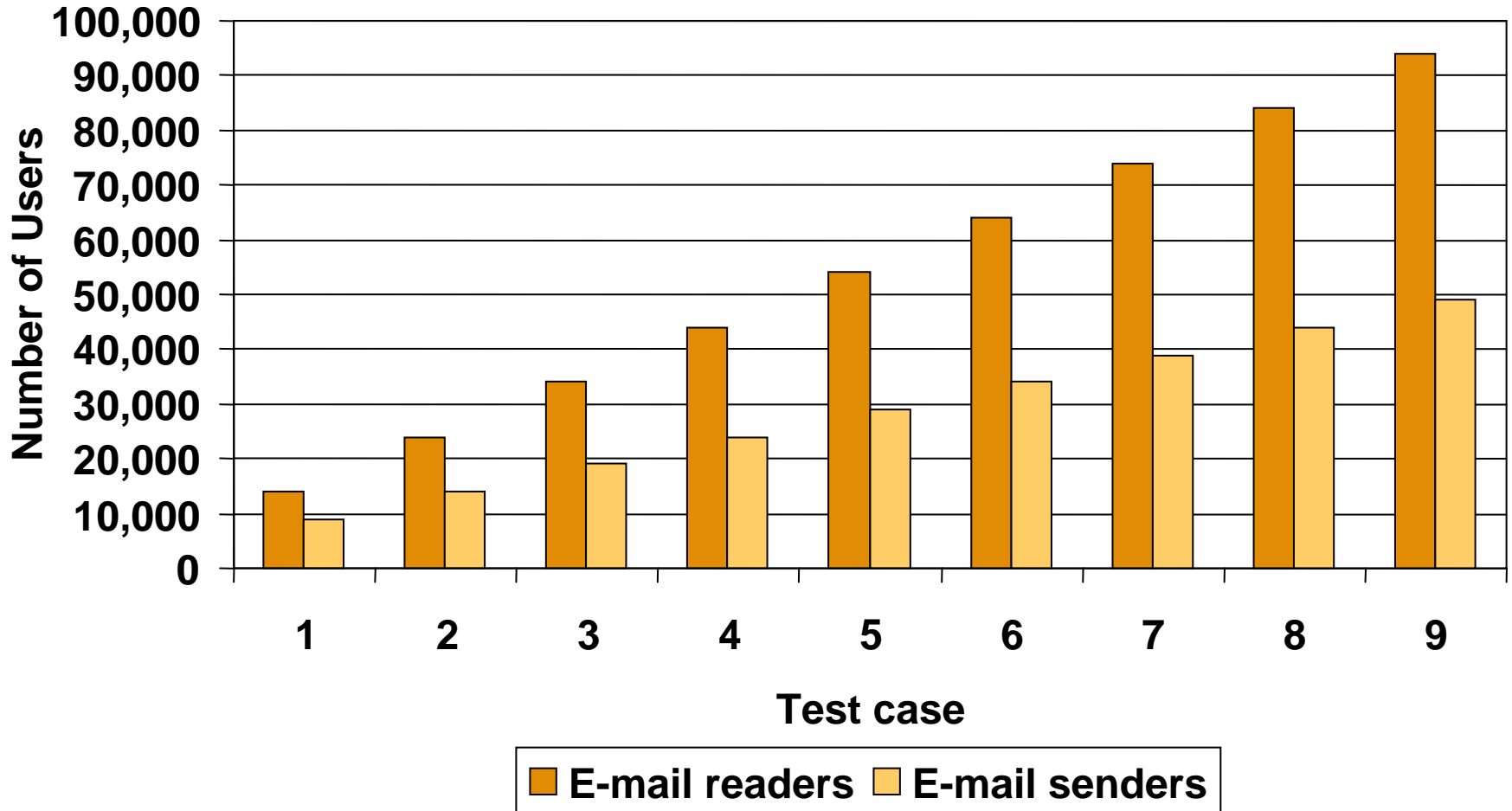
# Multiple System Workloads



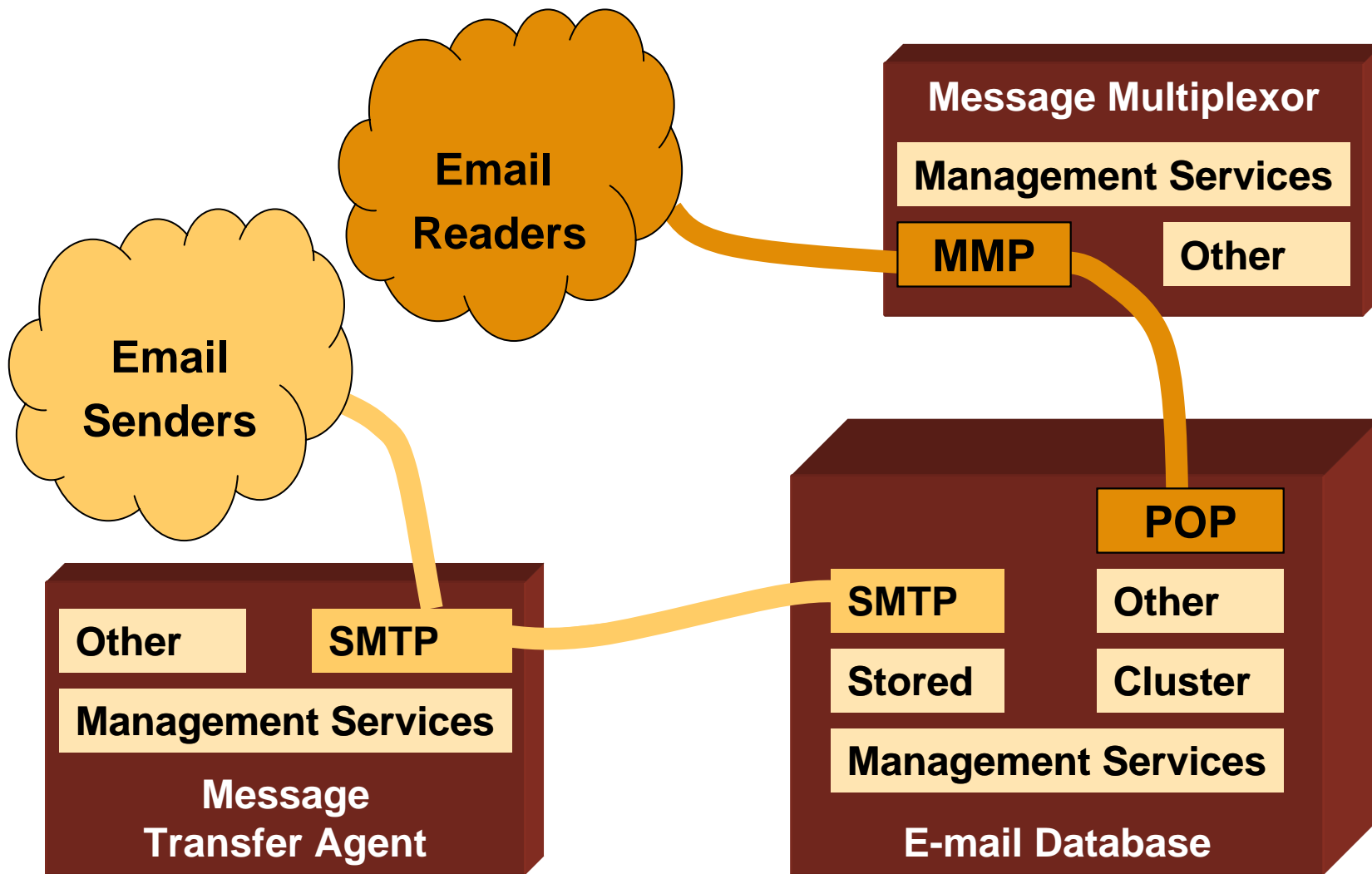
# ISP E-mail Infrastructure



# Projected User Activity



# ISP E-mail Infrastructure Model



**TeamQuest Model - [Model Description: ISPE-mail1.mdl]**

File Edit Calibrate Modify What-if Predict Window Help

**Model Title: Internet Service Provider Messaging Benchmark**

Systems		Active Resources	Workloads	Passive Resources		
User Notes		AR/WL Matrix	Steps	PR/WL Matrix		
	System Name	Workload	Type	Measured Throughput	Measured Response Time	Throughput Active
1	smtps01	Management Services	CLOSED	0.03167	315.9	DELAY
2	smtps01	OTHER	CLOSED	0.11167	430.02	DELAY
3	smtps01	SMTP	CLOSED	0.02667	194.5	DELAY
4	mmp01	MMP	CLOSED	0.001667	600.8	mmp01 DE
5	mmp01	mmp01 Management Services	CLOSED	0.03333	300.4	mmp01 DE
6	mmp01	mmp01 OTHER	CLOSED	0.055	600.8	mmp01 DE
7	ha01	Cluster	CLOSED	0.01333	600.22	ha01 DELA
8	ha01	IMAP	CLOSED	0.001667	600.21	ha01 DELA
9	ha01	ha01 Management Services	CLOSED	0.01833	491.09	ha01 DELA
10	ha01	ha01 OTHER	CLOSED	0.92333	82.355	ha01 DELA
11	ha01	Other IMS	CLOSED	0.02333	171.54	ha01 DELA
12	ha01	POP	CLOSED	0.04	600.21	ha01 DELA
13	ha01	ha01 SMTP	CLOSED	0.02	252.2	ha01 DELA
14	ha01	Stored	CLOSED	0.001667	600.21	ha01 DELA

**Workload name can be any 51 characters.**

# Building a Multiple System Workload

Define Multiple System Workload

Select System

- smtps01
- mmp01
- ha01**

OK  
Cancel  
Help

Select Workload (maximum one per system)

- Cluster
- IMAP
- ha01 Management Services
- ha01 OTHER
- Other IMS
- POP**
- ha01 SMTP
- Stored

Tier	Selected Workloads	Number of Systems in Tier
<< 1	System: mmp01 Workload: MMP	6
>> 2	System: Workload:	1
>> 3	System: Workload:	1
>> 4	System: Workload:	

New Multiple System Workload Name: Readers

Execution Environment: INTERACTIVE

Measured Throughput: 73.33

Measured Population: 440.

# Multi-tiered Application Model

TeamQuest Model - [Model Description: ISPE-mail1.mdl]

File Edit Calibrate Modify What-if Predict Window Help

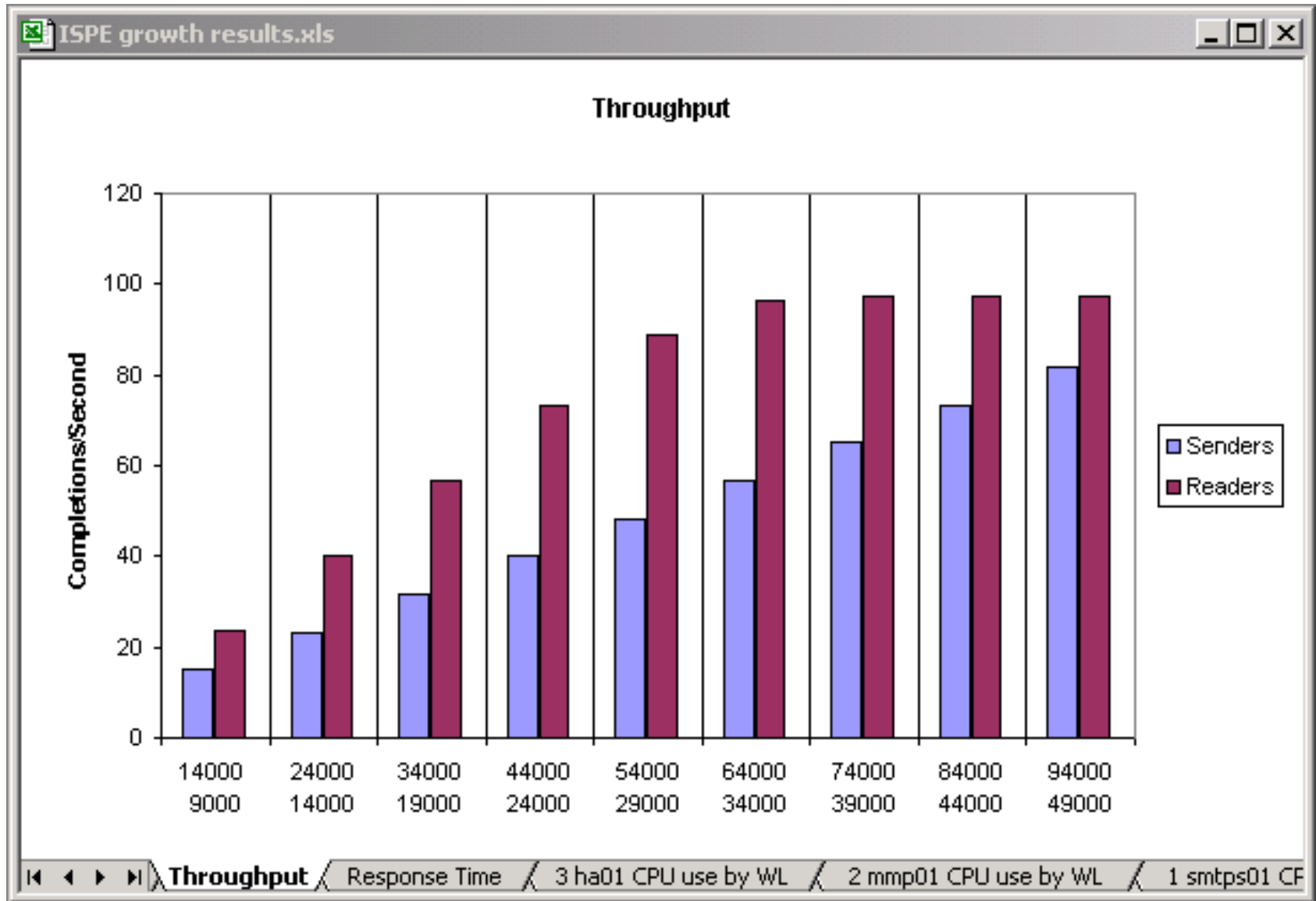
**Model Title: Internet Service Provider Messaging Benchmark**

Frame Name: Calibrated model Frame 2 of 2

Systems		Active Resources	Workloads		Passive Resources	
User Notes		AR/WL Matrix		Steps		PR/WL Matrix
	System Name	Workload	Type	Measured Throughput	Measured Response Time	Through Active
1	<Multi>	Senders	CLOSED	40.	0.	THINK
2	<Multi>	Readers	CLOSED	73.33	0.	ha01 THINK
3	smtps01	Management Services	CLOSED	0.03167	315.9	DELAY
4	smtps01	OTHER	CLOSED	0.11167	430.02	DELAY
5	mmp01	mmp01 Management Services	CLOSED	0.03333	300.4	mmp01 DE
6	mmp01	mmp01 OTHER	CLOSED	0.055	600.8	mmp01 DE
7	ha01	Cluster	CLOSED	0.01333	600.22	ha01 DELA
8	ha01	IMAP	CLOSED	0.001667	600.21	ha01 DELA
9	ha01	ha01 Management Services	CLOSED	0.01833	491.09	ha01 DELA
10	ha01	ha01 OTHER	CLOSED	0.92333	82.355	ha01 DELA
11	ha01	Other IMS	CLOSED	0.02333	171.54	ha01 DELA
12	ha01	Stored	CLOSED	0.001667	600.21	ha01 DELA

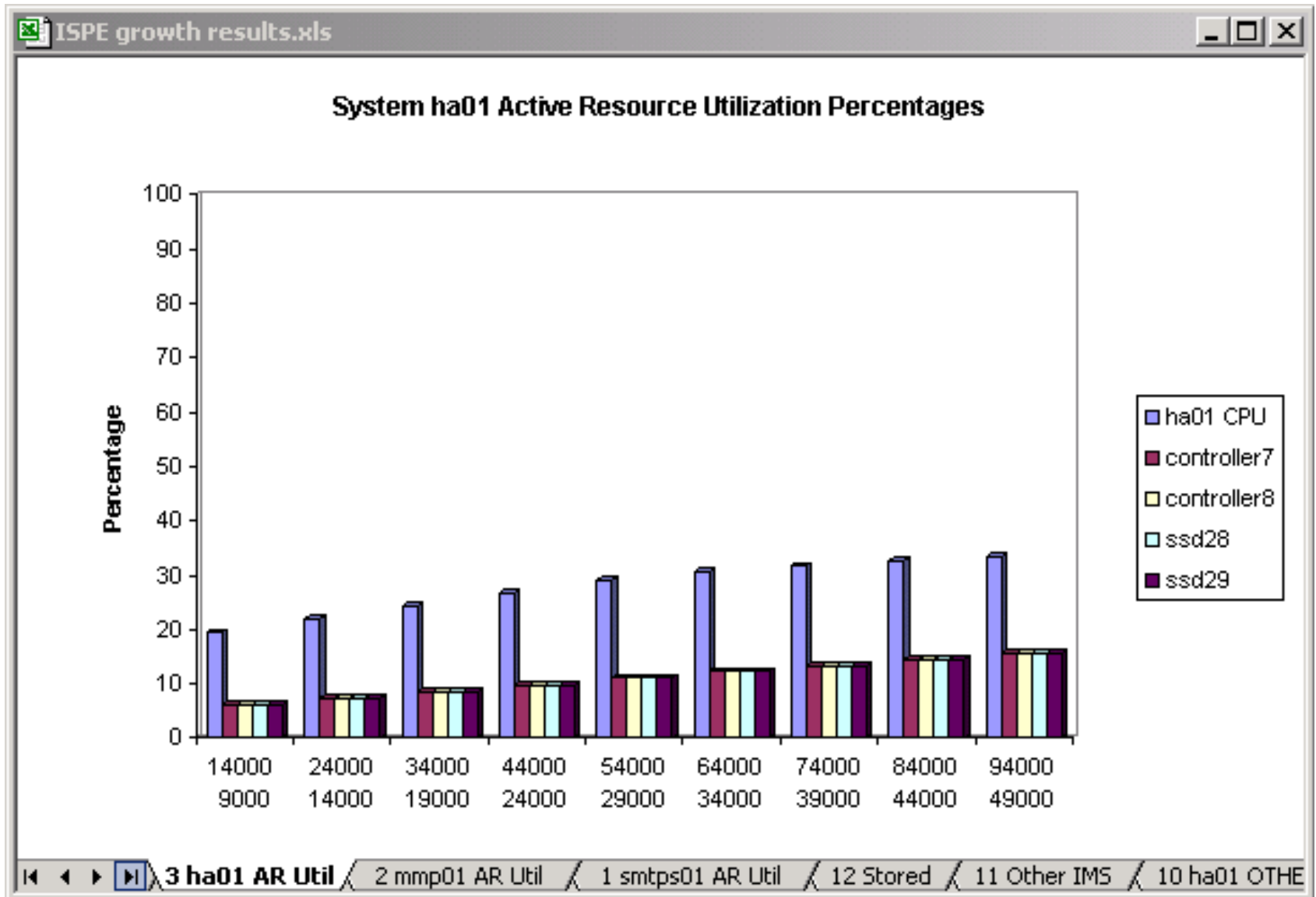
Measured response time can be any real positive number.

## Predicted Workload Throughput

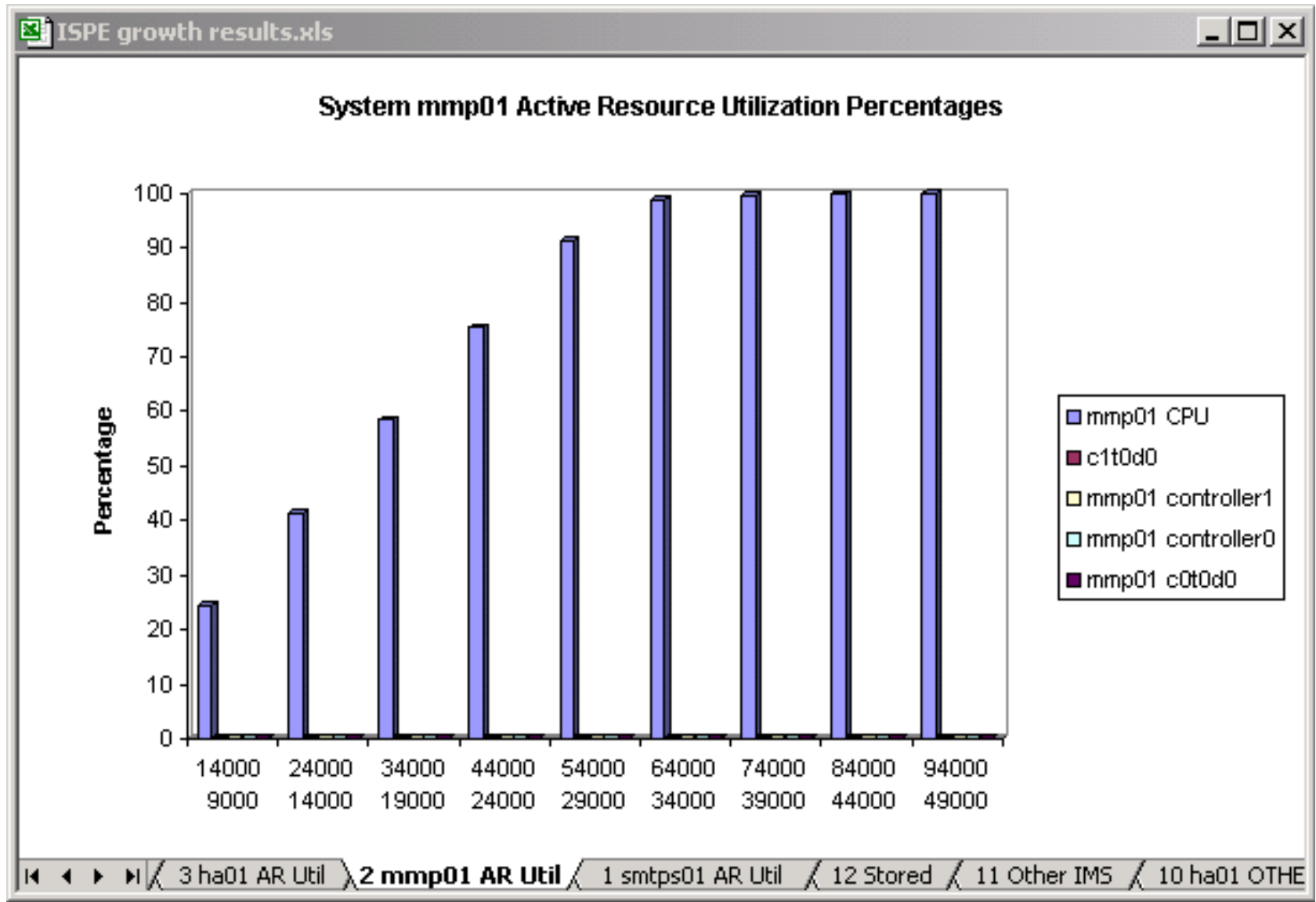




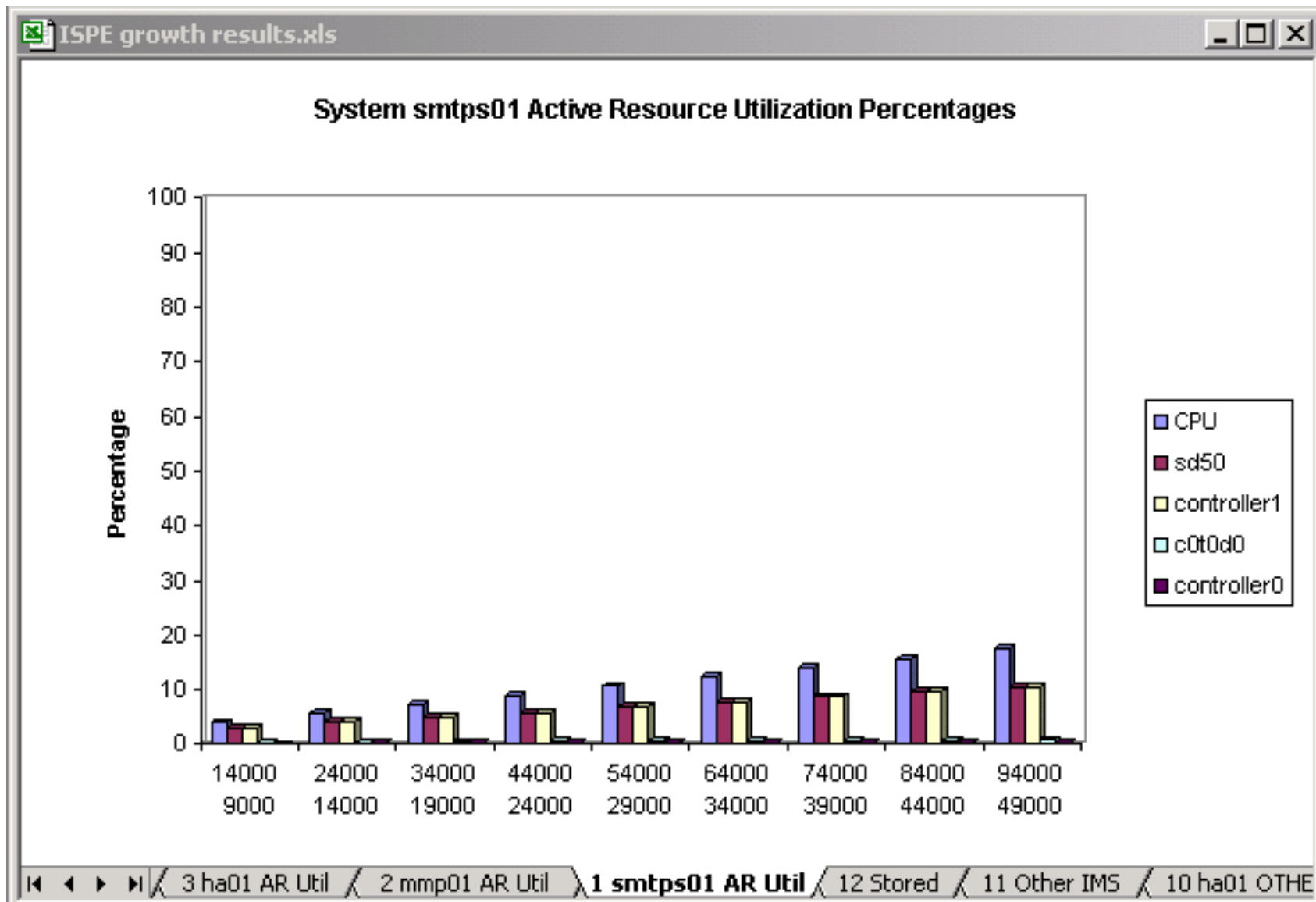
# E-mail Database Server Utilization



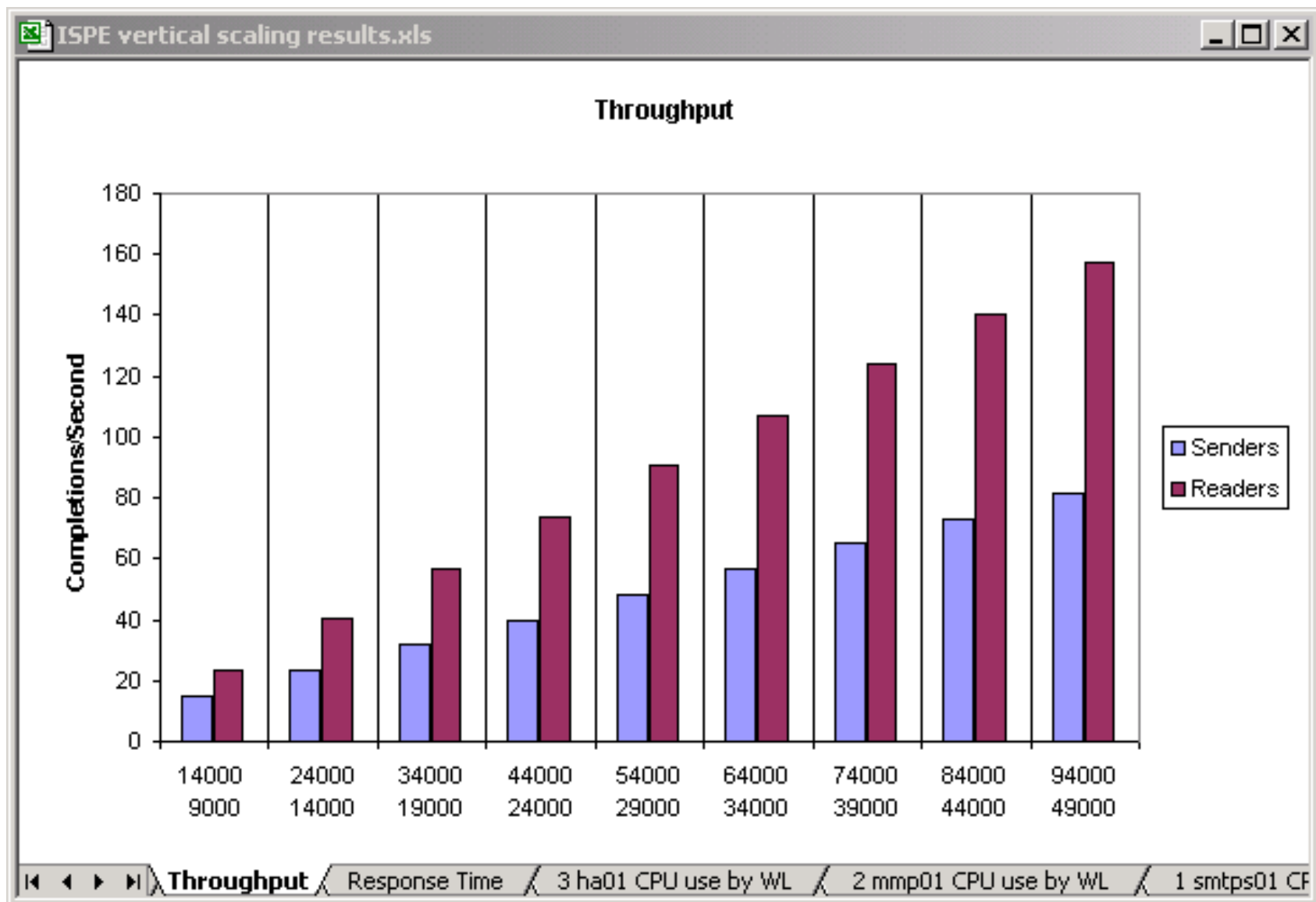
# Message Multiplexor Server Utilization



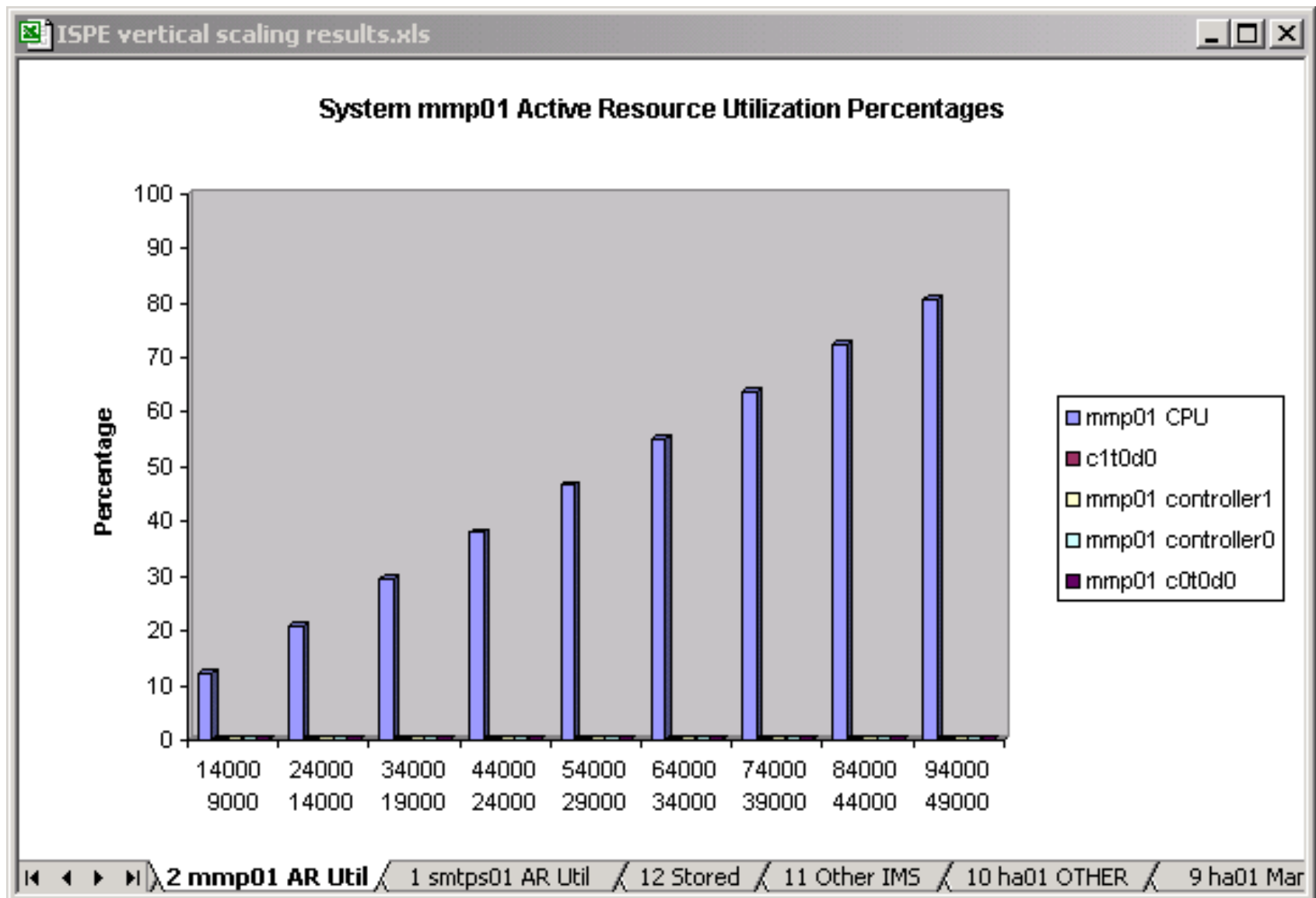
# Message Transfer Agent Server Utilization



# Predicted Workload Throughput for Vertical Scaling



# Message Multiplexor Utilization for Vertical Scaling



- Two multi-tiered applications
- Workload definition is key
- Same modeling techniques used

- Capacity planner has enterprise-wide perspective
- Modeling approach reduces complexity
- Prediction results can be evaluated quickly