

A New Vision for Computing in a Complex Lab Environment

Paula J. Santrach MD
Mayo Clinic

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Topics

- The practice of Laboratory Medicine & Pathology today
- Roles and options for information systems to support the practice
- Our approach to lab computing
- Summary

The Practice of Laboratory Medicine & Pathology Today

- Multiple practice types
 - Academic
 - Intramural
 - Physician/clinic
 - Hospital
 - Extramural
 - Outreach
 - Reference
 - Clinical trials

The Practice of Laboratory Medicine & Pathology Today

- Multiple performing laboratories
 - Size
 - Distance
 - Nature of practice

The Practice of Laboratory Medicine & Pathology Today

- Multiple disciplines with unique information needs
 - Chemistry
 - Bacteriology/mycology
 - Transfusion medicine
 - Anatomic pathology
 - Lab genetics

The Practice of Laboratory Medicine & Pathology Today

- Movement toward a more consultative practice
 - Integration of results from multiple laboratory disciplines (e.g. bone marrow analysis)
 - Integration of results to answer clinical question (e.g. bleeding diathesis)

The Practice of Laboratory Medicine & Pathology Today

- Oversight by numerous regulatory & accrediting organizations
 - Healthcare (JCAHO, CLIA, CAP)
 - Blood & tissue donors (FDA, AABB, FACHT)
 - Clinical trials (FDA, trial sponsors)

The Practice of Laboratory Medicine & Pathology Today

- Expanding menus, particularly of esoteric tests
- Increasing test volumes, depending on the nature of the practice
- Cost pressures

The Practice of Laboratory Medicine & Pathology Today

- Focus on quality
 - Throughout the testing process
 - Human error with manual processes
 - Need to build quality into processes
 - Technology as a tool
 - High customer expectations

The Practice of Laboratory Medicine & Pathology Today

- Need for data mining ability
 - Practice patterns
 - New test development
 - Research/discovery

The Practice of Laboratory Medicine & Pathology Today

- National laboratory technologist shortage
 - Projected need for 710,000 technologists by 2012
 - ~12,200 new technologists needed each year
 - 4,000 – 6,000 new graduates each year
- Movement toward licensure in multiple states

The Practice of Laboratory Medicine & Pathology Today

- Optimization of workflow requires a shift in identification
 - Patient \Rightarrow specimen \Rightarrow patient
 - Necessary for automation
 - Necessary for consultative reporting

Mayo Perspective

- Major system replacement project
 - Core LIS
 - Microbiology
 - Extramural practice applications
- Existing internally & vendor developed applications
- All of the previous issues were applicable to our practice

Roles for Information Systems

- Manage transactions
- Manage process flow
- Control process flow
- Manage quality data
- Accept information from others
- Deliver information to others
- Share information with others
- Source of operational data
- Source of practice information
- Source of regulatory & accreditation compliance data

Possible IT Solutions

- Enterprise Package
- Single Laboratory Package
- Multiple Laboratory Packages
- Composite Solution

Composite Solution

- Services Oriented Architecture (SOA)
- What is an SOA for Labs?
 - Standards, software, and hardware that allows a composite solution of “Best of Breed” applications
 - Allows agility and innovation for solving problems now and in the future
- How does an SOA enable a Lab “Best of Breed” solution to happen?
 - Applications communicate with each other through reusable services that are well-defined

SOA Analogies

■ Conference call

- Multiple technologies
 - Cell phone, land phone, Blackberry, IP phone, etc.
- Standards to enable voice and tone “messaging” for all
- Integration to reach decision

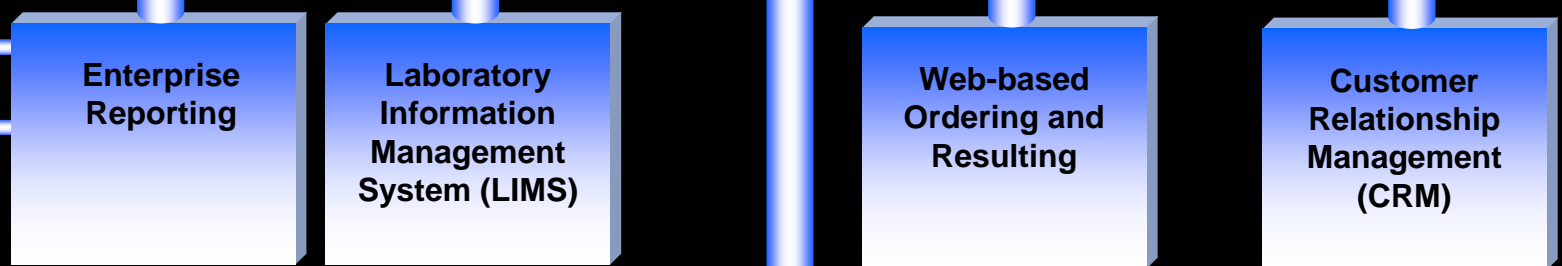
■ Bone marrow analysis

- Multiple technologies
 - Morphology, cell counts, chromosome studies, flow cytometry, molecular markers, etc.
- Multiple information systems with standards to enable messaging among them
- Integration to reach a final report

Lab SOA - Architectural Strategy

LAB Development Platform

System Configuration & Management



Infrastructure Services (Security, Operating Systems, Servers, Database, Terminal Servers . .)

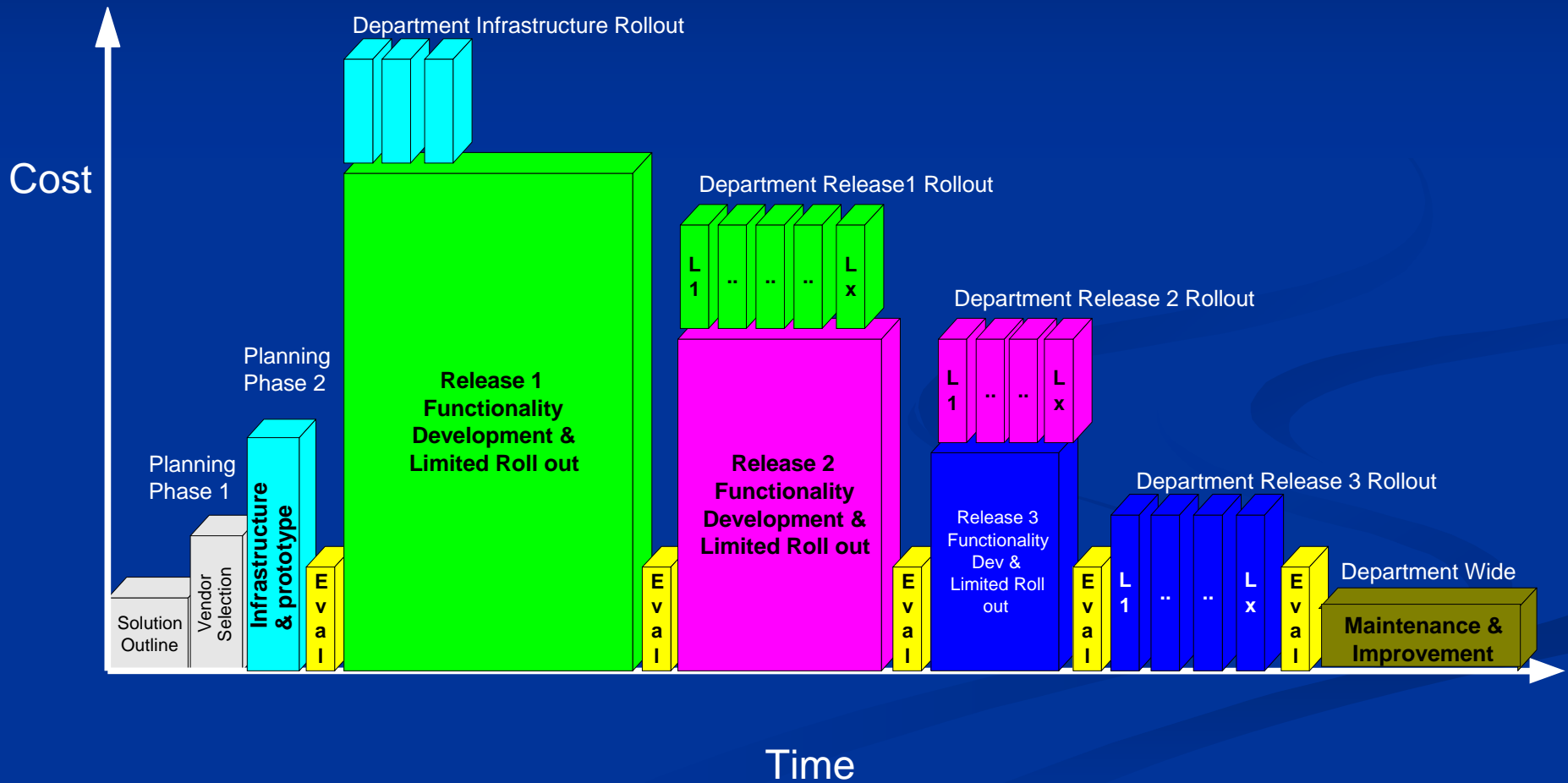
Why is the Composite Solution the Choice for our Practice?

- Need for sophisticated, discipline-driven information support for cutting edge labs
 - Microbiology, Blood Bank, Genetics as examples
- Need for process control elements for the laboratory processes
 - Specimen focus
 - Operational management
 - Quality management

Why is the Composite Solution the Choice for our Practice?

- Need for integration of data to produce consultative reports
- Need for data mining capability
- Need for communication among sites
- Need for long term solution

Project Approach



Planning Phase 1

- Functional, system & strategic requirements
- High level budget, timeline, implementation approach
- Architectural approach
- Preferred vendors

Vendor Evaluation Process

- Vendors were evaluated through multiple points of evaluation
 - RFP scoring
 - General capabilities & required functionality
 - 400 elements of consideration
 - Oral presentations
 - RFP score validation
 - Vendor demonstrations
 - Scenario and functionality based
 - 530 elements of consideration
 - One week on site evaluation
 - Rating from lab personnel
 - Quality assurance assessment
 - Company profile
- Multiple lab disciplines involved, quantitative

Planning Phase 2

■ SOA Prototype

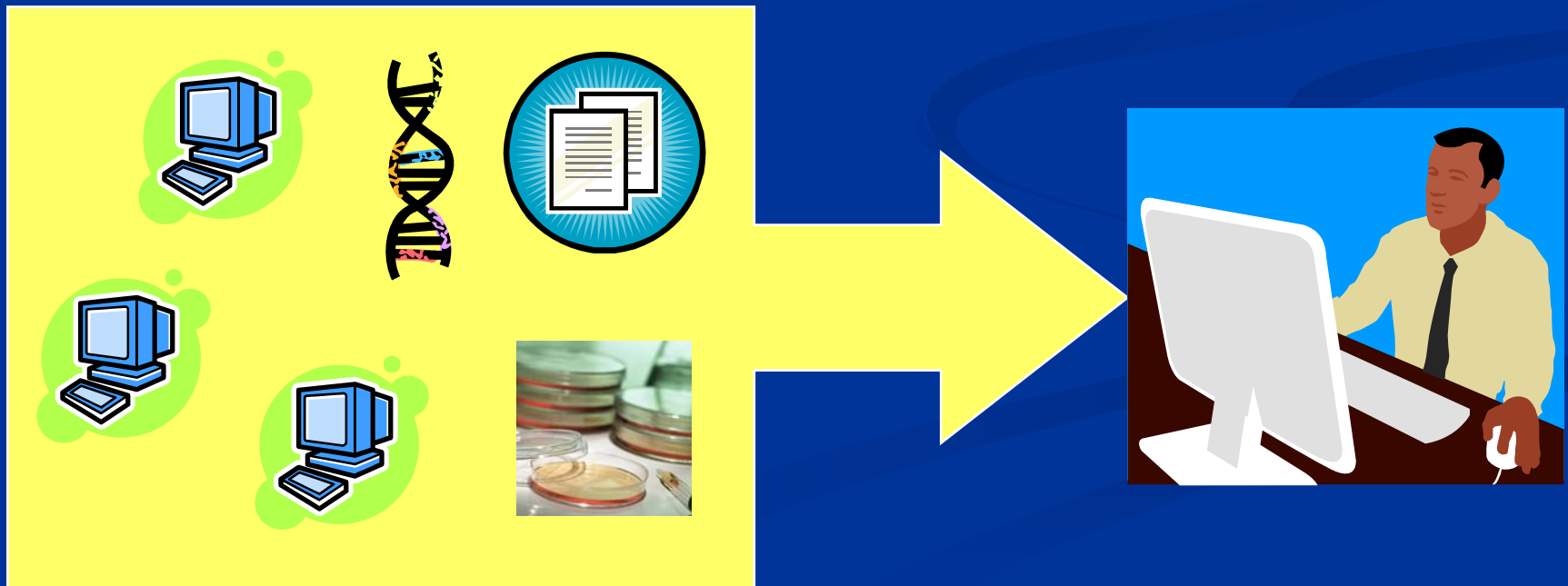
- A prototype phase used to mitigate risk and included installing, configuring and testing in the Mayo environment to provide:
 - Proof of concept
 - Technical and architectural performance
 - Volumes
 - Basic functionality
- Vendor selection not final until completion of prototype.

Prototype Goals

- Integration
 - Multiple applications (both vendor & internally developed) with the Enterprise Service Bus (ESB)
 - Consolidated view of data from multiple applications
 - Composite functionality from multiple applications

Consolidated View

To enable consultants and other allied health professionals to access laboratory data including historical results and images.



Consolidated View

Application
1

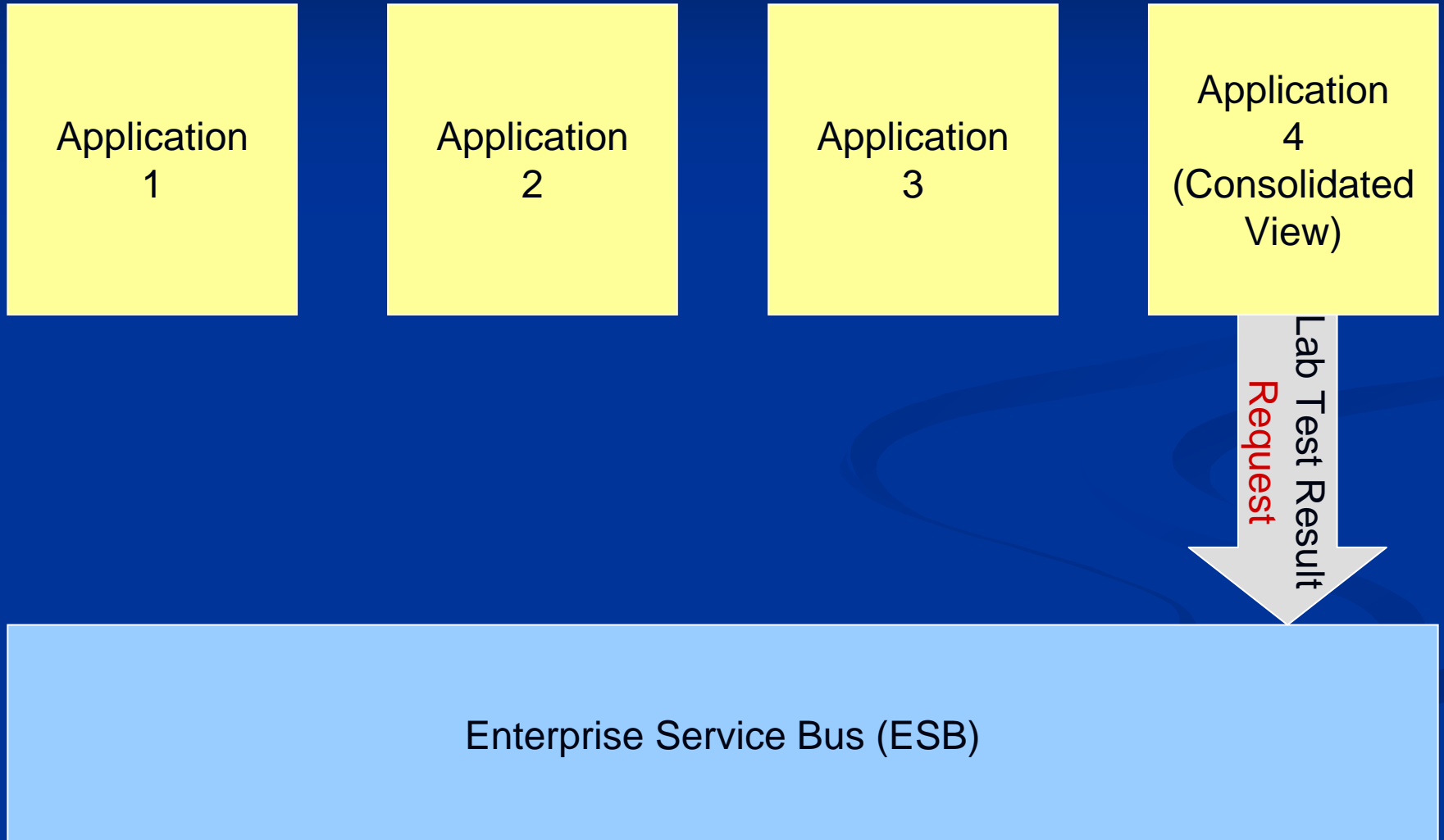
Application
2

Application
3

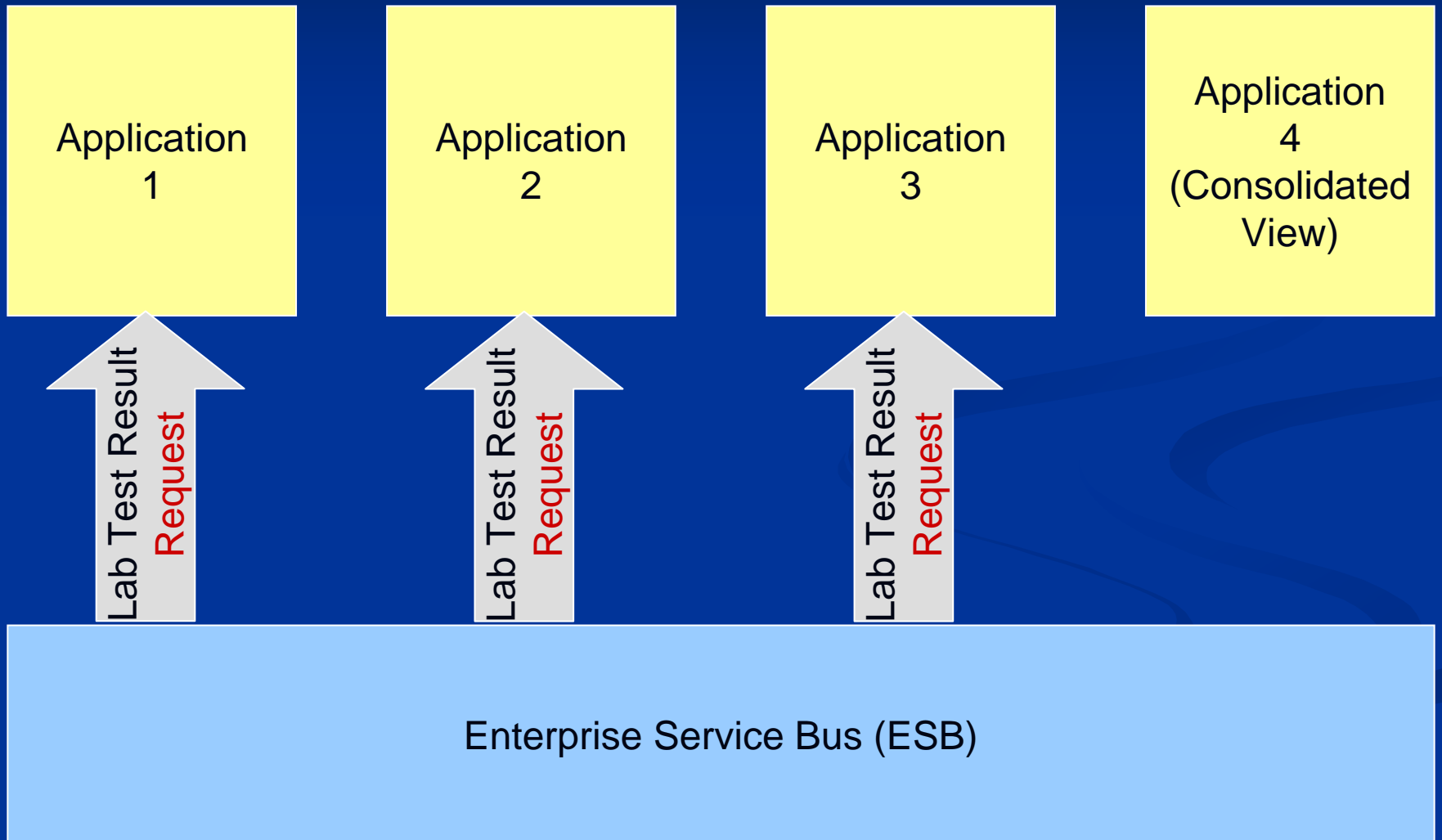
Application
4
(Consolidated
View)

Enterprise Service Bus (ESB)

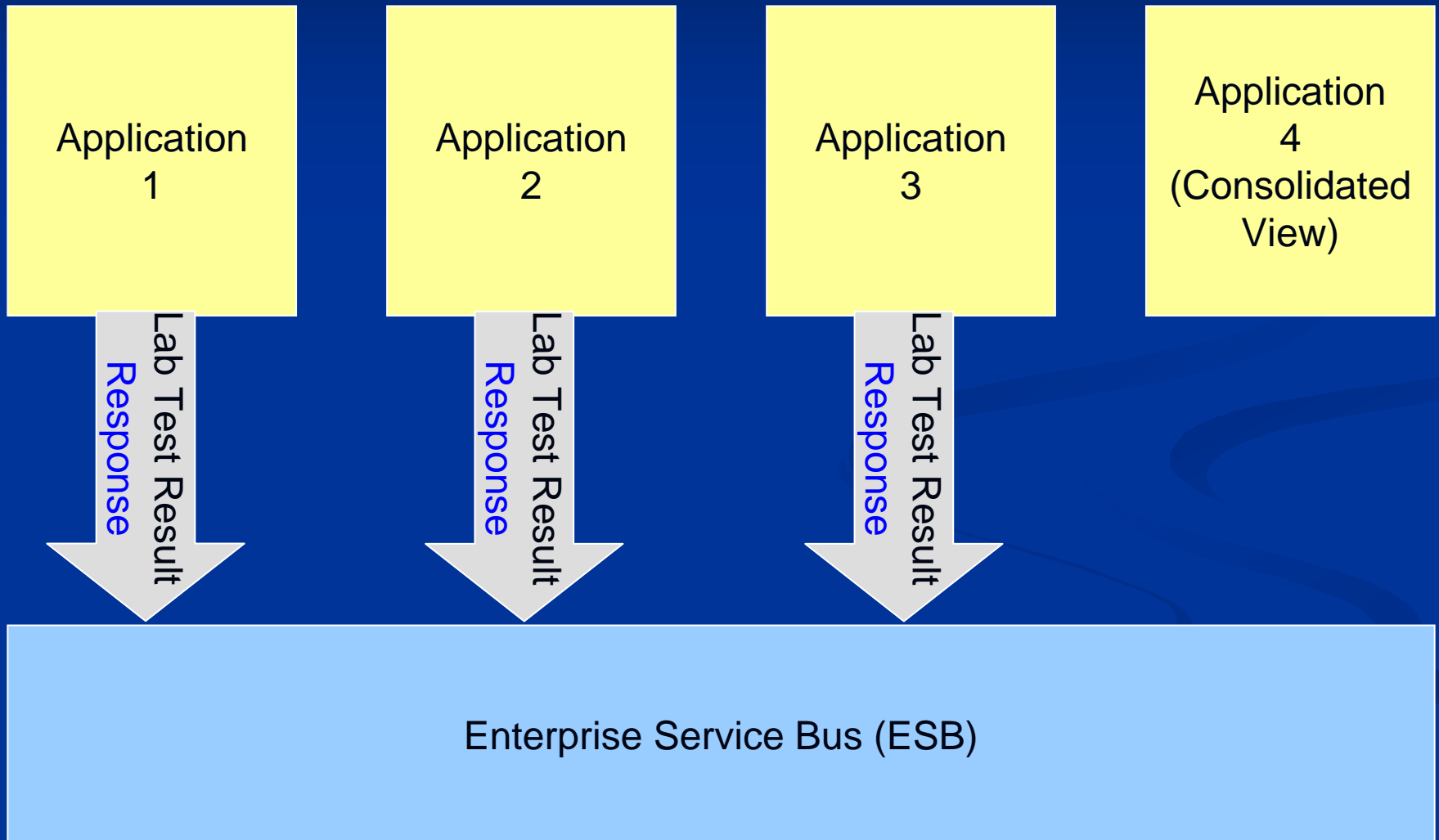
Consolidated View



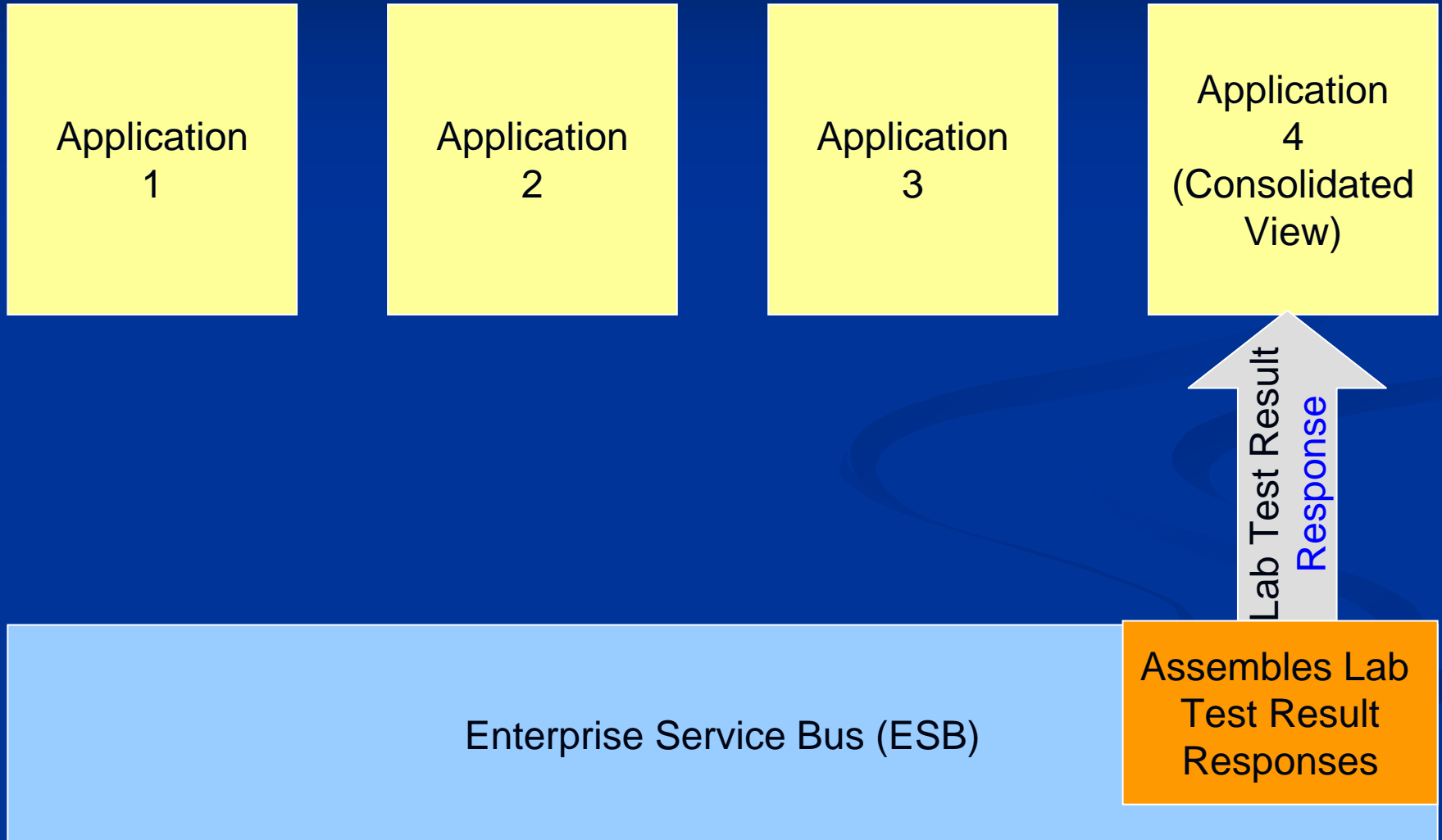
Consolidated View



Consolidated View



Consolidated View



Prototype Goals

- Performance
 - Individual applications
 - ESB
 - Composite solution
 - Extension beyond Rochester
- Vendor participation & capabilities

Performance Testing

- Aspects
 - Concurrent users
 - Transaction volume
 - Simple & complex transactions
 - Hardware configuration
 - Database size & tuning
- Testing done with current and future business volumes

Performance Testing

- Automated tools to enable:
 - Multiple levels of test scripts – simulate load
 - Detailed monitoring of results including times & defects
 - Extended duration of simulation (up to 72 hours)
- Large loaded database
- Hardware
- Software

Standalone Application Performance Testing

- Acceptance Criteria
 - Based on User Experience
 - Lab Resources, Business Analysts
 - Tested 7 key business transactions
 - Order entry
 - Result entry
 - Edit order
 - Create report
 - Create QC chart
 - Search results by patient
 - Search pending test by test code

Standalone Application Performance Testing

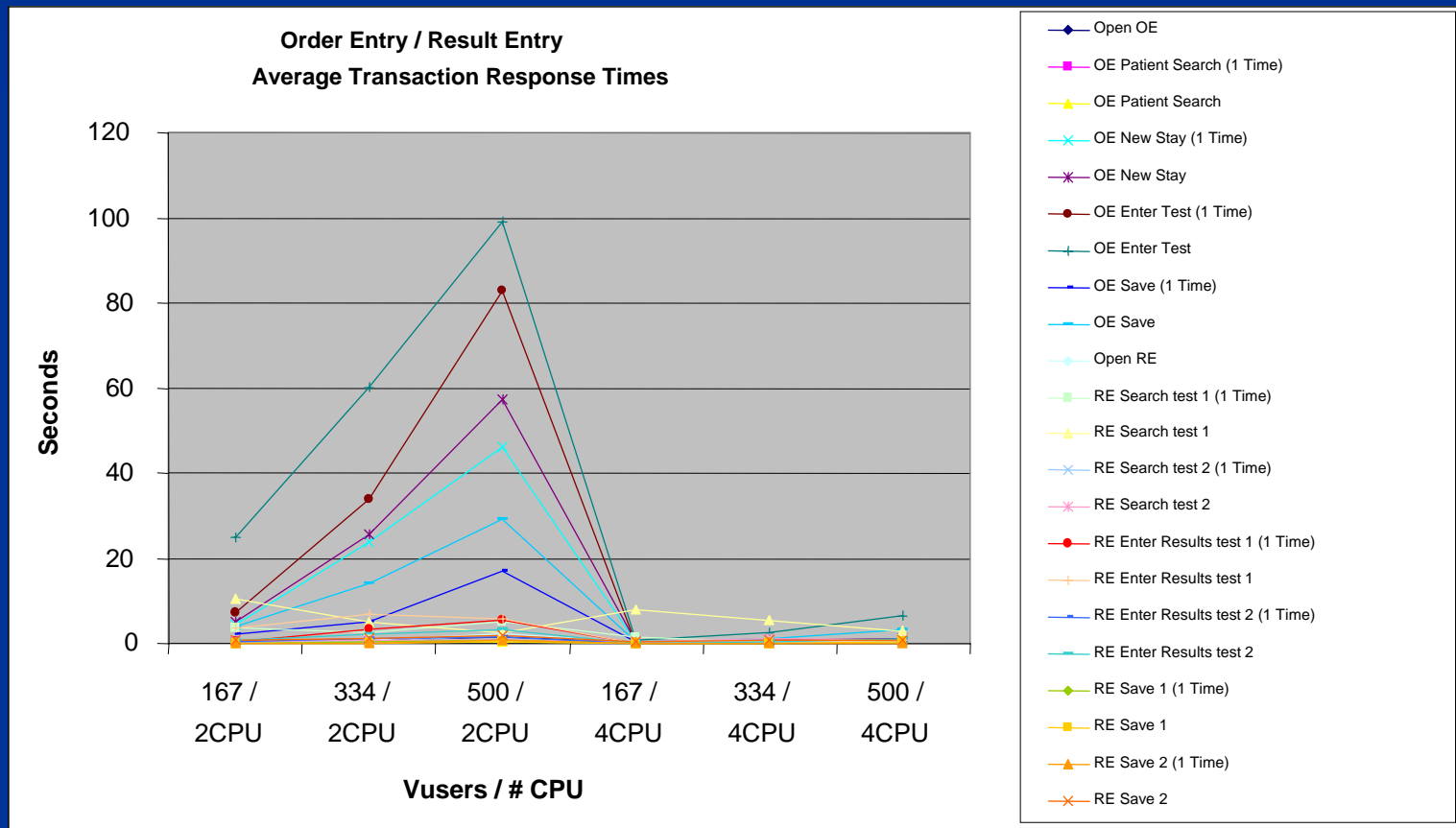
- Acceptance Criteria
 - Measured the response times for transactions
 - Evaluated the amount of information returned versus elapsed time
 - Identified maximum amount of time willing to wait

Performance Testing Monitoring

4 CPU / 16 GB RAM – 1X Run	Average	Min	Max	Std Dev
Order Entry				
Open App	.037	.016	.070	.011
Login	.911	.281	15.688	1.761
Open Order Entry	.270	.062	1.125	.131
Patient Search (1 st Time)	.171	.015	5.578	.757
New Stay (1 st Time)	.185	.078	5.312	.520
Enter Test (1 st Time)	.081	.031	.547	.083
Save New Order (1 st Time)	.273	.172	3.360	.316
Patient Search	.098	.010	70.250	1.427
New Stay	.205	.078	1.515	.111
Enter Test	.716	.015	6.589	.526
Save New Order	.459	.156	69.891	2.205
Logout	2.695	2.433	2.969	.150

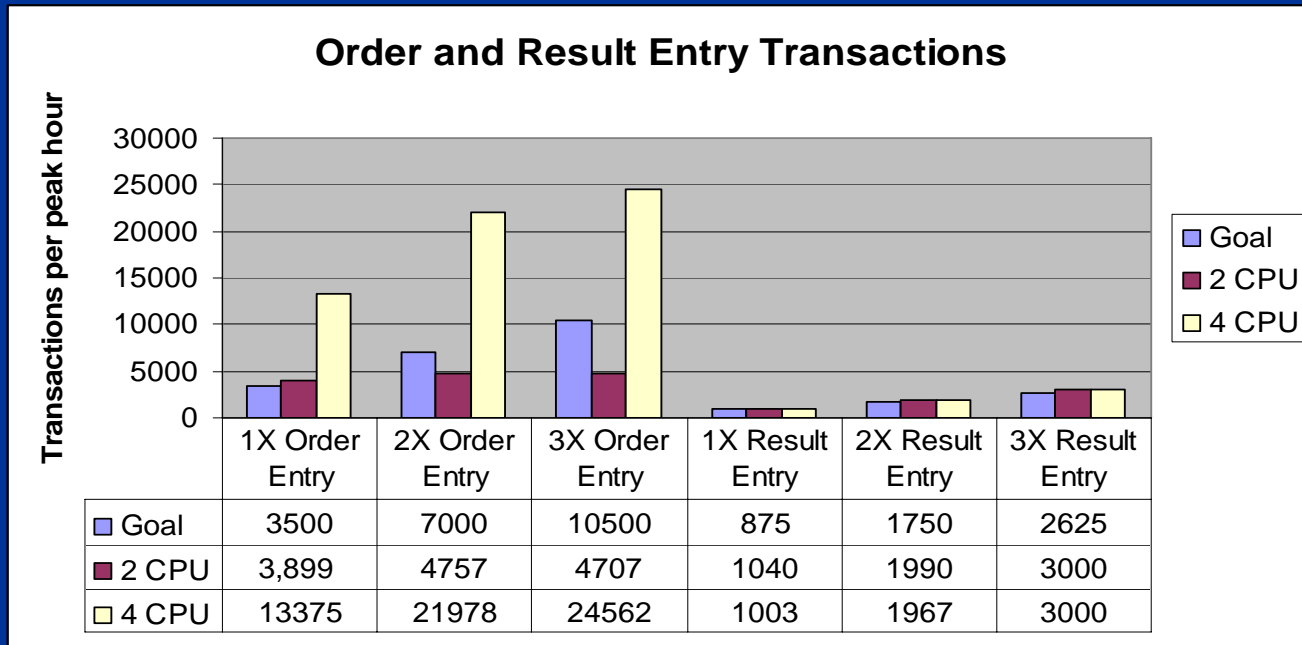
Performance Test Results

- Transaction response times under load
 - In the 4 CPU configuration, 98% of the transaction response times for 1X, 2X, and 3X test runs met the acceptance criteria.



Performance Test Results

- Exceeded 3X peak hour order volume goal (10,500)
 - The 3X order entry volumes were achieved with 167 concurrent Vusers and the application far exceeded the goal with 500 concurrent users (6X+ peak hour order entry volumes).



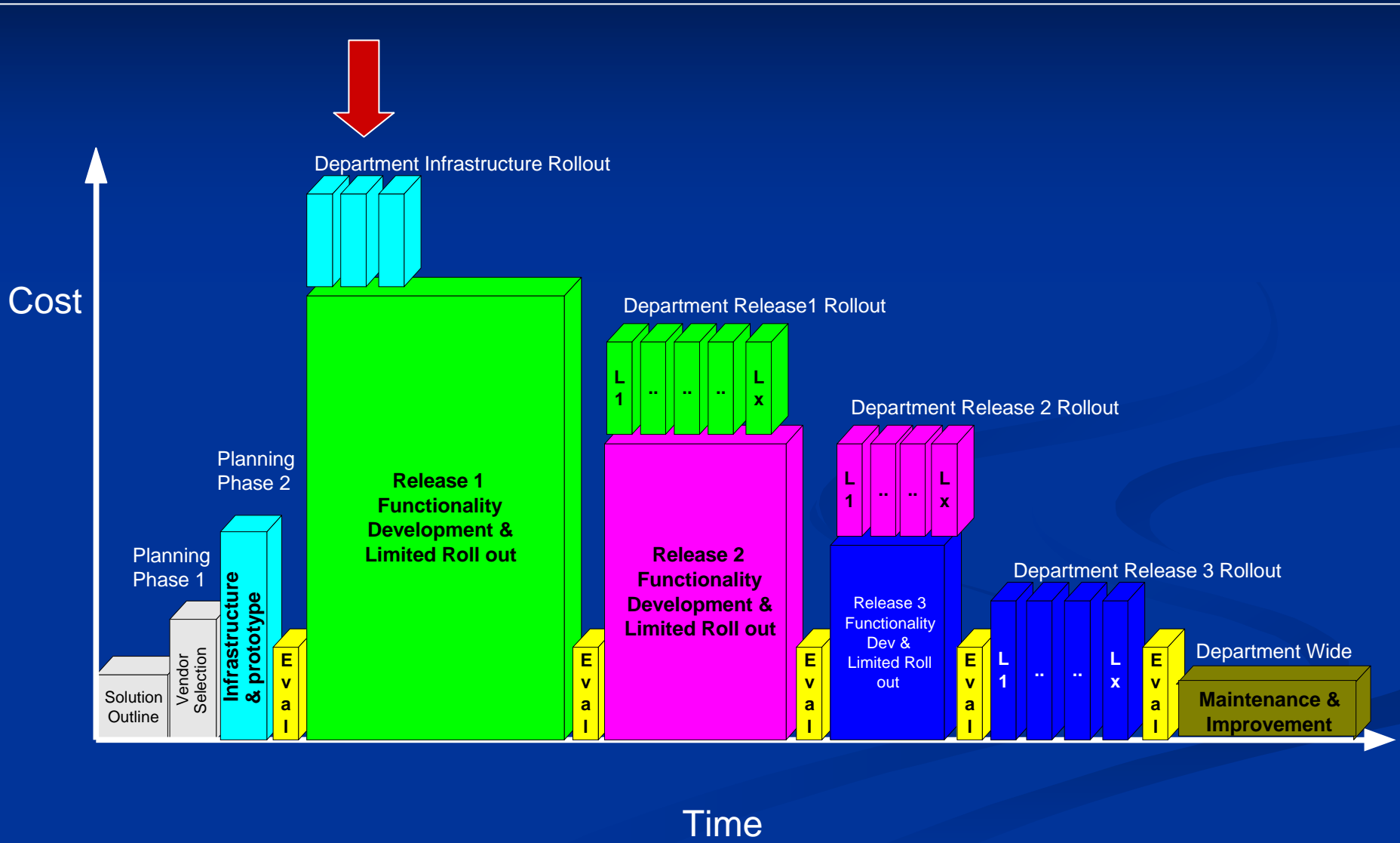
Composite Solution Performance Test Results

- Enterprise Service Bus can handle a load of 12,000 orders per hour
- Potential bottlenecks identified and options for resolution considered
 - Application design has significant impact
- Application response time for non-Rochester site acceptable

Prototype Outcomes

- Integration possible in our environment
- Performance met prototype criteria
- Standards and discipline required for implementation planning
- Vendor partnership essential

Where Are We Today?



Summary

- Composite solution
 - Meet specialty needs of many types of laboratories
 - Possible to build upon existing systems
 - Longevity & flexibility of solution
 - Virtual information integration
- Workable in a multi-laboratory environment, such as a health system
 - Select from suite of application to best fit needs
 - SOA allows a virtual single database view

Summary

- Things to consider regarding composite solution
 - Leading edge approach (risk)
 - Multiple vendor methodologies and cultures
 - Complex infrastructure

Conclusion

- The real business of laboratory medicine & pathology is the delivery of information to guide the diagnosis & treatment of patients
- IT provides a set of powerful tools to enable that business in many aspects
- Therefore, system replacements are PRACTICE projects and IT (both internally and externally) is a vital partner for success