Storage Overview

Broadcom and Bernstein Storage Teach-In

July 21, 2021

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Safe Harbor Statement

This presentation contains forward-looking statements, including statements as to our priorities and goals, business strategy, performance and market opportunities, industry trends, and products and technology development, that are based on our current expectations and beliefs of the management of Broadcom, as well as assumptions made by, and information currently available to, such management, current market trends and market conditions, and involve risks and uncertainties, many of which are outside the Company's and management's control, and which may cause actual results to differ materially from those statements. Many of these risks and uncertainties are, and will be, exacerbated by the COVID-19 pandemic and any worsening of the global business environment as a result.

Our filings with the SEC, which you may obtain for free at the SEC's website at https://www.sec.gov, discuss some of the important risk factors that may affect our business, results of operations and financial condition. Actual results may vary from the estimates provided. We undertake no intent or obligation to publicly update or revise any of the estimates and other forward-looking statements made in this presentation, whether as a result of new information, future events or otherwise, except as required by law.

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Broadcom Speakers

Hock E. Tan
President and CEO

Jas Tremblay
VP and GM,
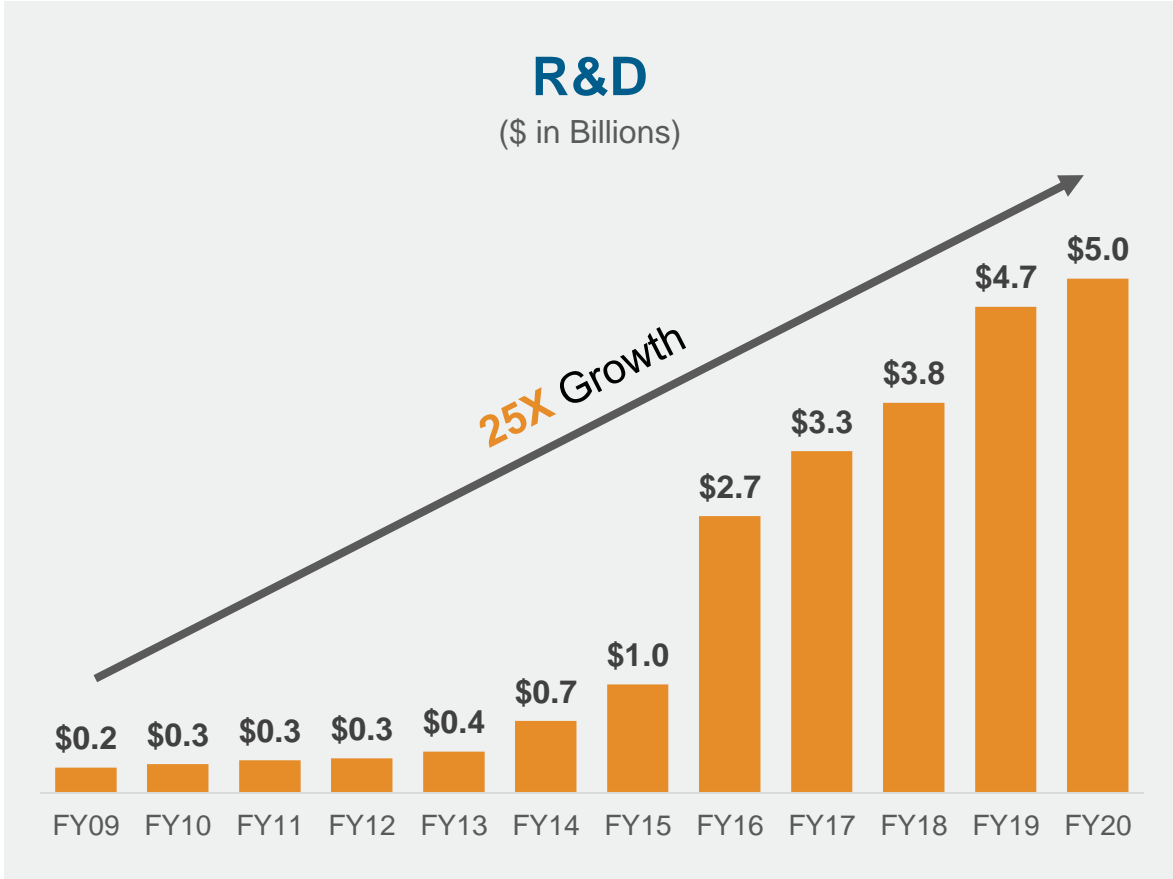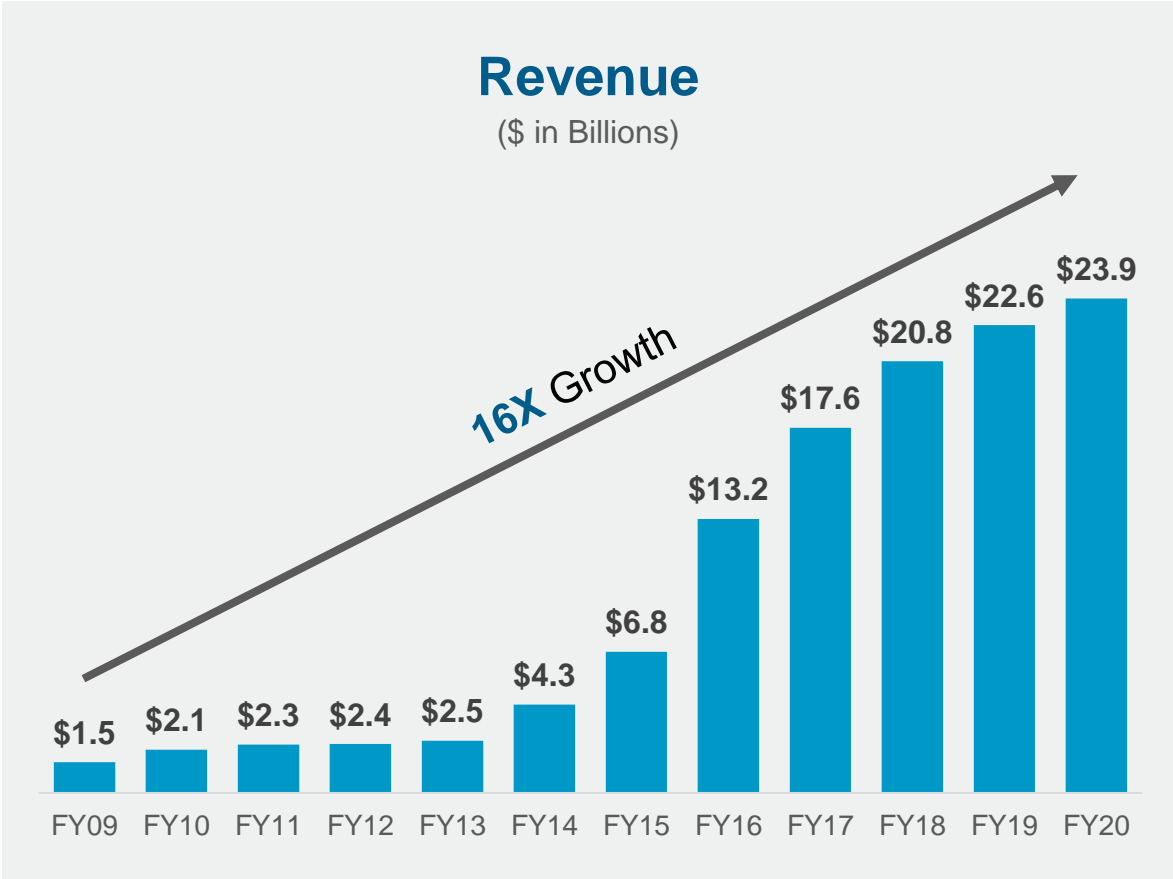Data Center Solutions

Jack Rondoni
SVP and GM,
Brocade Storage Networking

Dan Dolan
Sr. Director of Marketing,
HDD Storage

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How Broadcom Became a Global Technology Leader

Category-Leading Franchises: 8 in 2009 → 23 Today

Revenue
($ in Billions)

16X Growth

FY09	FY10	FY11	FY12	FY13	FY14	FY15	FY16	FY17	FY18	FY19	FY20
$1.5	$2.1	$2.3	$2.4	$2.5	$4.3	$6.8	$13.2	$17.6	$20.8	$22.6	$23.9

R&D
($ in Billions)

25X Growth

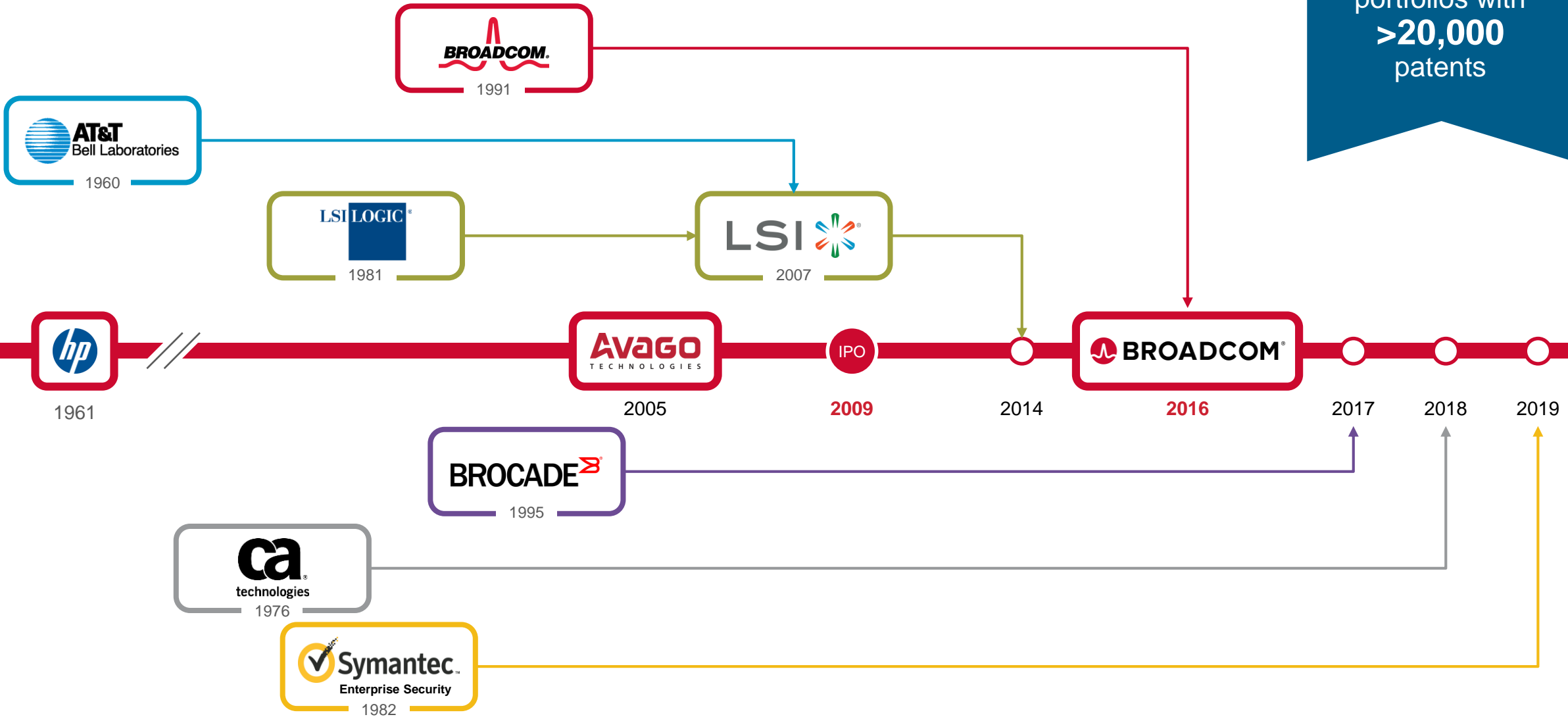| FY09	FY10	FY11	FY12	FY13	FY14	FY15	FY16	FY17	FY18	FY19	FY20
$0.2	$0.3	$0.3	$0.3	$0.4	$0.7	$1.0	$2.7	$3.3	$3.8	$4.7	$5.0

84X Growth in Operating Profit from 2009 → 2020

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Heritage of Innovation

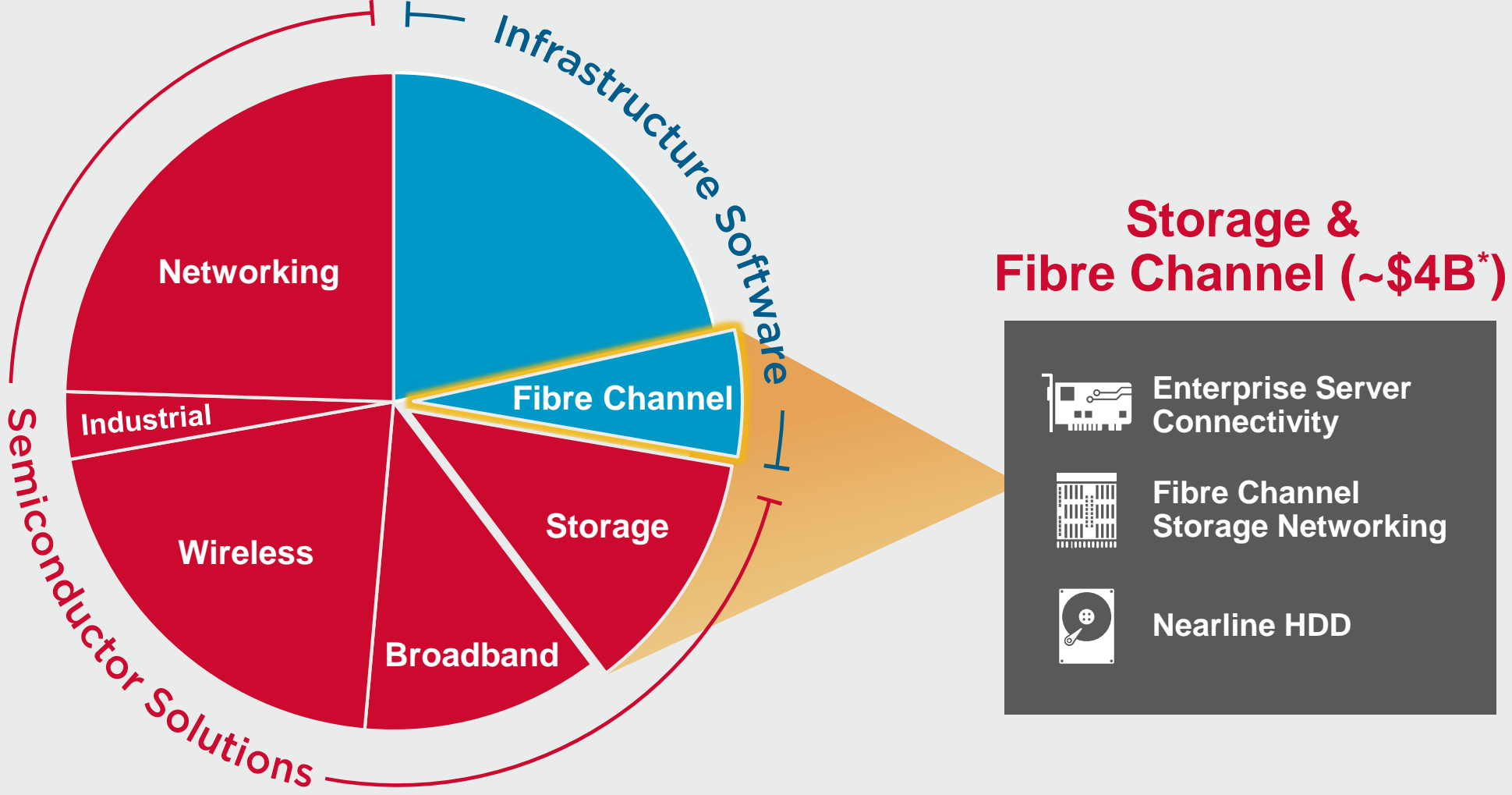One of the industry's broadest IP portfolios with **>20,000** patents

Semiconductors

Infrastructure Software

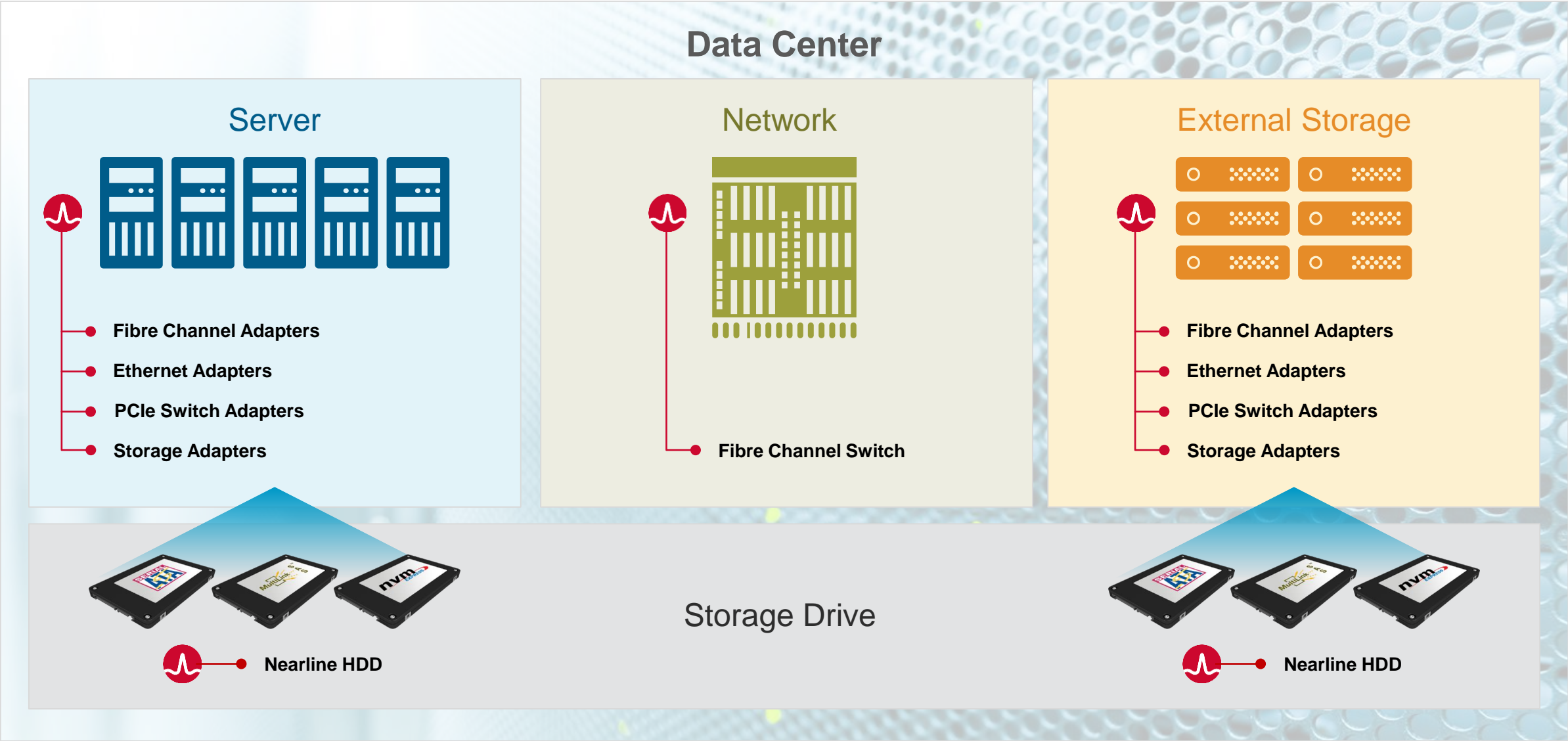BROADCOM 1991

AT&T Bell Laboratories 1960

LSI LOGIC 1981

LSI 2007

hp 1961

Avago TECHNOLOGIES 2005

IPO **2009**

2014

BROADCOM **2016**

2017

2018

2019

BROCADE 1995

ca technologies 1976

Symantec Enterprise Security 1982

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Category-Leading Franchises in Diverse End Markets

Storage &
Fibre Channel (~$4B*)

- Enterprise Server Connectivity
- Fibre Channel Storage Networking
- Nearline HDD

Pie chart segments: Networking, Industrial, Wireless, Broadband, Storage, Fibre Channel. Outer labels: Infrastructure Software, Semiconductor Solutions.

* In FY20

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Connecting the Enterprise Storage Ecosystem

Data Center

Server
- Fibre Channel Adapters
- Ethernet Adapters
- PCIe Switch Adapters
- Storage Adapters

Network
- Fibre Channel Switch

External Storage
- Fibre Channel Adapters
- Ethernet Adapters
- PCIe Switch Adapters
- Storage Adapters

Storage Drive
- Nearline HDD
- Nearline HDD

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Enterprise Server Connectivity

Jas Tremblay

Vice President and General Manager,
Data Center Solutions

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Enterprise Data Protection Approaches

Mission Critical

Server

Fibre Channel Switch

External Storage

Enterprise HDD

Enterprise Grade

Server

Enterprise HDD

Cloud

Server

Server

Server

Nearline HDD

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Broadcom Server Storage: Most Trusted Data Protection Solution

Server

Enterprise Grade Storage

1. Drive protocol conversion
2. Drive failure protection
3. Server power failure protection

Broadcom Data Protection Usage

- Sector: Financials, health care, manufacturing, etc.
- Application: Databases, ERP, CRM, etc.
- 10 of top 10 server OEMs use Broadcom data protection

Used in **70%** of Enterprise Servers

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Broadcom Server Storage: Leadership for 30+ Years

	700	320	9300	9400	9500	9600	9700
Industry First	First Controller	Simplified Driver Firmware	PCIe Gen 3	Tri-Mode Controller	PCIe Gen 4	Hardware Accelerated Control	
Transaction per Seconds	Hundreds	Thousands	50,000	150,000	250,000	1 Million	Millions…
Protocol	PATA	SATA	SAS	SAS	SAS	NVMe	NVMe
	1990's	2000's	2010	2016	2019	2021	Next Generation
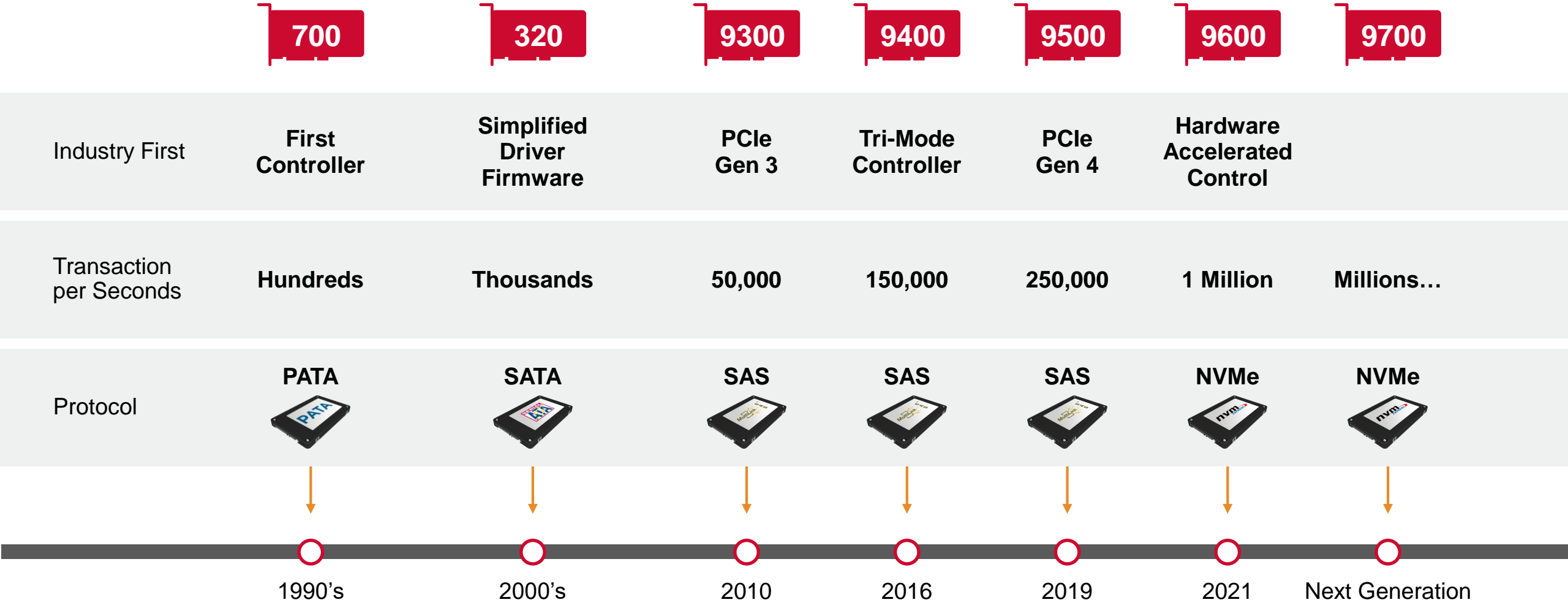
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Broadcom Storage Adapter Leadership

Most Trusted Data Protection Software

Highest Performance Silicon

Strongest Ecosystem Support

CentOS Citrix Hypervisor debian freeBSD ORACLE Linux SEAGATE Western Digital KIOXIA

Red Hat SUSE ubuntu vmware vSphere ESXi Windows intel Micron SanDisk SAMSUNG

Operating System

Drives

Best-in-Class Technology + Ecosystem Support

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Server Storage Delivers Across Global Market Routes

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Server OEM

DELL · Hewlett Packard Enterprise · Lenovo · CISCO · IBM · SUPERMICRO · HITACHI Inspire the Next · FUJITSU · inspur · H3C · ORACLE

Channel

System Builder | Distributors | Integrators

Server ODM

Quanta Computer · wiwynn · Celestica · SANMINA · zt Systems · Inventec · FOXCONN · MiTAC

Enterprise | **Telecommunications** | **Cloud**
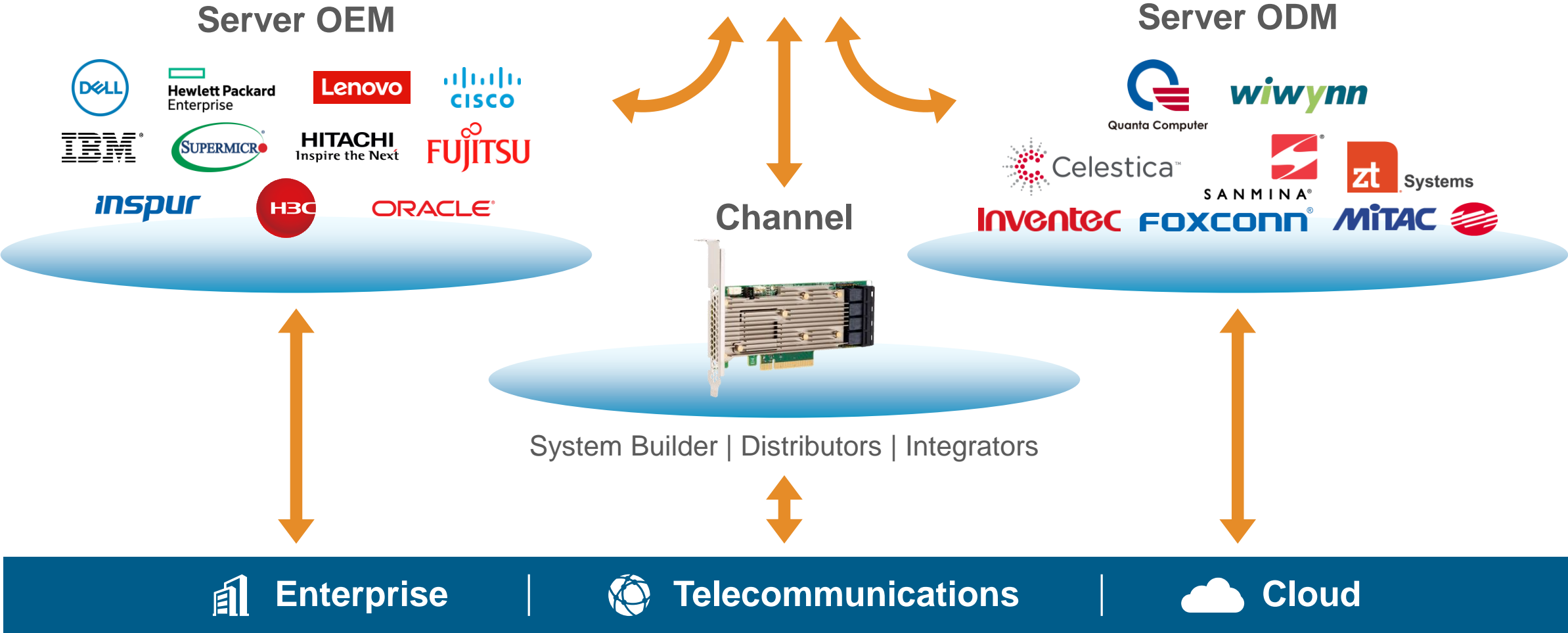
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Largest Enterprise Server Connectivity Portfolio

Storage — LSI

Ethernet — BROADCOM

PCIe — PLX TECHNOLOGY

Fibre Channel — EMULEX

Server

BROADCOM

Leader in Server Connectivity

	BROADCOM®	intel®	Mellanox TECHNOLOGIES	Microsemi.	QLOGIC™
Storage	⭐			⭐	
Ethernet	⭐	⭐	⭐		
PCIe	⭐			⭐	
Fibre Channel	⭐				⭐

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Broadcom: Leader in Large and Growing Market

Largest Portfolio

Storage

Ethernet

PCIe

Fibre Channel

Storage Leadership

Critical Data Protection for **70%** of Enterprise servers

30 Years of Sustained Innovation

Over **100 Million** Units shipped

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Storage Networking Overview

Jack Rondoni

Senior Vice President and General Manager,
Brocade Storage Networking

The Network Matters for Mission Critical Applications

General-purpose Ethernet networks aren't good enough

- Mission critical applications require servers, storage, and networks that deliver
  - ✔ Reliability and resiliency
  - Low latency
  - Security

- On-premises infrastructure is required to meet service level agreements

- Brocade and Emulex brands are the trusted names in Fibre Channel SAN

⚠ "Microsoft cloud outage takes Azure, Teams and Office 365 offline"

⚠ "Prolonged AWS outage takes down a big chunk of the internet"

Sources: https://siliconangle.com/2021/04/01/no-foolin-microsoft-cloud-outage-takes-azure-teams-office-365-offline/
https://www.theverge.com/2020/11/25/21719396/amazon-web-services-aws-outage-down-internet

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What is a Storage Area Network (SAN)?

A purpose-built network for mission critical servers and storage

Servers   Network   Storage
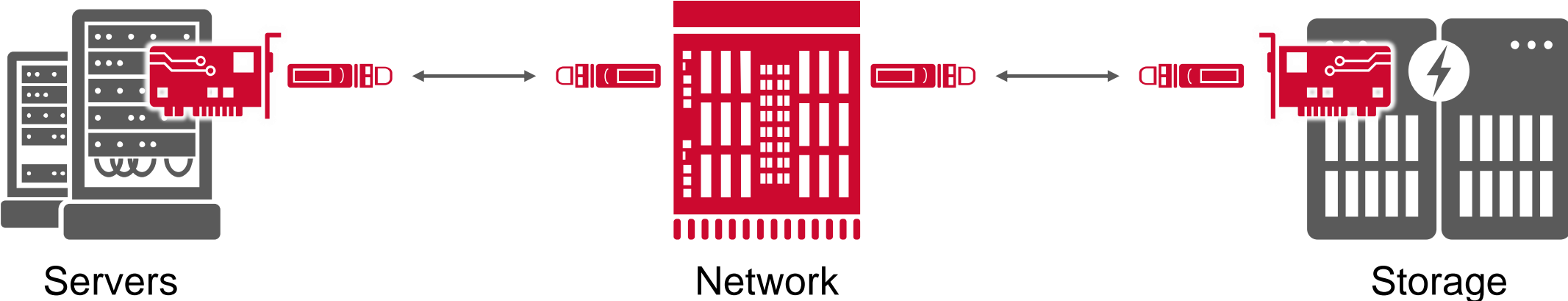
Fibre Channel Protocol Differentiation

Lossless Network

2X Speed Doubling Every Generation

Integrated Security

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Fibre Channel Revenue (TAM) Trends
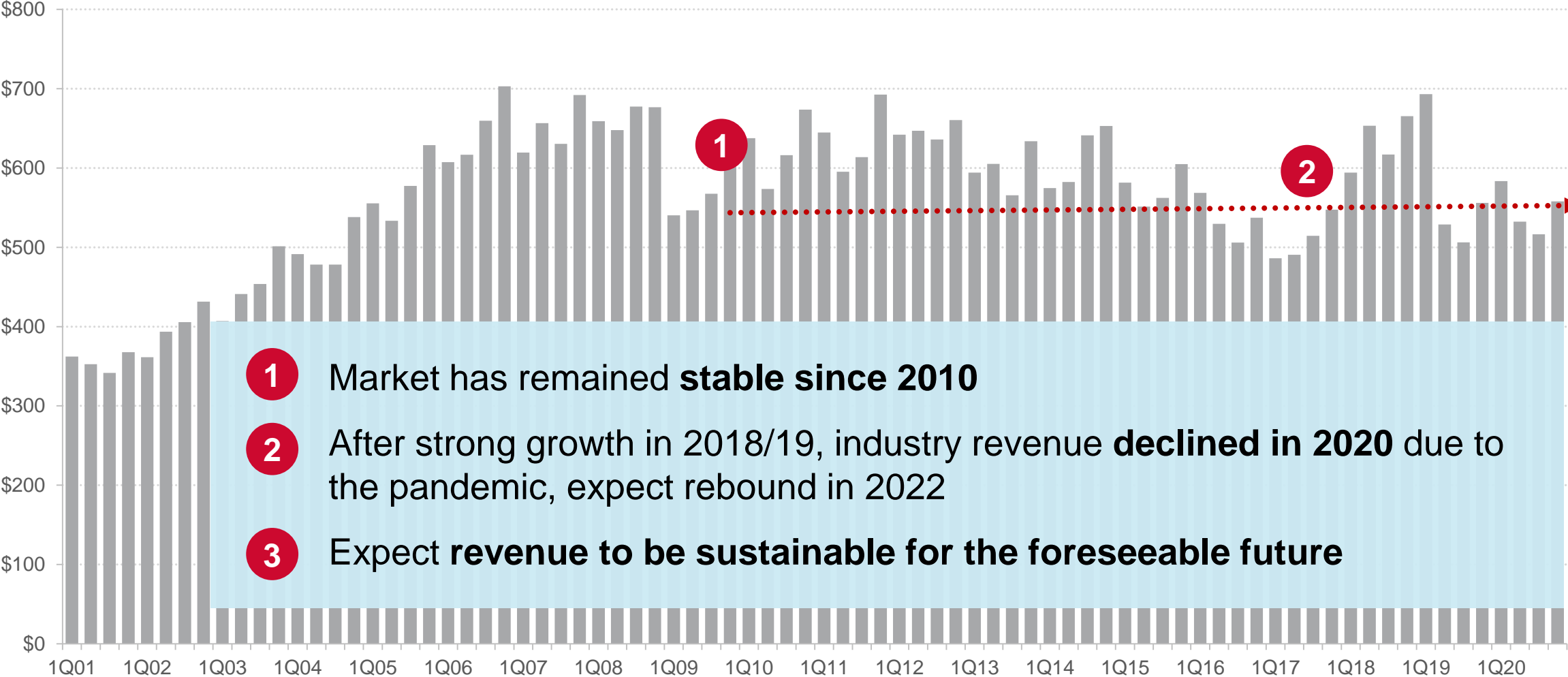
1. Market has remained **stable since 2010**

2. After strong growth in 2018/19, industry revenue **declined in 2020** due to the pandemic, expect rebound in 2022

3. Expect **revenue to be sustainable for the foreseeable future**

Sources: Dell'Oro SAN Quarterly Report 1Q20
Quillin Research 4Q20 SAN Quarterly Market Report

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Fibre Channel Revenue History by Product Generation
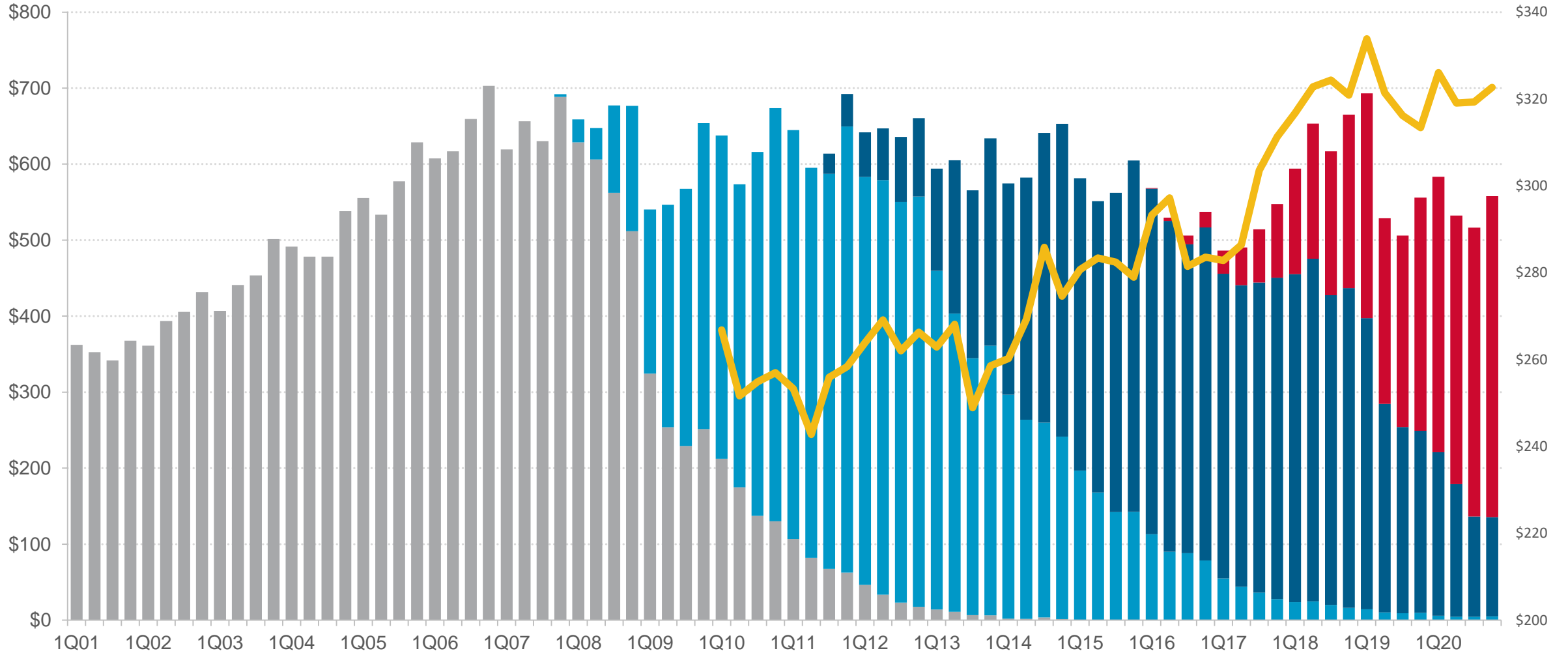
Legend: 1/2/4G · 8G · 16G · 32G · ASP per Port

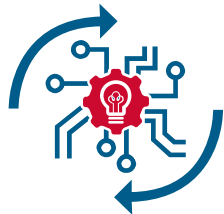BROADCOM®

Tech Refresh Sustains Revenue

Tech refresh is required to keep up with increasing application demands

– SAN product generations have a ~5 year lifecycle

– New products enable price premiums reflecting faster speed and new capabilities that simplify operations

Fibre Channel install base

– 43M switch and adapter ports

Refresh dynamics

– ~90% refresh of existing footprint

– ~10% greenfield opportunities
(5% new Fibre Channel installs, 5% alternative technologies)

– Introduction of Gen 7 64G in 2021 further enables
a refresh cycle for 2022 and beyond

GEN7
FIBRE CHANNEL

Sources: Dell'Oro SAN Quarterly Report 1Q20
Quillin Research 4Q20 SAN Quarterly Market Report

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Broadcom is the SAN Industry and Market Leader

AUTONOMOUS SAN

25+
Continuous years of innovation

Brocade
GEN7
FIBRE CHANNEL

~70%
Switch market share leader for 10+ years

Emulex®
GEN7
FIBRE CHANNEL

~60%
HBA market share

Sources: Dell'Oro SAN Quarterly Report 1Q20
Quillin Research 4Q20 SAN Quarterly Market Report

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Broadcom's Differentiated Portfolio

Market, industry, and technology leader

- Industry's first end-to-end 64G portfolio
  - Brocade switches and directors
  - Emulex server and storage adapters

- End-to-end autonomous SAN technology
  - Self-learning, self-optimizing, and self-healing

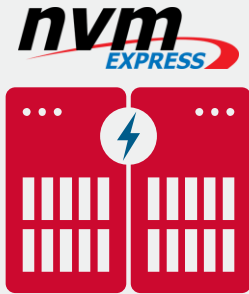- Proactive and automated support with Fibre Channel experts

GEN7
FIBRE CHANNEL

BROCADE X7-8

AUTONOMOUS SAN

Gb/s

Brocade Global Support

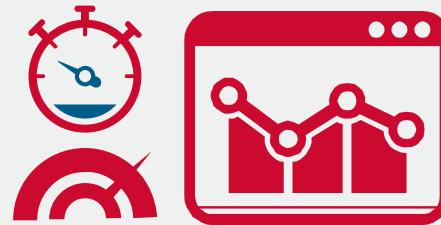BROADCOM®

Broadcom Fibre Channel Roadmap

Aligned with future enterprise storage requirements

Storage Modernization

Align portfolio with AFA/NVMe storage trends to enable the on-demand data center

Analytics

Transform SAN health and performance data into actionable insights

Automation

Empower IT with simple and open automation to increase productivity

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Nearline HDD

Dan Dolan

Senior Director of Marketing,
HDD Storage

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Changing Profile of HDD Data Storage

Data Shipped (Stored)

SSD Enterprise

HDD Nearline

HDD Client

2016   2017   2018   2019   2020   2021   2022   2023   2024   2025
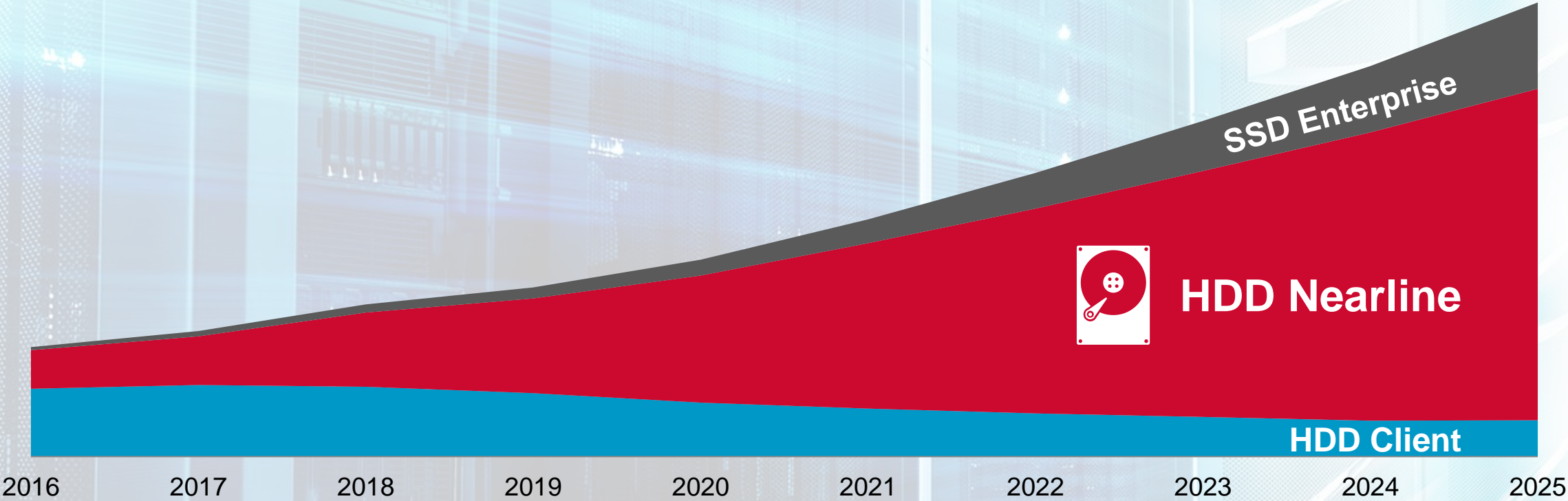
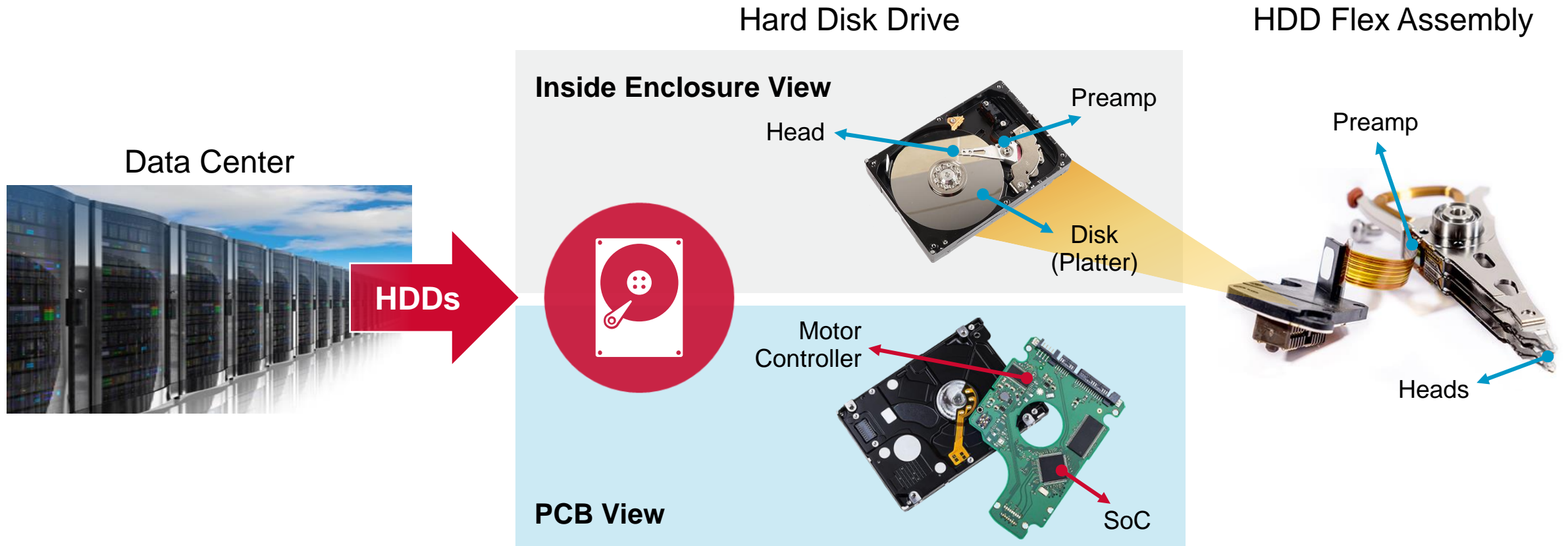**~80% of Data Shipped in the HDD NL & SSD EP Space in 2025 is Expected to Reside on HDDs**

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Broadcom Electronics Are a Key Part of HDDs in Data Centers

Preamplifiers and SoCs

Data Center

HDDs

Hard Disk Drive

Inside Enclosure View

Head

Preamp

Disk (Platter)

Motor Controller

PCB View

SoC

HDD Flex Assembly

Preamp

Heads

Enabling ~$10 Billion Per Year in the Growing Nearline Hard Disk Drive Market

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Broadcom Products Play a Critical Role in the HDD

HDD Heads and Media (Disks) → Read Data / Write Data → **Preamplifier** → Read Data / Write Data → **SoC** → Interface → Host

Preamplifier

Complex, analog mixed signal, custom product

- Semiconductor process optimized for HDD preamp applications
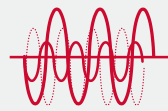
Small Signal, Large Signal, High Speed, Laser Driver

System On Chip (SoC)

Intelligence of HDD

- Read channel, processors, high speed interfaces and customer designed controller IP

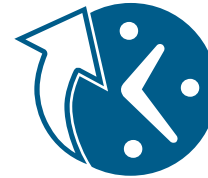**Read Channel Signal Processing Provides Capacity Gain**

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Why We Win…

Process Technology Leadership

Leading IP & Performance

Time to Market

Proven Quality

Preamp

VTC Inc.
Value The Customer™

SoC

Lucent Technologies
Bell Labs Innovations

agere systems

LSI

AVAGO
TECHNOLOGIES

- Decades of Experience
- Broad System Expertise
- Leading Custom Products

BROADCOM®

Preamp

SoC

Customers

SEAGATE

TOSHIBA

Western Digital

Winning Strategy for More than 20 Years

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HDD Innovation: Driving Increases in Capacity & IC Content

Innovations Continue to Drive Increased Capacity

HAMR

MAMR

Next Gen CMR

20TB+

18TB

16TB

14TB

12TB

10TB

Nearline HDD Capacity

2016   Today

Enabling Innovation Adds IC Content

2010   Today

Preamp & SoC Content Increasing

2ch Non-EP

20ch + Advanced Features

Content Increase Driving Growth Above HDD Unit TAM

Content

TAM
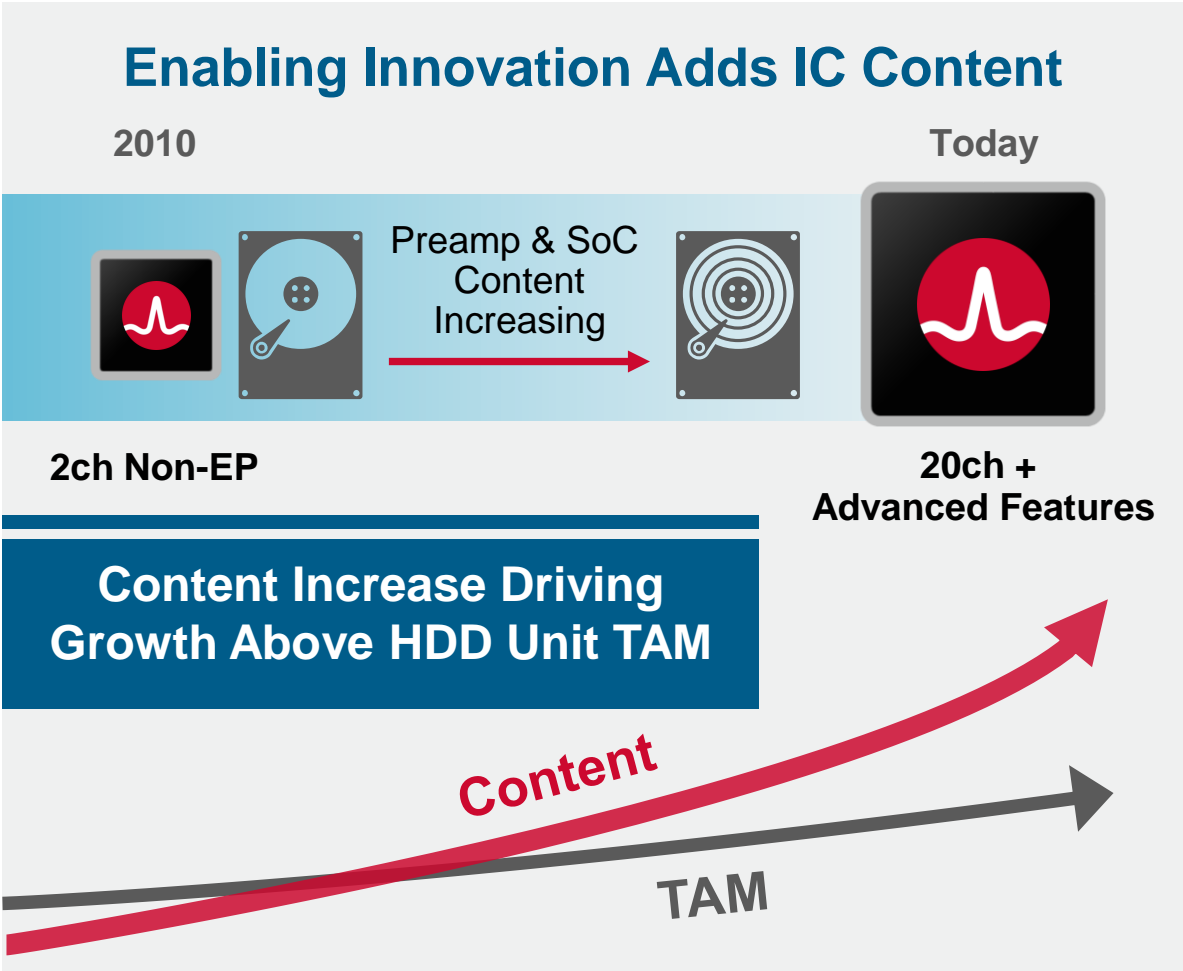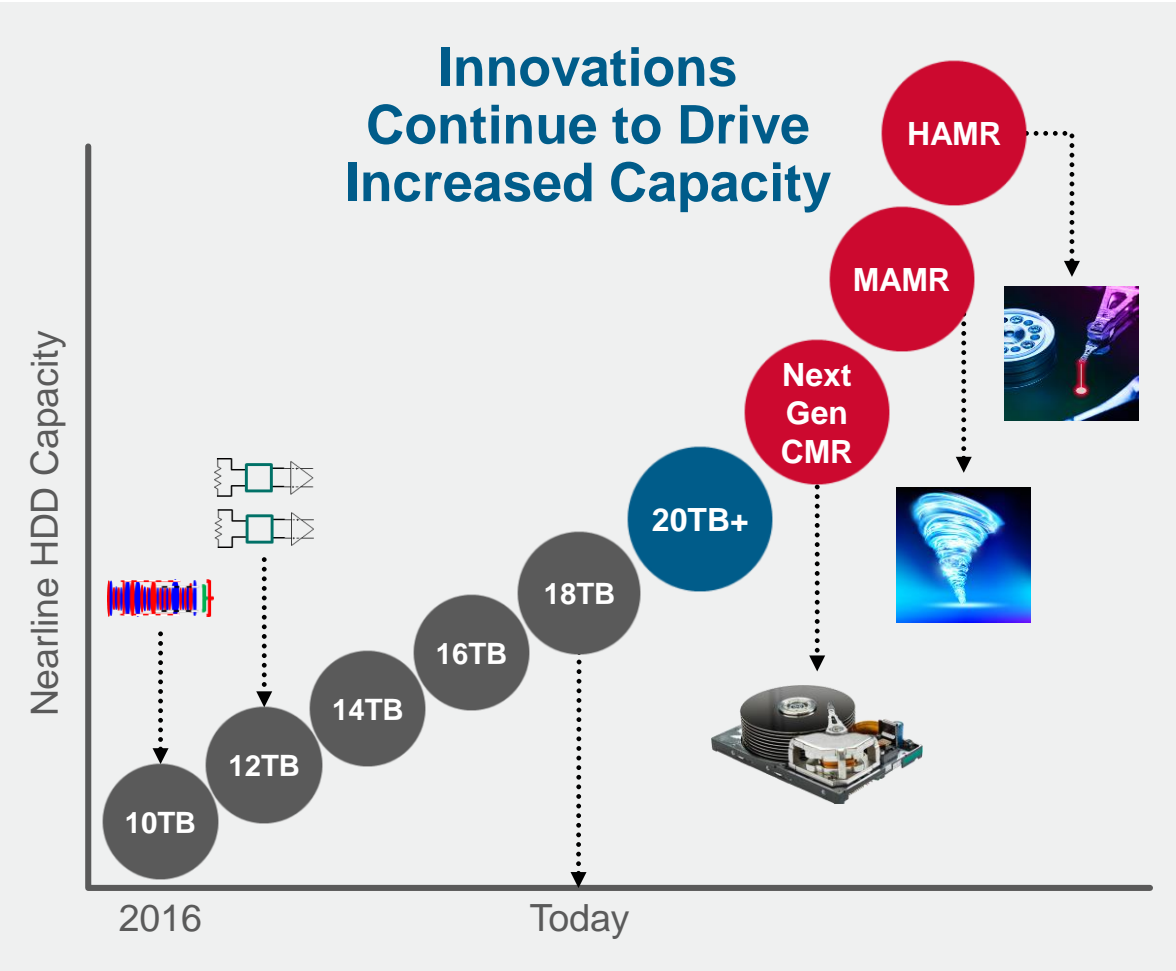
HDD Roadmap Requires Additional IP that Will Grow Broadcom Content for Many Years

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Large and Growing Nearline Market

Broadcom HDD Nearline Storage

~20% Nearline Revenue Growth and Over **2 Billion** Sold

HDD Nearline

HDD Client

Data Shipped

2016 2017 2018 2019 2020 2021 2022 2023 2024 2025
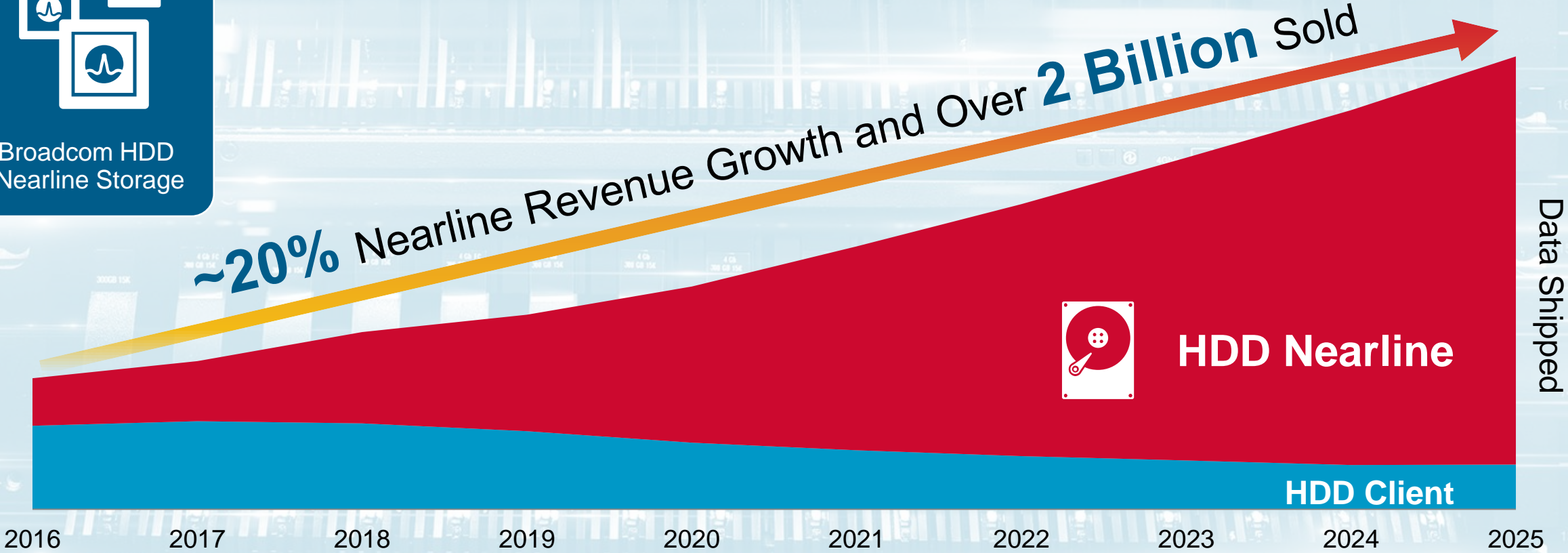
Broadcom Leadership Supported by ~20% Nearline Revenue Growth

Note: Revenue CAGR from 2016-2020; units sold since 2010

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Q&A

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