

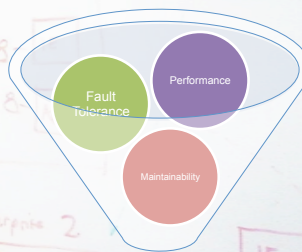
Architecting for Highly Available, Scalable, and Reliable Mission- Critical Applications

Diego Dagum
Microsoft Corp.

Mission-critical 101



Availability



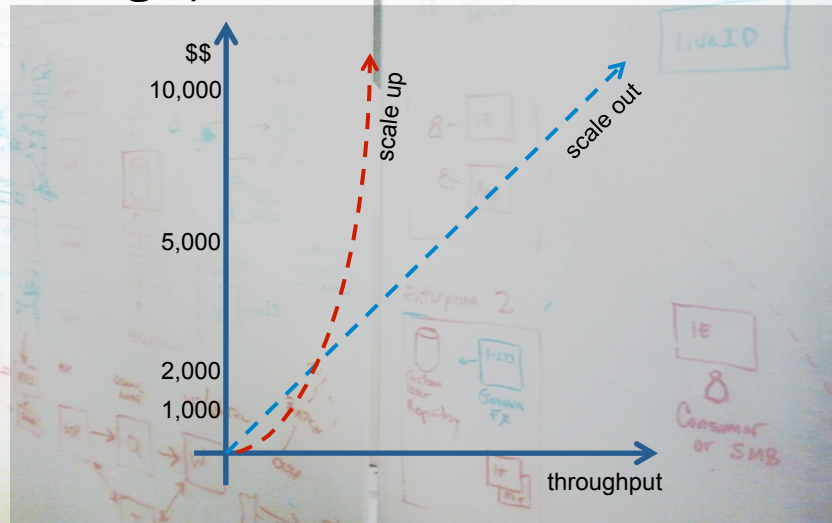
Reliability

Agenda

- Mission-critical 101 (just seen)
- Scalability
- Failover
- Performance
- Application health
- Fault-tolerance mindsets

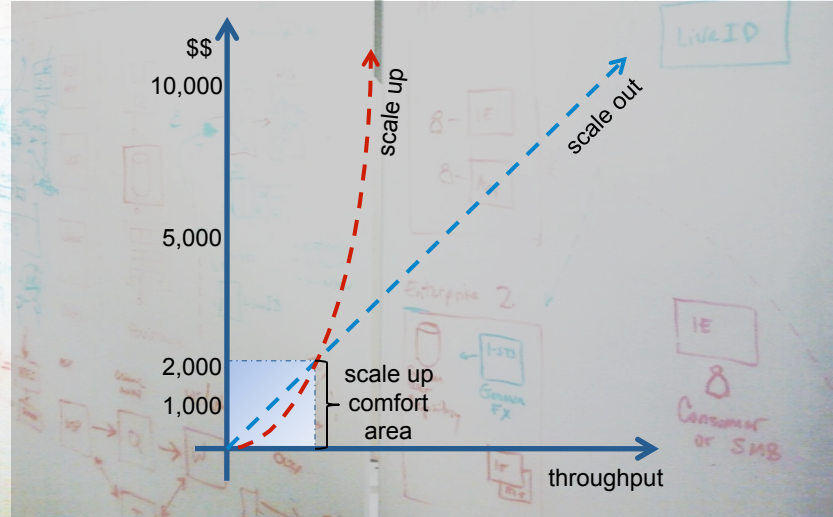
Scalability

Scaling up, out



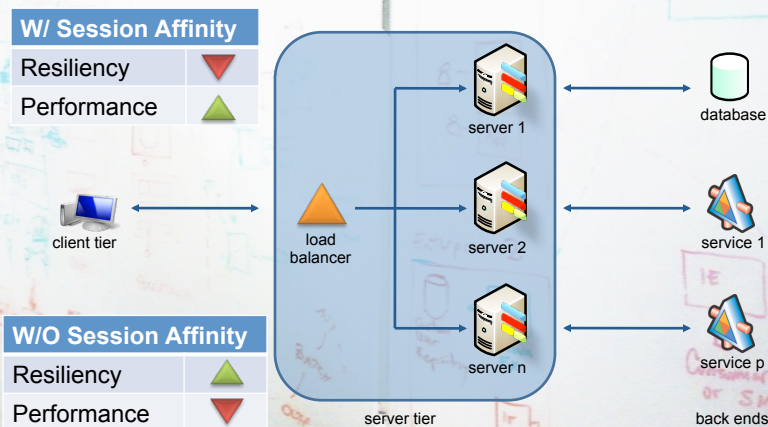
Scalability

Scaling up, out



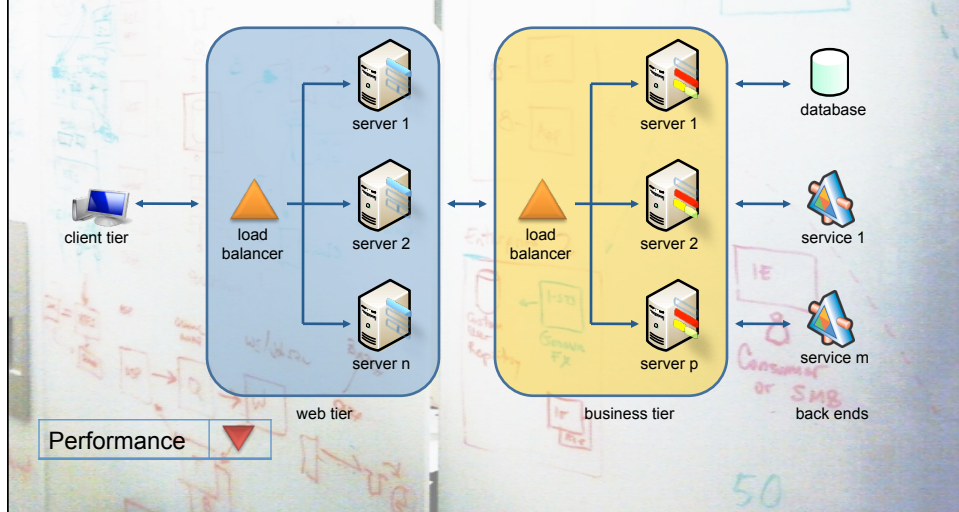
Scalability

Scaling out. Redundant approach



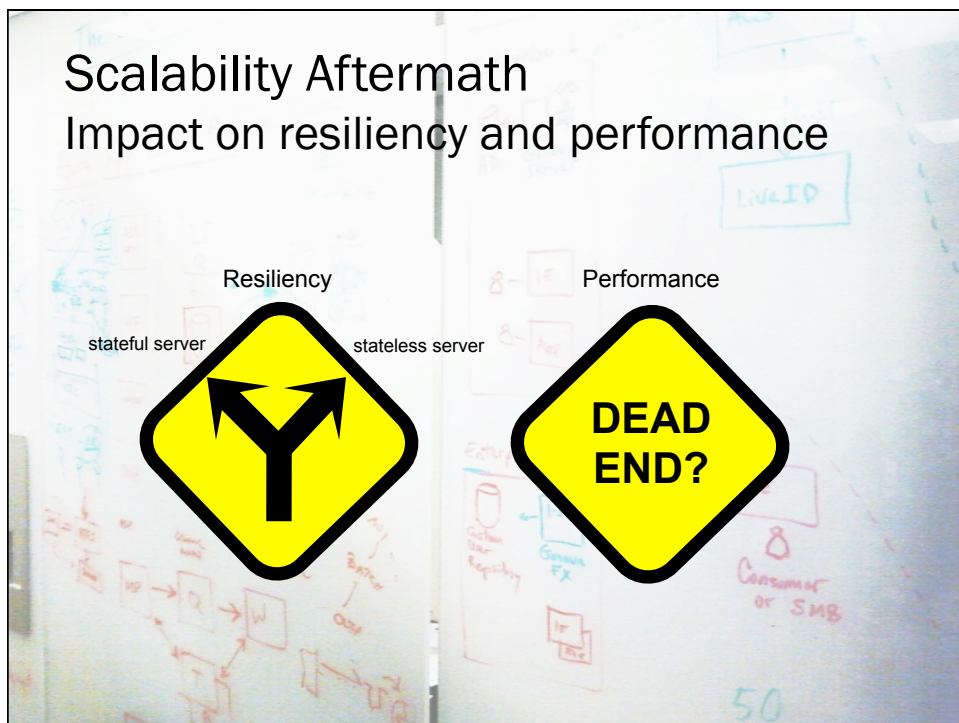
Scalability

Scaling out. Partitioned approach



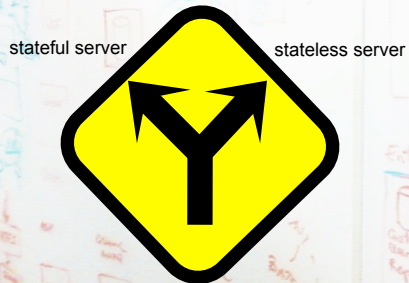
Scalability Aftermath

Impact on resiliency and performance



Resiliency

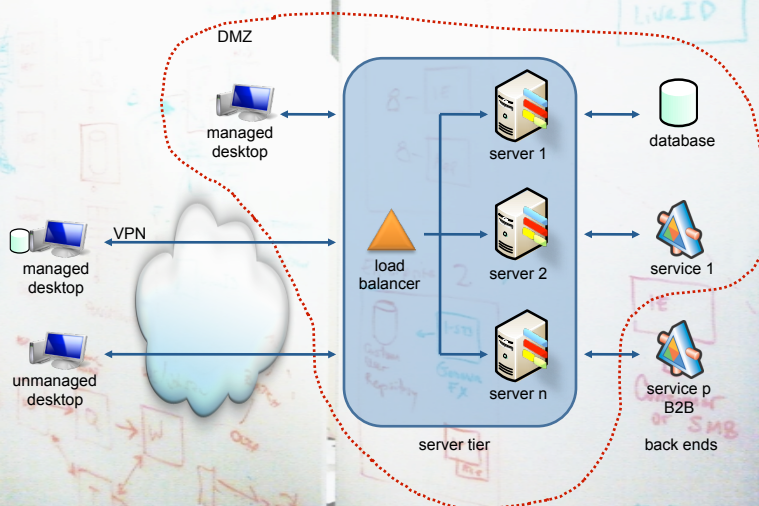
Server failover and state management



- Server-side
 - In memory
 - Database
 - Distributed caching
- Client-side
 - Managed desktops
 - Unmanaged desktops

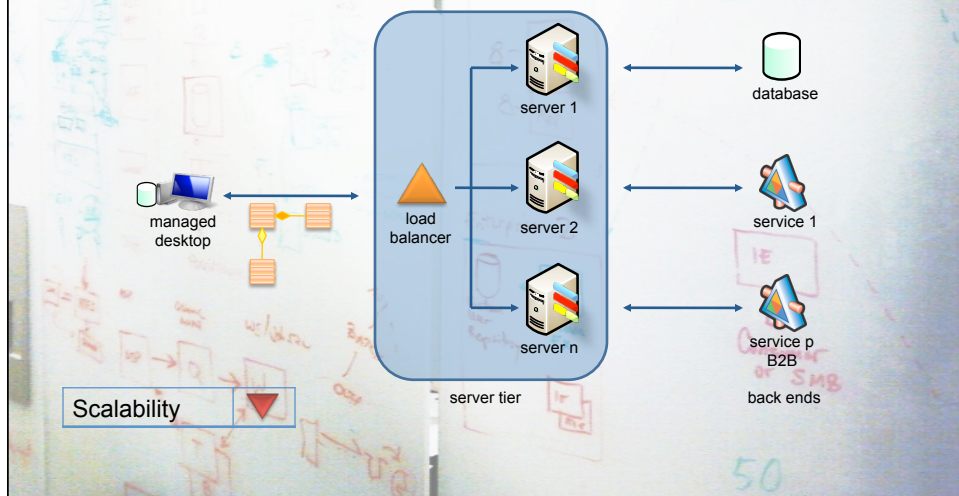
State Management for Failover

Keeping state in the client-side



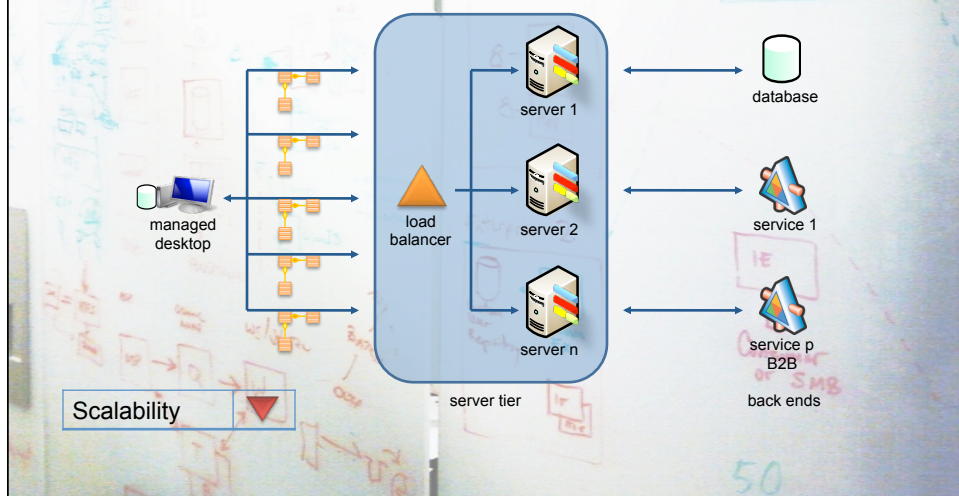
State Management for Failover

Keeping state in a managed client-side



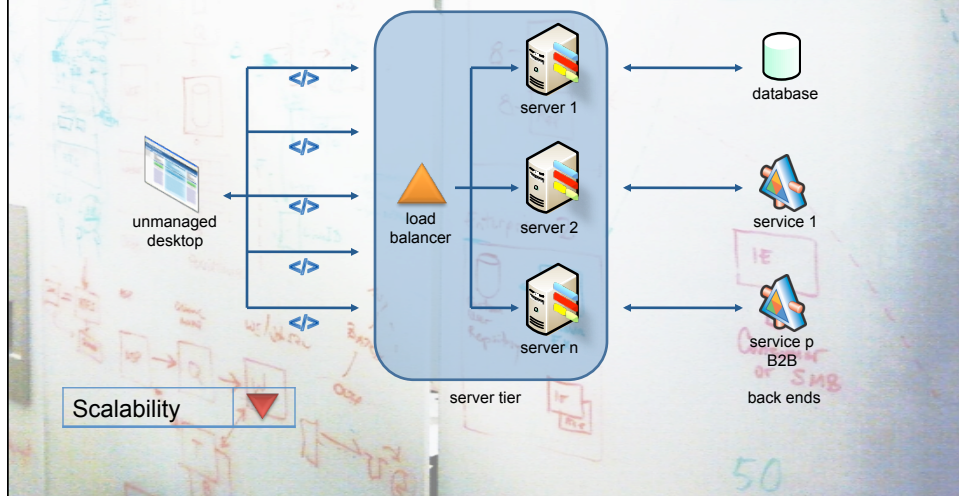
State Management for Failover

Keeping state in a managed client-side



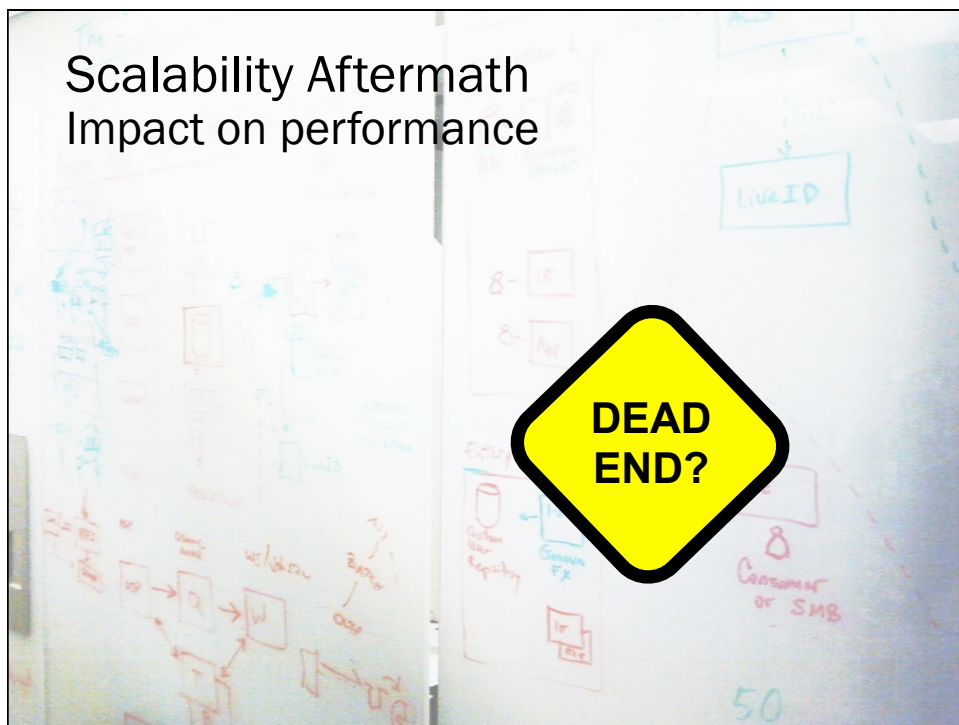
State Management for Failover

Keeping state in an unmanaged client-side



Scalability Aftermath

Impact on performance

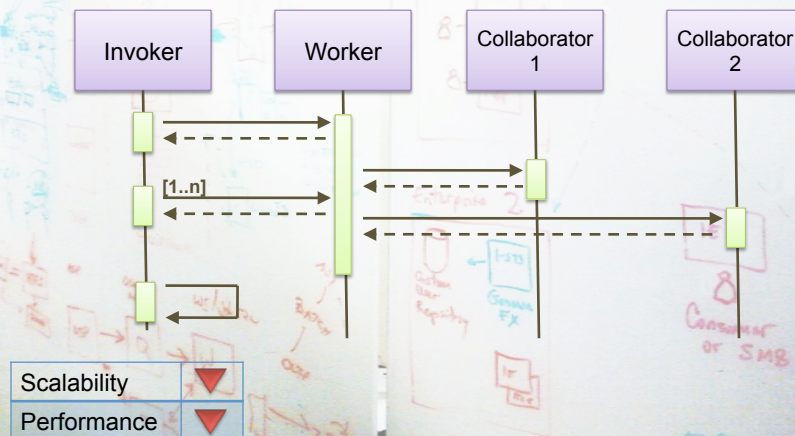


Scalability Aftermath Impact on performance

- Asynchronous execution
- Event-driven Architectures (EDA)
- Parallel execution

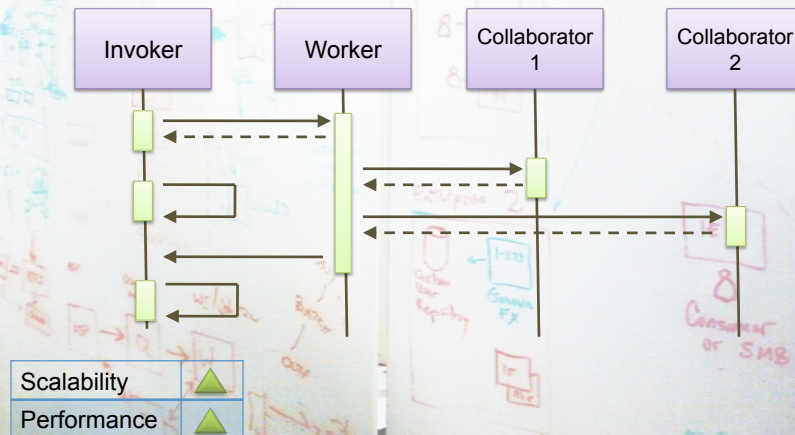
**HIGHWAY
ENTRANCE**

Performance Asynchronous execution (pull model)



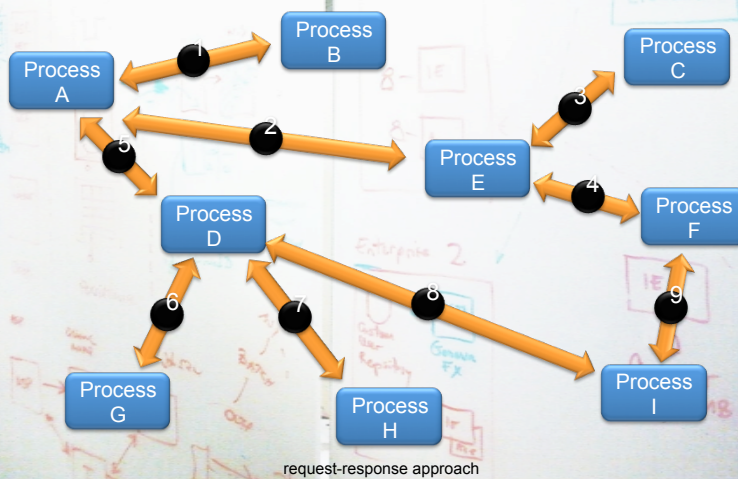
Performance

Asynchronous execution (push model)

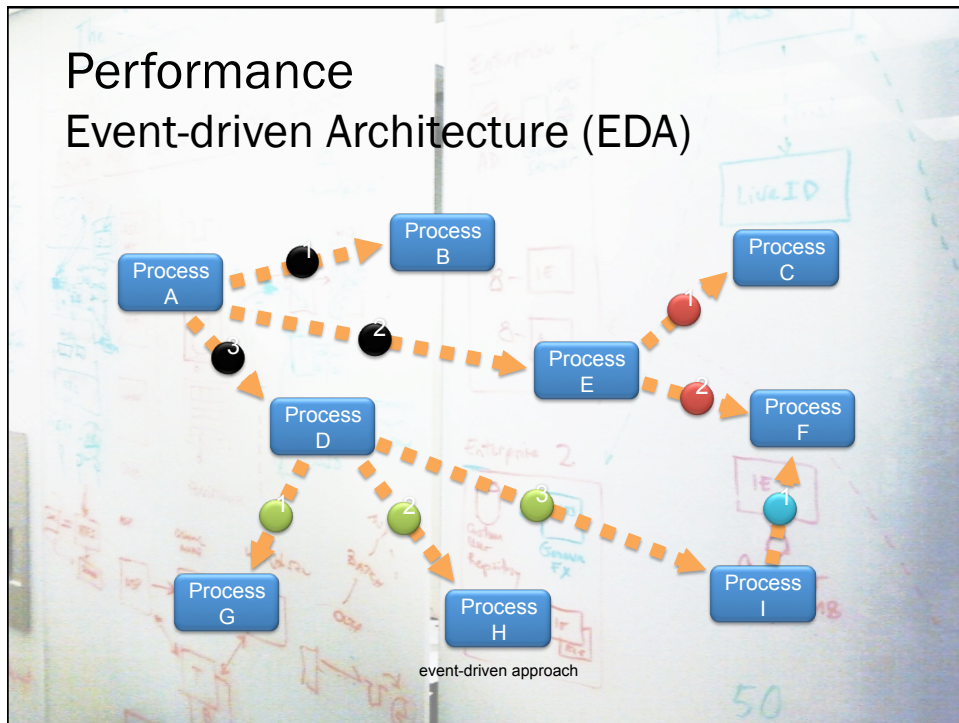


Performance

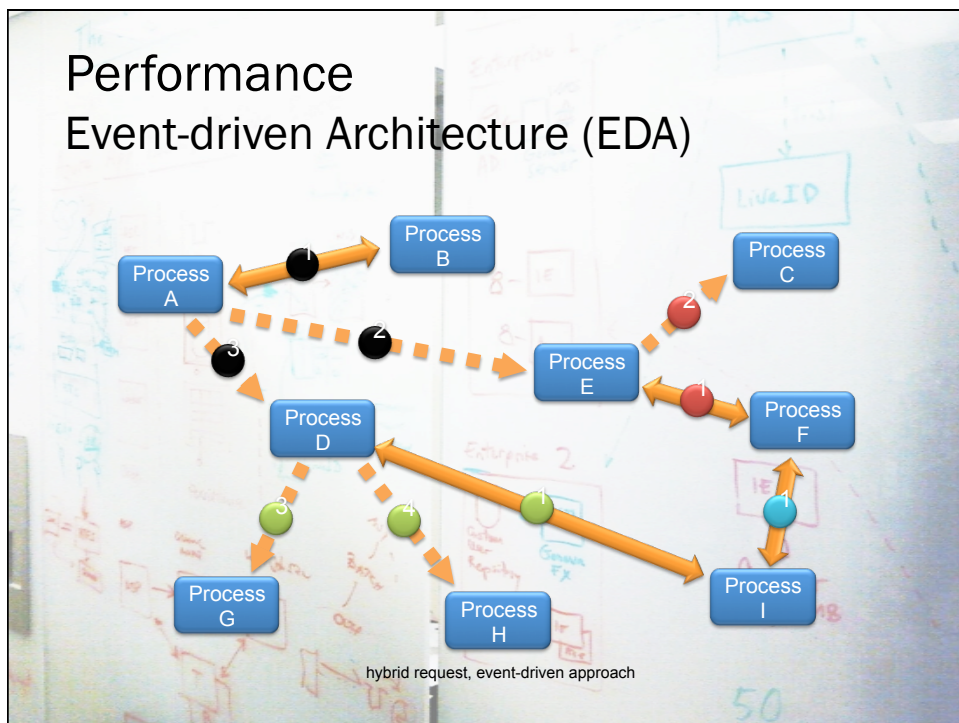
Event-driven Architecture (EDA)



Performance Event-driven Architecture (EDA)

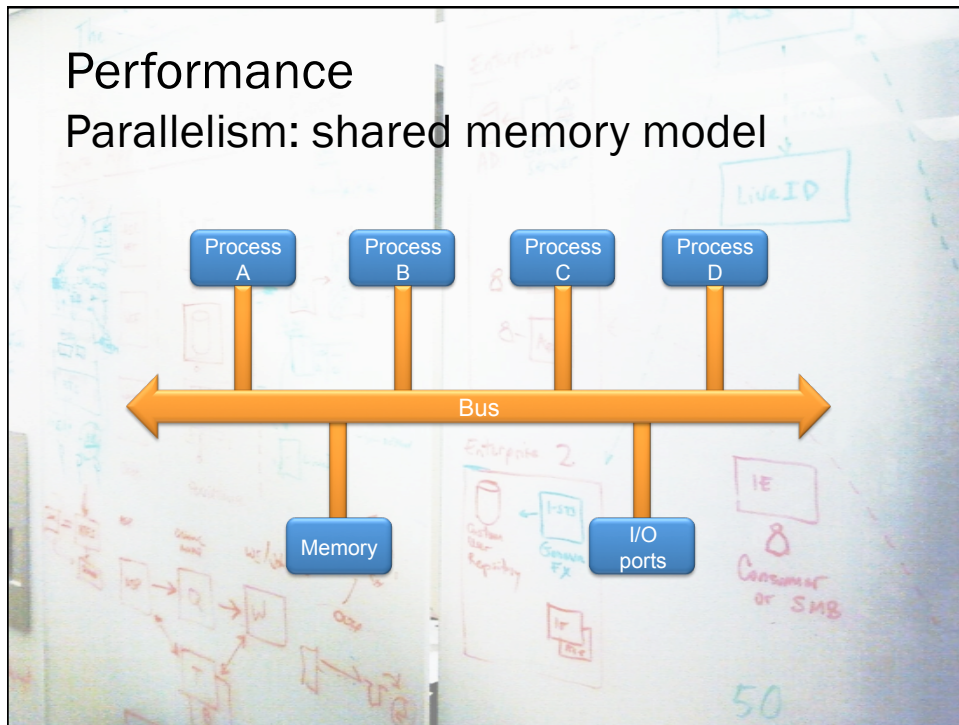


Performance Event-driven Architecture (EDA)



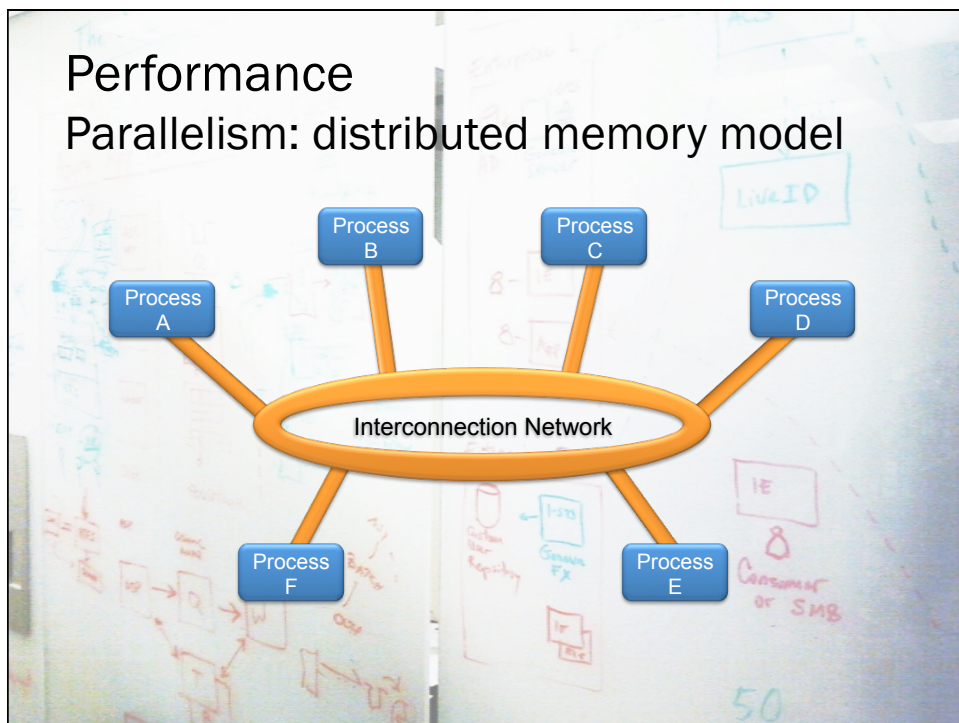
Performance

Parallelism: shared memory model



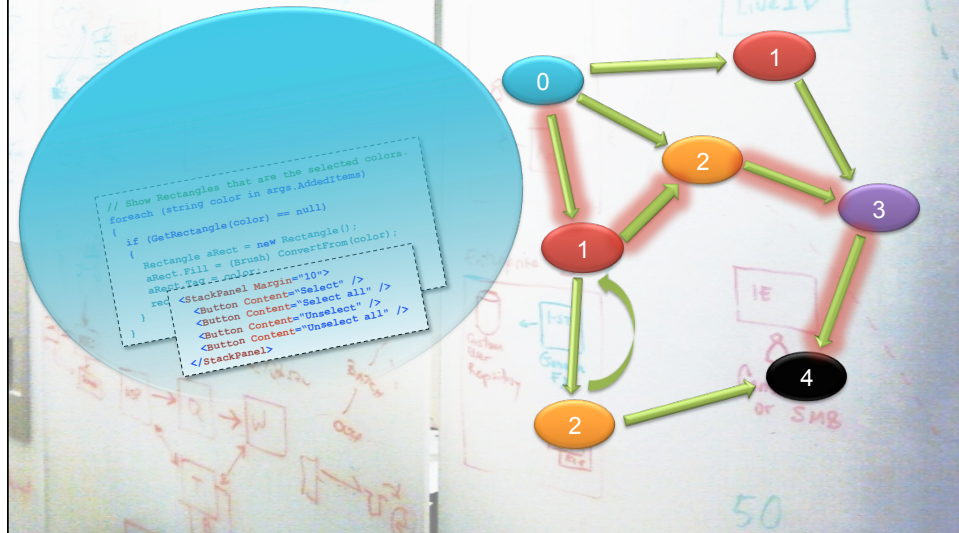
Performance

Parallelism: distributed memory model



Performance

Parallelism: task/channel model



Health and Instrumentation

Stopping issues before they stop us

Scenario	Test Environment	Requirement	Goal
Home page	Perf Environment #1	2s	1.5s
Search results page – 10 results	Perf Environment #1	3s	2s
Checkout complete	Perf Environment #1	5s	4s

E#1	Machine	CPU	RAM	Disk	Network
Client	Dell WS 650	1P 2.2 Ghz	1GB	7.5k eSata (100 GB)	600kb
App Server	Dell PE 6650	4P 2.2 Ghz	4GB	2x15k RPM SCSI	1Gb
Database	HP DT 9250	8P 2.6 Ghz	16GB	3 x 7.2 K SATA (480 GB) 15 x 7.2 k SATA2 (3 TB)	1Gb

Application	
Data Size	1,000 restaurants, 50,000 menu items, 1,500 orders
Work load	1,000 virtual users
Throughput	100 home pages/sec 50 searches/sec 2 checkouts/sec

Fault-Tolerance

Server Error in '/achar' Application.

No accessible overloaded 'OdbcCommand.Connection' is most specific for these arguments:

```
Public Sub set_Connection(value As System.Data.Odbc.OdbcConnection)
Public Sub set_Connection(value As System.Data.Common.DbConnection)
```

Description: An unhandled exception occurred during the execution of the current web request. Please review the stack trace for more information about the error and where it originated in the code.

Exception Details: System.Reflection.AmbiguousMatchException: No accessible overloaded 'OdbcCommand.Connection' is most specific for these arguments:
Public Sub set_Connection(value As System.Data.Odbc.OdbcConnection)
Public Sub set_Connection(value As System.Data.Common.DbConnection)

Source Error:

An unhandled exception was generated during the execution of the current web request. Information regarding the origin and location of the generated exception is identified using the exception stack trace below.

Stack Trace:

```
[AmbiguousMatchException: No accessible overloaded 'OdbcCommand.Connection' is most specific for these arguments:  
Public Sub set_Connection(value As System.Data.Odbc.OdbcConnection)  
Public Sub set_Connection(value As System.Data.Common.DbConnection)]  
Microsoft.VisualBasic.CompilerServices.VBBinder.BindToMethod(BindingFlags bindingAttr, MethodBase[] match, Object[]& args,  
Microsoft.VisualBasic.CompilerServices.VBBinder.InvokeMember(String name, BindingFlags invokeAttr, Type objType, IReflect o  
Microsoft.VisualBasic.CompilerServices.LateBinding.InternalLateSet(Object o, Type& objType, String name, Object[] args, Str  
Microsoft.VisualBasic.CompilerServices.LateBinding.LateSet(Object o, Type objType, String name, Object[] args, String[] par  
achar.inq_currday.Page_Load(Object sender, EventArgs e) in c:\inetpub\wwwroot\achar\inq_currday.aspx.vb:59  
System.Web.UI.Control.OnLoad(EventArgs e) +99  
System.Web.UI.Control.LoadRecursive() +47  
System.Web.UI.Page.ProcessRequestMain(Boolean includeStagesBeforeAsyncPoint, Boolean includeStagesAfterAsyncPoint) +1436
```

Version Information: Microsoft .NET Framework Version 2.0.50727.1433; ASP.NET Version 2.0.50727.1433

Thank You!!

diego.dagum@microsoft.com

Q&A

References

- [Application Architecture Guidelines 2nd Edition, Chapter 5 "Deployment Patterns"](#), J.D. Meier et al. (2009)
- [Application Architecture Guidelines 2nd Edition, Chapter 7 "Quality Attributes"](#), J.D. Meier et al. (2009)
- [Performance Testing Guidance for Web Applications](#), J.D. Meier (2007)
- [Distributed Caching: Microsoft Project Code Named "Velocity"](#)
- [Selecting the Right Virtualization Technology](#) (2008)
- [Backup and Disaster Recovery for Server Virtualization](#), Adam Fazio (2008)
- [Asynchronous Programming Design Patterns](#) (2007)
- [Multithreaded Programming with the Event-based Asynchronous Pattern](#) (2007)
- [Using Events in Highly Distributed Architectures](#), David Chou (2008)
- [MSDN Magazine on Parallel Execution](#) (2008)
- [Developing Parallel Programs](#), Ranjan Sen, PhD (2008)
- [Design for Operations](#)
- [Design Guidelines for Exceptions](#) (2007)
- [Exceptions and Performance](#) (2007)