20,000 LEAGUES UNDER THE SEA: Sub-Marine Solutions for the Future of Cloud Computing

Technology for the next decade will become increasingly—if not completely—**dependent on cloud computing**. Two of the biggest costs facing cloud providing companies today are the **real estate** and **cooling costs** associated with maintaining cloud-enabling infrastructure. In a cost-cutting experiment, **nearly 1,000 servers were dropped into one of the harshest marine climates**. While we still worry about dropping our phones in the tub, forward-thinking cloud companies are making waves by rethinking the scalability, cost structure, and logistics of one of the future's **foundational technologies** with **profound ripple effects on virtually every industry**.

I *think* I know this, but explain "the cloud" *one more time...*

What is Cloud Computing?

Cloud computing is the reason we can access so much information from our tiny mobile phones. It's the reason millennials can run entire businesses on their laptops. The way computers *used to* work, any information—files, applications, music, you name it—a computer needed to access had to live in a physical piece of hardware, a server, that sat next to the computer. If you needed more storage, you needed another server where data lived.

We need servers more than ever before. In an era where we are drowning in data, businesses and individuals alike expect their computers to access, read, store, and manipulate more information every day. The average Equity Long/Short Hedge Fund, for example, used to use anywhere between 9-15 servers when using on-premise servers was the norm.

But servers are expensive, bulky, and annoying to store. That's where cloud providers come in. They take care of housing the many servers required to execute daily computing needs. These servers live in huge data warehouses, and they transfer information via lengthy and powerful cables.

Soon, both the warehouses and the cables may live under the sea.

CHALLENGE

With the cloud market slated to grow 2x by 2020, providers need to optimize and save money on:

1. Real estate expenses
2. Cooling expenses

SOLUTION

Use the ocean like a natural ice box. It may be an efficient and cheap storage facility for cloud-enabling infrastructure.

Okay, I understand the cloud. But why put computers under water?

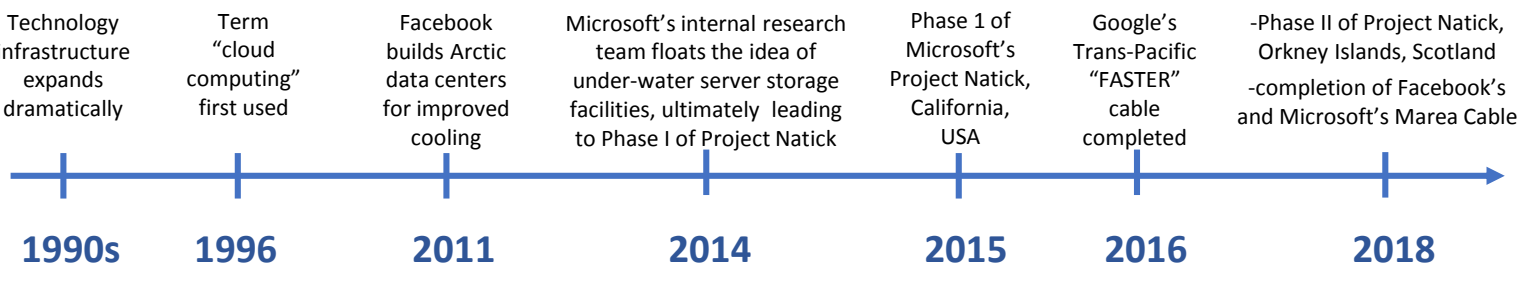
One of the biggest issues plaguing cloud providers as demand for their services grows is keeping data centers cool. With thousands of servers humming alongside each other at all times, overheating is a serious concern because it can lead to system failure.

Why does this matter?

Cloud computing is the key to the future of data processing on both the individual and enterprise levels. In the past year, Amazon's cloud business has grown nearly 50%, while Microsoft and Google have seen their cloud businesses grow by almost 100% each.[1] Data is flooding every industry, and cloud computing is just about the only adequate solution to staying afloat. Using the cloud is a cheaper, easier, and more powerful way to process data.

Rather than housing the relevant software themselves, individual entities can offload the responsibility of storage and maintenance of servers to cloud providers. Businesses simply pay by the gigabyte, thereby purchasing the exact amount of storage they need to operate their businesses, with the ability to scale as they grow.

From Floating the Idea to Sinking the Sub: A Brief History of How We Got Here*



*This timeline is not exhaustive but merely a representative snapshot of some key points in the past few decades.

Jefferies

The Ripple Effect:
Potential Frontiers for Disruption

Cash Flow

2 years – time it takes to build a land-based data center

vs.

90 days – time it takes to build a sub-marine data center

↓

Sub-marine storage facilities are better for cash flow.

Real Estate

245,000 sq. ft. – size of land-based data centers. This is larger than 4 football fields in a row!

↓

Migrating data centers from land to sea could free up real estate on land.

Not to mention, sub-sea datacenters are smaller than their land-based cousins. Think of how much space is saved by eliminating the need for aisles, restrooms, and ladders for human server operators.

Streaming Speeds

Data Warehouses

Servers work fastest when close to users. Since 40% of the population lives on or near a coast, putting data warehouses near coastlines improves streaming speeds.

Submarine Cables

Data is processed via huge cables on the ocean floor that connect the U.S. to the U.K. and Asia. Until recently, connection could be disrupted or lost due to harsh weather and hurricanes. Now, projects like Google's FASTER cable and Microsoft and Facebook's Marea seek to solve this problem. Among the most technologically advanced cables of their kind, they are designed to weather any storm.

The Environment

Cooling land-based data warehouses takes a toll on the environment:

In 2014, air conditioning in US data centers consumed roughly 2% of the entire country's energy consumption.

The ocean's frigid waters could solve this problem. For example, Microsoft's Project Natick is entirely energy-self-sufficient.

Cost Efficiency

Putting data warehouses and cables underwater could save money on:

1. **Cooling:** Cloud providers spend billions on air conditioning and other cooling mechanisms, but **cold water is free**.
2. **Warranty:** Since submerged hardware is inaccessible for years, cloud providers need not pay warranty on it.
3. **Real Estate:** Unlike on-land real estate, **space on the ocean floor is free**.

Supply Chains

- **Hardware:** The same servers used today can live happily underwater.
- **Storage:** Submarine storage vessels can be mass-produced and shipped cross-country.

Submarine Storage by the Numbers

864 — Number of servers in Natick Phase II's submarine.

$68 billion — What Amazon Web Services will add in revenue to its parent co. in the next 5 yrs. (per Jefferies's Brent Thill and his team)

40% — Percentage of global population living on or near a coast, making the ocean a perfect place to store cloud servers

10.25 million — Weight in pounds of Marea cable (the equivalent of 34 whales)

2 — Number of cameras stationed on Natick's exterior, showing live feeds of surrounding fish and marine life

$15 billion — Dollars Microsoft has spent on infrastructure since opening its first data center

~$64 billion — Dollars Amazon, Google, and Microsoft have invested in cloud infrastructure and innovation since 2015

$1 million — Dollars Guggenheim spends each year on electricity to run its supercomputer at its offices in California[2]

17,000 — Feet below sea level where Google and Microsoft's Marea cable can be found

38 million — Length in feet of Google's trans-Pacific subsea "FASTER" cable

5 — Years an average server can last without maintenance

34,000 ft. — Height of all the servers in a Google data center stacked on top of each other (5,000 ft. taller than Mt. Everest)

100 million — # of LED bulbs that could be lit by Microsoft's most recent solar energy purchase. The largest deal of its kind in US history, it only covers 10% of the company's data center energy usage.

117 — Feet below sea level of Natick's resting spot. The submarine floats well above the sea bed, minimizing disruption to sea life.

5 — Years Microsoft's Project Natick will remain submerged

Forward Considerations

There remain a number of potential regulatory and environmental concerns to take into account. As subterranean solutions become mainstream, cloud-providing companies will likely see their businesses affected by the following variables.

Regulatory and Legal Factors

Companies storing cloud-enabling infrastructure under the sea may find it beneficial or even mission critical to:

- Identify which regulatory body will **govern the business activities and impose taxes** on companies making use of international waters and **ensure compliance**. This adds a wrinkle to corporations drawing revenues from both single jurisdictions and across several globally.
- Identify which organization will **govern activity in the oceans in terms of real estate** and **ensure compliance with its laws and guidelines**.
- Stay compliant with guidelines relating to these projects as they are written and ratified. Guidelines could be updated on different timelines relating to a host of factors, including but not limited to:
    - How clients are charged for access to submarine storage
    - Size and scale of the storage infrastructure
    - Frequency of infrastructure maintenance
- Liaise with the **International Seabed Authority (ISA)**, the governing body that monitors activity in the ocean with respect to mining.

Environmental and Social Concerns

In addition to legal concerns, companies will also likely need to consider their projects' environmental and social ripple effects. Just a few of the many questions worth considering:

- Will data centers be **energy-efficient**?
- Will they affect the **temperature** of the ocean?
- What guidelines should be put in place to ensure that these projects do not contribute to the deteriorating **health of the globe overall**?
- Should these projects employ marine biologists to ensure that they do not disrupt the health of the oceans, marine wildlife, or ecosystems they'll enter?
- How might **companies partner with oceanographic institutes or departments within larger research universities** so that the two can leverage each other's data, knowledge, expertise, and information in the most efficient and effective manner?

Considering these questions could ensure efficient business ventures and may become increasingly necessary to pleasing shareholders with the **rise in popularity of ESG investing**.

Putting the Cloud Back in the Sky: A Moonshot Prediction

Though companies are still in the early stages of exploring if submarine solutions are feasible and sensible, the search for real estate begs the question: will they eventually attempt to store cloud-enabling infrastructure in Outer Space? While it sounds enticingly poetic to house the cloud in the skies, this would require more sophisticated cooling mechanisms and computing speeds than those that exist currently.

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1. Forbes, "Cloud Revenue 2002: Amazon's AWS $44B, Microsoft's Azure $19B, Google Cloud Platform $17B," April 30, 2018
2. WSJ, "The Quants Run Wall Street Now," May 21, 2017

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