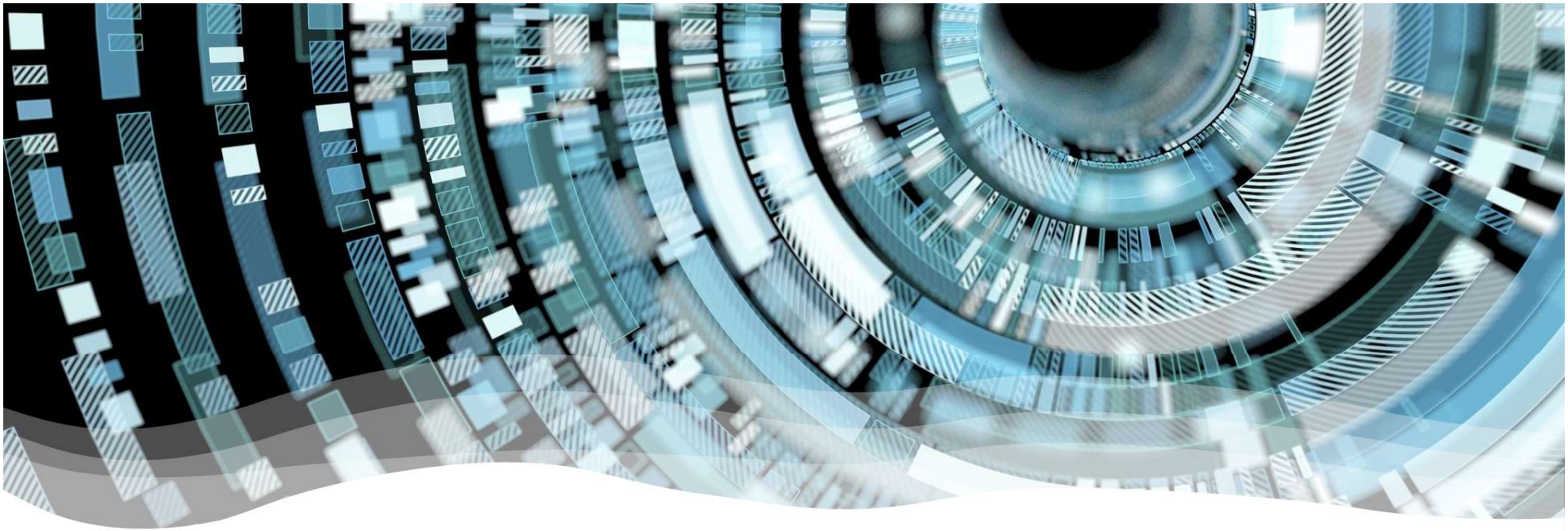
BLOCKCHAIN ASSOCIATION SINGAPORE

SP PACE ACADEMY

SINGAPORE POLYTECHNIC SP

In support of

SG JOBS & SKILLS



Enterprise Blockchain Developers (Intermediate)

Powered By

SmartMesh®

MeshBox

Day 3 Lecture

Project Concept Options from previous Blockchain Challenge

Introduction to SmartMesh and MeshBox

How We Facilitate Inclusive Connectivity

06 January 2021

Agenda

- Blockchain Challenge Projects (for your consideration)
- Financial inclusion
- Introduction of SmartMesh ecosystem
- Spectrum – permissionless public blockchain
- Infrastructure and architecture
- MeshBox and HyperMesh

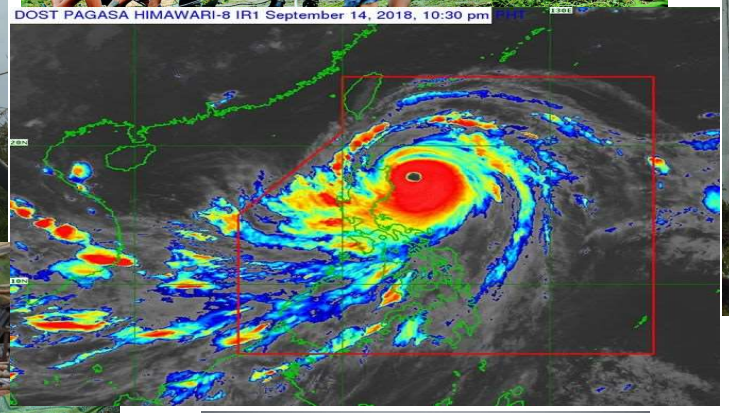
Blockchain Challenge Projects (for your consideration)

- 10:00 Tokenate Transparent Charity [BC14]
  https://eco.meshbox.io/projects/project-tokenate-a-project-on-transparent-charity-bc-14/
  (20:00)
- 10:20 DrugChain BC16]
  https://eco.meshbox.io/projects/drugchain-bc-16/
  (20:20)
- 11:40 Avocado Supply Chain [BC12]
  https://eco.meshbox.io/projects/avocados-sin-violence/
  (21:40)
- 12:00 SmartTravel [BC04]
  https://eco.meshbox.io/projects/smarttravelbc-04/
  https://t.me/joinchat/HGHG9NqI73iy9SCU

Status in Developing Countries

- Insufficient infrastructure
- Expensive and slow Internet
- High broadband data price

Philippines
Typhoon Ompong



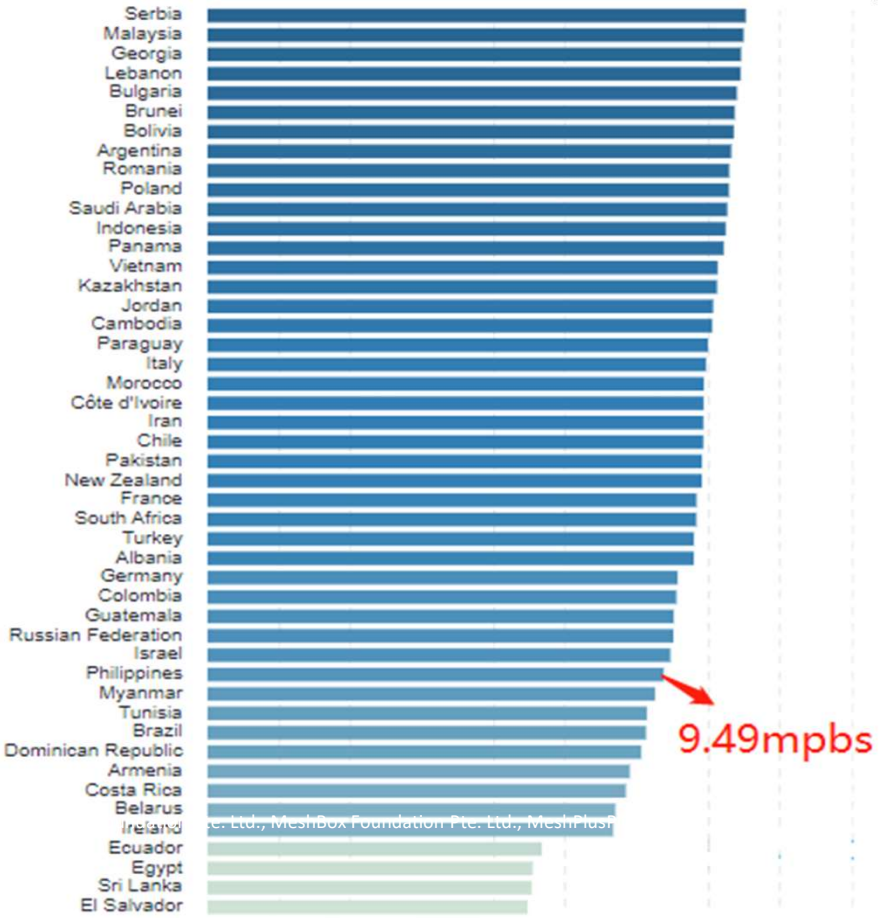
- Cagayan, Northern Philippines suffered 7 casualties due to their improved preparations since Typhoon Lawin in 2016, but telco and power outages continue to be a problem.
- “There has been no electricity supply … communications were also down...” Provided by Foremost Cagayan Development and Leisure Corporation

South East Asia Countries Internet Unavailability

Country	Internet Users (2016)	Penetration (% of Pop)
South Korea	43,274,132	85.7 %
Philippines	44,478,808	43.5 %
Turkey	46,196,720	58 %
Viet Nam	49,063,762	52 %
Indonesia	53,236,719	20.4 %

Internet in Developing Nations: Expensive and Slow

According to Open Signal, the Philippines ranks 85th in terms of mobile network bandwidth speed out of 88 countries, with an average speed of 9.49 Mbps



The United Nations adopted the Alliance for Affordable Internet's threshold for affordability: 1GB of mobile data for less than 2% of average monthly income.
Cost in Philippines was 3.8% in 2015 and 2.02% in 2016.
The Majority of Filipinos do not have access to the Internet.

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13	Viet Nam	49,063,762	52 %
12	Indonesia	53,236,719	20.4 %
11	France	55,860,330	86.4 %
10	Mexico	58,016,997	45.1 %
9	U.K.	60,273,385	92.6 %
8	Germany	71,016,605	88 %

Price of Broadband Data (1GB mobile prepaid) as % of GNI per capita, 2016

UN Broadband Comission recently adopted the Alliance for Affordable Internet's threshold for affordability: 1GB of mobile data for less than 2% of average monthly income.

	2016	2015
Philippines	2.02%	3.80%
Colombia	2.02%	1.79%
Morocco	2.10%	2.05%
Cambodia	2.11%	3.36%
Jordan	2.17%	1.45%
South Africa	2.35%	2.48%
Sudan	2.60%	0.99%
Bangladesh	2.66%	3.63%
India	2.69%	3.55%
China	2.89%	Data not available.
Bolivia	2.90%	2.89%
Namibia	3.49%	2.69%
Peru	3.60%	3.80%
Senegal	3.87%	10.20%
Jamaica	3.94%	1.26%
Ghana	4.11%	3.89%
Ecuador	4.12%	6.58%
Guatemala	4.20%	Data not available.
Kenya	4.33%	9.72%
Nepal	4.60%	9.14%
Botswana	5.11%	5.74%
Haiti	5.90%	7.94%
Tanzania	6.25%	8.74%
Côte d'Ivoire	6.36%	7.23%
Cameroon	6.43%	12.27%
Mozambique	6.85%	11.94%
Nicaragua	8.12%	9.45%
Rwanda	8.42%	20.16%
Honduras	9.75%	8.56%
Zambia	12.25%	14.94%
Yemen	13.39%	12.48%
Ethiopia	13.53%	19.63%
Burkina Faso	15.10%	15.45%
Uganda	15.33%	27.71%
Benin	16.50%	16.60%
The Gambia	17.85%	14.12%
Mali	19.33%	19.37%
Malawi	20.09%	35.96%
Zimbabwe	44.68%	Data not available.
Venezuela	Data not available.	3.51%
Myanmar	Data not available.	5.90%
Sierra Leone	Data not available.	51.89%

https://a4ai.org/affordable-internet-is-1-for-2

Mentimeter
Digital Divide

Introduction to the SmartMesh Ecosystem

SmartMesh

- Token-based next-generation protocol for the HyperMesh architecture.
- Spectrum: SmartMesh public blockchain
- SMT (SmartMesh Token)
  - Base coin on the Spectrum public blockchain.
  - After staking SMT on a Spectrum node (Laptop, server, MeshBox) the signer (miner) will earn SMT.
  - SMT can be used to pay for MeshBox services such as Internet access.

MeshBox

- An ecosystem project of SmartMesh which provides the hardware platform for the SmartMesh protocol and various inclusive applications.
- Hardware box device capable of Spectrum blockchain mining, backhauling to internet access, decentralized data storage, edge-computing and storage, and IoT bridging to the Internet.
- MESH
  - MeshBox token, on Spectrum
  - Used to pay for MeshBox services such as IoT data transfers, decentralized data storage, decentralized parallel computing, etc.

Spectrum

- Compatible with Ethereum Smart Contracts and Tokens
- Runs light Proof-of-Capability Consensus
- Spectrum Mining Node runs on MeshBox

- Photon Network
  - A layer-2 Extension to Spectrum which scales Transactions-per-Second
  - P2P, fast, secure transfers of crypto-currencies, scalable Transactions-per-Second (TPS) metric.
  - For intermittent internet, in Inclusive applications Photon operates off-chain and off-internet

- Tango Smartphone App
  - A mobile application that acts as a crypto-wallet for Spectrum tokens
  - Spectrum and Photon transfers
  - SMT mining management

Architectural Enhancements

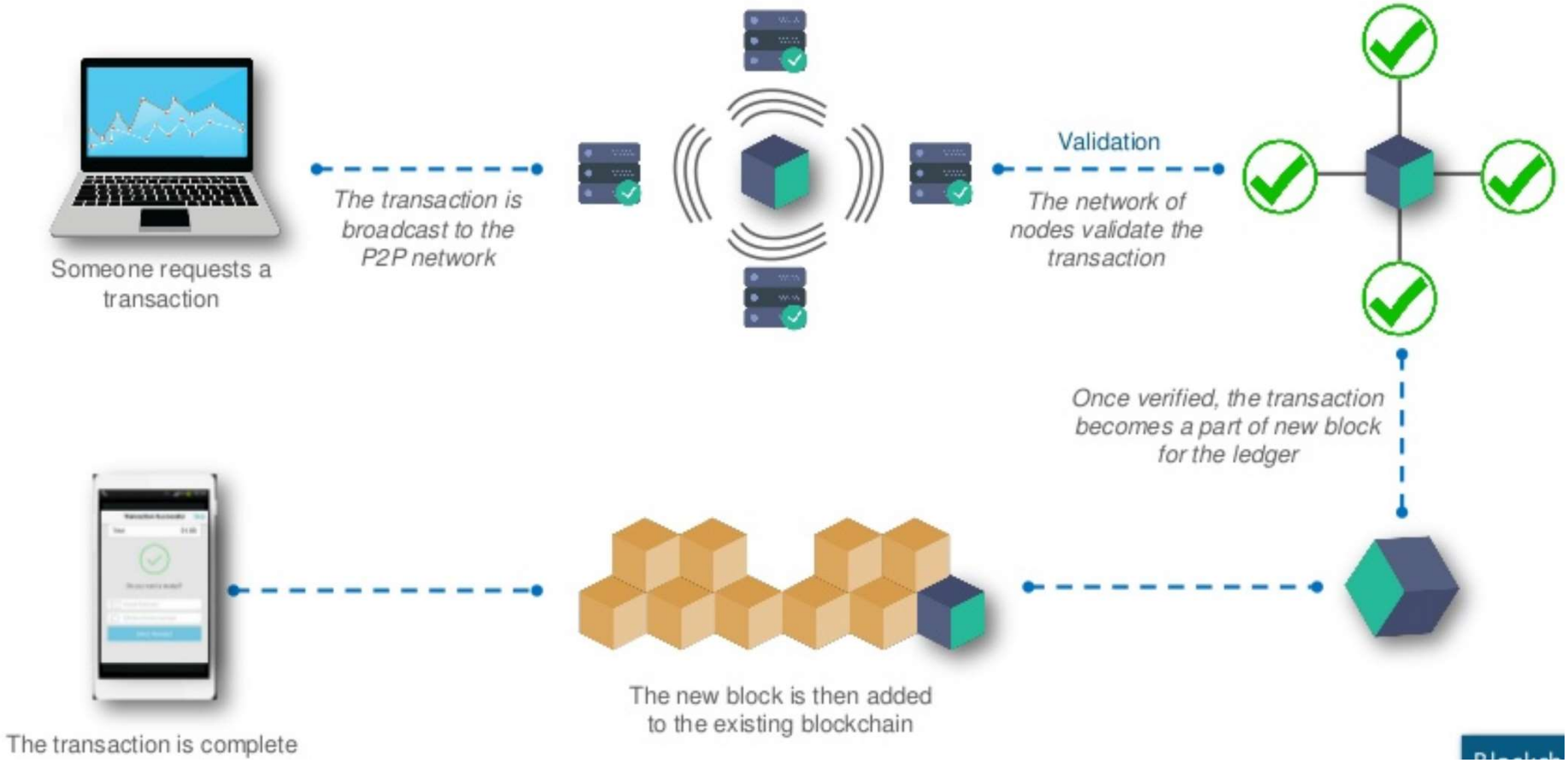
- Atmosphere
  - SmartMesh's cross-chain interoperability architecture
  - Connects to other blockchain ecosystems and associated tokens
- HyperMesh Architecture
  - The next-generation cyber-physical architecture
  - Provides seemless interworking of Spectrum Blockchain, Photon Payment Network, MeshBox edge computing/storage, Internet backhaul, Wifi mesh routing, and Internet of Things LPWAN connectivity.
  - Supports applications: inclusive connectivity, payment systems, transactive IoT and energy

Spectrum Permissionless Blockchain

- Blockchain Intro
- Spectrum and mining
- Why do we need Spectrum?
- What are the differences between Spectrum and conventional blockchains and what are the goals that can only be enabled by Spectrum?

Blockchain Basics

Blockchain – Flow Diagram



BlockChain Tutorial | Getting Started With BlockChain | BlockChain Certification Training | Edureka

https://www.slideshare.net/EdurekaIN/blockchain-tutorial-getting-started-with-blockchain-blockchain-certification-training-edureka?qid=c4313a3b-9c22-4fea-b394-acb18880cf0c&v=&b=&from_search=1

SmartMesh Spectrum Blockchain Architecture

Blockchain is so slow (14 TPS) !
How to incentivize connectivity ?

- The secret is at Layer 2, Photon Network for Spectrum
- A long lasting Public Blockchain should have a scalability solution ➔ Secondary layer architecture
- Global consensus on main chain should not be overwhelmed by trivial transactions.
- Offline Payment Enabled for the first time - How???

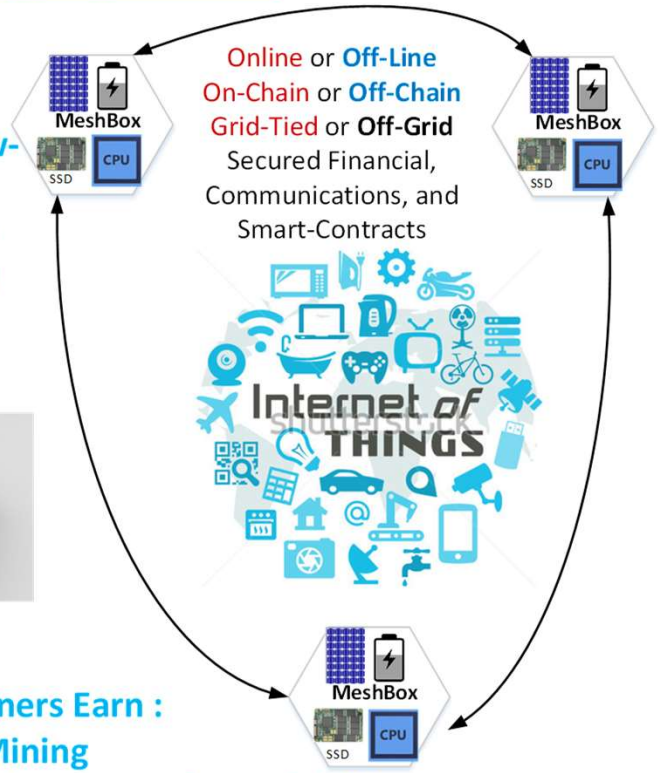
Spectrum vs Conventional Blockchains

- Inclusive payment system
- Inclusive connectivity
- Issues related to conventional blockchains:
  - PoW Mining Cost
  - PoW Energy consumption

Energy Cost for Inclusive Applications

SPECTRUM: SmartMesh Chain
Proof of Capability (PoC) consensus

Online or **Off-Line**
On-Chain or **Off-Chain**
Grid-Tied or **Off-Grid**
Secured Financial, Communications, and Smart-Contracts



Simpler, with low-computation requirements ➔ Inexpensive CPU is adequate (cellphone CPU)

MeshBox Owners Earn :
* **SMT from Mining**
* **SMT by sharing Network Bandwidth**
* **MESH by sharing Disk Storage**
* **MESH for Iot Data Communication Support (Transactive IoT)**

MeshBox-Tesla uses 72 Watts max
Over 1 day:
1728 Wh (=72W * 24h)
➔ $0.17 (=1.728 kWh * $0.10/kWh)

Traditional Blockchains

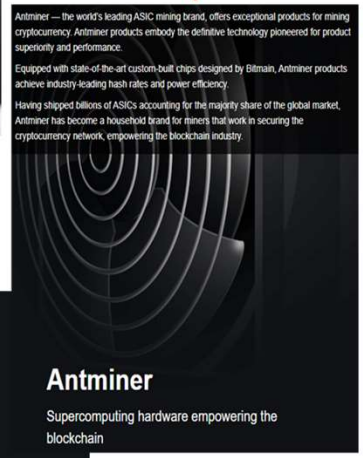
Proof-of-Work Power-Hungry, Expensive Hardware
GPU Miners **ASIC Miners**

Bitcoin, Ethereum: Proof of Work

Nvidia GTX 1080 Ti
A brilliant, yet expensive, GPU for mining

Core Clock: 1,582 MHz | **Memory:** 11GB GDDR5X | **Memory Clock:** 11GHz | **Power Connectors:** 1 x 6-pin; 1 x 8-pin | **Power Draw:** 250W | **Outputs:** 3 x

BitMain ASIC Miners are Heavy, with high Energy Consumption



110 TH/sec at 29.5 J/TH

How much Power is required ?
Total Energy Cost ?

(Assume $0.10 per KWh)

Energy Cost for Inclusive Applications

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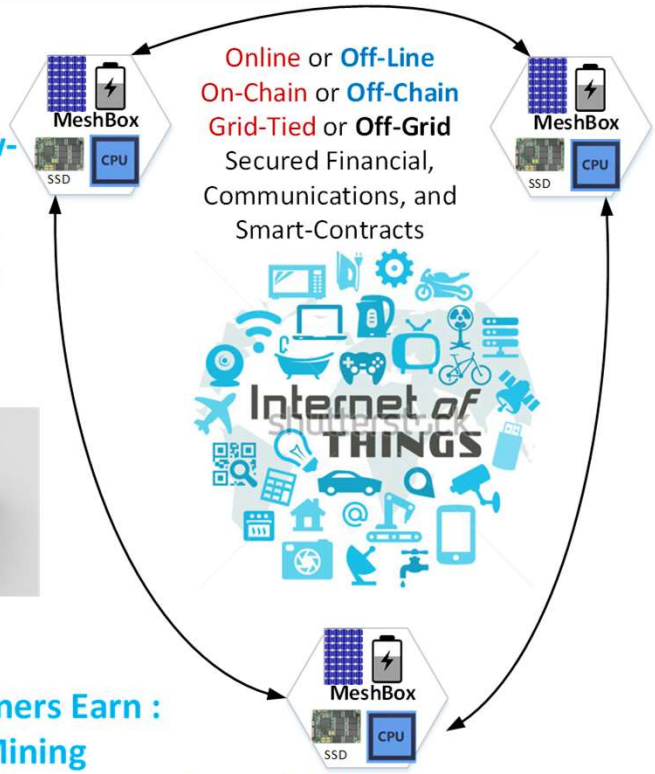

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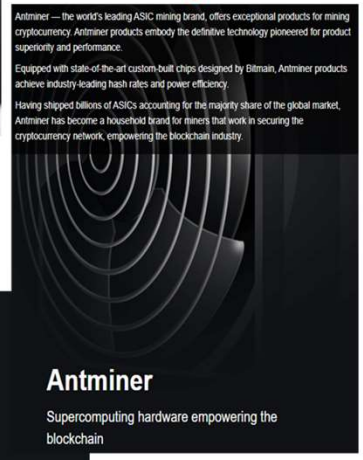

110 TH/sec at 29.5 J/TH

110 TH/sec at 29.5 W sec/TH

How much Power is required ?
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Energy Cost for Inclusive Applications

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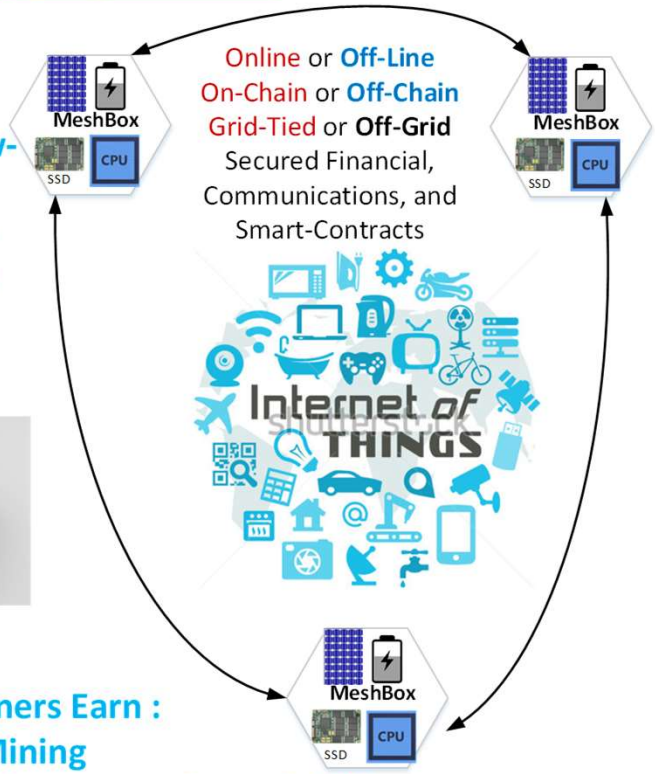

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Over 1 day:
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Home Air-conditioner is typically between 1000 and 4000 watts.
Over a day, requires 24 to 96 kWh
➔ $2.40 to $9.60

(Assume $0.10 per KWh)

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BitMain ASIC Miners are Heavy, with high Energy Consumption

3245 W = 110 TH/sec * 29.5 Watt sec/TH
Over 1 day:
77,880 Wh = 3245 W * 24 hours
➔ $7.79 (=77.880 * $0.10/kWh)

Spectrum and Photon

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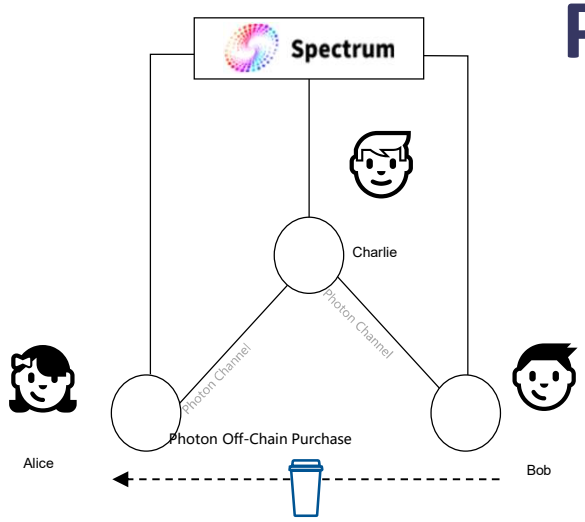
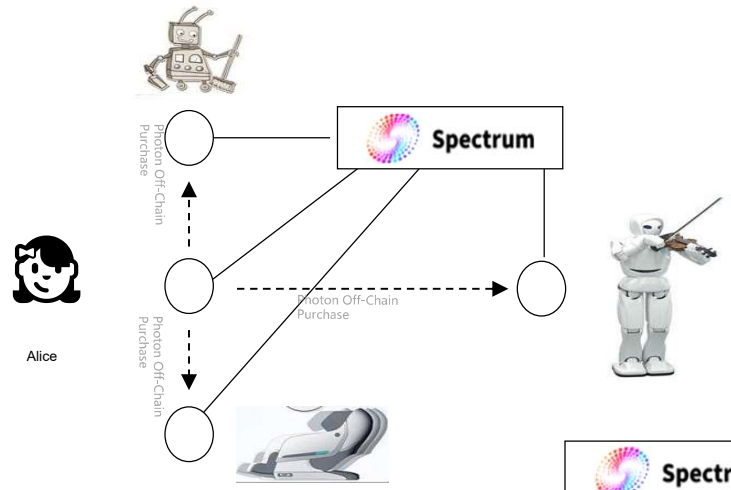
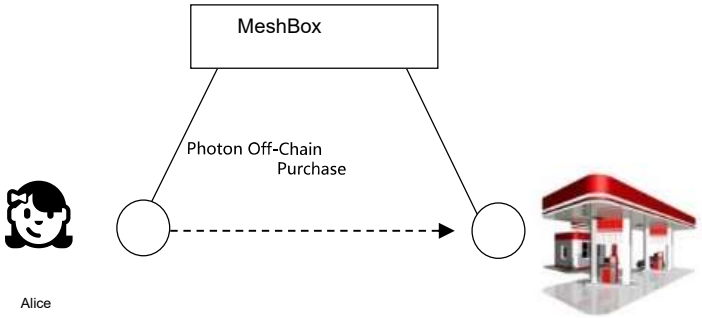
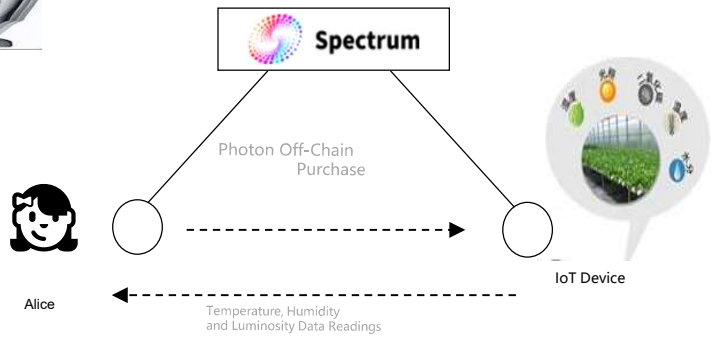
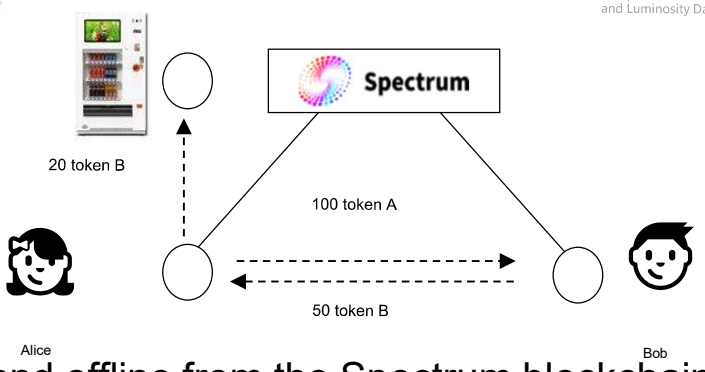
Photon Network











Photon Network

- Makes payments possible both on and offline from the Spectrum blockchain with security, speed, scalability and low cost
- Satisfies multiple types of off-chain payment scenarios.

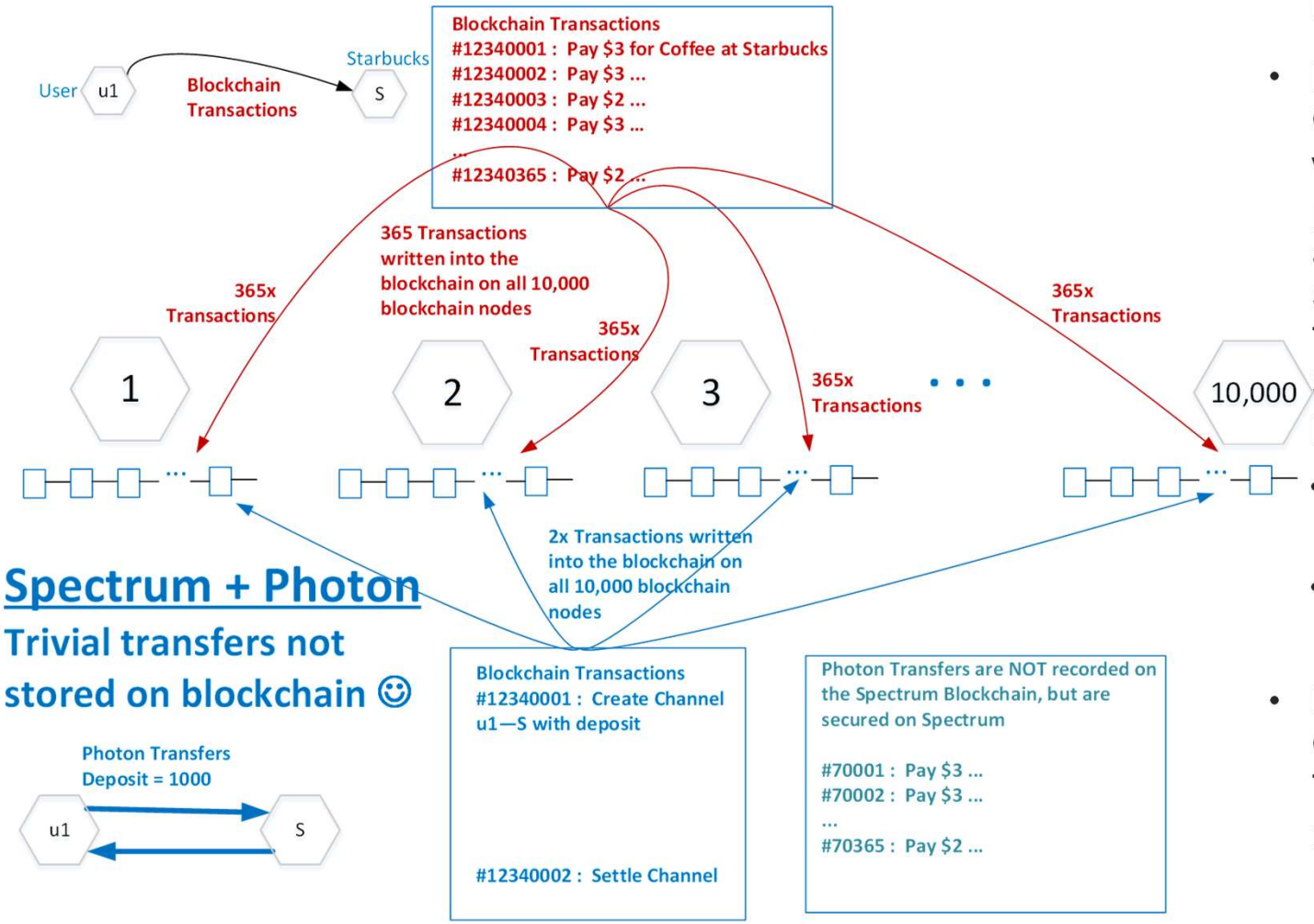
Photon Differentiation

- Photon Synergy with Spectrum: Photon Offloads most transactions from Spectrum
- Off-chain Payment Network for Intermittent Internet Access
- Lightweight, running on Smart Device
- Low-latency finality
- High Transactions-per-Second (TPS) throughput with concurrent Peer-to-Peer transfers
- Synergy with MeshBox Mesh Network (providing a super-highway of payment routes)

Synergy : Spectrum + Photon

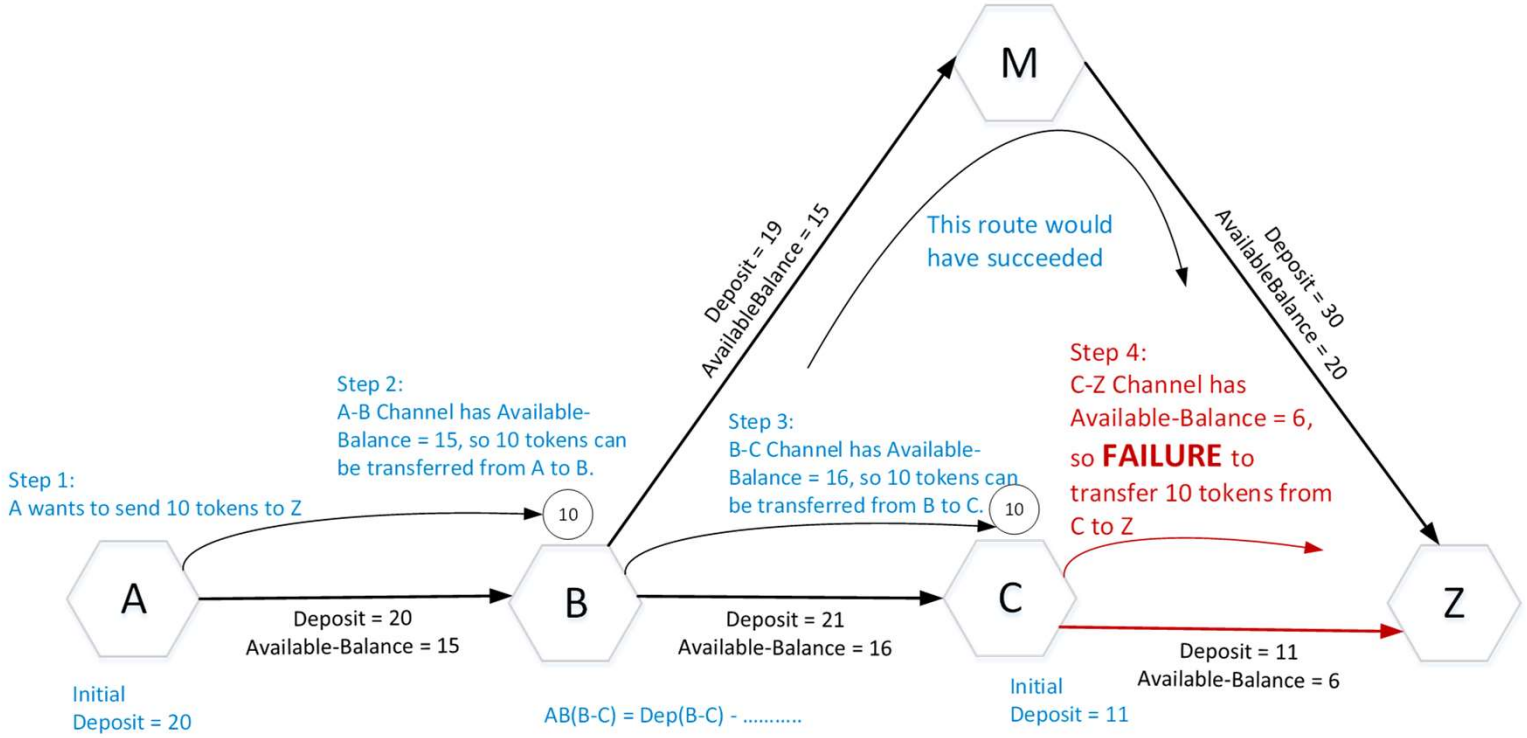
Blockchain ONLY

(Large amount of trivial information is stored on all nodes, forever ☹



- Photon for Spectrum is analogous to Lightning for Bitcoin and Raiden for Ethereum
- Photon is a Smart-Contract on Spectrum which execute in parallel (peer-to-peer) and thus do not impact Spectrum Transactions-per-Second (TPS)…. Except:
  - Initial Deposit onto Channel
  - When Channel is settled.
- Photon transfers are CONCURRENT, so TPS scales with the number of Photon nodes to Millions+

Issues with Conventional Payment Networks

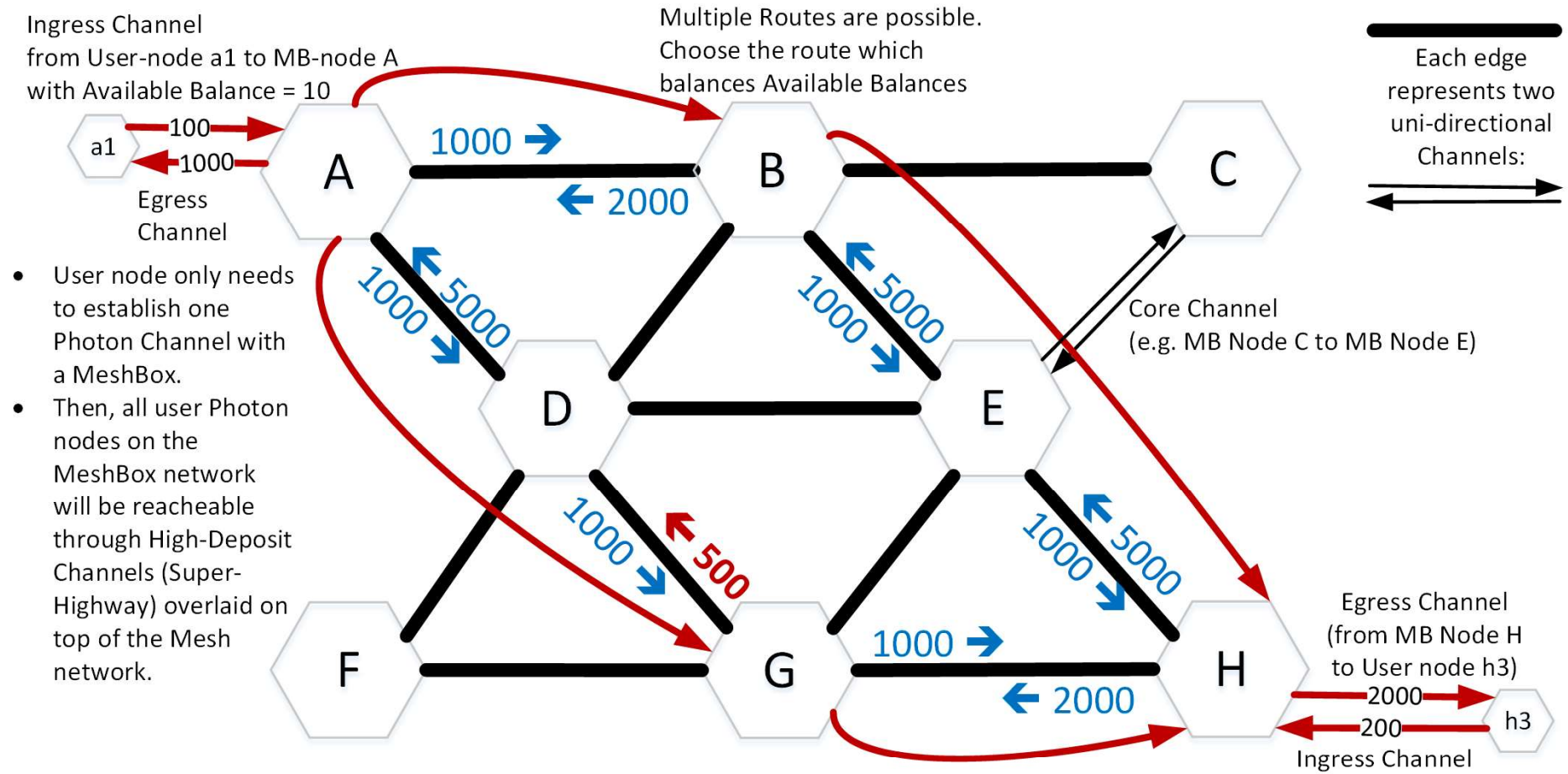


Payer-A wishes to transfer tokens, through Photon, to Payee-Z

- Bitcoin Lightening and Ethereum Raiden are conventional Payment Networks.
- A transfer is successful when a Route can be found from Payer (A) to Payee (Z)
- Conventional Payment Networks are usually User Defined, with **small deposits** on each Channel
- Routing from Payer to Payee has high chance to FAIL
  - **Complicated Topology**
  - **Inadequate Available-Balance** on links results in **no feasible route**
- Only **small Payments are supported** due to small user-defined Channels.

Conventional Payment Networks (Bitcoin, Ethereum) suffer from narrow Channels and high routing FAILURES

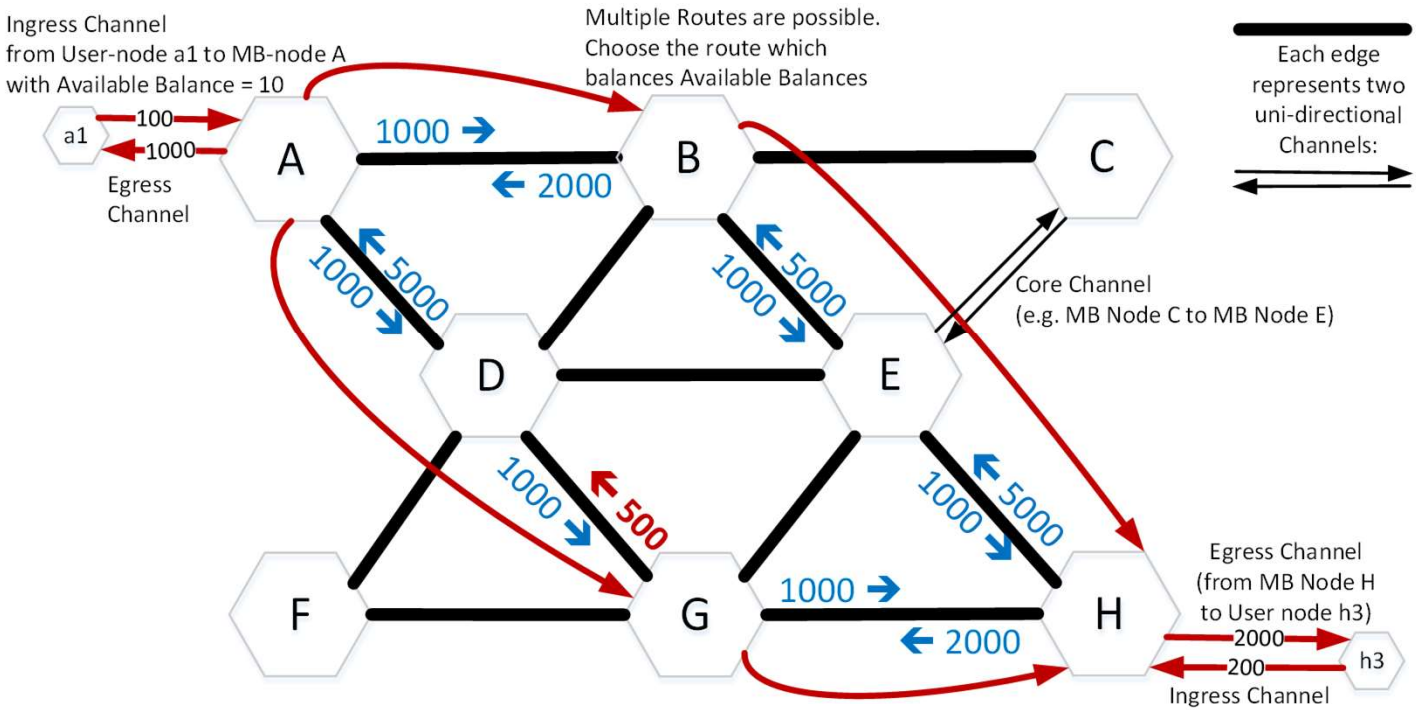
Synergy : Photon + MeshBox



- MeshBoxes are Photon nodes with large Deposits on Channels
- Routing through Topology is simplified
- Large Deposits reduces routing failures
- Large transfers are supported

MeshBoxes support Wide Photon Channels which increases Token Routing Success

Smartmesh Photon Secondary Layer Architecture



- At Creation, each Channel has a Deposit (=D), which is recorded on the Spectrum blockchain.
- When a Channel is settled, each side gets what is due.
- A gets AvailableBalance(A_B)
- B gets AvailableBalance(B_A)

- At initialization, each Channel has a Deposit (=D), which is recorded on the Spectrum blockchain.
- AvailableBalance of the Channel from A to B (A_B) is a function of
  - X(A_B) = Sum of all DirectTransfer amounts, which is the amount which A owes to B directly. Initial value = zero.
  - X(B_A) = Sum of all DirectTransfers which B owes to A directly.
  - Y(A_B) = Sum of all LockedTransfer amounts for mediated transfers from A to B
    (e.g. a transfer a1—A—B—E—H—h3), which are the locked amounts of MediatedTransfers which may or may not succeed.
  - Y(B_A) = Sum of all LockedTransfer amounts for mediated transfers from B to A.
- AvailableBalance of the channel (A_B) = D – X(A_B) + X(B_A) - Y(A_B)