Blockchain & Distributed Ledgers for Telecoms & IoT: Hype or Here?
Prepared for IIT RTC2018
Chicago, October 2018
Dean Bubley & Disruptive Analysis

- Tech/telecom analyst & strategic consulting since 1991
- Futurism, Forecasting, Anti-Forecasting, Policy
- Cross-silo, contrarian, independent

Network Tech, Policy & Business Models

Communications Apps & Services

Telecom-Futurism

Industry Analyst Papers & Reports
There’s a lot going on. Blockchain use-cases must sit alongside all of these
Tech innovations can take markets in 2 opposing directions

Democratise
Hybridise
Commoditise
Decentralise
Arbitrage

Centralise,
Optimise
Monetise
Federate
Regulate

Network access
Voice calls & messages
Devices & OSs
Music & video content
Social networking

Network transport
Banking / payments
Identity
Cloud
IoT & verticals
Telcos' IT/networks hugely complex & broad

- Planning
- Deployment
- Operations
- Test/monitor
- Maintain / Fix
- Price / Bill
- Control & Policy
- Virtualise
- Customer Exp
- Partner & interconnect mgt

Physical & spectrum  Access networks  Transport & core  Data centres  Voice & Phones  Home & TV  Cloud & Enterprise verticals
In essence, a decentralised, self-verifying database

This changes nature of trust in data & transactions
More than just “The Blockchain”

Original Public BitCoin Blockchain: “The Blockchain”

Other Public Blockchains & DLTs e.g. Ethereum, Ripple, IOTA

Consortium or Permissioned Blockchain

Private, Enterprise Blockchain

Blockchains can act as platforms for dApps & Smart Contracts. Ethereum, Hyperledger, Corda etc – or 1000s of others chains.
Blockchains vs. Distributed Ledgers

- Ledger Type
  - Blockchain, DAG/Tangle etc [scalability]
  - Permissioned vs. Public vs. Hybrid

- Consensus (PoW, PoS, PoET etc)
  - Scalability vs. centralisation
  - Support for sharding / other ways to drive scalability

- Smart Contract support
  - Type of language / sophistication / execution environment

- Application type
  - Crypto-currency, digital asset mgmt, general dApps etc

- Underlying technology model
  - Open-Source vs. Proprietary
Where is BC/DLT appropriate?

When your project meets certain criteria

Answering a few questions can determine if blockchain is appropriate

- Is this a business process that crosses trust boundaries?
- Do multiple parties share data?
- Is there a requirement for verification?
- Can intermediaries be removed?

Source: Microsoft

- Immutability
- Disintermediation
- Smart contracts
- Automation
- Byzantine fault tolerance
Telecoms has *many* stakeholders & moving parts

- Spectrum
- Core & transport networks (4G, WiFi, etc)
- Tower & indoor coverage
- SIM & eSIM
- NFV & SDN & operations software
- Billing & customer support systems
- Numbers, network codes, IDs
- Roaming, wholesale, interconnect, MVNO
- Regulatory & lawful intercept compliant
- Phones, devices & chipsets
- IoT & enterprise solutions
- Content & Internet partner apps
- Industry & standards orgs
- Phone & SMS platforms / PaaS
- Retail & online channels
- Numbers, network codes, IDs
- Roaming, wholesale, interconnect, MVNO
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Top-level DLT use-case segmentation for telecom SPs

- **Internal processes**
  - Blockchain used for internal efficiencies within the CSP
  - Streamlined interactions with suppliers, regulators or other CSPs

- **New services built on blockchain**
  - Services developed for customers and delivered and controlled by CSPs

- **Curating, or collaborating in, business ecosystems**
  - Broader multi-party federations and industrial clusters
  - CSP may be a peer and trusted partner – but not always the lead
  - Notably includes IoT, finance, manufacturing & many other verticals
### Blockchain / telecom intersections & use-cases?

<table>
<thead>
<tr>
<th>Data Integrity</th>
<th>Micropayments</th>
<th>Disintermediation</th>
<th>Escrow</th>
<th>Registries</th>
<th>Smart Contracts</th>
<th>Coins &amp; Tokens</th>
<th>Identity Mgmt</th>
<th>Supply chain</th>
<th>Network, NFV/SDN &amp; w/sale</th>
<th>Roaming</th>
<th>Billing / OSS</th>
<th>Calls &amp; data</th>
<th>Content &amp; Money</th>
<th>Cloud &amp; XaaS</th>
<th>IoT &amp; verticals</th>
<th>Vendors &amp; partners</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1" alt="Red Dot" /></td>
<td><img src="image2" alt="Red Dot" /></td>
<td><img src="image3" alt="Red Dot" /></td>
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</tbody>
</table>
If you only have a Blockchain hammer....
### Between which entities does blockchain make sense?

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Color</th>
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</thead>
<tbody>
<tr>
<td>Within one telco’s functional unit / opco</td>
<td>Red</td>
</tr>
<tr>
<td>Between a telco’s functional units / opcos</td>
<td>Yellow</td>
</tr>
<tr>
<td>Between “peer” telcos / counter-parties</td>
<td>Green</td>
</tr>
<tr>
<td>Along a telecom vendor supply-chain</td>
<td>Yellow</td>
</tr>
<tr>
<td>Between telco &amp; customers for a service</td>
<td>Yellow</td>
</tr>
<tr>
<td>Managed by telco for a community</td>
<td>Yellow</td>
</tr>
<tr>
<td>Between telco &amp; regulators/government</td>
<td>Green</td>
</tr>
</tbody>
</table>
Timescales matter: How fast does data change?

Public & some private blockchains are extremely slow & may have latency of minutes or more

- Millisec
- Second
- Minute
- Hour
- Day
- Month
- Year

Network Mgmt
- Balance Management
- Sporadic IoT data / keep-alives
- Interconnect Reconciliation
- Number Porting
Public/tokenised or private/permissioned blockchains?

- **Public Blockchains**
  - End users
  - Partner enterprises
  - Telcos
  - General vendors
  - Blockchain vendors/SPs

- **Internal use-cases**, eg between telcos & suppliers

- **Direct chain adjacencies**
  - Regulatory, tax, legal
  - Other vendors
  - Other SPs
  - Media, devlpers & apps
  - W/sale SPs
  - Partner SPs

- **Multi-SP & consortium arrangements & contracts**
- **Application enablement**, eg vertical IoT data mgmt
- **Service enablement / supply chain**

October 2018

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Settlements: one of the most “real” uses so far…

Wholesale Voice Settlement – Automation PoC

Bilateral agreements > Loaded to Ledger as Smart Contracts

- T&C, Payment and Credit terms, Legalities, Technicalities
- Periodical exchange of Rates for Services
- Dispute resolution algorithm

CDRs are generated by each carrier

- Periodical Rating of CDRs, Loaded to Ledger by both parties
- Automated Comparison of rated CDR and Dispute Identification.
- Automatic Dispute Resolution (defer to Manual based on threshold)

Generate Cryptographically enforceable invoices
Blockchain may enable market-based spectrum mgmt

Table 1. Summary of use cases and blockchain applicability analysis.

<table>
<thead>
<tr>
<th>Use case</th>
<th>Shared write</th>
<th>Absence of trust</th>
<th>Disintermediation</th>
<th>Interaction</th>
<th>Confidentiality</th>
</tr>
</thead>
<tbody>
<tr>
<td>SAS-SAS data exchange</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>Hybrid</td>
</tr>
<tr>
<td>SAS marketplace</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>Hybrid</td>
</tr>
<tr>
<td>Sensing as a Service</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>Hybrid</td>
</tr>
<tr>
<td>Element tracking</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>Hybrid</td>
</tr>
<tr>
<td>Neutral hosting</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>Hybrid</td>
</tr>
<tr>
<td>Operator roaming</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>Hybrid</td>
</tr>
<tr>
<td>CBSD measurements</td>
<td>+</td>
<td>-</td>
<td>+/-</td>
<td>-</td>
<td>Private</td>
</tr>
<tr>
<td>FCC database</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Private</td>
</tr>
<tr>
<td>ESC sensing</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>Private</td>
</tr>
</tbody>
</table>

Numerous potential use-cases, but still largely in early research phase
Potential to create completely new radio protocols / meshes

Helium
A Decentralized Machine Network
Amir Haleem  Andrew Allen  Andrew Thompson  Marc Nijdam  Rahul Garg
Helium Systems, Inc.
Release 0.4 (2016-08-10)

Figure 4. Proof-of-Coverage flow

Figure 11. Geolocation via TDoA
Telco example of BaaS – KPN (builds on top of IT BaaS)

Blockchain integration in the KPN portfolio

Blockchain Solution Blueprint

PS&C

BSP

BaaS

solution accelerators

KPN - Blockchain as a Service

BaaS

KPN Core

TSP

CSP

KPN Cloud

Toezicht afval/geovaarlijke stoffen

PJP connected lastipaten

nul-op-de-meter compliance

Gehandicapten parkeerkaart uitzigfte

Persoons Gebonden Budget uitkening

AOIOS/microjobs

KPN Ventures startups inclusion

Realtime memeran sanctions

Digital Notary

Decentralized Marketplaces

Proof of Origin

Self-soverein identity

Permits chains

E-voting Services

KPN Azure

Stack Ethereum

KPN Appfactory

Tymedix/BigchainDB

KPN Hybrid cloud

Hyperledger

IBM Bluemix

Hyperledger

Other Public Cloud BaaS

Short range: RFID, NFC, BLE, Wifi

Long range: LoRa, LTE, UMTS, GPRS, etc

Secure Element Provider

Fintech Services

Digital Identity

Service Provider

Gemeente Cloud

ZorgCloud

DC NL/Managed hybrid Cloud

IBM Bluemix

Microsoft Azure

Others...
NFV management has a lot of promise
Regulatory use-cases emerging

- India: TRAI pushing blockchain approach for SMS/call spam consent
- UK: Ofcom researching blockchain-based MNP approach
- Various: spectrum-sharing concepts converging with DLTs
- Potential future options:
  - License management
  - Network-operation data retention
Possible blockchain roles in IoT: Device-centric view

<table>
<thead>
<tr>
<th>Device fit with a Broader Supply Chain</th>
</tr>
</thead>
<tbody>
<tr>
<td>Device (micro)payments</td>
</tr>
<tr>
<td>Device Usage Data</td>
</tr>
<tr>
<td>Device Data Integrity</td>
</tr>
<tr>
<td>Device Power Generation / Supply</td>
</tr>
<tr>
<td>Device Connectivity (cell / WiFi / roaming etc)</td>
</tr>
<tr>
<td>Device Security</td>
</tr>
<tr>
<td>Device HW, SW &amp; associated services</td>
</tr>
<tr>
<td>Device Identity, Authenticity &amp; Ownership</td>
</tr>
</tbody>
</table>

Same IoT Blockchain, or different for each layer?
(Or non-BC entirely for some?)
What’s happening in telecom BC so far? (publicly, at least…)

- Orange investment in chain.com
- Verizon / Filament + other VZ projects (eg data integrity protection)
- TMForum WG + Catalyst project for IoT (inc. AT&T, MS, Ericsson, others)
  - New Catalyst with Globe Telecom, KDDI, Ultrafast Fibre and Singtel (& Huawei and other vendors)
- BT: people everywhere but no announcements beyond security patent
- AT&T patent for blockchain-based HSS (authentication database for mobile)
- Du prototype for healthcare IT
- Telstra IoT firmware anti-tamper & biometric identity verification
  - “Also experimenting with blockchain for legal interception, environmental sensor monitoring, car safety, agriculture, network operations, fraud, compliance and audit, and e-voting”
- Sprint / Softbank / TBCASoft / FarEastOne / CBSG (subsequently adding LG Uplus, Etisalat Group, KT, Telefónica and PLDT)
- Ericsson (especially pitch around data integrity & GuardTime partnership)
- Huawei, Cisco, NEC, (Nokia), NTT Data, Swisscom all members of Hyperledger
- IBM talking about payments & other uses; Microsoft significant presence & BaaS
- Some generalists getting telco focus, eg GuardTime & Sytel
- Huawei “blockchain-enabled smartphone”: may include coin/token wallet?
What’s happening in telecom BC so far? (part 2)

- PCCW & Colt pilot on settlement automation (with clearx.io)
- KPN BaaS architecture
- Nokia Sensor-as-a-Service and data marketplace
- Swisscom hosting ITU blockchain standardisation group
- SKT investment in Korbit exchange
- PortaOne / Emercoin call routing & peering/federation (decentralised version of ENUM)
- KT “Future Internet” project
  - “will let people and businesses earn rewards for using their own data”
  - “KT already incorporated the cryptocurrency platform K-Coin into its mobile coupon service”
  - Part of CBSG along with SoftBank & Sprint
- PLDT trial with DENT Wireless
- Avaya Identity-as-a-Service concept (aimed at contact-centre fraud checks)
- Telefonica Wayra investment in Wibson personal data marketplace app
- Comcast Ventures investment in BlockDaemon
- Reliance Jio working on JioCoin cryptocurrency with 50-person team
- US Mobile Authentication Taskforce – VZW, AT&T, T-Mo US, Sprint
- T-Mobile Hyper Directory (open source) project & T-Labs involvement in Sovrin Foundation
Some other examples:

- Managing intermittent connectivity, eg spot-markets
- Tracking of usage or licences for NFV
- Escrow / anti-tamper validation of call records for law enforcement
- Micropayments for content
- Marketplaces for IoT or personal data
- Data integrity-management as a service
- ID-verification as a service (KYC & similar)
- Secure credentials for non-SIM / low-power devices
- SLA management (with smart contracts)
- “Permissions directory” for cloud or network services
Miners can help run the platform/service, and earn some level of access to it as an incentive (imagine a marshall at an event, or shareholder discounts for an airline’s fares)
Tokens are not new in principle
What telecom / network assets are being tokenised?

- Mobile data quota
  - National
  - Roaming
- Fixed/WiFi Internet access
- SD-WAN & long-distance transport capacity
- SMS quota
- Call minutes
- Mobile money
- IoT or personal data
- Content
- VNF “credits”, eg for SD-WAN functions
- VPN capability
Roaming plans as “smart contracts”

- “In the near future 100% of devices will be eSIM-enabled. In the IoT segment the pace of eSIM adoption is even higher.”
Telecom / network related tokens / ICOs…

Airfox $AIR – mobile advertising, data allowances microloans & loyalty
DENT Wireless $DNT – marketplace for mobile data packages / quotas
Mysterium $MYST – decentralised VPN (basically blockchain meets Tor)
EncryptoTel $ETT – decentralised cloud PBX
Ammbr*, $AMR [Dean Bubley is an advisor] – wireless mesh & transaction platform
BirdChain, $BIRD - Messaging app & platform for users to re-sell their SMS allocation
BlockNum, $GIGA – Using PSTN & SIP signalling + e164 numbers as basis for transactions
BubbleTone, $UMT – marketplace for mobile data / MVNO / IMSI / eSIM provision
CrypVisr $CVN – secure messaging & VoIP for consumers & enterprises
Mobilink $MOBI - ad-funded mobile voice & data with custom SIM card, MNO/MVNO deals
RightMesh $MESH – P2P mesh networking, including device-to-device
SmartMesh $SMT - tokenised device-to-device mesh based on WiFi, Bluetooth LE etc
SMSChain $SMSTo – secondary marketplace for SMS messaging & A2P platform
OpenCT $OCT – telecom signalling BC. Initial uses for SD-WAN & L2-island connection
And yet more network tokens / ICOs…

Qlink $QLC - sharing & micropayments for telco "assets": WiFi access, cellular data, SMS and content. Also planning own access points, including LTE-U unlicenced cellular
Telcoin $TEL - Payment/money-transmission token distributed through MNOs & aggregators
Cederis, $ISP – WISPaaS
Stealth Grid, $QMN – “quantum security” + mesh + edge compute
NKN – underlying “blockchainised” network protocol, akin to TCP/IP
SpaceChain – decentralised satellite / satcom mesh / “space apps” pltfm
BitMinutes – using prepay mobile airtime as basis for loans/finance
VideoCoin – video encoding, streaming & CDN
Pareteum - SaaS player partnering AirFox to link offer BaaS for IoT/MVNOs
Nebulis – decentralised DNS
Gladius – decentralised CDN
Nynja – Messaging app, mobile wallet & transaction platform
Emercoin – token-based alternative to ENUM, DNS etc for VoIP peering & other apps
Horizon $HRZN – Fixed-wireless ISP in Bermuda & Caribbean
Conclusions

- Many potential applications for blockchains / DLTs in networks/comms
- … many, many possible niches (or broader horizontals)
- Both private & public opportunities
- But very early stages, mostly still research
- Initial wins around data integrity
- Many concerns on cryptocurrency / token approaches
- Small-to-medium chance of disruption on a 5yr view
- Medium-to-large chance of disruption in 10yrs