Решения для высокопроизводительных вычислений от Dell EMC

Павел Борох

Менеджер по маркетингу корпоративных решений

Кто такие
Dell EMC ?

Время трансформации пришло…

DELL EMC

DELL

Глобальная ИТ компания, наиболее сфокусированная на доступности ИТ-инфраструктуры для организаций любых размеров
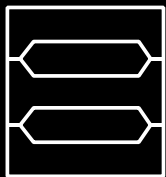
DELL EMC

Крупнейшая в мире частная технологическая компания с корпоративными продажами и поддержкой мирового уровня

EMC²

Мировой лидер инноваций для ЦОД с передовыми корпоративными инфраструктурами для самых требовательных приложений

#1
CONVERGED

Конвергентные
инфраструктуры

#1
СХД

#1 iв
традиционном,
#1 в
all-flash

#1
ЦОД

Виртуализованная
инфраструктура
ЦОД

#1
КЛИЕНТЫ

Самые легко
администрируе-
мые **и безопас-
ные** ноутбуки и
планшеты

#1
ОБЛАКО

Облачные
ИТ
инфраструктуры

#1
ВИРТУАЛИЗАЦИЯ

ПО
виртуализации
серверов
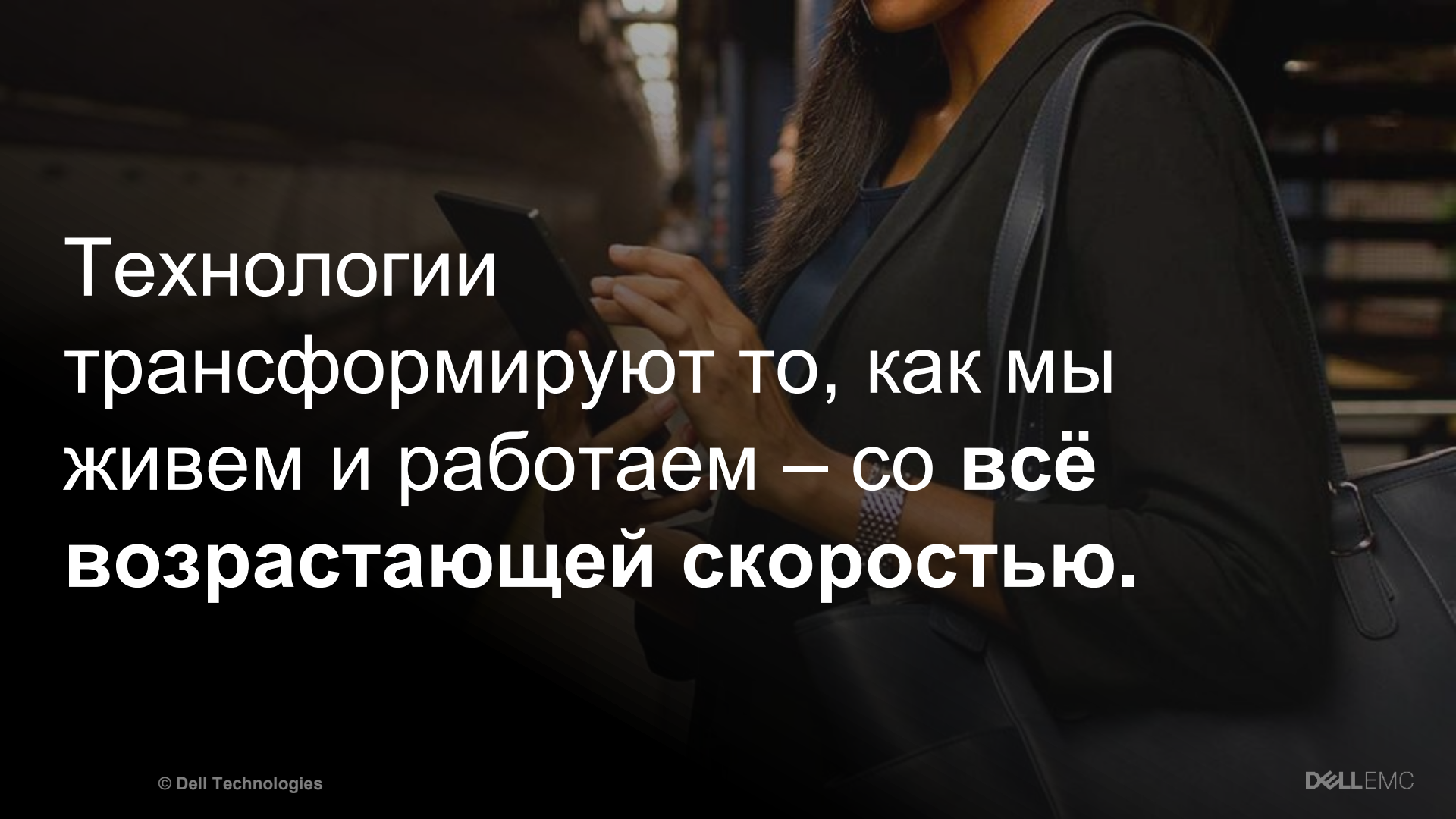
#1
DATA CENTER SECURITY

D✗LLEMC

Признанный лидер рынка в 20 рейтингах Gartner MQ

(«Магические квадранты»)

20
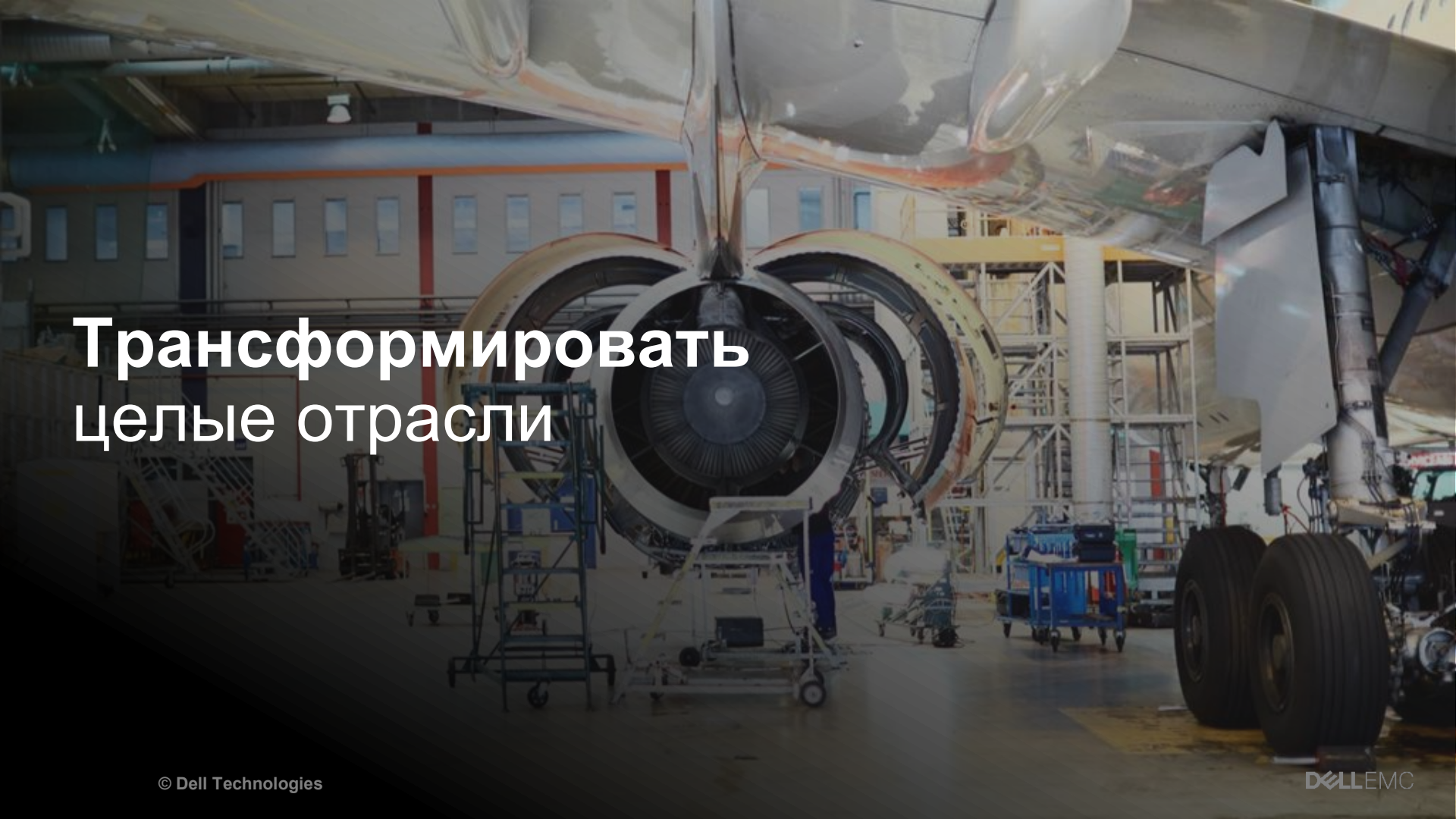
DELLEMC

Технологии трансформируют то, как мы живем и работаем – со **всё возрастающей скоростью.**

DELLEMC
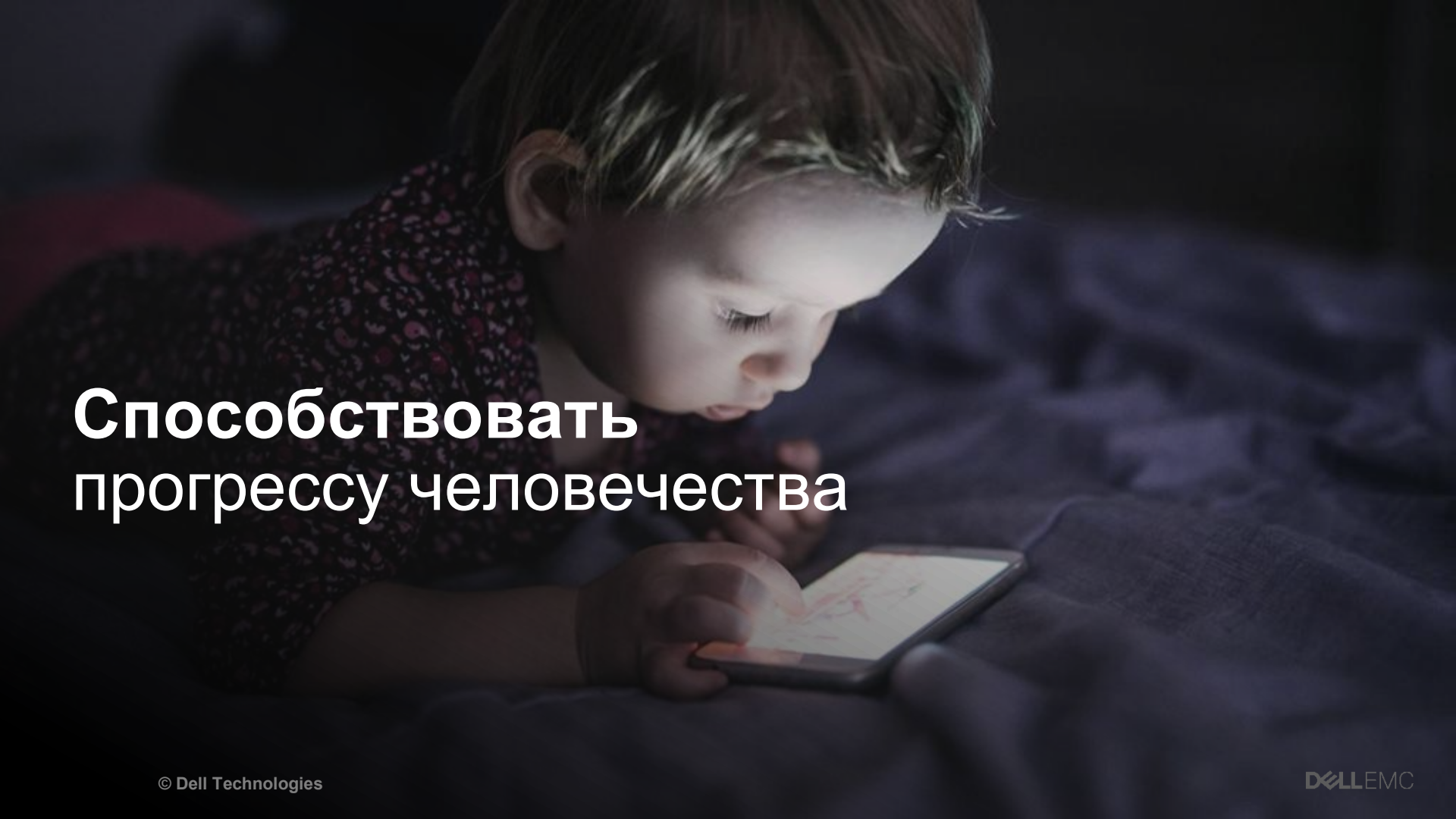
Изменения могут принести
богатые **возможности**

DELLEMC

Трансформировать
целые отрасли

DELLEMC

Улучшить **мир**

DELLEMC

Способствовать
прогрессу человечества

DELLEMC

Десятикратный рост каждые 5 лет

10x

CPU
SSD

DELLEMC

2031

10x x 10x x 10x = 1000x

© Dell Technologies

DELL EMC
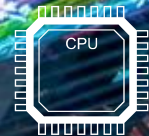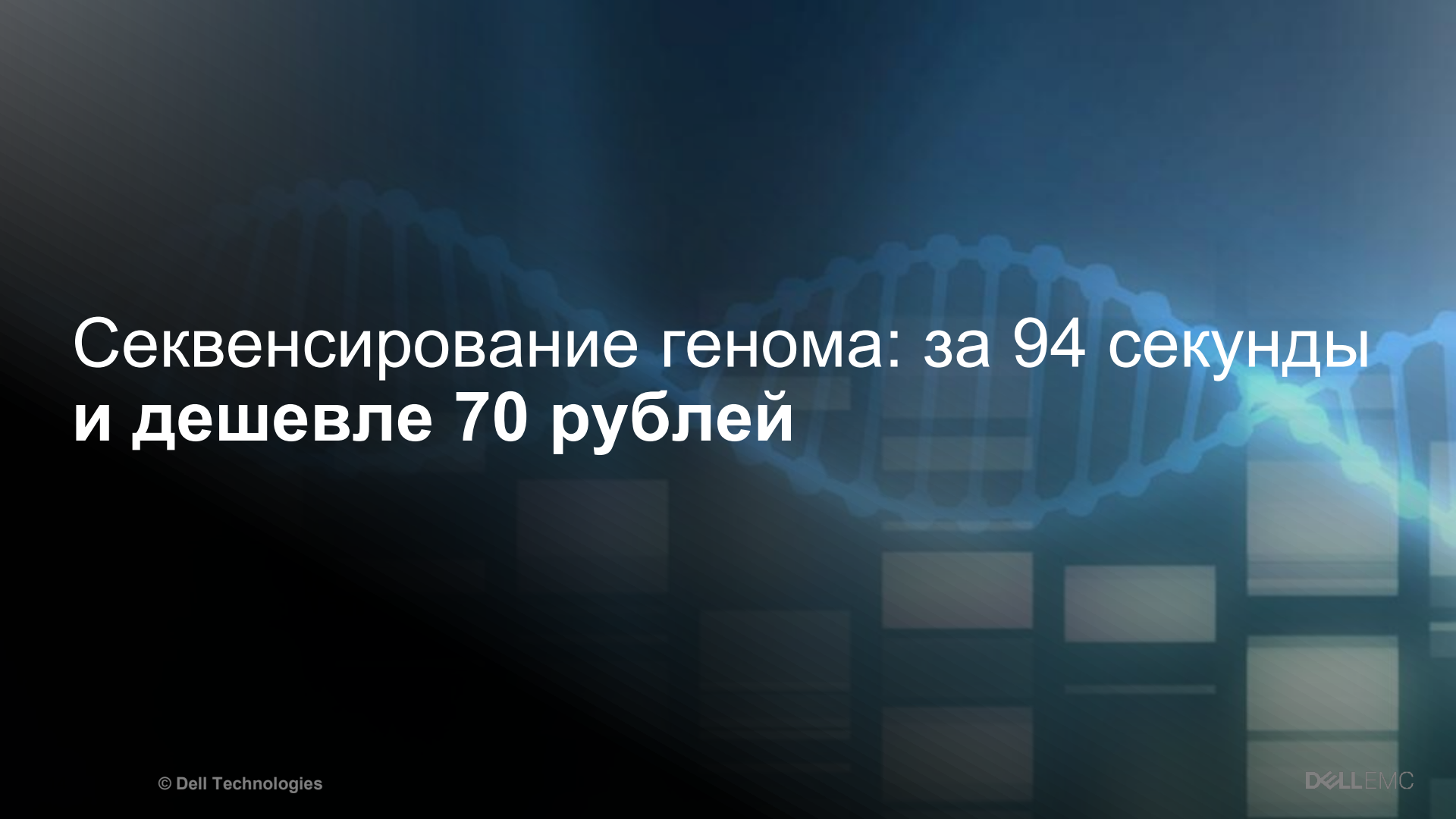
Секвенсирование генома: за 94 секунды и дешевле 70 рублей

DELLEMC

Компьютер, работающий со скоростью **человеческого мозга**

DELLEMC

Цифровая **ТРАНСФОРМАЦИЯ**

DELLEMC

Суперкомпьютерные технологии важны для СЕРЬЕЗНЫХ задач, где требуются масштабируемые решения

Моделирование Симуляторы

Традиционные параллелизованные кластеры

Big Data Аналитика

Fast Answers & Insights for Data Intensive Problems

High Throughput Computing

Large Ensemble Problems Analyzing Multiple Data Sets

Облачные вычисления

Emerging Usage Model to Simplify HPC

DELLEMC

Портфолио решений Dell EMC для HPC

Dell HPC System for **Research**

Dell HPC System for **Life Sciences**
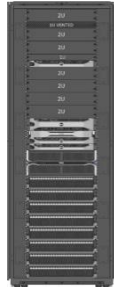
Dell HPC System for **Manufacturing**

NFS Storage Solution with HA

Dell Storage for HPC with Intel EE Lustre

EMC Isilon Storage для HPC

Plus Dell Engineered Solutions for Big Data, Cloud, VDI, …

Built on industry leading Dell and partner products and services

PowerEdge Servers

Dell EMC Storage

Dell Networking

Processors/ Accelerators

Management

DataCenter

Services

	Scalable System Framework				
C series Rack Servers Blade Servers Converged Extreme Scale-out	Intel EE Lustre	H-series / Omni-Path	Intel Xeon & Xeon Phi	OpenHPC	Modular Data Center
	MD Series Extreme Scale-out	High Performance Ethernet Mellanox InfiniBand	NVIDIA and AMD GPUs	Bright Cluster Manager	Deployment Remote Mngt Support Cloud Financial

18

DELLEMC

Технологии HPC - в массы!

- Наши решения на основе Intel оптимизированы для HPC и масштабируемы до гипермасштабов.

C6320
Dense compute
& storage

C4130
Dense accelerated
compute

FX2 w/ FC430 IB
dense CPU

DSS 7000
dense storage

G5
Rack optimized

Оптимизированные для HPC

Подходят для HPC

R430   R630   R730   R730+GPU   R930

HPC-оптимизированные серверы

PowerEdge C4130
Суперплотный 1U стоечный сервер

Для HPC, визуализации данных, рендеринга и т.п.

До 4-х GPU или Phi карт в 1U
- Сейсмика для нефтегаза
- Машинное обучение - Deep learning
- Финансовые сервисы
- Университетские исследования

PowerEdge C6320
Уникальная гиперконвергентная серверная система

Для самых требовательных HPC-нагрузок, а также для облака

4 двухпроцессорных серверных узла в 2U
- Универсальная высокоплотная система для HPC
- 288 ядер
- OmniPath или InfiniBand
- 3+ TFLOPS

PowerEdge C6320p на основе Intel Xeon Phi KNL

1U серверный узел, оптимизированный для параллельных вычислений.

процессор Intel® Xeon Phi™ - до 72 ядер,
384 ГБ памяти,
Omni-Path или InfiniBand IO
до 12ТБ локального хранилища

Performance	Availability	Expandability, I/O, Storage	Simplified Systems Management
• One (1) Intel® Xeon Phi™ processor with up to 72 out-of-order cores (max.) • Up to 288 cores per chassis • Up to 6 DIMMs DDR4, 384GBs (max.) • Omni-Path or InfiniBand IO	• Hot-plug SATA hard drives * • Hot-plug redundant PSU, HDD, Fans (in chassis) • 4 Independent sleds	• 6 x 2.5" HDD/SSD 6Gbs SATA per sled • Up to 12TB local storage • Mezz and PERC options • 1 GbE BT LOM • 1x16 PCIe Gen 3, 1x4 Mezz • 10 GbE dual port SFP+ (via PCI)	• iDRAC8 with LifeCycle Controller • Intelligent systems mgmt • Extensive power management • Integration into virtual consoles • IPMI 2.0

HPC software stack: опции open source и не только

Provisioning	Bright Cluster Manager		Open Source Tools	
Monitoring	OpenManage	BCM	Open Source	
Management	iDRAC	BCM	IPMI	
Resource Management	SLURM	Torque	Grid Engine	PBS Pro	Moab	LSF
MPI Libraries	OpenMPI	MPICH2	MVAPICH2	MPICH2-MX	
Math Libraries	FFTW	GotoBLAS	MKL	ScaLAPACK	ACML
Compiler	GNU	Intel	PGI	
Debugger	Totalview	Allinea	TAU	
File System	NFS		Lustre	

Dell – участник и основатель OpenHPC

- Совместный проект в рамках Linux foundation

- OpenHPC стремится:
  - Упростить внедрение, администрирование и использование систем HPC
  - Повысить их надежность, масштабируемость и производительность

openHPC

openhpc.community

Новые технологии и взрывной рост данных

Data intensive, HPC workflows

Медицина - Imaging
Bethesda Healthcare System
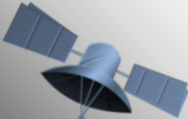
Биология
BROAD INSTITUTE illumina®

Сейсмо-исследования
PetroChina arcis SEISMIC SOLUTIONS

Media & Entertainment
SONY NBC Sports

Satellite Images
NASA NAVTEQ

НИОКР
Pratt & Whitney Une société de United Technologies ARM

DELLEMC

Хранилища для HPC охватывают множество задач

Производительность и ёмкость

Глобальные параллельные файловые системы

- Параллельный доступ
- Cluster file systems, scratch

Масштабируемые NAS

- Масштабирование емкости и производительности в едином пространстве имен
- Постоянное хранилище / home / data

Архивирование и backup

- Долгосрочное, сверхбольшие объемы

Интегрированные решения Dell Storage

Dell Storage for HPC with Intel Enterprise Edition (EE) for Lustre Solution
- HDFS-коннектор обеспечивает реализацию масштабируемого решения для Hadoop.

Dell NFS Storage Solution with High Availability (HA)

Scalable NAS Software with Dell Storage

Scality (Scality Ring) и Nexenta (NexentaStor)
- Software Defined Storage

EMC Isilon

- Изначально для БОЛЬШИХ ДАННЫХ
- СХД для HPC кластеров из коробки

Решение HPC NFS Storage with HA (NSS-HA): разделяемое хранилище начального уровня «под

Сценарии

Постоянное хранилище совместного доступа:

- Домашние директории,
- Код,
- Данные для Input/output (/data, /home)
- Рабочее пространство кластера, малой и средней пропускной способности

Преимущества

- До **30% бОльшая пропускная способность** по сравнению с неоптимизированными решениями NFS
- От **48ТБ до 480ТБ** сырой ескомсти в рамках одного пространства имен

Solution Stack

- 12 Gbps SAS failover connections
- 6 Gbps SAS connections
- PowerEdge R630 servers
- PowerEdge R730 server
- PowerVault MD3460 storage
- Optional Dell PowerVault ND3060e expansion storage

PowerEdge R730 NFS Server

PowerEdge R730 NFS Server

PowerVault MD3460

PowerVault MD3060e

DELLEMC

Dell HPC Storage for Lustre: высокоскоростное пространство для scratch-файлов

Сценарии

Высокопроизво-
дительное
хранилище
совместного
доступа:

- Код приложений
- Домашние
  директории
- Input/output data
  (/data, /home)
- Рабочее
  пространство,
  высокоскорост-
  ной scratch-
  файл

Преимущества

- Единое файловое
  пространство имен
  от 120ТБ до
  петабайт
- **11 GB/s read and 7
  GB/s write**
- Масштабирование
  на ходу
- Intel Hadoop Adapter
  for Lustre (HAL) для
  интеграции

Solution Stack

- 12 Gbps SAS
  failover connections
- 6 Gbps SAS
  connections
- PowerEdge R630
  servers
- PowerEdge R730
  server
- PowerVault MD3420
  storage
- PowerVault MD
  3460 storage
- Optional Dell
  PowerVault
  ND3060e expansion
  storage
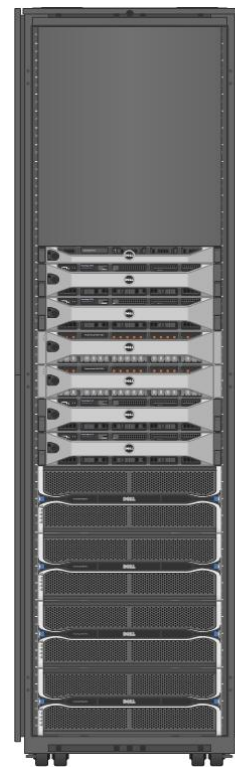
PowerEdge R630 IML Server
PowerEdge R730 MDS
PowerEdge R730 MDS
PowerVault MD3420 DNE MDT
PowerVault MD3420 DNE MDT
PowerEdge R730 OSS
PowerEdge R730 OSS
PowerVault MD3460 OST
PowerVault MD3460 OST
PowerVault MD3460 OST
PowerVault MD3460 OST

DELLEMC

EMC Isilon - Life Sciences в числах

- Целенаправленная работа с проектами в Life Science с 2008 года

- Более 300+ организаций для NGS, HPC и исследовательских архивов

DELLEMC

Dell Networking серия H на основе Intel Omni-Path

HFI Adapter

x16 Adapter (100 Gb/s)

H1024-OPF Edge Switch

24 x 100 Gbps ports with up to 4.8 Tbps aggregate bandwidth for small to medium systems.

H1048-OPF Edge Switch

48 x 100 Gbps with up to 9.6 Tbps aggregate bandwidth for medium to large systems.

H9106-OPF Director-Class Switch

192 ports, 6 slots, 100 Gbps director-class switch supporting up to 38.4 Tbps switching capacity.
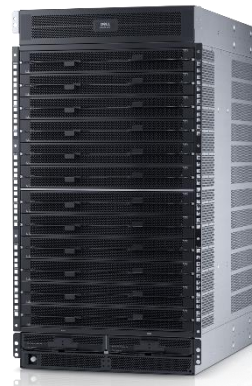
H9124-OPF Director-Class Switch

768 ports, 24 slots, 100 Gbps director-class switch supporting up to 153.6 Tbps switching capacity.

HFI	Edge switches	Director-class switches

Масштабируемость | экономичность | надежность

Texas Advanced Computing Center – Stampede 2.0

Stampede-KNL (1.5 PF peak, TOP500 #12)
- Ранние версии Knights Landing (KNL)

Stampede 2.0 1H'17
- ~3700 серверов Dell EMC PowerEdge C6320p с KNL, Omni-Path, интегрированные со Stampede 1.5

Результат
- Стратегический национальный ресурс мощностью 18 petaflop, крупнейшая система XSEDE
- Для фундаментальных научных исследований

tgen®

Improving patient outcomes with personalized medicine

Business need

To help fight cancer and other diseases, TGen needs extremely scalable, reliable and available high-performance computing (HPC) nodes to develop personalized medical treatments

Solution

TGen tuned its system for Genomics I/O demands by scaling its existing Dell HPC cluster to include more servers, storage and networking bandwidth so that researchers can get the IT resources they need faster without having to depend on shared systems

Benefits

- Researchers can create more-targeted treatments at least one week faster
- Improves outcomes for more patients, including children battling neuroblastoma
- Supports 100 percent data growth and increases storage density

Read the full case study ›

"Today, we help save more lives because researchers spend less time waiting for HPC resources. And it's also easy for us to scale and customize our Dell HPC System for Genomics to support our unique requirements."

James Lowey, Vice President of Technology, Translational Genomics Research Institute

DELLEMC

![NMTRC logo]

Giving pediatric cancer patients hope for the future

Business Need

To improve outcomes for patients battling diseases including neuroblastoma and medulloblastoma by developing new treatments

Solution

Team of oncologists, pediatricians, geneticists and patient families establishes Neuroblastoma and Medulloblastoma Translational Research Consortium (NMTRC) to treat patients using precision medicine

Benefits

• Achieves remission in patients previously deemed incurable
• Improves long-term health outcomes for cancer survivors
• Increases scientific understanding of cancer and genes
• Gathers big data that can facilitate medical breakthroughs
• Shows organizations how to implement precision medicine

"We never would have been able to get to the point where we are today without Dell. We have what we need to improve outcomes for more patients."

– *— Dr. Giselle Sholler, Chair of the NMTRC and Director of the Pediatric Oncology Research Program at Helen DeVos Children's Hospital*

DELLEMC

Beijing Genomics Institute

- BGI Powers one of the World's Largest DNA Sequencing Environments with Isilon

Challenge
- Needed to power more than 100 Illumina Sequencers
- Needed to eliminate data fragmentation and performance bottlenecks within DNA sequencing workflow

- Solution
  - X-series Isilon

- Applications
  - Illumina

- Results
  - Unified over100 Illumina Genome Analyzers onto a single, high performance, highly scalable, shared pool of storage
  - Improved performance, increased productivity, reduced capitol and operating expenses

DELLEMC

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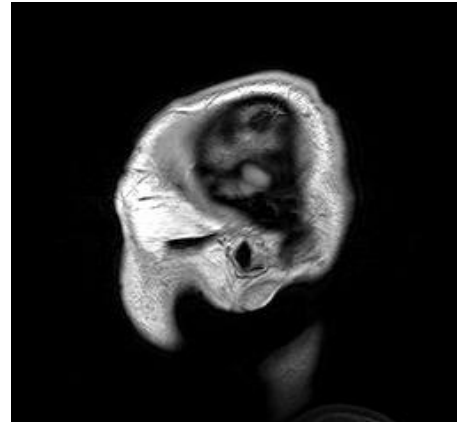
- EMC Isilon speeds biomedical breakthroughs in fight against neurological diseases

Challenge

- Fast-growing catalog of brain scans
- Previous storage clusters approaching capacity

ARTHUR W. TOGA Ph.D.
Director

- "Isilon plays an important role in enabling Big Data for scientific research. It's already helped produce many discoveries working toward cures for neurological diseases."

- Solution
  - EMC Isilon NL Series
  - EMC Isilon SmartConnect, SmartQuotas, and SnapshotIQ

- Results
  - Reduced neuroimaging processing from 24 to less than 6 hours
  - Accelerated metadata reads significantly
  - Increased available capacity from 600 TB to 2.6 PB
  - Minimized administration

- Applications
  - Neuroimaging analysis, processing, and archiving

DELL EMC

Processing speed capable of a thousand-trillion floating point operations per second

- Business need
- Open up new research avenues and stimulate private-sector projects.

- Solution
- A supercomputer powered by 1,039 Dell PowerEdge servers, Dell Storage, Dell Networking and Mellanox FDR InfiniBand

- Benefits
- Increases capacity for production and dissemination knowledge
- Enhances the competiveness of regions and nations
- Opens doors to help drive new research and innovations
- Helps enable human potential

![Sensus logo]

Make a world of difference for a world of people

Business need

Implement real-time analytics to define, validate and communicate that data in a meaningful way.

Solution

Implement a data cluster based on Dell PowerEdge R730 and R730xd servers with Hadoop

Benefits

- 10x improvement in investigation response time

- Instant access to customer's full data set

- Faster and more accurate results

"Now, our project managers can instantly get a customer's full data set. Having this data at our fingertips makes us a lot quicker on response time and allows us to provide faster and more accurate results … so that we make really good decisions with real data."

– —Mike McGann, vice president of quality at Sensus.

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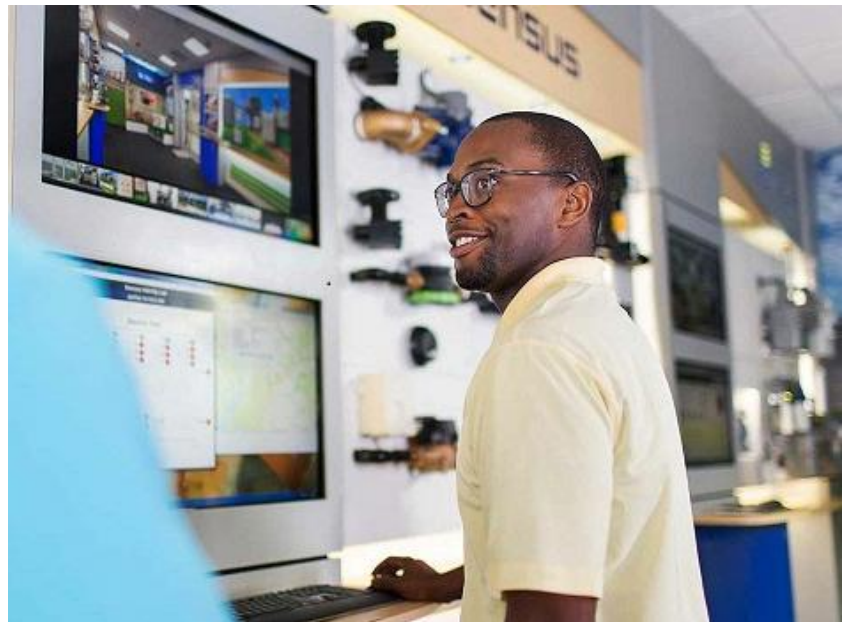
TAPAD

Personalized advertising in the blink of an eye

Business need

To help clients maximize digital advertising investments while supporting its own rapid growth and innovation, Tapad needed to increase operating efficiency and reduce costs.

Solution

Tapad adopted a warehouse-scale distributed systems architecture that consolidates servers, storage and some networking gear using a Dell PowerEdge FX architecture featuring Intel® Xeon® processors.

Benefits

- Boosts agility and innovation so Tapad can stay on the leading edge
- Provides insight into billions of data objects within millseconds
- Accelerates employee efficiency to fuel growth and client ROI

Read the full case study >

"We're well positioned to continue providing innovative digital advertising solutions and look forward to helping shape where the industry is going by choosing technologies like the Dell PowerEdge FX architecture with Intel Xeon processors."

Ryan Tennant, Vice President of Technical Operations, Tapad

Powering cutting-edge research on campus and beyond

Business need

The Fulton Supercomputing Lab (FSL) at Brigham Young University needed to address performance bottlenecks and capacity issues to better meet the demands of researchers.
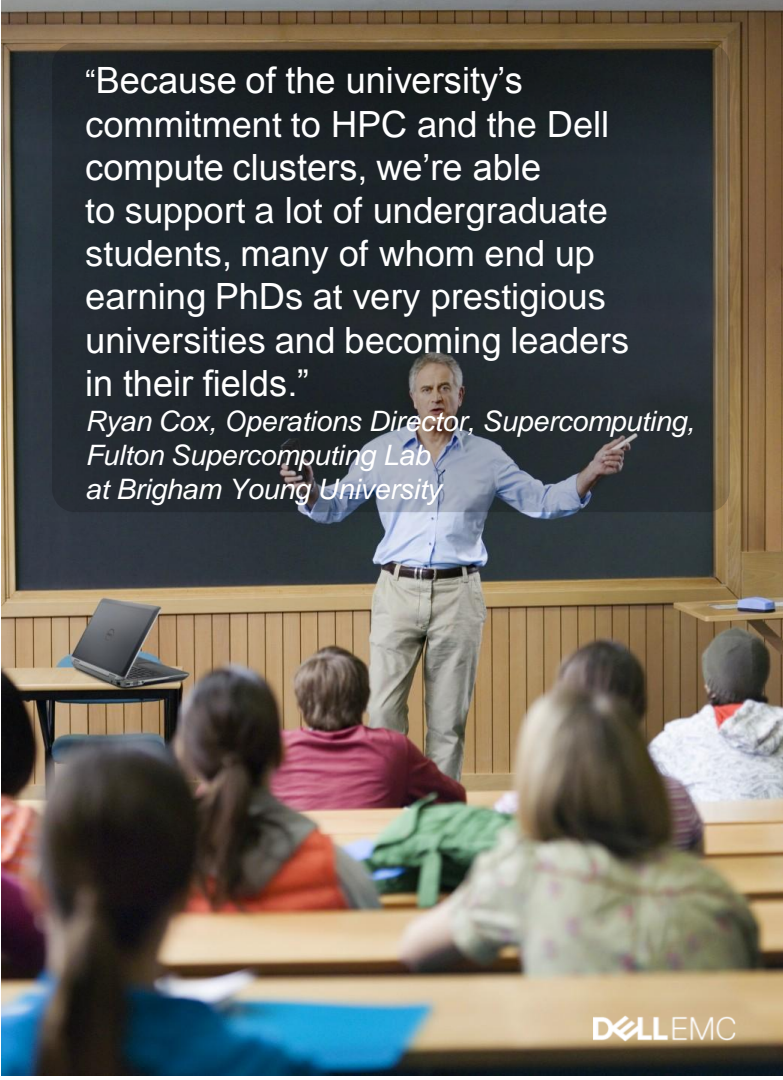
Solution

FSL expanded its HPC clusters with new technology, including Dell blade servers, Dell networking switches and Dell storage arrays.

Benefits

• FSL can accommodate differing needs of researchers
• Researchers can run jobs without losing work by using reliable, stable technology
• Four-person IT staff uses automation to ease IT management in the lab
• FSL cuts costs by reducing cables
• System deployment is simplified

Read the full case study >

"Because of the university's commitment to HPC and the Dell compute clusters, we're able to support a lot of undergraduate students, many of whom end up earning PhDs at very prestigious universities and becoming leaders in their fields."

Ryan Cox, Operations Director, Supercomputing, Fulton Supercomputing Lab at Brigham Young University

NCSU LIBRARIES

Taking care of business

Business need

North Carolina State University (NC State) wanted to build a new library that would support researchers' big-data and visualization needs and give students the opportunity to learn to use the latest technologies.

Solution

The new Hunt Library features large-scale data visualization displays and offers an HPC cluster and render farm built on Dell technologies to power research and provide collaborative spaces.

Benefits

- Gives students access to cutting-edge technologies that prepare them for the job market and advanced studies
- Provides researchers and students with centralized HPC resources and data visualization capabilities so they can share results in collaborative spaces
- Supports virtualized infrastructure for remote access, easier desktop management, and cost savings
- Completed fast data migration, minimizing service downtime

Read the full case study >
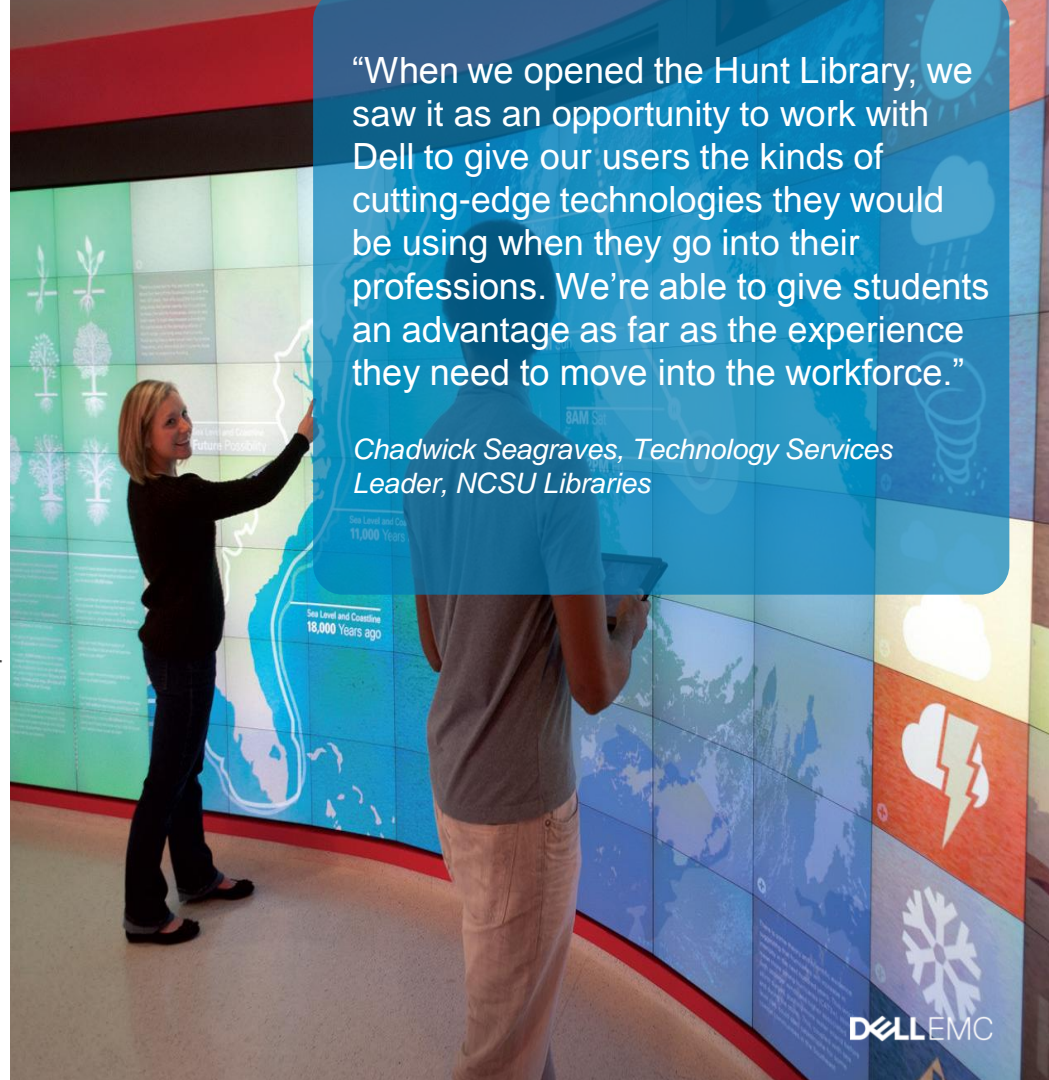
"When we opened the Hunt Library, we saw it as an opportunity to work with Dell to give our users the kinds of cutting-edge technologies they would be using when they go into their professions. We're able to give students an advantage as far as the experience they need to move into the workforce."

Chadwick Seagraves, Technology Services Leader, NCSU Libraries

DELLEMC

Facilitating breakthroughs with next-generation HPC

Business need

To answer increasingly complex questions in science and other disciplines, ASU researchers needed a faster and easier way to analyze any type of big data with any model.

Solution

ASU created a holistic First Generation Data Science Research Instrument. It uses Dell and Intel® technologies to support high-performance computing, big data, parallel processing and tiered storage.

Benefits

- Supports "big picture" analysis that was previously impossible
- Speeds research by weeks with 30 teraflops and 83 percent faster provisioning
- Reduces high-performance storage costs by 70 percent

Read the full case study ›

"We've had long-standing, deep relationships with Dell and Intel for many years, so we engaged Dell Consulting Services to help us design and construct the NGCC and its networking infrastructure."

Gordon Wishon, Chief Information Officer, Arizona State University

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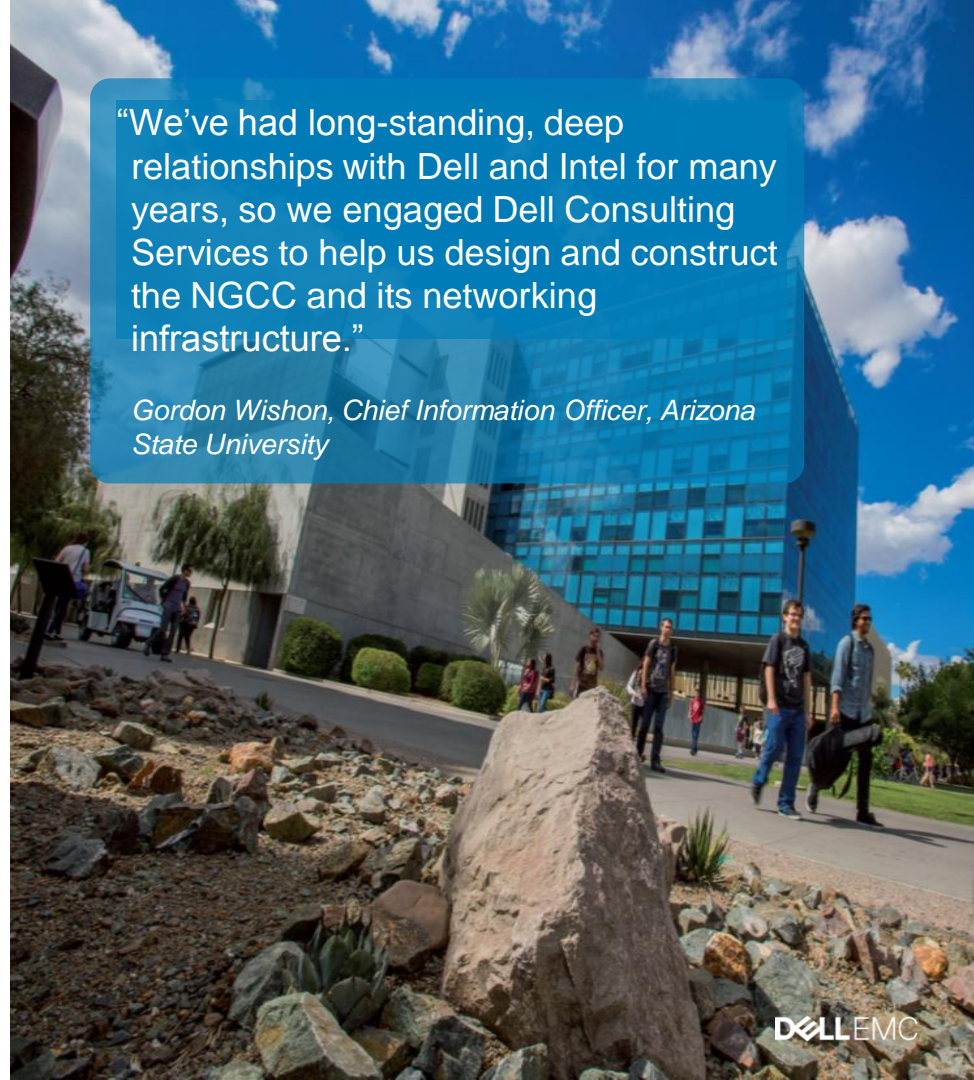
Rebuilding a research powerhouse

Business need

As part of its rebuilding efforts after Hurricane Katrina, Tulane University needed to create a new high-performance (HPC) infrastructure to regain its status as a world-class research institution.
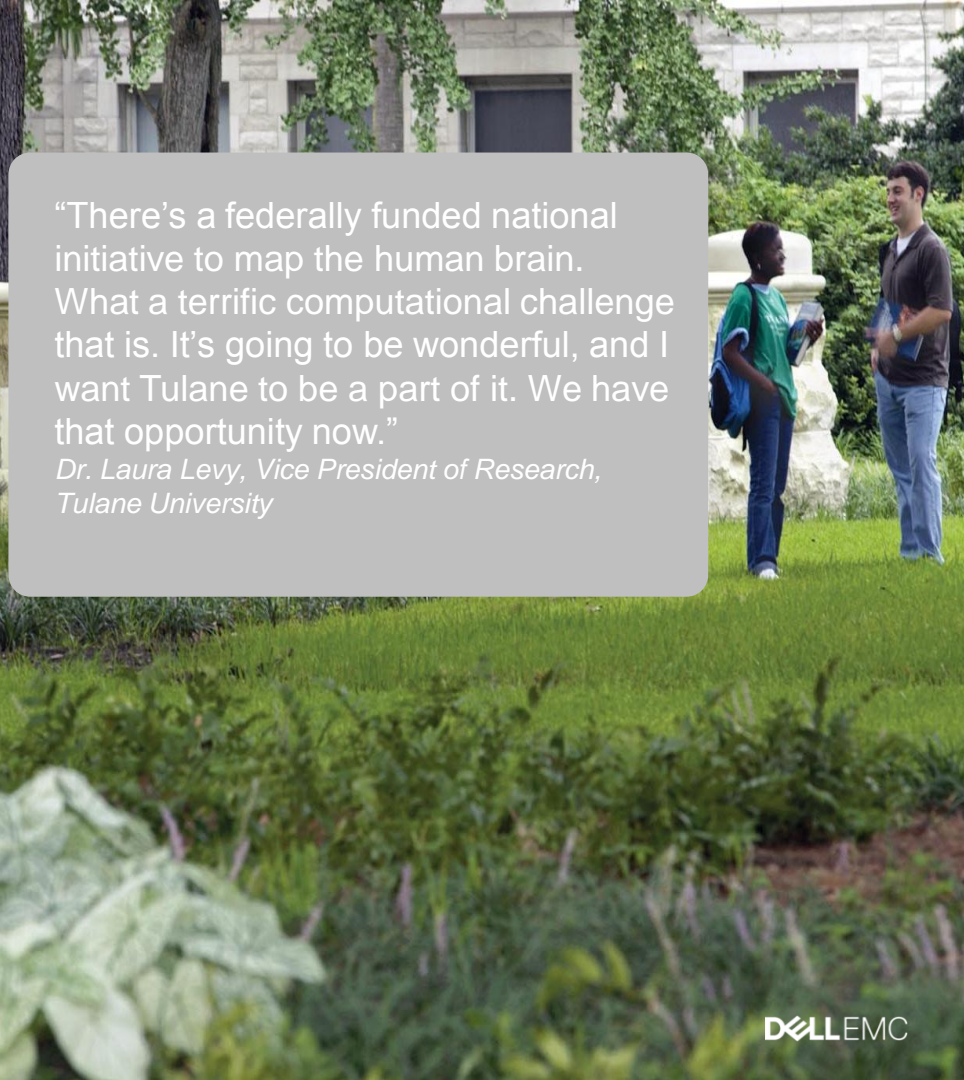
Solution

The university partnered with Dell to build a new HPC cluster that is powering new scientific discoveries, speeding research results and attracting new faculty.

Benefits

- High-throughput HPC cluster enables analysis of large sets of scientific data
- Assists researchers in making discoveries in genetics and cellular studies
- Helps researchers determine the risks of playing sports
- Provides data-transfer rates up to 40 times faster

Read the full case study >

"There's a federally funded national initiative to map the human brain. What a terrific computational challenge that is. It's going to be wonderful, and I want Tulane to be a part of it. We have that opportunity now."
Dr. Laura Levy, Vice President of Research, Tulane University

National Center for Supercomputing Applications Private Sector Program

Mission

- Help others do what they do better through high value-added advanced computing and data techniques

- Stay 15 minutes ahead of world's most sophisticated companies

Impact

- NCSA PSP is the nation's leading industry-facing supercomputing service

- Working with Boeing, Caterpillar, Deere, Dow, GE, P&G and Rolls-Royce

- Dell is the partner of choice for PSP's iForge

Dell Technologies - это уникальное семейство компаний, которые создают всю инфраструктуру, необходимую организациям на пути к цифровому будущему, трансформации ИТ и защиты самого важного актива - информации.

Dell Technologies состоит из 7 брендов:

DELLTechnologies