Ethernet Technology Summit

Fibre Channel over Ethernet (FCoE)
Origin and Current Status

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EMC Corporation

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Agenda

- Origins of FCoE / Network Convergence
- Status of FCoE

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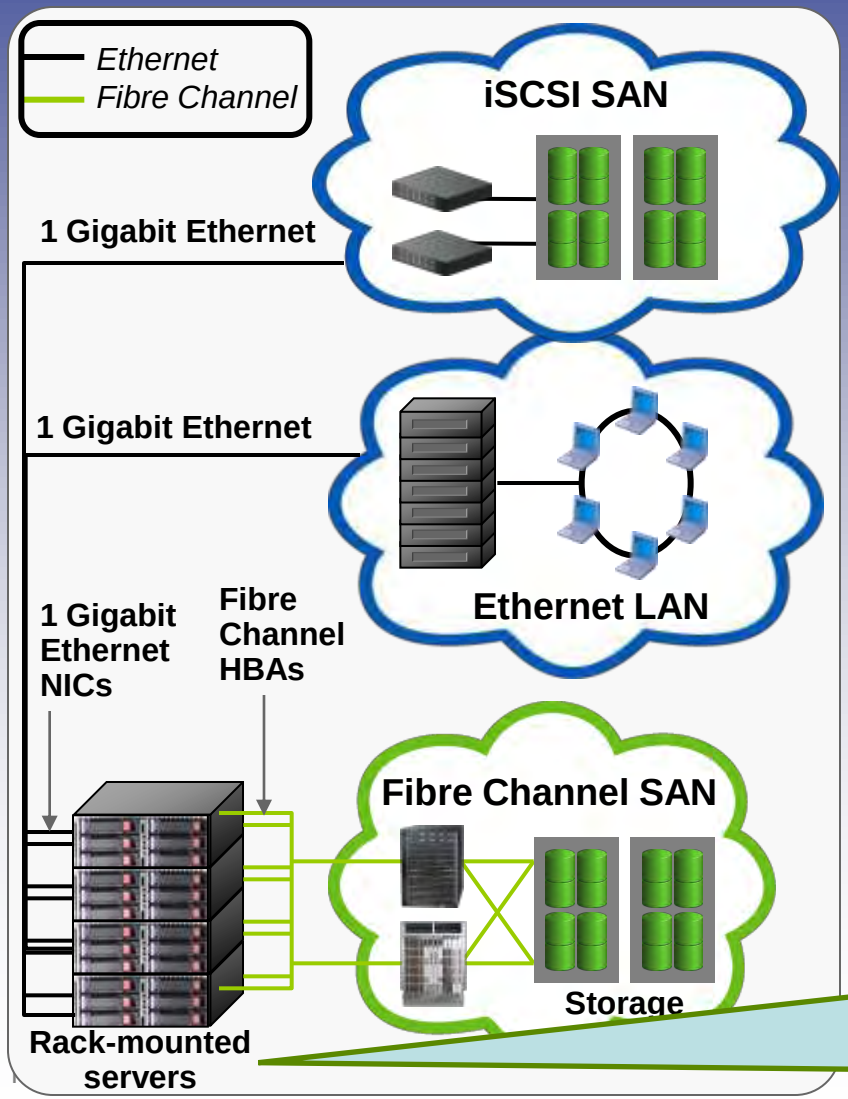
Rack Server Environment Today



- Servers connect to LAN, NAS and iSCSI SAN with NICs
- Servers connect to FC SAN with HBAs
- Many environments today are still 1 Gigabit Ethernet
- Multiple server adapters, multiple cables, power and cooling costs
  - Storage is a separate network (including iSCSI)

Note: NAS will continue to be part
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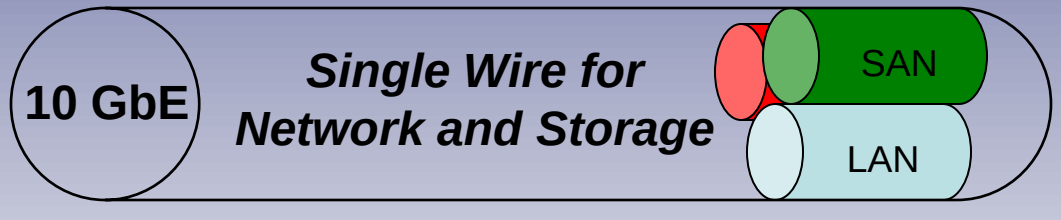
Today only 20% of servers in the data center have access to networked storage

10Gb Ethernet allows for Converged Data Center

- Maturation of **10 Gigabit Ethernet**
  - 10 Gigabit Ethernet allows replacement of n x 1Gb with a much smaller number (start with 2) of 10Gb Adapters
  - Many storage applications require > 1Gb bandwidth



- 10 Gigabit Ethernet simplifies server, network and storage infrastructure
  - Reduces the number of cables and server adapters
  - Lowers capital expenditures and administrative costs
  - Reduces server power and cooling costs
  - Blade servers & server virtualization drive consolidated bw

10 Gigabit Ethernet is the answer!
iSCSI ***and*** FCoE both leverage this inflection point

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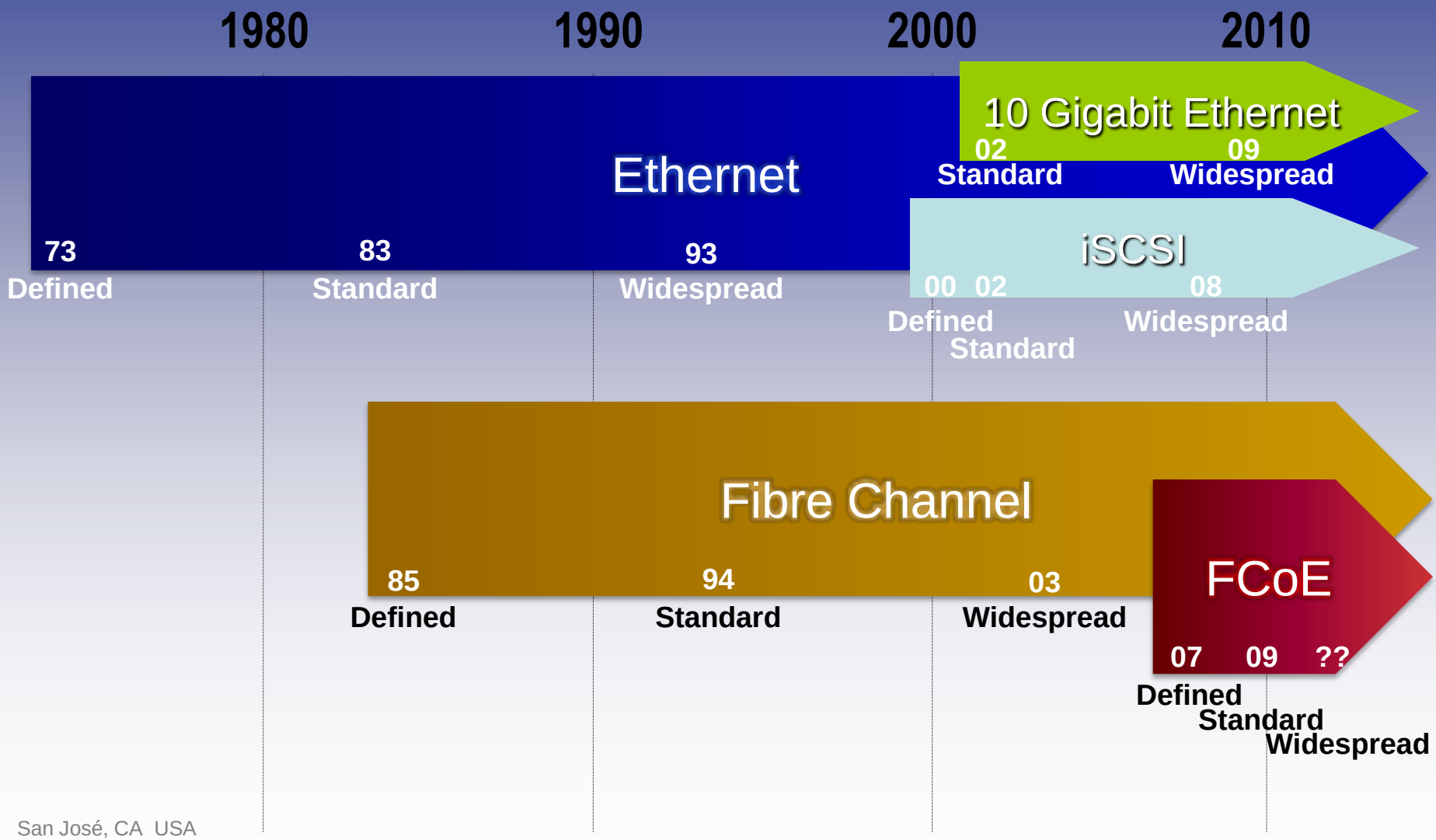
Time To Widespread Adoption



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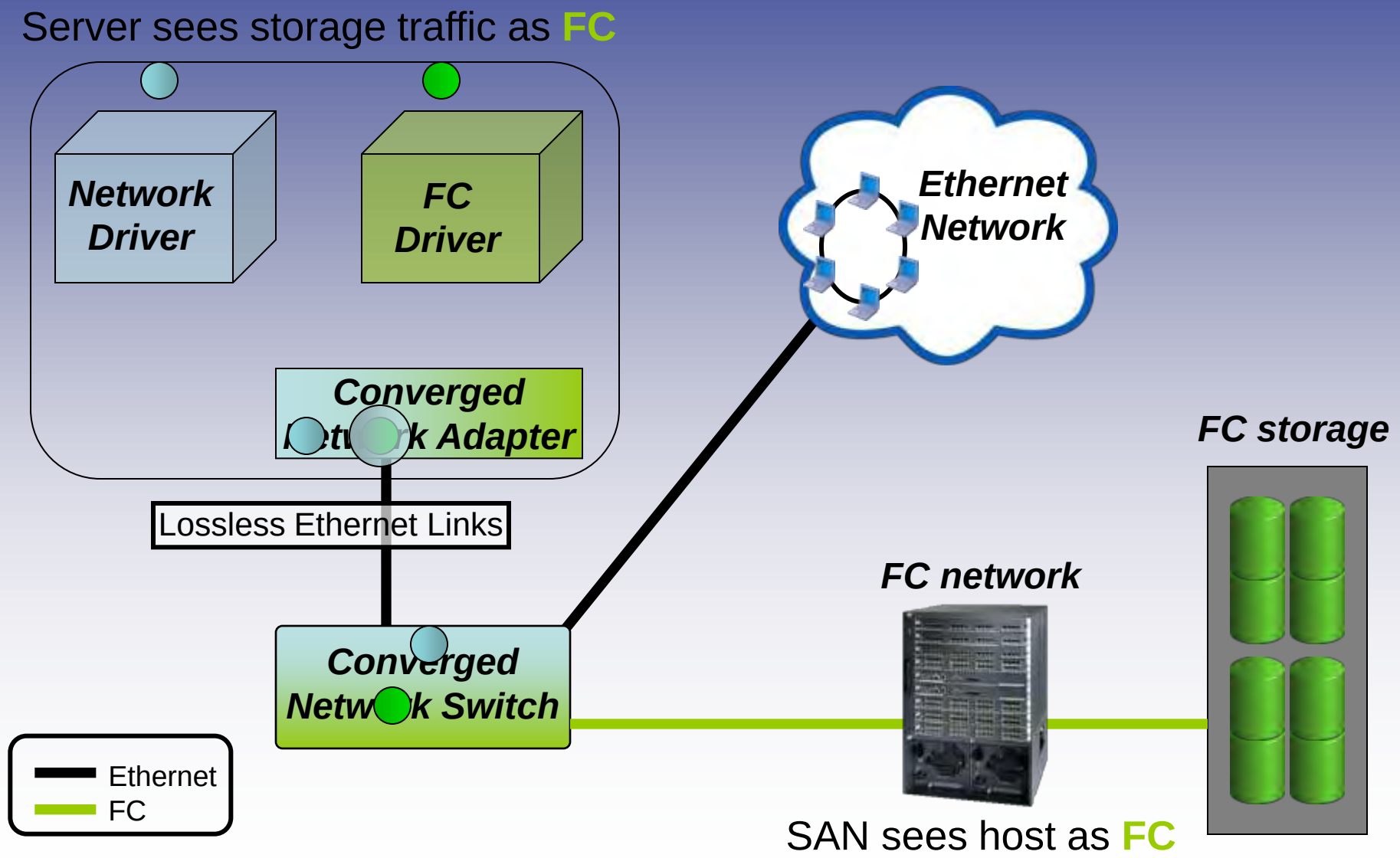
Why a New Option for FC Customers?

- FC has a large and well managed install base
  - Want a solution that is attractive for customers with FC expertise / investment
  - Previous convergence options did not allow for incremental adoption
- Requirement for a Data Center solution that can provide I/O consolidation
  - 10 Gigabit Ethernet makes this option available
- Leveraging Ethernet infrastructure and skill set has always been attractive

FCoE allows an Ethernet-based SAN to be introduced
into the FC-based Data Center
without breaking existing administrative tools and workflows

FCoE Extends FC on a Single Network



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Standards for Next-Gen Data Center

Two emerging parallel industry standards seek to drive I/O consolidation in large data centers over time:

Fibre Channel over Ethernet (FCoE) protocol

- Developed by International Committee for Information Technology Standards (INCITS) **T11** Fibre Channel Interfaces Technical Committee
- Fibre Channel over Ethernet allows native Fibre Channel to travel unaltered over Ethernet
- FC-BB-5 standard **ratified** in June 2009
- FC-BB-6 in process to expand solution

Converged Enhanced Ethernet (CEE)

- Developed by Ethernet **IEEE** Data Center Bridging Task Group
- Converged Enhanced Ethernet creates an Ethernet environment that drops frames as rarely as Fibre Channel
- Technology commonly referred to as **Lossless Ethernet**
- IEEE standards targeting ratification in 2009/2010
- Requirement for FCoE; Enhancement for iSCSI

Companies working on the standard committees
Key participants: Brocade, Cisco, EMC, Emulex, HP, IBM, Intel, QLogic, Sun, others

FCoE Support Timeline

Fibre Channel over Ethernet Development Timeline

2008

Fibre Channel over Ethernet pre-standard switches & CNAs

T11 & IEEE standards defined

2009

T11 standard ratification (FC-BB-5)

FCoE standard switches & CNAs

FCoE embedded in servers

2010+

IEEE standard ratification

FCoE embedded in blades, servers & storage

T11 FC-BB-6

vmware®

Microsoft Windows

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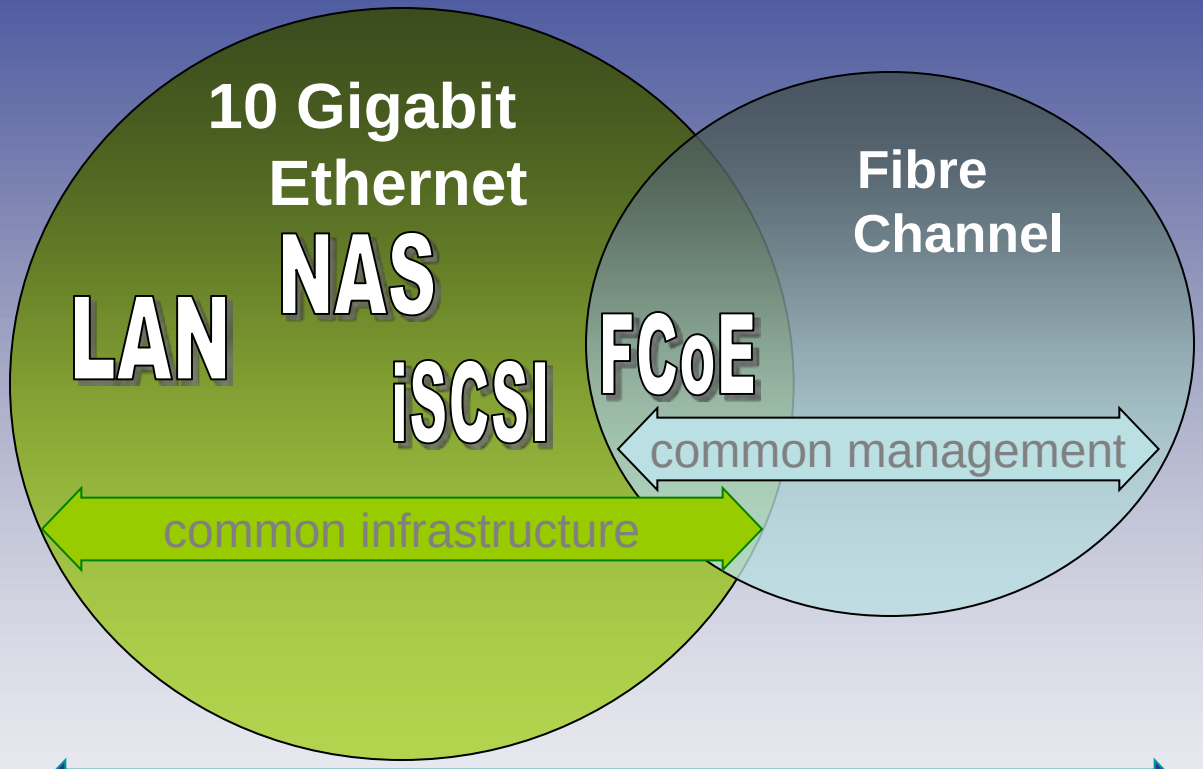
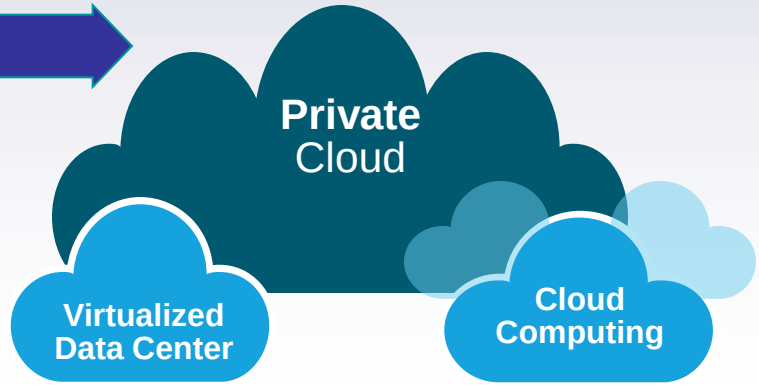
Next Generation Data Center



- EMC is working with the standards communities and partners to deliver the same reliability and robustness in the next generation virtual data center that we deliver today

virtualization

The Converged Data Center sets the operational and capital efficiency foundations for the virtual data center and private clouds



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Bio & Company Information

Stuart Miniman is a Technologist in EMC Corporation's CTO Office focused on networking and virtualization technologies. In 10 years with EMC, he has helped develop solutions with storage networking technologies including Fibre Channel over Ethernet (FCoE), Fibre Channel, iSCSI and Distance Solutions (IP, SONET, WDM). Stuart is also an active participant in EMC's innovation and social media communities. He holds a BS Degree in Mechanical Engineering from Cornell University and an MBA from Bryant University.

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