Cloud impact on Satellite Communication

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January 17, 2020
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Cloud Market 2020

- “Daddy, what are clouds made of?”
- “Linux servers, mostly.”

- Worldwide, Private, Hybrid and Public Cloud computing market is expected to grow to $650B by 2025.
- 70% of enterprise tech spending in 2020 is expecting to be in cloud.
- Hybrid (Private + Public) strategies are preferred by most companies.

- Key attributes of Cloud:

1. Provide services without buying and maintaining HW when and wherever needed.	2. Access content anywhere, anytime, at low latency with high speed links.

Source hostingtribunal.com

Cloud Market

- Our every day lives have been impacted by todays Cloud Services
- Cloud Services are still in its infancy and growing average 17.5%/yr.

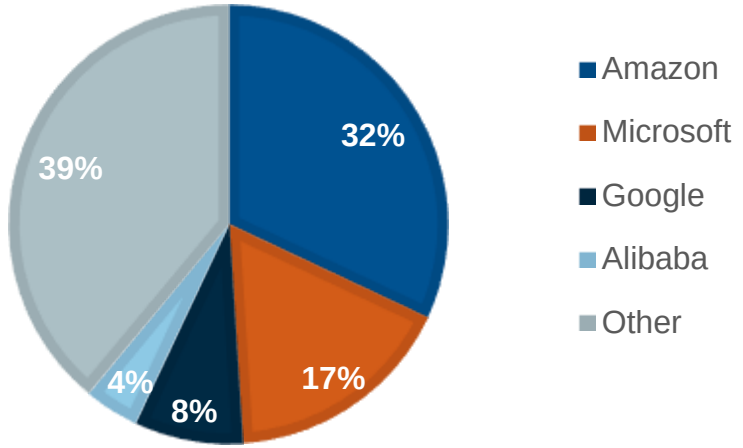
Table 1. Worldwide Public Cloud Service Revenue Forecast (Billions of U.S. Dollars)

	2018	2019	2020	2021	2022
Cloud Business Process Services (BPaaS)	45.8	49.3	53.1	57.0	61.1
Cloud Application Infrastructure Services (PaaS)	15.6	19.0	23.0	27.5	31.8
Cloud Application Services (SaaS)	80.0	94.8	110.5	126.7	143.7
Cloud Management and Security Services	10.5	12.2	14.1	16.0	17.9
Cloud System Infrastructure Services (IaaS)	30.5	38.9	49.1	61.9	76.6
Total Market	**182.4**	**214.3**	**249.8**	**289.1**	**331.2**

BPaaS = business process as a service; IaaS = infrastructure as a service; PaaS = platform as a service; SaaS = software as a service
Note: Totals may not add up due to rounding.

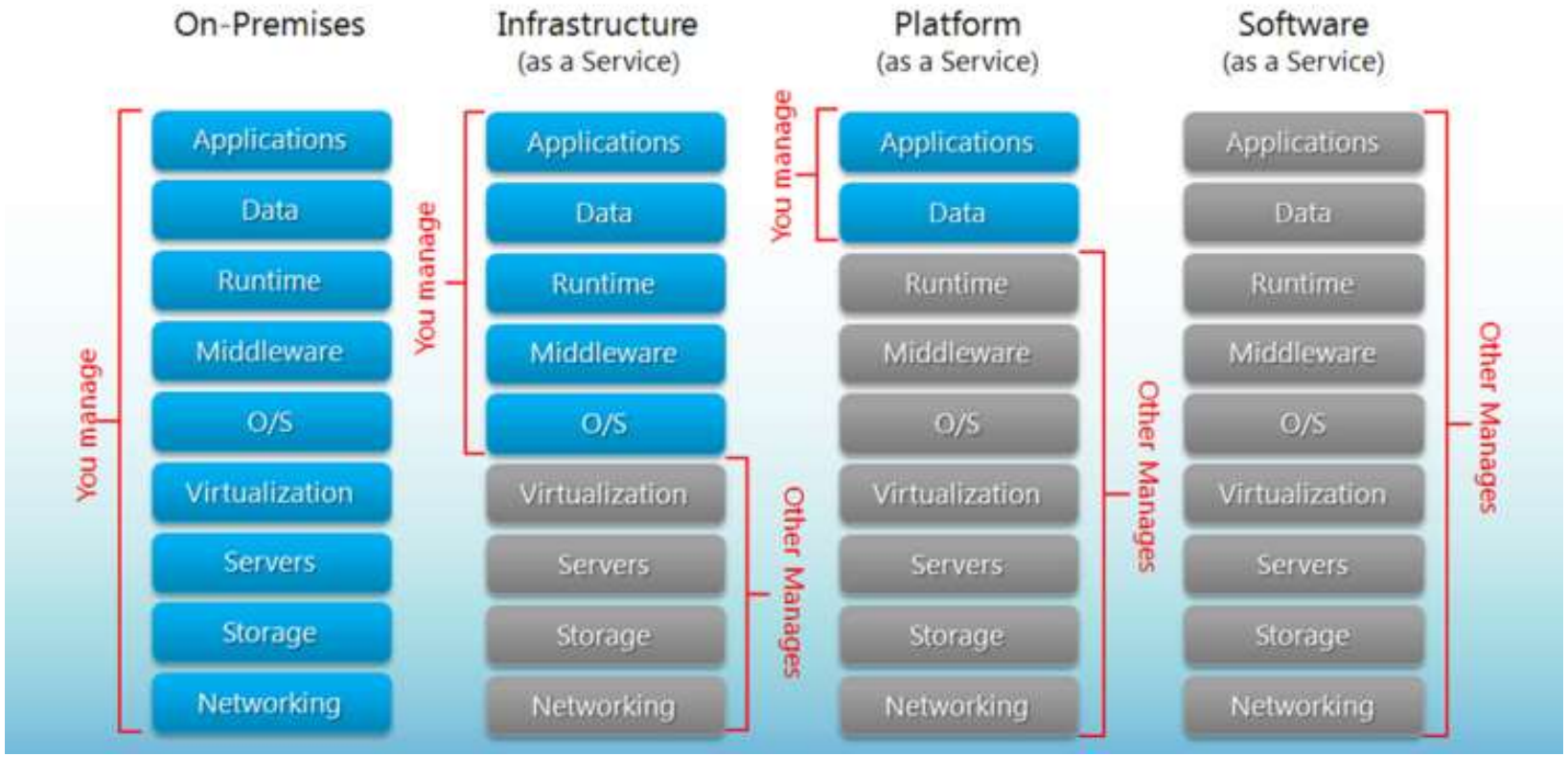
Source: Gartner (April 2019)

- SaaS is most mature of the services while PaaS and IaaS are growing most rapidly at average 25%/yr.



93% of new cloud efforts are with AWS or Azure

Cloud Services



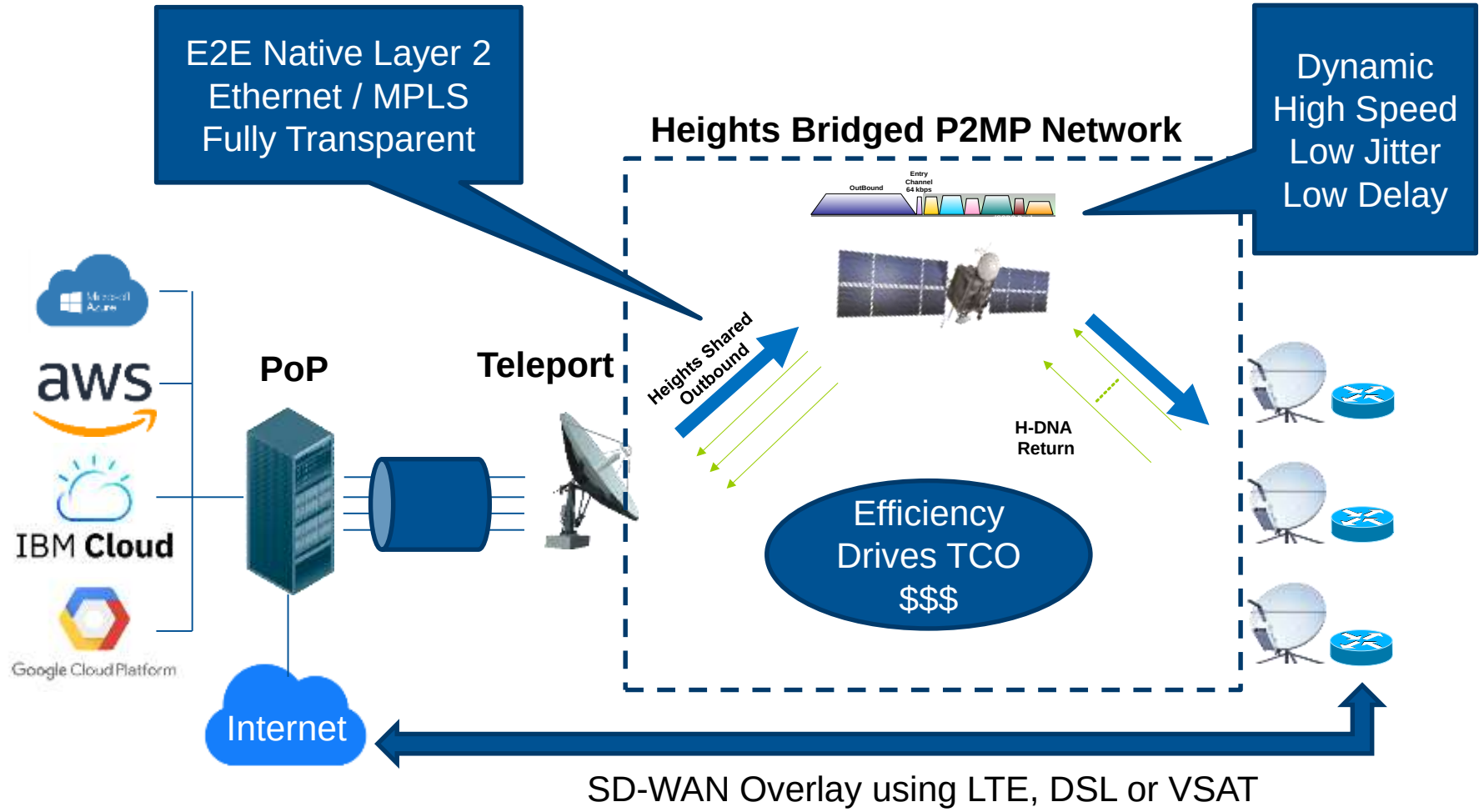
Source Innovabe Solutions

- New services being launched daily: E-Gaming as a Service, Video Processing as a Service (collaboration with innovative HW platforms GPU/Nvidia, etc)

Satellite support for Cloud

	GEO	MEO	LEO
Latency (msec)	HIGH (550)	LOW (150)	Very LOW (50)
Throughput	10-1000Mbps (HTS)	10-10000Mbps	10-15000Mbps
CAPEX	MEDIUM	HIGH	???
Ideal application	Video Broadcast Internet distribution Large geographical coverage	Business focus Cloud services Ideal for voice, data, interactive services	Business/consumer focus Fiber performance internet Cloud services (including new EGaaS, VaaS
Deployment comments	Most web based services operate well or are supported with additional hardware (PEP, Intelligent EDGE peering)	Cloud services well serviced with high throughput, low latency links, however, high cost of ground equipment and lack available BW (until mPOWER is available)	LEO can provide high performance ultra low latency and is perfect for Cloud, however, need to wait and see.

The Opportunity for GEO Satellite

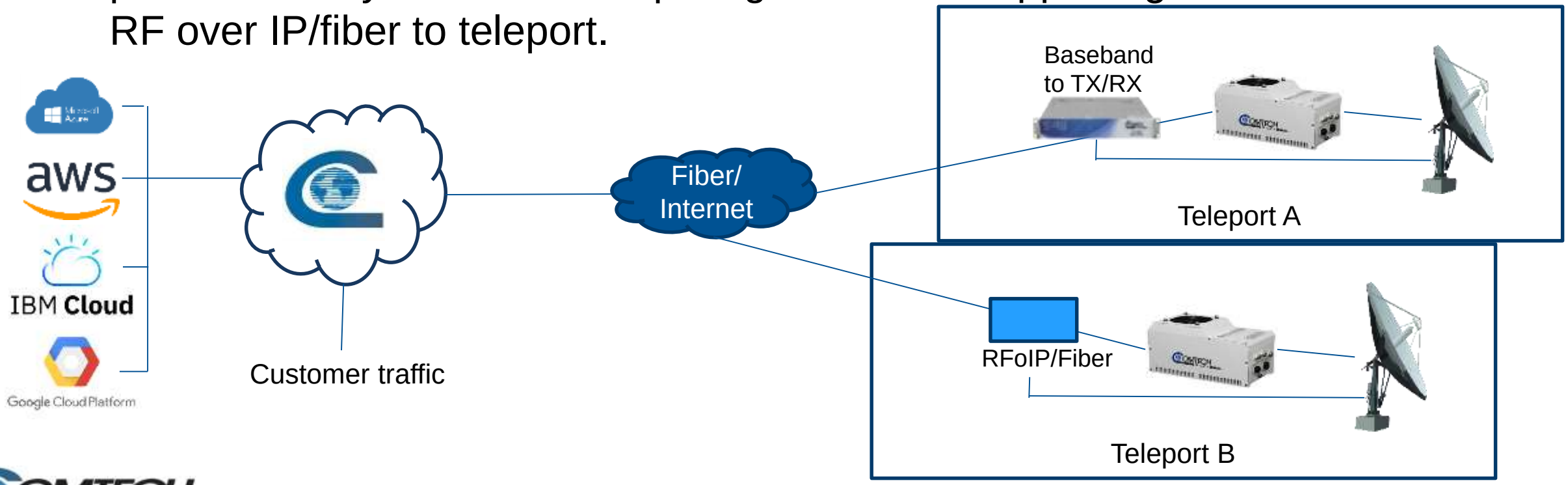


Cloud Access and the Satellite Operator

- 2019 – SES announces first Cloud partnerships delivering cloud services to cruise ships, oil platforms, military through O3B MEO. Extending the Cloud via O3B to the intelligent EDGE.
- 2019 – Starlink demonstrates 610Mbps connectivity US military aircraft. When fully deployed will be able to provide Cloud access through high speed low latency links to regional gateways. Regional gateway to cloud is over terrestrial links. Max 16-20Gbps per satellite.
- 2020 to 2022 – Telesat LEO and Starlink networks operational. Anywhere in the world to anywhere with latency < terrestrial expands cloud access to areas with no fiber access.

Future: Cloud and Evolution for Ground Equipment and Teleport

- SATaaS: Satellite as a service?
- Future (Virtualization of the HUB and Teleport): Ground Equipment vendors migrate compute intensive processes from dedicated HW platforms to hybrid cloud computing resources supporting “baseband” or RF over IP/fiber to teleport.



Conclusion

- Cloud is having big impact on enterprise and consumer bandwidth consumption.
- Over 50% of cloud revenue currently comes from US. Traction around the world is accelerating and represents greatest growth opportunity.
- High availability of highspeed and low latency satellite access is key to greater adoption of cloud services by enterprise currently suffering from bandwidth constraints.

About Us

- Our parent company is COMTECH TELECOMMUNICATIONS CORP.
- We are a leading supplier of communications equipment with a focus on satellite bandwidth efficiency and link optimization
- Our high-performance satellite communications ground equipment is deployed globally to support mission-critical and demanding applications