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Mobile Edge Computing:
What did not work and what the future may hold

Fog World Congress

Santa Clara, October 31, 2017

All generalizations are false, including this one.

Mark Twain

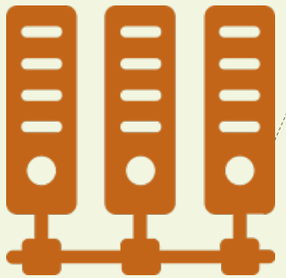
Repeating Cycle

Distributed

Centralized

Client-Server
1980-2000

Edge Intelligence
2020-



Mainframe
1950-1970

Mobile Cloud
2005-2020

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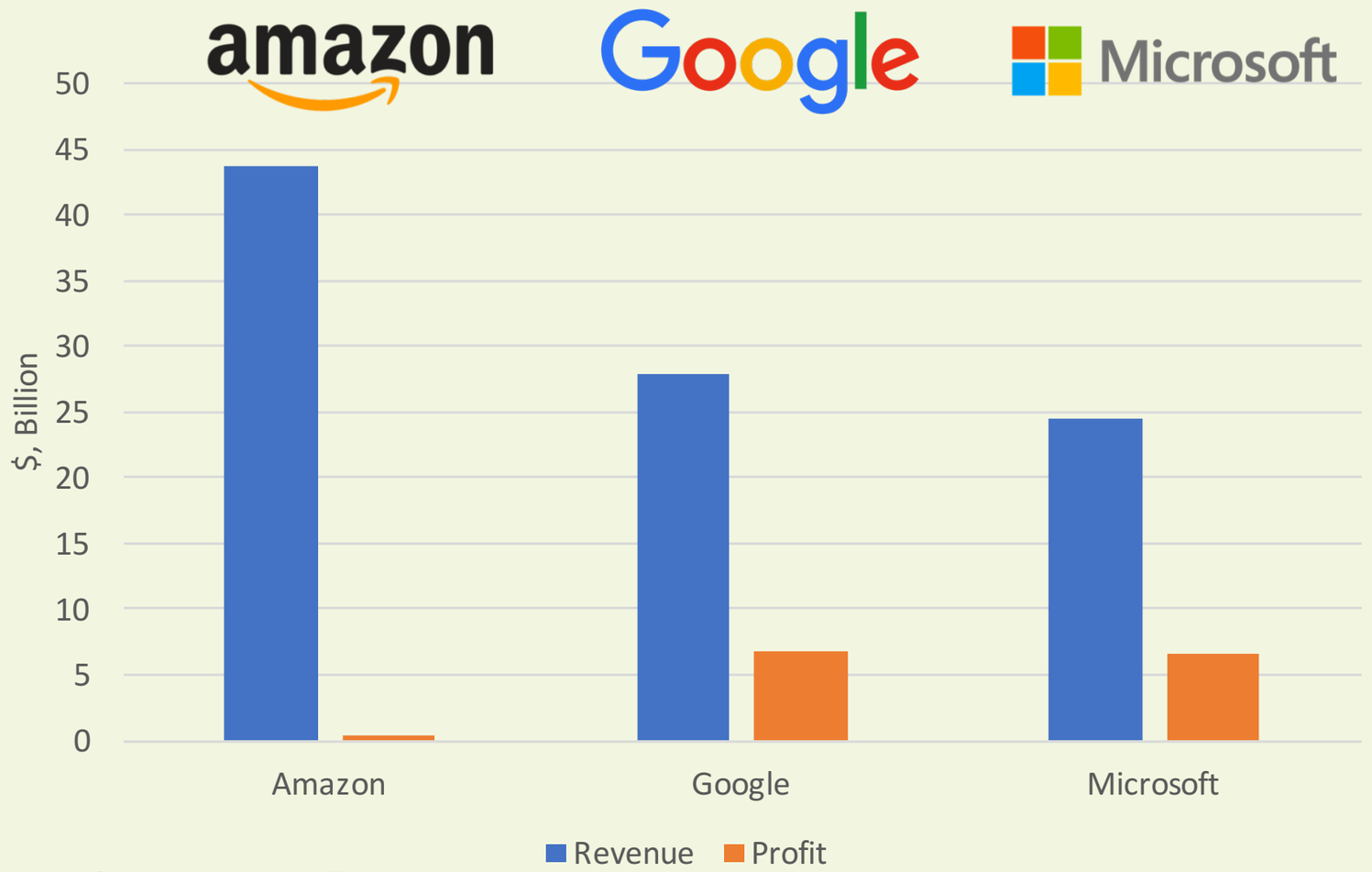
Performance of Cloud Players



$1.9T
Market Cap*

Quarter ending Sep. 30, 2017

* 10/27/2017

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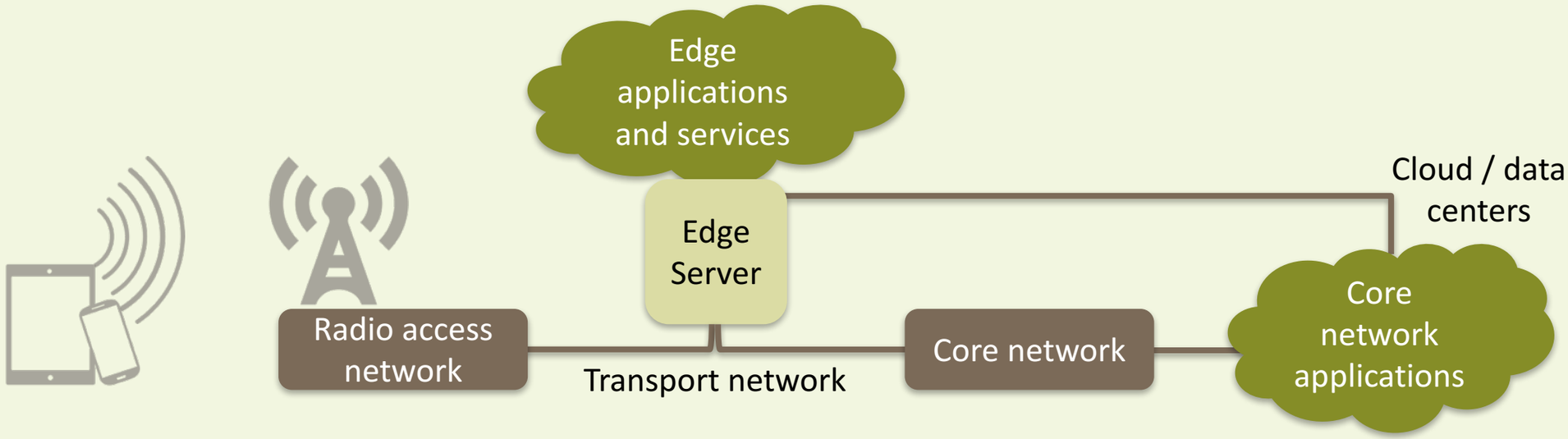
Edge Computing in Wireless Networks

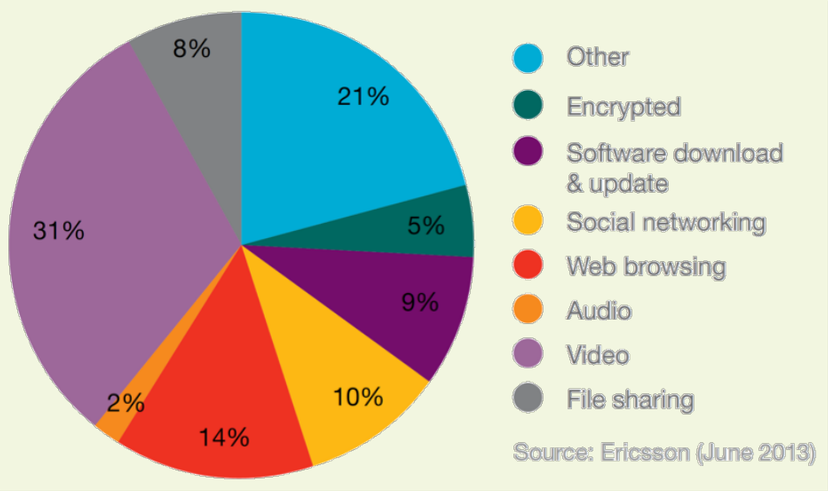
Is this architecture viable?



Will MNOs leverage edge computing to gain competitive advantage over the OTTs?

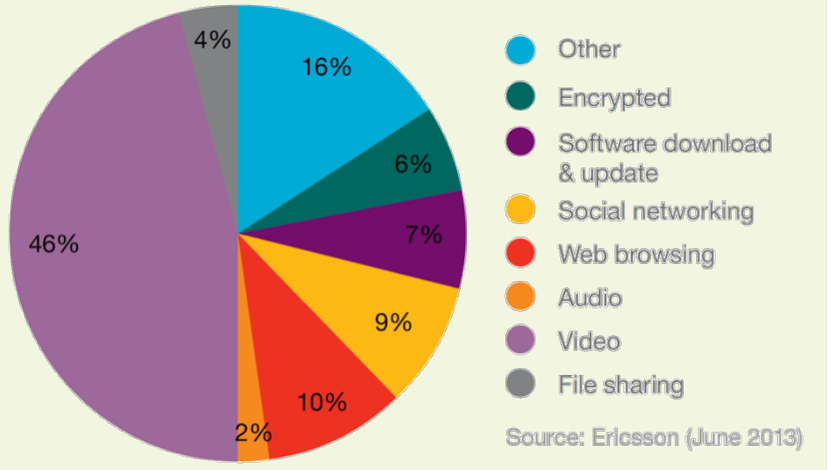
Case Study: Video Traffic

2012 Mobile data application traffic share



< 1 ExaByte/month

2018 Mobile data application traffic share



6.5 ExaByte/month*

Caching as edge application succeeded.

Why caching as <u>mobile</u> edge application did not succeed?

2016: 8.8 ExaByte/month; 50% of traffic

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Mobile Edge Applications

Optimization Applications	Monetization Applications
› Business case tilted towards reducing operating expenses	› Business case revolves around generating new revenues
› Particularly useful for consumer segment	› Particularly useful for enterprise segment
› Better economic viability with edge closer to core	› Better performance advantage in placing MEC closer to user
› Amenable to deployments by MNOs	› Amenable to deployments by MNOs and third party service providers

Application Adoption Timelines

Applications	Latency	Caching	Context	Location	Computation	Transcoding	Power	Deployment Timeline
Content Caching	✓	✓		✓				M/L
Traffic optimization			✓	✓		✓		S
Augmented reality	✓				✓			L
Virtual reality	✓				✓			L
Multimedia content delivery (video)		✓				✓		S
Enterprise applications								
Asset tracking				✓			✓	M
Video surveillance & analytics					✓	✓		M
Local voice and data routing		✓		✓				M
Retail services								
Ad delivery			✓	✓				M
Footprint analysis			✓	✓				M
IoT Connectivity								
Massive IoT (e.g. sensor or meter reading)					✓		✓	M/L
Critical IoT (e.g. smart grid switching, fault detection)	✓							M/L
Critical Communications								
Traffic safety and control systems	✓							L
Precision farming	✓							L
Industrial IoT, time critical process control	✓							M/L
Hazard warning	✓							L
Cooperative autonomous driving	✓							L
Healthcare applications	✓		✓	✓				M/L

Deployment timeline: S: short term; < 3 years | M: Medium term; 3-5 years | L: Long term > 5 years

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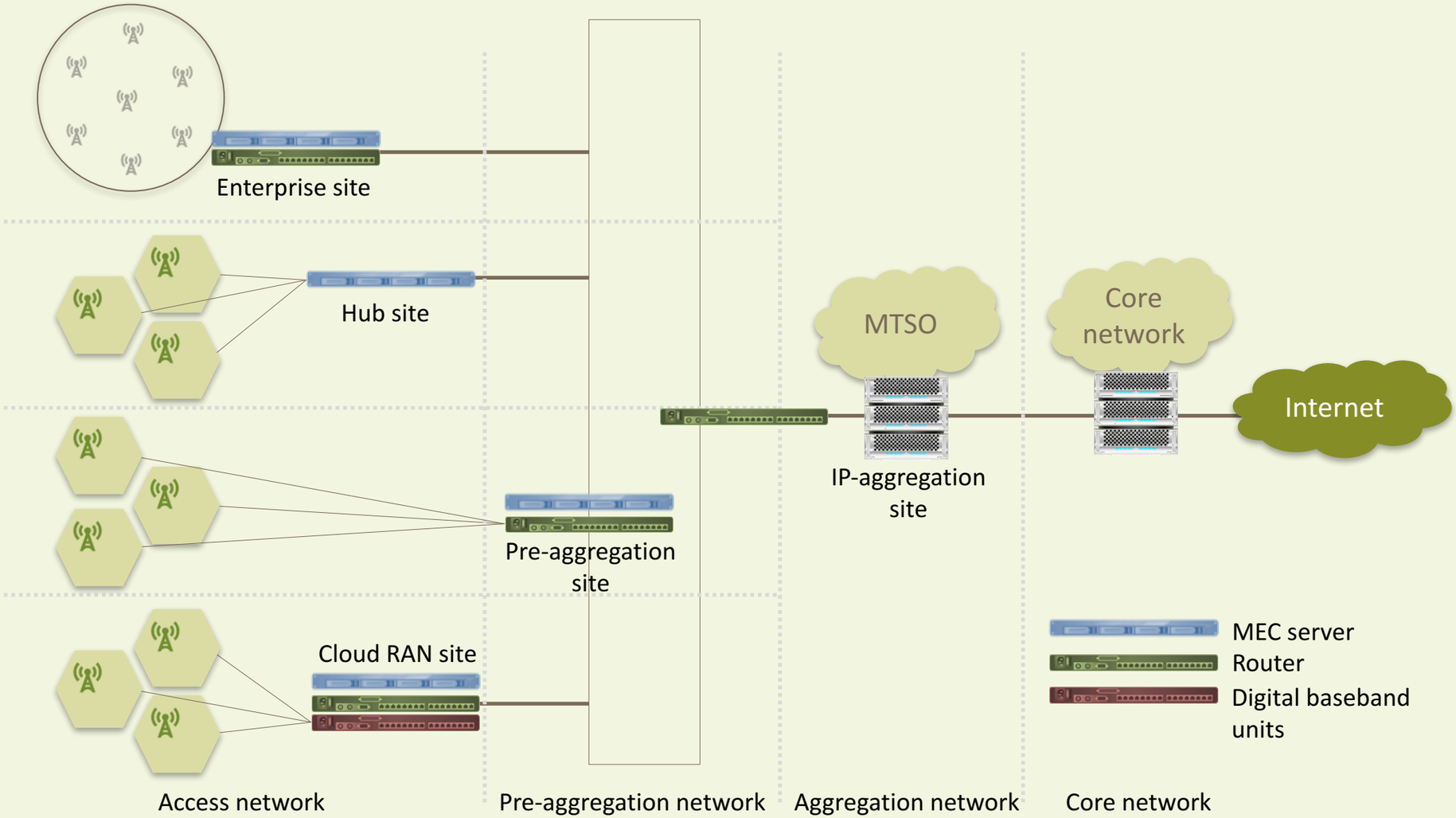
The Edge Can Be Anywhere?!

Cost: $$
Benefits: High

Cost: $$$$
Benefits: High

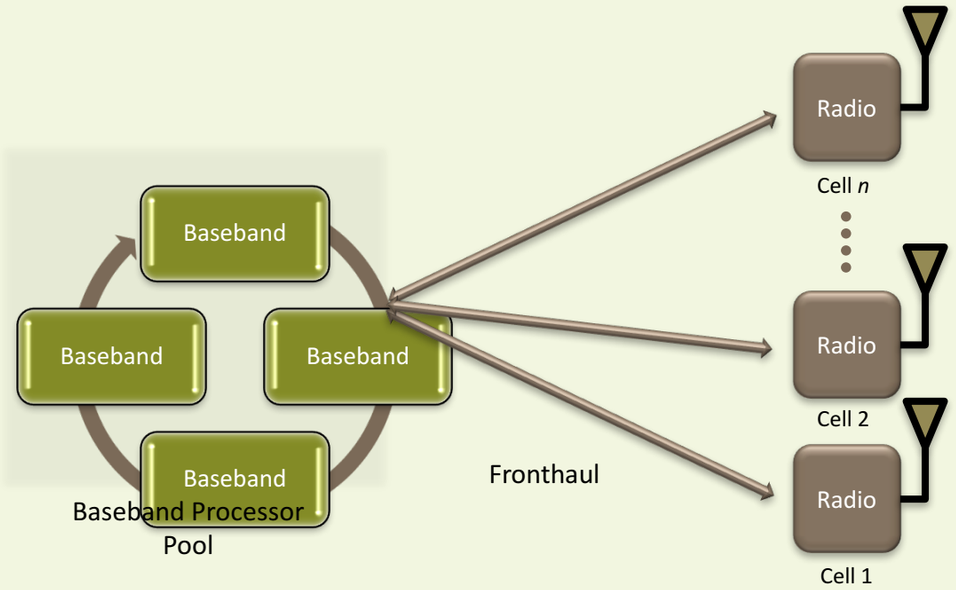
Cost: $
Benefits: Medium

Cost: $
Benefits: Medium

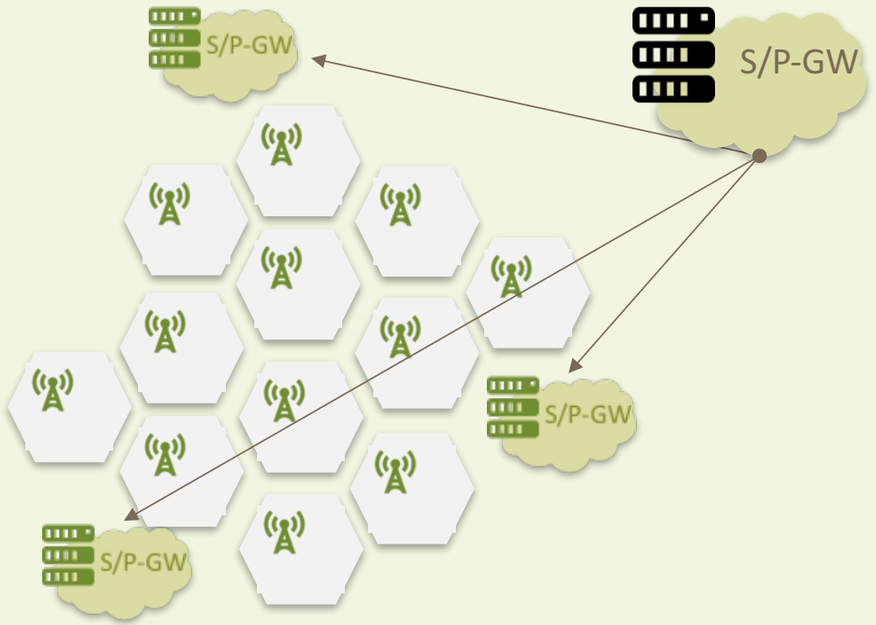


Bring the Edge and Core Closer to Each Other

Bring the edge closer to the core: Cloud RAN



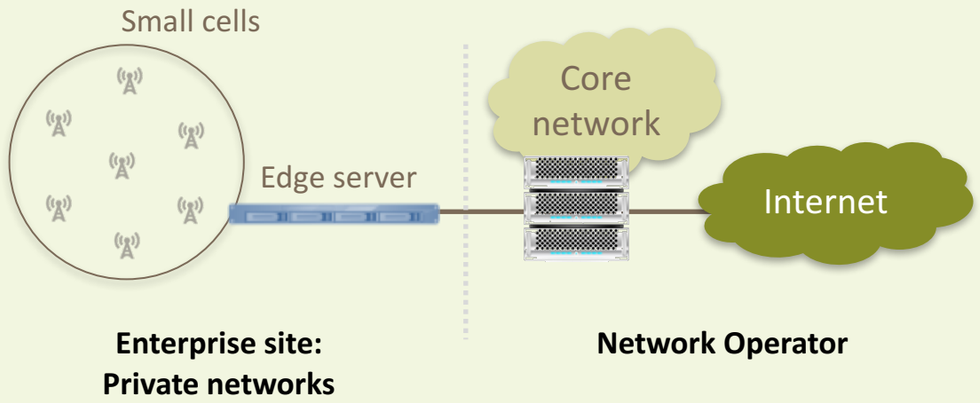
Push the core closer to the edge: Distribute S/P-GWs



Virtualization makes both options more feasible than ever before

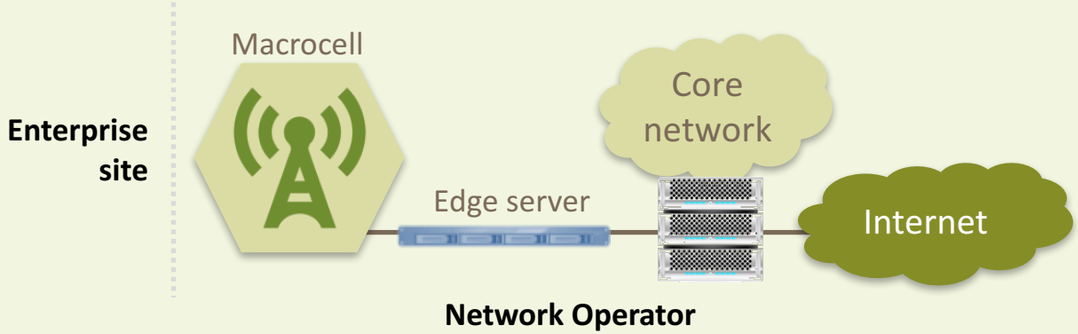
Who Control the Edge?

Edge at the enterprise



- Enabled by small cells
  - Licensed spectrum
  - Shared/unlicensed: CBRS 3.5 GHz, 5 GHz MuLTEfire
- Performance advantage
- How to penetrate the enterprise?

Edge at the network operator



- Upgrade to existing networks
- Lower performance enhancements
- Who owns:
  - Subscription management?
  - Equipment management?
  - Service management?
  - Device management?

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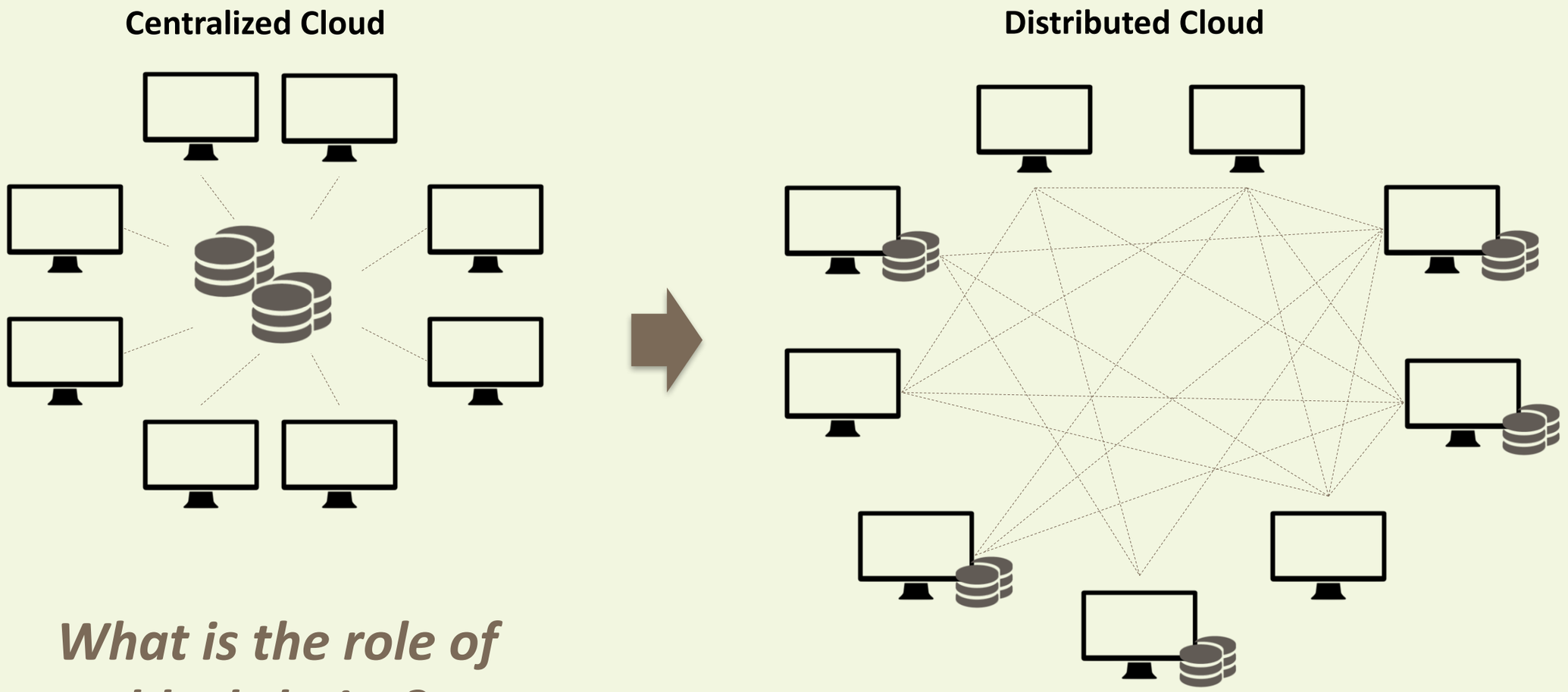
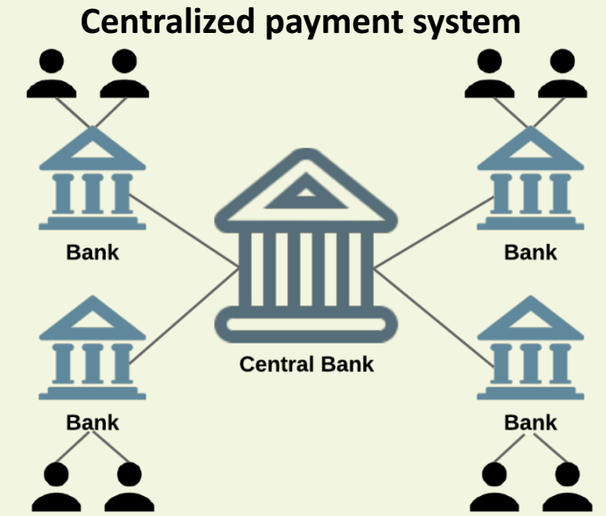
Intersection of Edge/Fog Computing with Blockchains

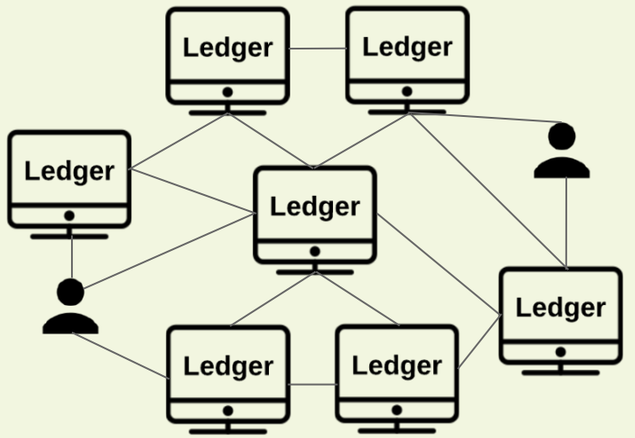


What is the role of blockchains?

Blockchains – A Brief Introduction

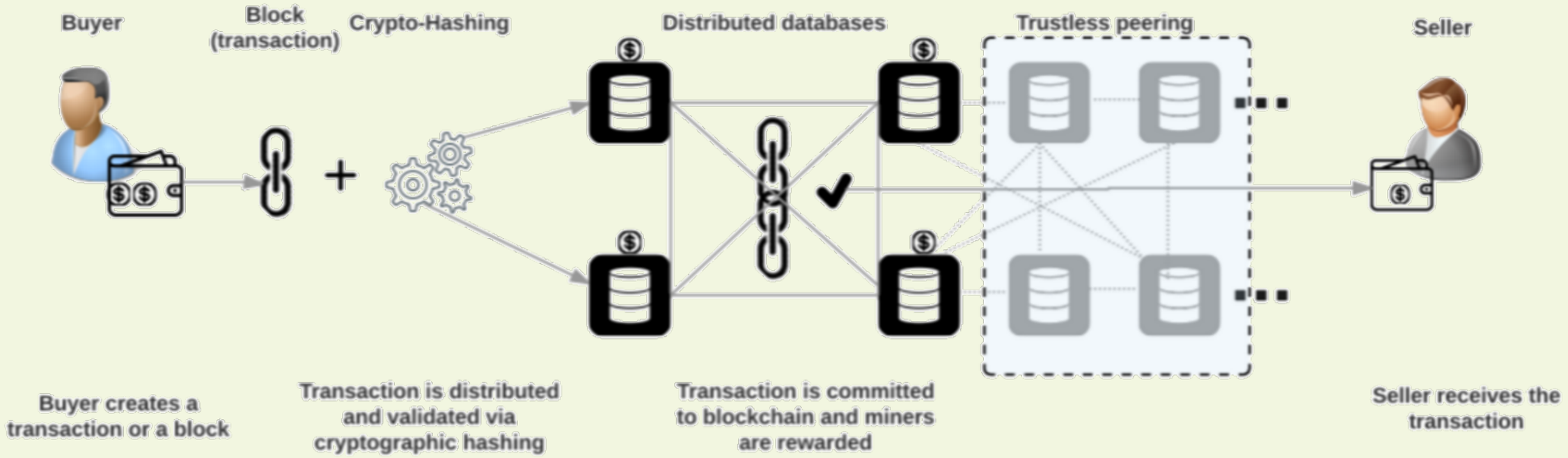
- Distributed database (ledger)
  - Decentralized - every user has a copy of the blockchain (database)
- Peer-to-peer
  - No central trust authority
- Open, secure
  - “Internet of Trust”





Distributed Ledger - Blockchain

Blockchain Process



Blockchains provides a secure peer-to-peer solution to store, access and transfer data a the edge

Source: Cloud Technology Partners

Applications of Blockchains in Telecom / IoT

Smart Contracts
Details of transaction elements among multiple parties are securely stored in blockchains and processed automatically as each milestone is fulfilled

Asset Transactions and Micropayments
Low blockchain-based transaction cost enables micropayments for digital assets such as music, games, gift cards, loyalty cards, etc. It also enables payments for IoT enabled services such as asset leases/rentals

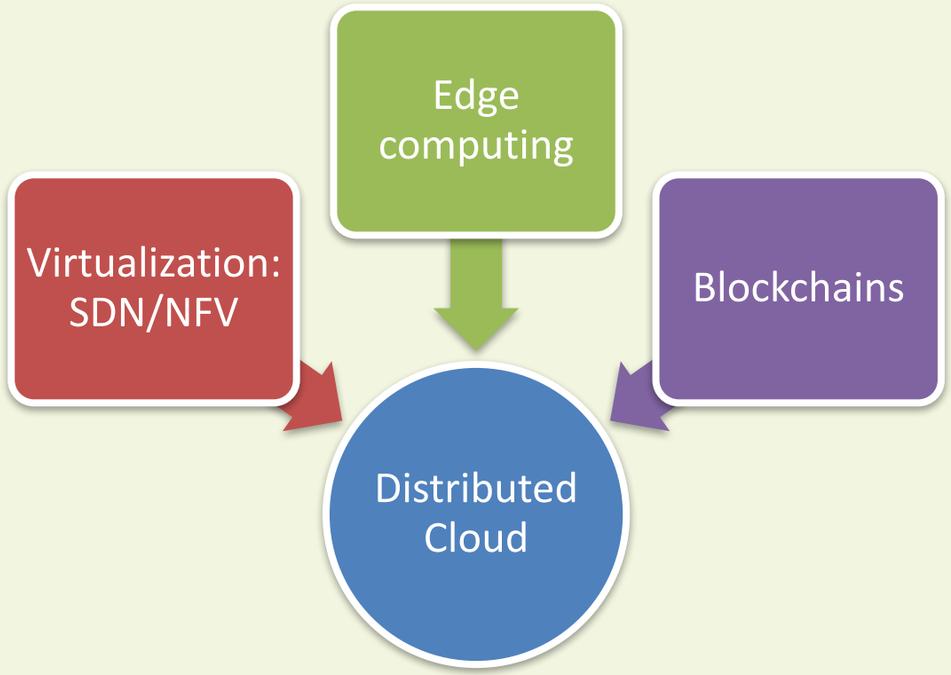
Healthcare
Secure electronic healthcare storage and transmission on permissioned blockchains

Smart Cities
Blockchains are transparent and auditable allowing for smart charging among other services

PKI and Digital Certificates
Blockchains as a complementary and alternative model to PKI based security infrastructure

Identity Management
blockchain-based identity management platform to enable authentication across devices, apps and organisations

New Business Models Emerging



Is blockchains a threat to the cloud players?

Does blockchains provide telcos the opportunity to challenge the cloud players?

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Boutique Advisory Firm Specialized in Developing New Growth Strategies

Private Equity & Venture Funds

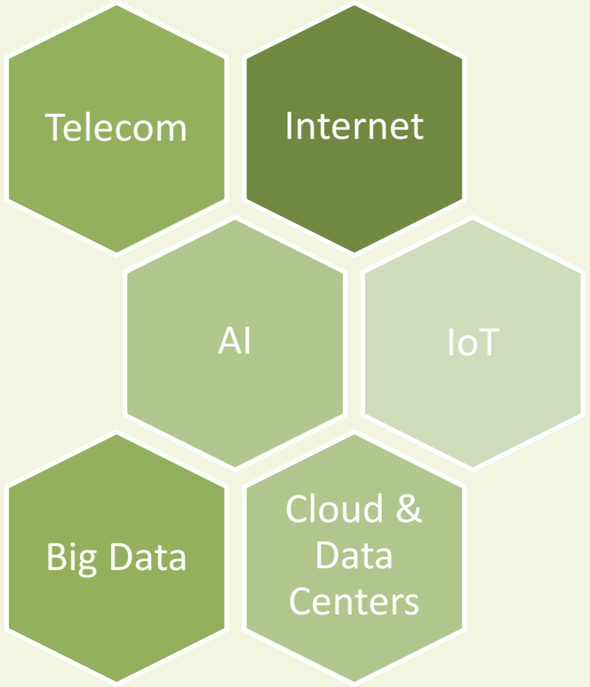
- M&A due diligence; competitive analysis & positioning

Technology Corporations

- Develop new business ventures from concept validation to implementation

Governments, Regulatory & Policy Makers

- Market & technology assessment for policy decisions



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