Innovation in Hyperscale Storage

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Sr. Director of Product Line Mgmt

Seagate

OPEN HARDWARE.   **OPEN SOFTWARE.**   **OPEN FUTURE.**

You May Know Seagate as a

Hard Drive Manufacturer…

- 1st and only to ship over 2 billion drives
- Stores more than 40% of the world's data
- #1 OEM storage – over 2 billion drives

But We're **Also** a Company That:

Delivers deep expertise and unique IP in storage & data management

Offers a complete range of storage components & solutions

Works with providers & solution builders to combines UX, software & design to create new categories of storage solutions

Ranks as one of the top 25 companies worldwide in supply chain operations

The Digital Universe of 2020...

... Generates a LOT of data!!

44 Zetabytes

of raw data is created. Video, social media, mobility, IOT & scientific research and discovery drive this explosive explosive growth.
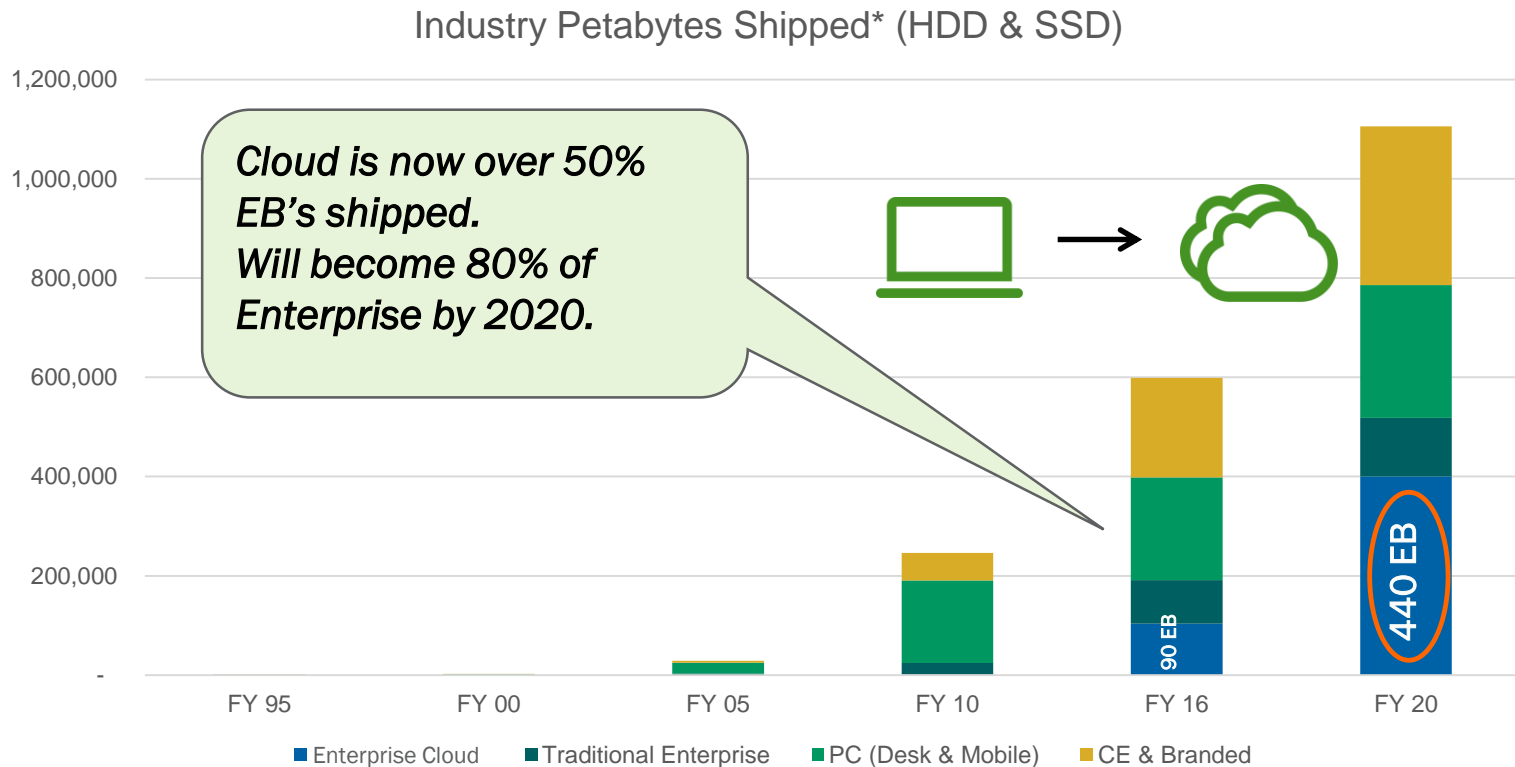
13 Zetabytes

of this data "could" be valuable if stored. Advancements in real-time analytics are driving better efficiencies in deciding what data unlocks incremental value.

6.5 Zetabytes

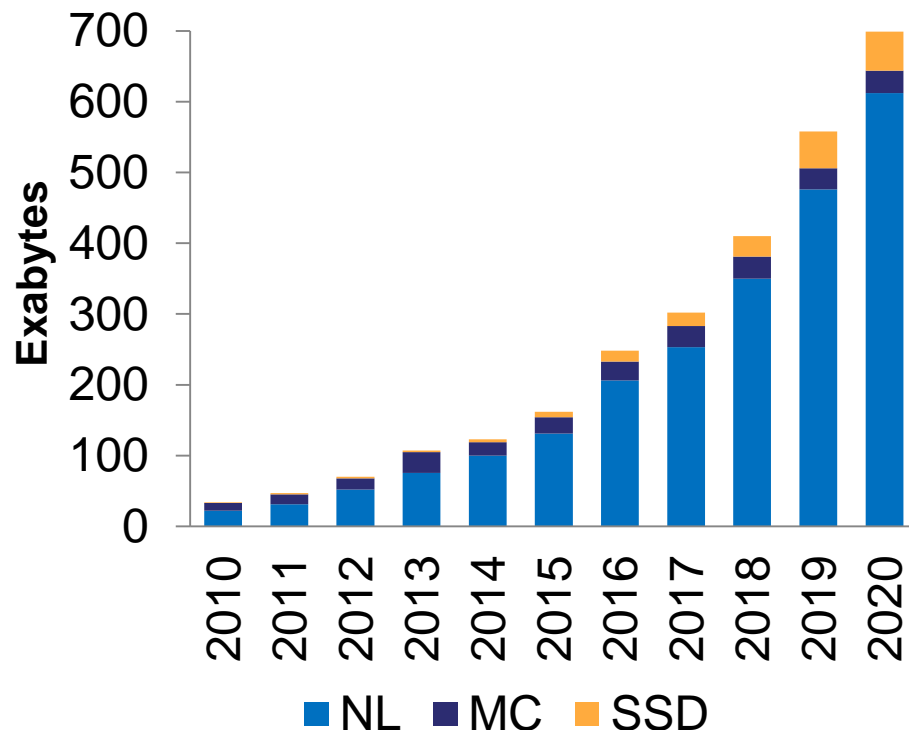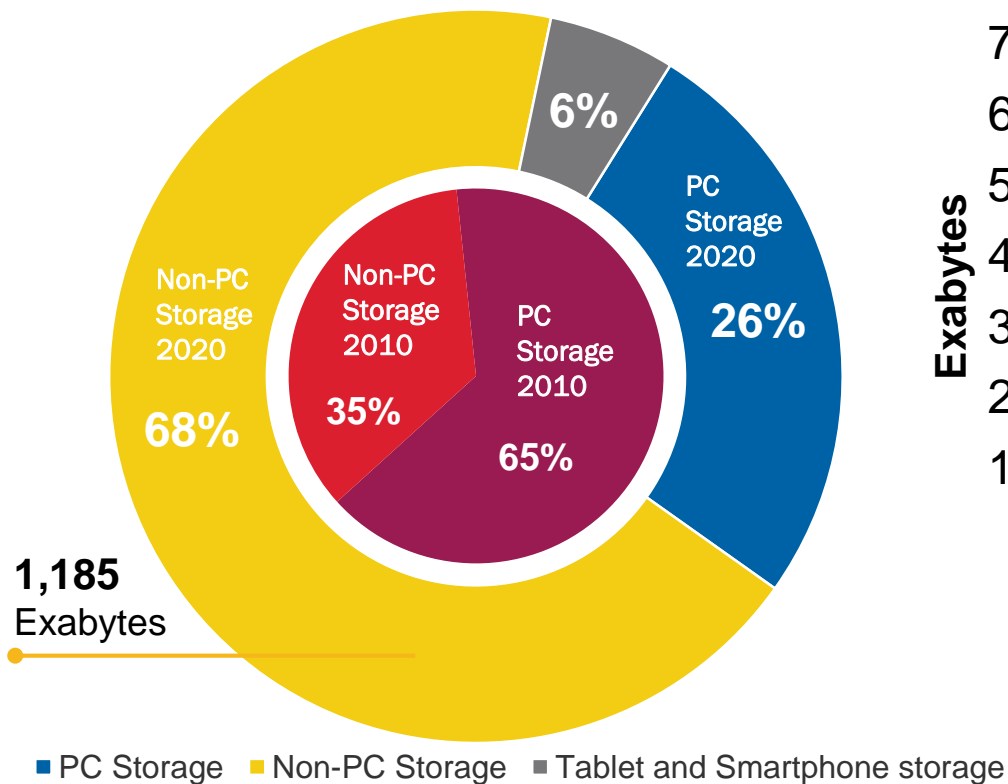*is a realistic estimate of what the entire universe of data storage capacity will be.*

- **Major industry storage trends?**

- **SSD impact on HDDs?**

- **How will HDDs stay relevant?**

Data Explodes|Demand for Storage Components Grows

Ten-fold increase between 2016 and 2025!

Industry Petabytes Shipped* (HDD & SSD)

> *Cloud is now over 50% EB's shipped.*
> *Will become 80% of Enterprise by 2020.*

90 EB (FY 16)

440 EB (FY 20)

Chart vertical axis: 1,200,000 / 1,000,000 / 800,000 / 600,000 / 400,000 / 200,000 / -

Horizontal axis: FY 95 | FY 00 | FY 05 | FY 10 | FY 16 | FY 20

Legend:
- Enterprise Cloud
- Traditional Enterprise
- PC (Desk & Mobile)
- CE & Branded

Nearline Hard Drives - The Home For Cloud Data

PC Storage 2020 — 26%
PC Storage 2010 — 65%
Non-PC Storage 2010 — 35%
Non-PC Storage 2020 — 68%
Tablet and Smartphone storage — 6%

1,185 Exabytes

■ PC Storage   ■ Non-PC Storage   ■ Tablet and Smartphone storage

Exabytes

700
600
500
400
300
200
100
0

2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020

■ NL   ■ MC   ■ SSD

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Storage Tiers & Specialized Storage Components

Different tiers & use cases in Hyperscale call for differing component choices

Real-time Computing	Transaction Processing	Big Data Storage	Content Storage	Cloud Content Storage	Object Storage	Data Archive

Cost	Highest						Lowest
CPU Proximity	Closest		**Data** ⟵⟶				Farthest
Latency	Lowest						Highest

Delivering Data	Processing Data	Streaming Data	Storing Data	Saving Data

Challenges in Cloud Storage

Cloud players need to carefully weigh their options & priorities

PERFORMANCE
(IOPS, WRL, SDR)

CLOUD & HYPERSCALE

SECURITY
(Stds: SED, FIPS)

COST
($/TB, $/IOPS)

CAPACITY
(TB's, Areal Density)

SUPPLY QUALITY
(Reliability, MTBF, Supply Chain)

Seagate Is the Leading Innovator

We continue to push the envelope on cloud-storage innovations

Storage Density
- Seagate **HAMR** Leadership
- 16TB-20TB HDD's in next 3 years
- Unlock 10x Areal Density for 10 years

Performance
- **Dual Actuator and Parallelism** designs
- Firmware queuing and latency bounded I/O solutions

Cost
- Continued erosion of $/TB
- Added features, improved weight
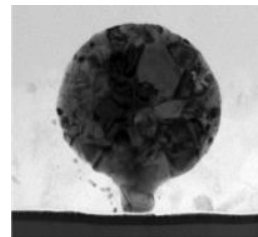- Reduced power for better TCO

Supply & Quality
- Global supply chain
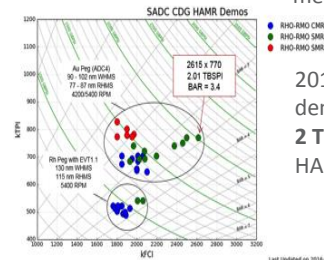- Reliability & tough quality control

Security
- Self-encrypting, crypto-erase (SED / ISE), FIPS certification, etc.

2000: Seagate **invents** the lollipop nano-plasmonic antenna (NFT)

2012: Seagate CEO presents a **HAMR drive** at the STX analysts' meeting

2016: Seagate demonstrates **2 Tbpsi** using HAMR and SMR

Near future: Seagate will deliver 16TB+ Nearline drives for data center growth

10

Seagate Cybersecurity Strategy Moving Forward
Next Gen Security Platform for Products in 2018/19 and beyond

Endpoint Security in Present Products

+

Endpoint and Cloud Security

Customer Needs

Seagate Secure Solutions

Pyramid (top to bottom):

FIPS 140-2 CERTIFIED — FIPS

TCG-COMPLIANT SECURITY
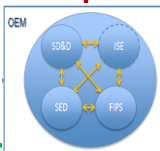Full Deployment with Key Management Software — SED

INSTANT SECURE ERASE
Quick and Simple
Crypto-Erase and Sanitize Features — ISE

BASE DRIVE SECURITY
Cryptographically-Signed Firmware, Secure Boot and Protected Download/Diagnostic Ports — SD&D

SECURITY FOUNDATION

Customer Needs boxes:

- Certified, Government-Grade Security
- Data at Rest, Locking Protection
- Fast, Complete - Data Disposal & Repurposing
- Authentic Products

OEM — SD&D, ISE, SED, FIPS

Activate

In-field Activation
- Cybersecurity Configs. and Features
- Non-Security Features - Capacity on Demand and others

Cloud Key Management enabled by Seagate Proprietary **TCG API**

Common Criteria Certification on SED and FIPS Configs. **(CSfC)**

Security API Transition to **TCG Opal** for Enterprise
- TCG NVMe Leadership

Multi Tenancy & HW based end to end Security
- Max possible TCG bands
- Secure Messaging (TCG Standard and Certificates based)
- Data in Motion Security
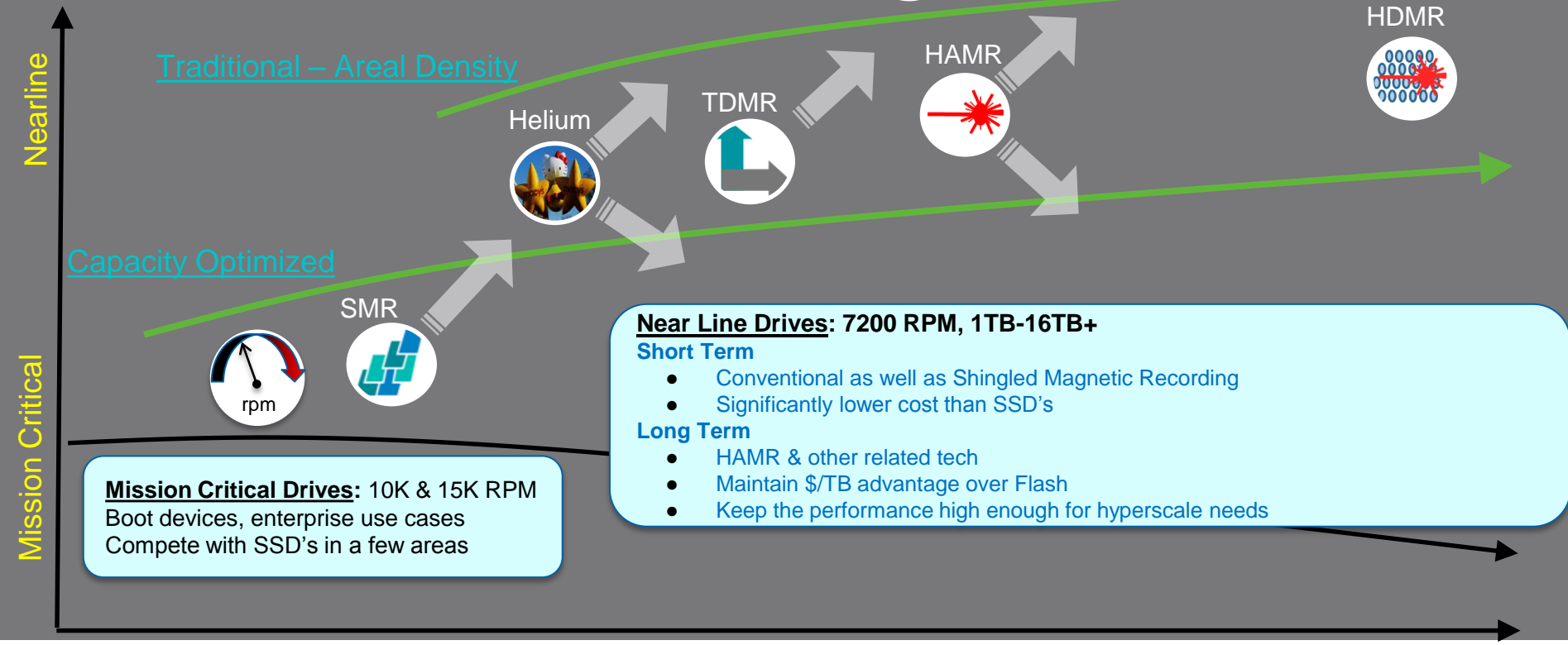
+

Manufacturing

Product Development

Supply Chain

Increasing Assurance (Authentic & Unaltered)

Infrastructure

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Enterprise Product Technologies
Path to 2020

Performance Optimized

Traditional – Areal Density

Capacity Optimized

Nearline

Mission Critical

Parallelism

Multi Actuator

HDMR

HAMR

TDMR

Helium

SMR

rpm

Near Line Drives: 7200 RPM, 1TB-16TB+
Short Term
- Conventional as well as Shingled Magnetic Recording
- Significantly lower cost than SSD's

Long Term
- HAMR & other related tech
- Maintain $/TB advantage over Flash
- Keep the performance high enough for hyperscale needs

Mission Critical Drives: 10K & 15K RPM
Boot devices, enterprise use cases
Compete with SSD's in a few areas

Announcing - 12TB Enterprise Capacity 3.5" CMR Drive

Leading Nearline High Capacity

- 20% added petabytes per rack

Power and Weight Supporting TCO

- Least operating power using helium technology
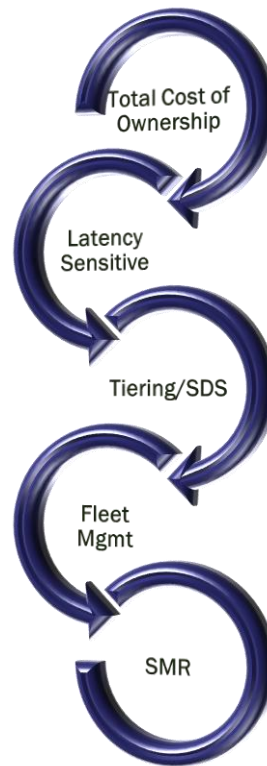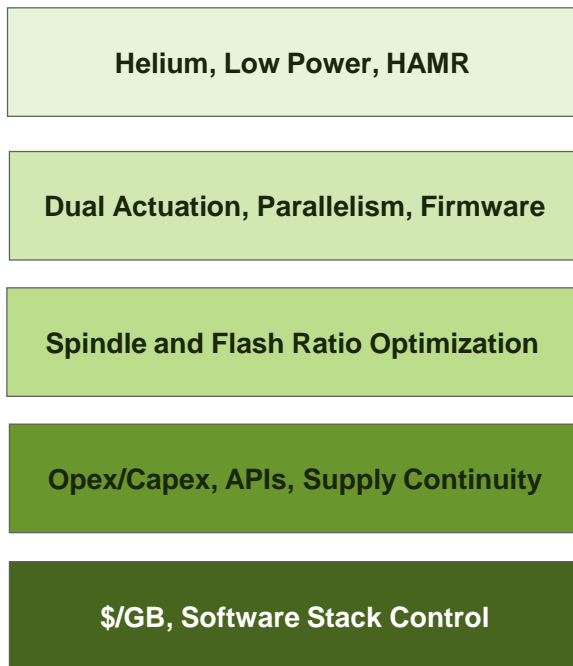- ~20% weight reduction vs air Nearline drives

Driving Increased Performance

- Scaling IOPs/TB with Seagate firmware
- Leading sustained data rate & random write performance

Collaborative Innovation for Competitive Advantage

Partners with HDD & Builder ecosystem for better TTM, Cost & Technology

Helium, Low Power, HAMR

Dual Actuation, Parallelism, Firmware

Spindle and Flash Ratio Optimization

Opex/Capex, APIs, Supply Continuity

$/GB, Software Stack Control

Total Cost of Ownership

Latency Sensitive

Tiering/SDS

Fleet Mgmt

SMR

PARTNER SHIP

SUMMARY

The Storage Industry Is Innovating for Cloud & Hyperscale

- Hyperscale storage is experiencing incredible growth

- For cloud-based storage, SSD's and HDD's complement each other.

- You need right components & architecture for scale, savings & TTM advantages in Cloud

- Partnership with the right HDD, SSD & systems vendors is the key to cloud success

- Seagate is innovating for cloud players by pushing the HDD & SSD envelope on capacity, scale, cost, performance & security

Data Centre

That great sucking sound? It's data going into the public cloud

The great slurp is inevitable, just you watch

The public cloud is like a data-sucking tornado

Article in The Register by Chris Mellor http://www.theregister.co.uk

APPENDIX

12TB Nearline Drive

SEAGATE

Density
- 12TB
- Standard 3.5" design
- 8 Platters, 16 heads
- Sealed drive (He)

Higher capacity in the same 3.5" footprint delivering 20% more petabytes

Efficiency
- PowerBalance™
- PowerChoice™
- Helium design

Helium-enabled lower power and weight plus the ability to tradeoff performance for additional power savings

Security
- Self-encrypting drive
- Instant secure erase
- Protection information

Robust drive-level data security and integrity for when the drive is at rest, recording, or retired

Reliability
- In-drive diagnostics
- RAID rebuild
- 2.5M-hour MTBF
- 5 Year warranty

Highest-proven quality and field reliability protecting from data loss and unneeded expense

Agility
- Enhanced caching
- 5xxe or 4Kn formats
- 12Gb/s SAS
- 6Gb/s SATA

Flexible design delivering wider integration options and support for a greater number of workloads

- *High Capacity Helium 3.5" reducing TCO*

Presenter Profile:

UNMESH KULKARNI

Unmesh works at Seagate as the Senior Director of Product Line Management for Hyper-scale & Cloud Segment.

Unmesh has extensive experience in Cloud Storage, Cloud based Data Protection & Enterprise Software. He can be reached at Unmesh.Kulkarni@seagate.com

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Compute Project