CONNECT2SMALLPORTS

Interreg South Baltic

EUROPEAN UNION

European Regional Development Fund

DLT (Distributed Ledger Technology) **for Transport Seminar / Workshop**

6 Feb 2020

KLAIPĖDA SCIENCE AND TECHNOLOGY PARK

Giovanni Di Noto

Agenda

background & credits
Module 1 | core concepts & underpinning technologies
Module 2 | DLT use cases (30+ over 10 core domains)
Morning break
Module 3 | AI, IoT, QC & DLT technologies convergence
Module 4 | challenges & opportunities in supply chain DLT

background

complex project management software and consulting worldwide

energy, construction, mobility, public sector, complex projects

established in 1991 in Ølensvåg (Top 2 IT company in Norway)

19 offices internationally (presence in 30+ countries)

Klaipeda strategic GBS in growth mode

1.350+ employees worldwide

2018 revenue €145m

equinor, Chevron, bp, ConocoPhillips, lyondellbasell, sasol, noble energy, Petrobras America Inc., Total, Kinder Morgan, DONG energy, AkerBP, Hydro, Repsol, Enbridge, TransCanada, devon, ALTALINK, energy XXI, Trans Adriatic Pipeline, Nord Stream 2, Moderniart, Valpro, Arcadis, aibel, Westcon, Leirvik, Tekfen Petrogaz, IHI E&C, Shell, Cobalt, Gassco, Deilmann-Haniel, OMV, VNG Norge, ABB, BIS Industrier, Statsbygg, Bane NOR, Veidekke, Sykehusbygg, sporveien, wintershall, TGE

Pims Contract Management
Planning, tendering, award and ongoing management of contracts

Pims Cost Management
Estimate, budget and control project cost and performance

Pims Quality Management
Plan audits and follow up non-conformances to elevate project standards

Pims Document Control
Manage project documents and ensure efficient workflow

Pims Risk Management
Identify, address and control project risks

Pims Experience and Benchmarking
Analyze project experience and improve decision making

Pims Team Documents
Collaborate, share workspaces and elevate communication

Pims Completion Management
Define project-wide strategies to achieve smooth handover of systems

Pims Interface Management
Identify and implement interface solutions for efficient information exchange

Pims Health and Safety
Increase safety, reduce risk, and ensure compliance

omega

health|energy|industrial|mobility|fintech|govtech|media

industrial DLT ecosystems & e-contracts platform

smart cities accelerator programs

digital transformation programs

startup accelerator programs

training/consulting services

CLOUDY BOSS

Safer Smarter Enterprising

COBRA

ANIMA

SKYE

Smarter Contracts | Faster Blockchain | Safer Ecosystems

IBM Cloud

aws

Keystone

Next

Enterprise Distributed Ledger Technology

NEXT+ ENGAGE CMS
dynamic content, dynamic navigations, multilingual, multimedia, web/mobile apps

NEXT+ MEASURE
COA, AR/AP, assets, simulations/budgets, banking, inventory, WMS/payroll, 3P

NEXT+ ENGAGE eCommerce
multicurrency (incl. cryptos), configurable products/services, prices/taxes/promotions

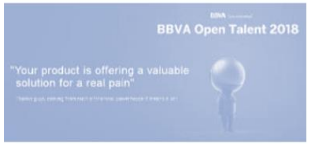
NEXT+ WORKFLOWS
dynamically configurable workflows on all transactional modules (20). DLT floors

NEXT+ ENGAGE CRM
events, locations, campaigns, enrichment, C2C/B2C/B2B/B2B2C, segmentation, GDPR

NEXT+ VISUAL DASHBOARDS
Data cubes, visualizations and configurable dashboards. AI-driven smart information

NEXT+ DLT/smart contracts
Permissioned, multi-consensus, on-chain, high TPS, codeless

NEXT+ API / IoT / AI
EDGE-X device integration by user/location, functional elasticity



startup lighthouse
HALL OF FAME
Horizon 2020
European Union Funding
for Research & Innovation

200 Businesses of Tomorrow
2018 WINNER

IBM Global Entrepreneur

computing
Technology Product Awards 2018

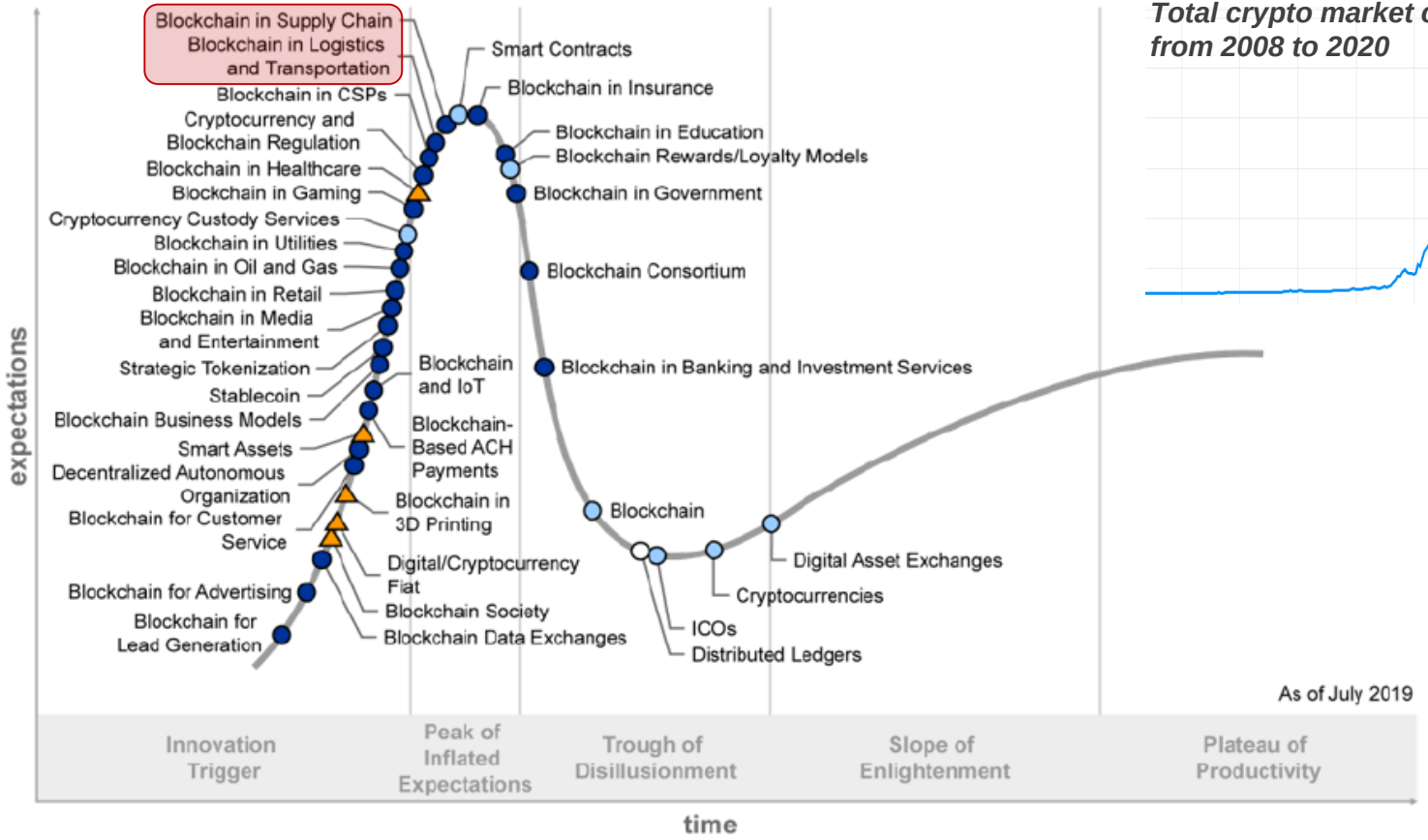
other content, credits & references

Apologies for missing references if any. Do let us know.

module 1
core concepts & technologies

introduction

Gartner Hype Cycle for blockchain use cases (July 2019)



Total crypto market cap from 2008 to 2020

the mother of all bubble charts, or the mother chart of all bubbles

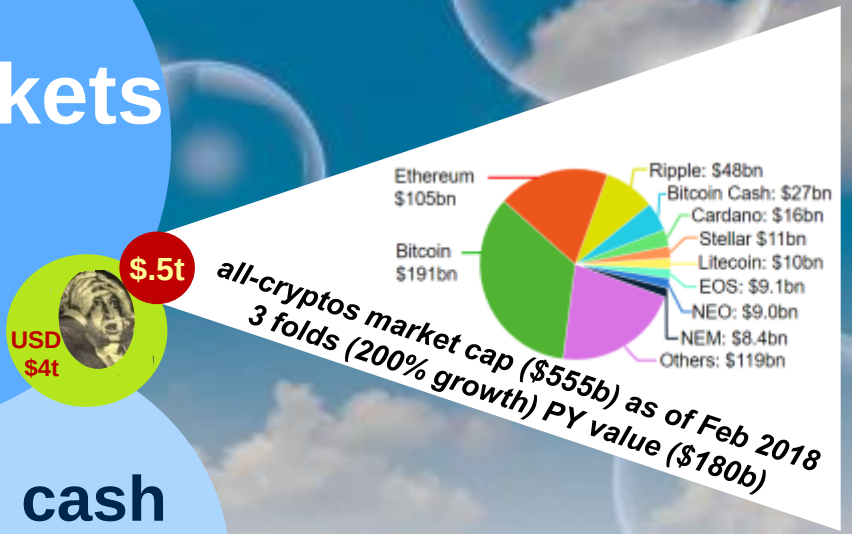
stock markets
~$70t

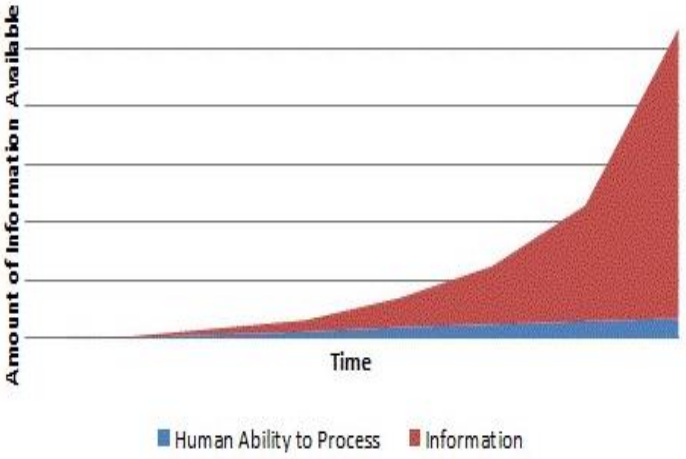
all money
~$90t

hard cash
(notes, coins)
~$35t

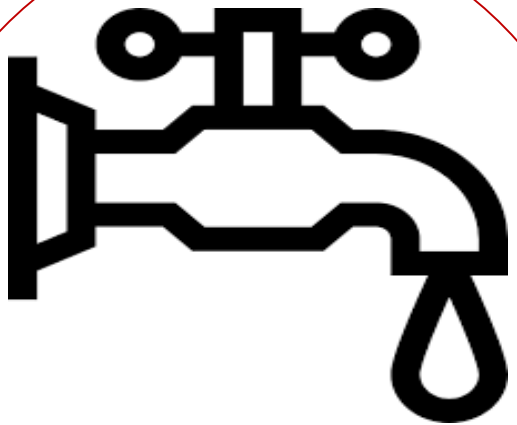
USD
$4t

$.5t





digital abundance



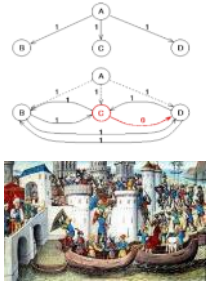
digital scarcity

DLT new invention

BBC explains cryptocurrencies in 2 minutes

blockchain the journey so far

DLT (Distributed Ledger Technology)



SKYE DLT contracts (NEXT+ r18a)
QC-based "unchained" DLT paper
cloudyBoss

Hyperledger Fabric SDK 1.0
Linux Foundation

NEXT+ EDLT
cloudyBoss

The DAO
Ethereum

Ripple Labs
Fintech

Lehman Brothers
collapse (GFC)

Decentralised money
G. Di Noto

1st bitcoin block
Bitcoin.org

Double-spending
S. Nakamoto

Computing Cost
Dwork,Naor

Chain of Blocks
Stornetta,Haber,Bayer

Byzantine Fault Tolerance
Castor, Liskov

PoW *(Proof-of-Work)*
Jakobsson,Juels

Byzantine Generals Problem
Lamport,Shostak,Pease

Hash Trees
Merkle

HYPERLEDGER
FABRIC SDK Go

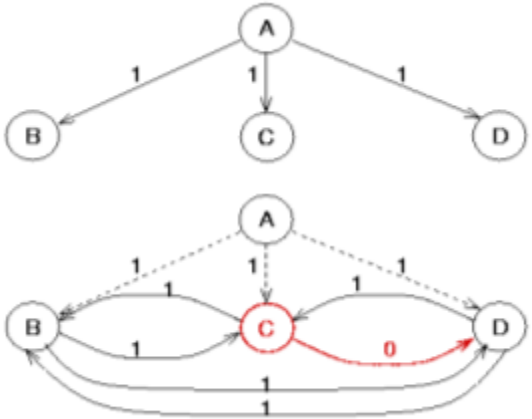
ripple

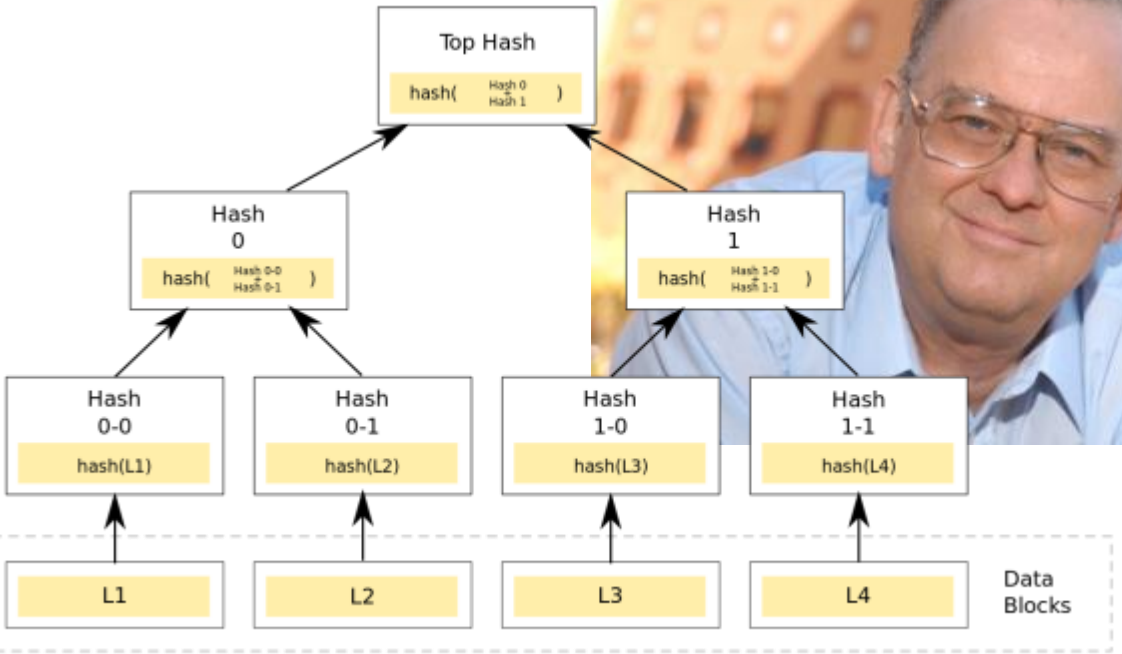
SKYE
Smarter Contracts | Faster Blockchain | Safer Ecosystems

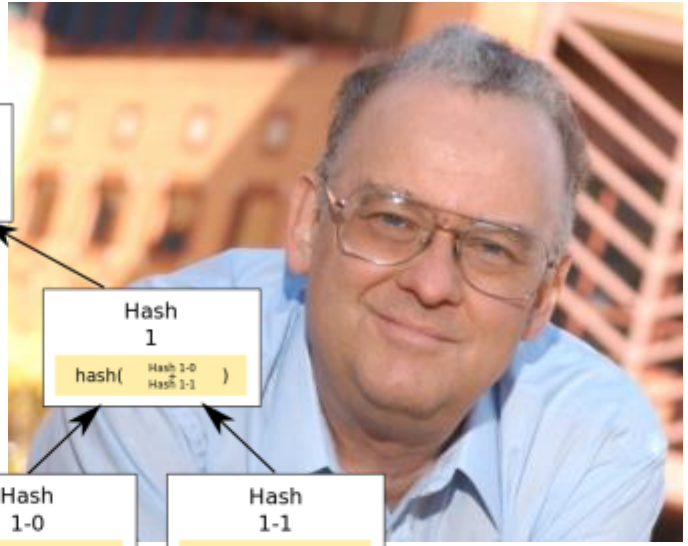
1979 1982 1991 1993 1999 2008/07 2008/09 2008/10 2009/01 2012 2014 2015 2017

...origins

When	Who	What
1979	Ralph Merkle (below)	"***Hash trees***" US patent no 4309569
1982	Lamport, Shostak, Pease	"*The Byzantine Generals Problem*" paper, basis for **consensus** protocols

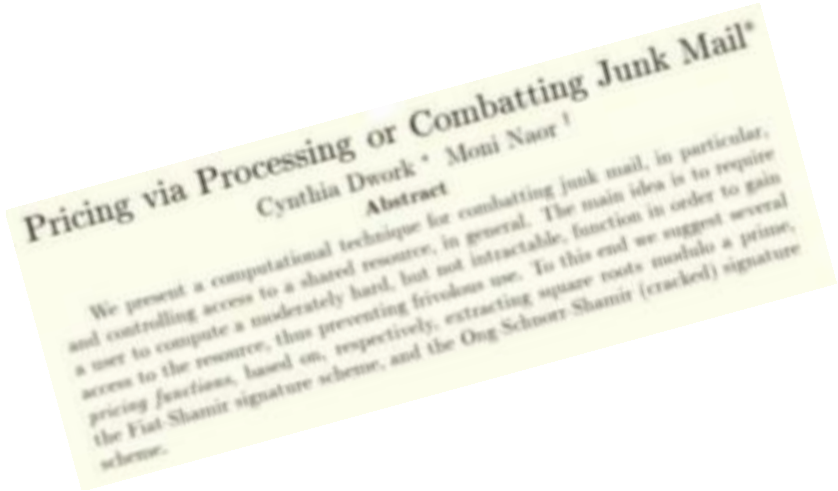






the 90's

when	who	what
1979	Ralph Merkle	"***Hash trees***" US patent no 4309569
1982	Lamport, Shostak, Pease	"The Byzantine Generals Problem" paper, basis for consensus protocols
1991/92	Stornetta, Haber, Bayer	"Chain of blocks" then "Merkle trees" paper applying hash trees to data validation
1993	Cynthia Dwork, Moni Naor	"***computing cost*** *as a solution to spam*", basis for "***Proof of Work***" concept in mining
1999	Jakobsson, Juels	Further formalisation of the PoW concept
	Castro, Liskov	PBFT (Practical Byzantine Fault Tolerance) algorithm



Pricing via Processing or Combatting Junk Mail*

Cynthia Dwork † Moni Naor ‡

Abstract

We present a computational technique for combatting junk mail, in particular, and controlling access to a shared resource, in general. The main idea is to require a user to compute a moderately hard, but not intractable, function in order to gain access to the resource, thus preventing frivolous use. To this end we suggest several pricing functions, based on, respectively, extracting square roots modulo a prime, the Fiat-Shamir signature scheme, and the Ong-Schnorr-Shamir (cracked) signature scheme.

the 00's

when	who	what
1979	Ralph Merkle	"***Hash trees***" US patent no 4309569
1982	Lamport, Shostak, Pease	"The Byzantine Generals Problem" paper, basis for consensus protocols
1991/92	Stornetta, Haber, Bayer	"Chain of blocks" then "Merkle trees" paper applying hash trees to data validation
1993	Cynthia Dwork, Moni Naor	"***computing cost*** *as a solution to spam*", basis for "***Proof of Work***" concept in mining
1999	Jakobsson, Juels	Further formalisation of the PoW concept
	Castro, Liskov	PBFT (Practical Byzantine Fault Tolerance) algorithm
Jul 2008	Giovanni Di Noto	"*the money-poly conundrum: basis for a* ***decentralised digital currency framework***" Griffiths University (Brisbane Australia) | ENV100 paper submission
Sep 2008	Lehman Brothers	Investment bank Lehman Brothers collapse (**GFC** starts)
Oct 2008	Satoshi Nakamoto	*"Bitcoin"* white paper solving the ***double-spending*** conundrum. metzdowd.com
Jan 2009		bitcoin.org, version 0.1 of the bitcoin software and mining of **1st bitcoin block**

the 10's

when	who	what
Jul 2015	Vitalik Buterin and team	ethereum **world computer** and **scripted** (solidity language) **smart contracts**
Dec 2015	Linux Foundation team	Open source Hyperledger project for **enterprise blockchain** starts
Jul 2017	Linux Foundation team	**Hyperledger Fabric** SDK 1.0 announced
	cloudyBoss team	**SKYE** (enterprise **blockchain clusters** + unscripted **skye-contracts**) released

	bitcoin	ethereum
concept	cryptocurrency	world computer
coin release method	early mining	through ICO
block time	~10 minutes	~12/15 seconds
protocol	SHA-256	ETHASH
hardware property	ASIC	ASIC-resistant

HYPERLEDGER
FABRIC SDK Go

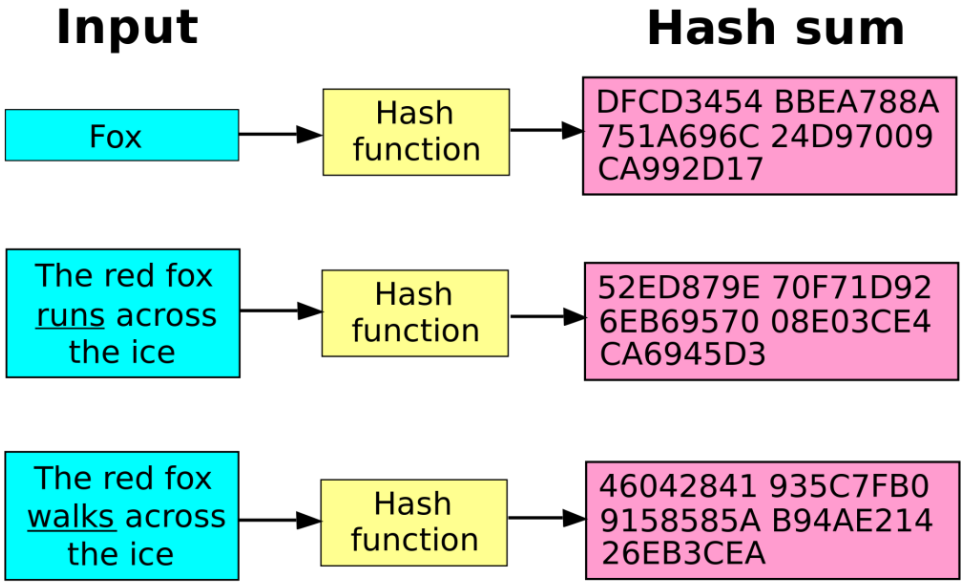
CLOUDY BOSS
Safer Smarter Enterprising

SKYE
Smarter Contracts | Faster Blockchain | Safer Ecosystems

blockchain core concepts & mechanics

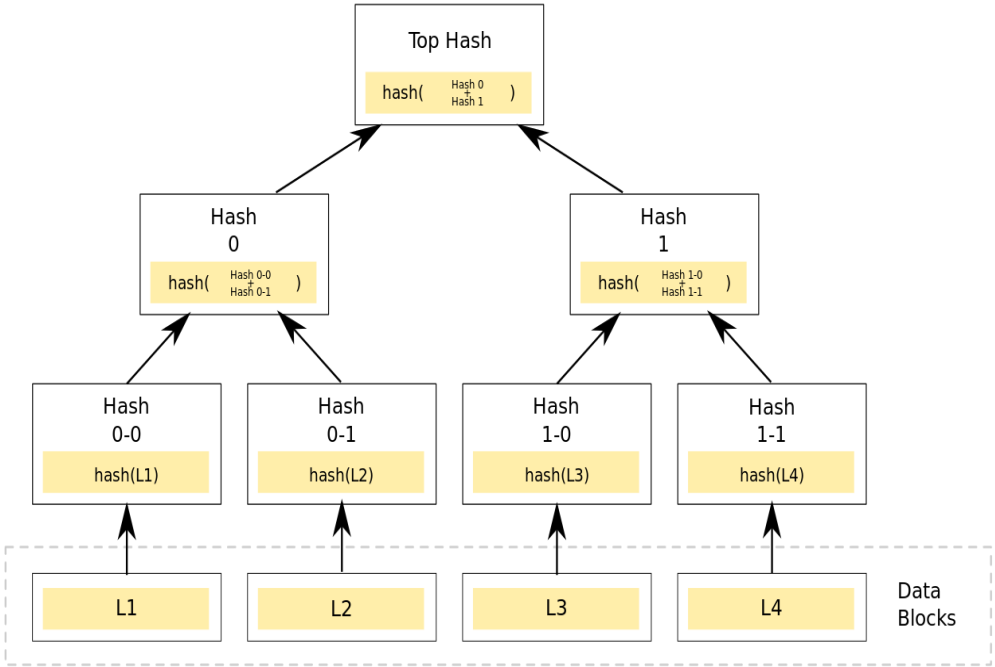
hashing

- non-trivially translates a value to another
- uniquely translates (~nil collisions)
- irreversible 1-way function



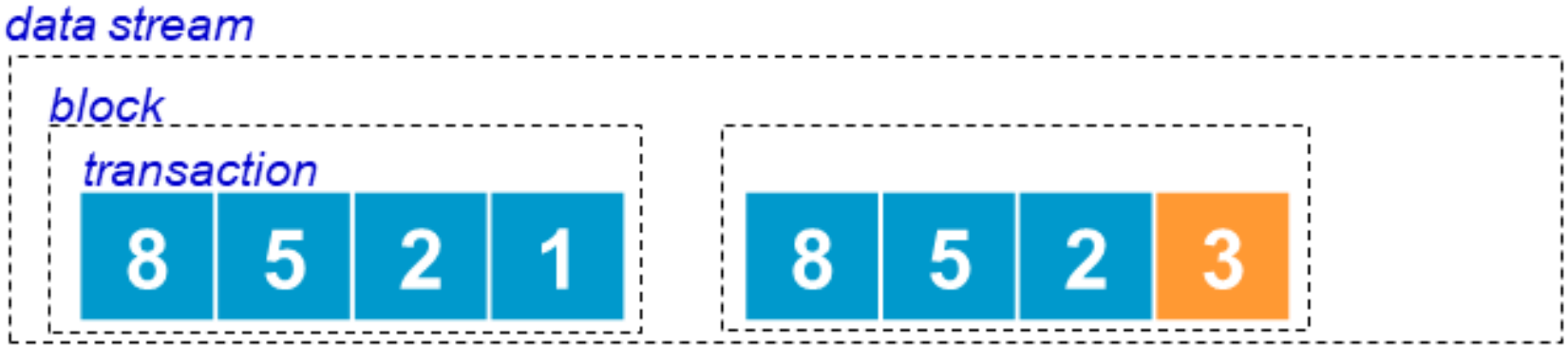
hash tree

Keyword	Description
Merkle Tree	a binary tree where the parent root hash is a function of child hashes derived from data leaves
Transaction	a value, balance, change of state or other data, corresponding to a leaf in a hash tree
Block	a group of transactions (leaves) ultimately pointing to the same top (or root) hash



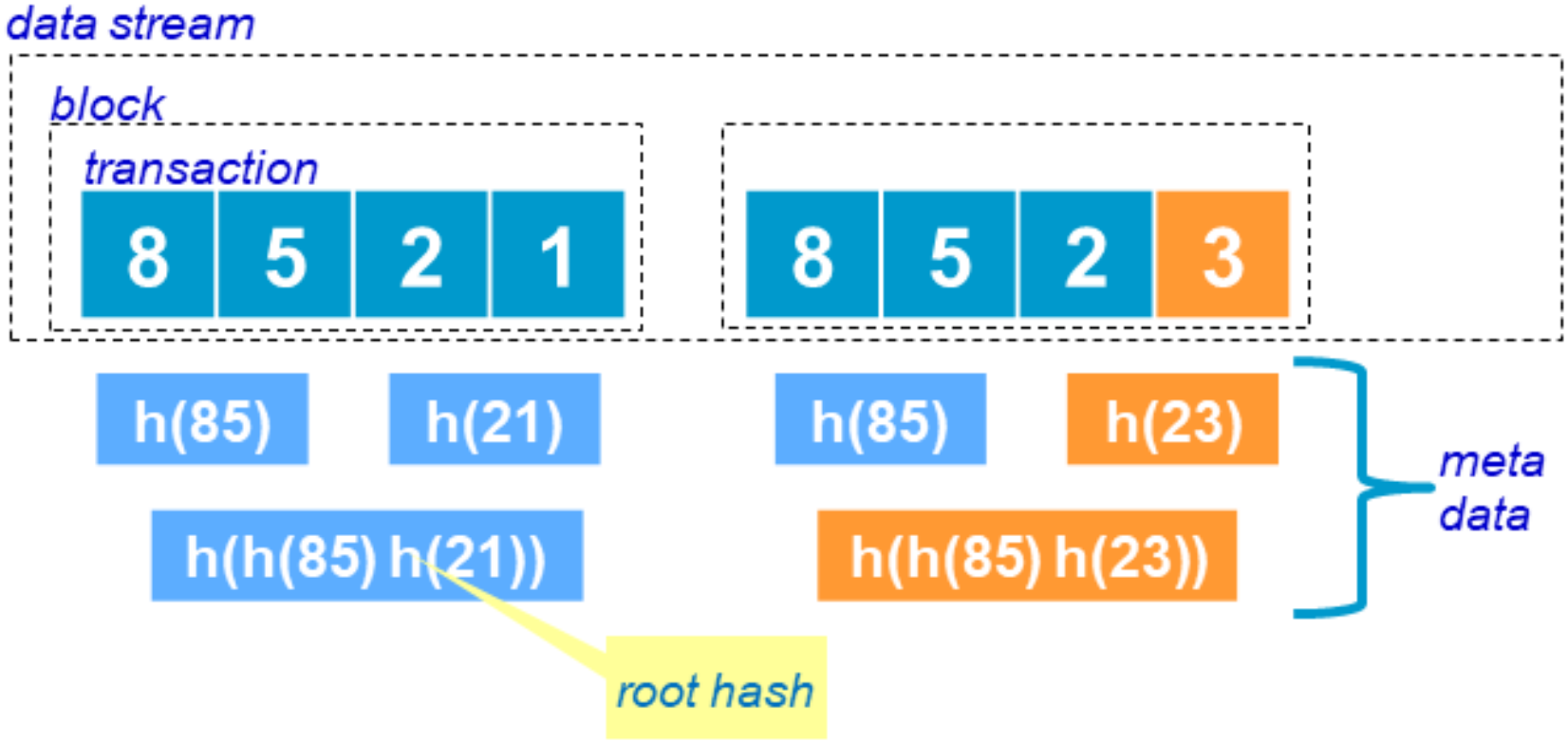
hash tree arithmetic 1/3

comparing data



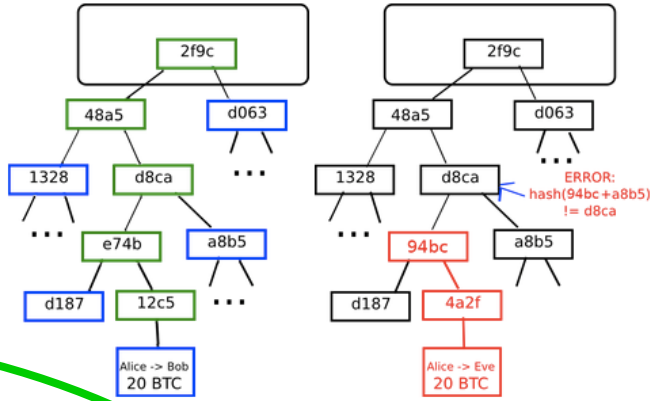
hash tree arithmetic 2/3

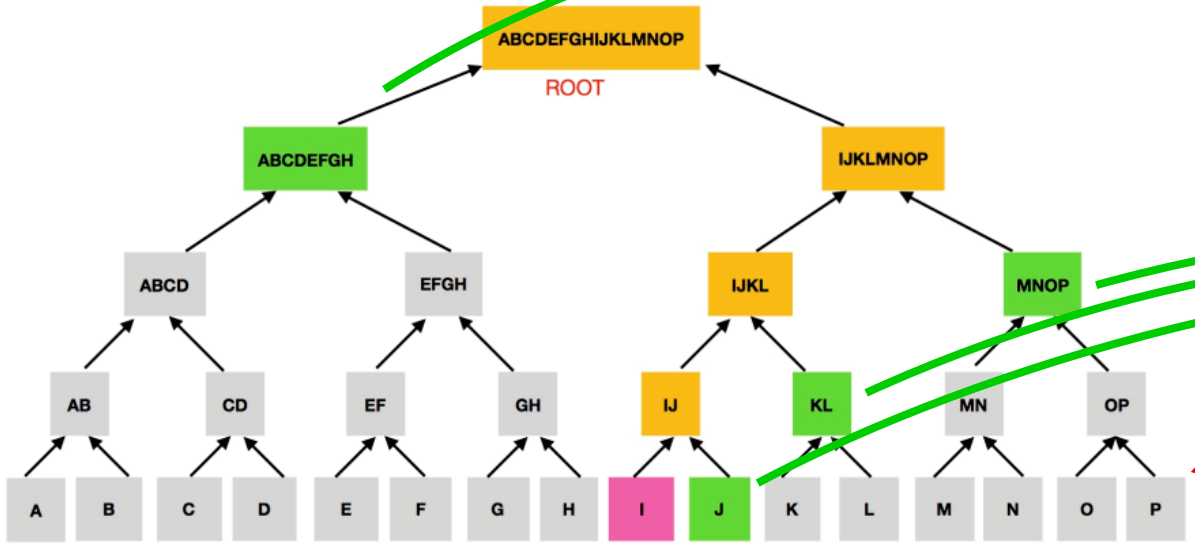
efficiently verifies the integrity of a transaction



hash tree arithmetic 3/3

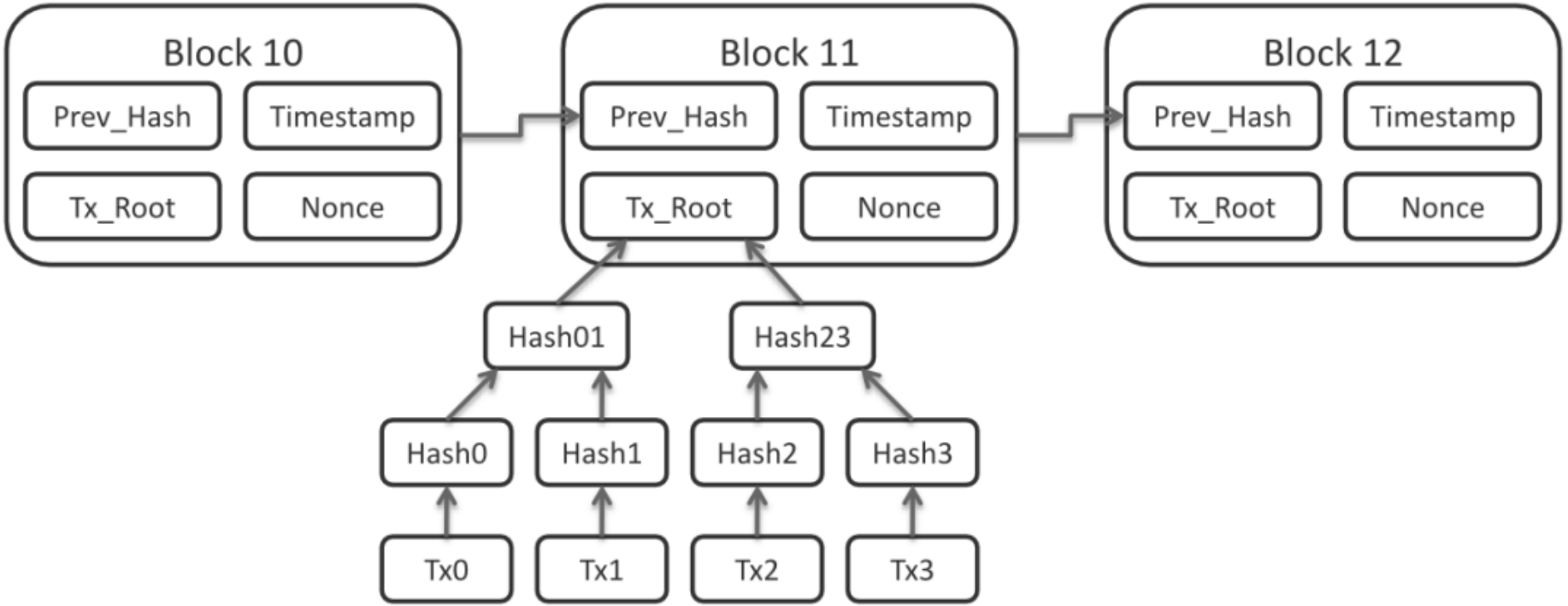
- *Transactions are **interdependent** (unalterable)*
- *They are validated via their **Merkle paths***
- *A Merkle path requires **$\log_2(N)$** hashes*





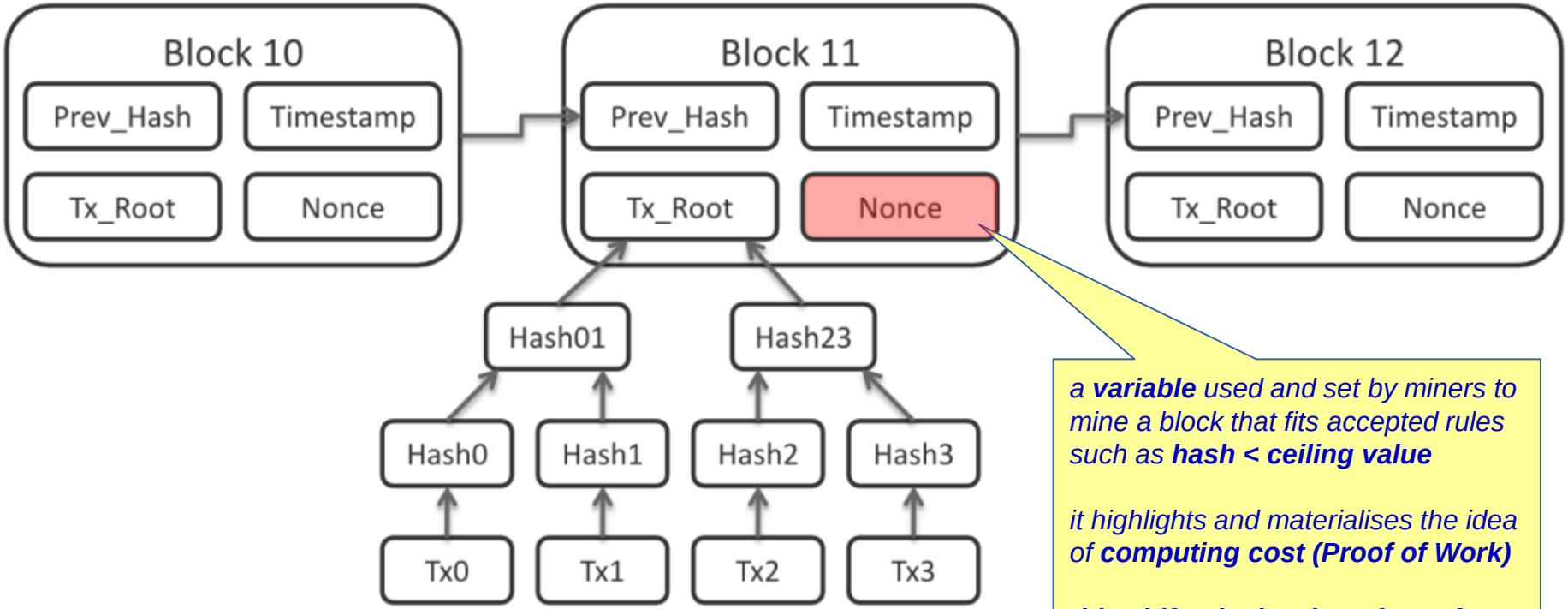
N (number of transactions)	$\log_2(N)$
4	2
16	4
1500	11

block-chain = ever-growing merkle tree



$$B_{n+1} = f(B_n)$$

what's the nonce for?



*a **variable** used and set by miners to mine a block that fits accepted rules such as **hash < ceiling value***

*it highlights and materialises the idea of **computing cost (Proof of Work)***

this shifts the burden of proof on one side of the ecosystem (miner)

why bitcoin is ASIC centric?

GPU

Graphics Processing Unit

FPGA

Field-Programmable Gate Array

ASIC

App Specific Integrated Circuit

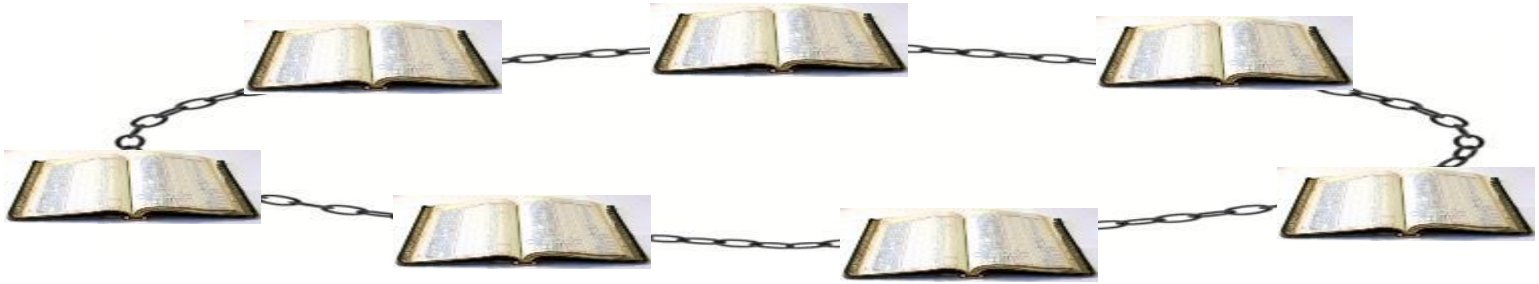
Alternative ASIC-resistant Proofs

- **PoS** | Proof of Stake
  example: ethereum ecosystem uses PoS
  how much cryptos do you hold?
  for how long?

- **PoI** | Proof of Importance
  example: NEM ecosystem uses PoI
  how much cryptos do you hold?
  how many transactions?

nem

ecosystems



Keyword	*Description*
Immutability	The property of an auditable transaction which irrefutable details (similarly to a **posted** transaction in a conventional accounting ledger) are no longer altered
Distributed ledger DLT, hyper ledger	shared immutable ledger kept up-to-date over discrete nodes (organisations and/or computers) which are all part of a same cluster, ring or ecosystem of nodes
Node	A single instance of a distributed ledger such as a server in a multi-node ecosystem
Ecosystem, cluster, ring	A group of at least 3 nodes each carrying an instance of a same distributed ledger
Byzantine fault tolerance	a consensus protocol for ecosystems to run when nodes crash or act maliciously
Consensus	an agreement on the state of the ledger reached via PBFT, PoW, PoS, PoI…
Propagation	The act of propagating a transaction across all nodes of an ecosystem
Genesis transaction	The first transaction in a distributed ledger

multi-chain ecosystems

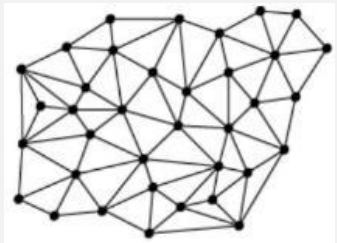
Keyword	*Description*
Mining	process by which bitcoin rewards nodes for solving math puzzles to create new coins
Trust-less	a decentralised modus operandi devoted of censorship typical of ***open blockchains***
Cryptocurrency	digital currency relying on mining and open blockchains to avoid double-spending
Bitcoin, Ether, Litecoin	cryptocurrencies, each with their own blockchain protocol and other rules
Multichain	meta-system of various ecosystems with distinct blockchain protocols

opened vs permissioned blockchain ecosystems

Keyword	*Description*
Enterprise blockchain SKYE, hyper-ledger, ebc, permissioned blockchain	a set of blockchain DLT use cases other than cryptocurrencies. Mining, ICO, PoW or trustlessness are generally alien to permissioned blockchains. Vice-versa, permissions (to control participating nodes), speed and consensus are required for data integrity.
MSP	Member Service Provider. An admin node in a permissioned blockchain
Permission	Control mechanism to allow node participation into a permissioned ecosystem

future-proofing current DLT challenges

future-proof	*challenges*
unchained quantum-resistant immutability	non-elastic data nodes
DLT use cases beyond crypto-coins	cryptos's fiat inner-nature
distributed / sharding ecosystems	enviro-adverse ASIC cryptos
inter-operable DLT protocols	quantum-adverse PKI / hashing
codeless DLT and contracts	centralised / cartelized ecosystems
scale-neutral data nodes	code-dependent DLT and contracts
real-world high TPS	legacy protocol systemic risks | forking
elastic data nodes	legacy protocol systemic risks | hacking
tokenomics	unscalable low TPS (transaction per second)



the TPS debate

*Card providers operating @ 20k TPS vs **BTC / ETH < 10 TPS***

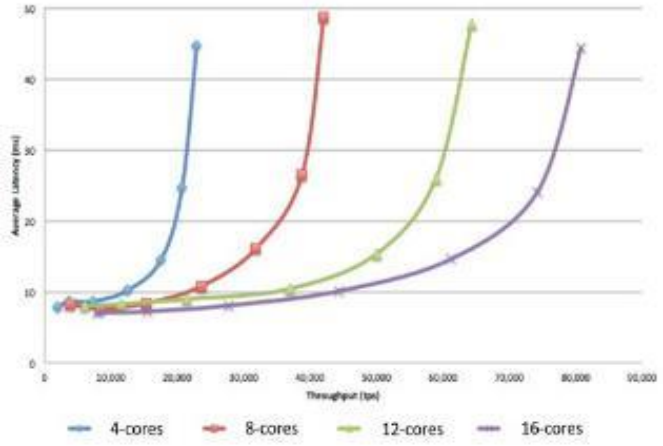
	Bitcoin	Ethereum	Ripple	Stellar	EOS	Cardano	NEM	SKYE	HL
Block time	*-10 min*	*-15 s*	*~0 *See below*	*-5 s*	*-0.5s*	*-20s*	*1 min*	*~0.0 * See below*	*~0.0 * See below*
Data structure	*Fixed*	*Flexible*	*Fixed*	*Fixed*	*Fixed*	*Fixed*	*Fixed*	***Flexible***	*Flexible*
Consensus	*PoW*	*PoS*	*N/a*	*N/a*	*Dlg PoS*	*Dist PoS*	*PoI*	***baseline BFT***	***baseline BFT***
Stated TPS	*-5*	*-10*	*1,500*	*4,000*	*>3000*	*200 (lab test)*	*4,000*	***Unlimited*** **See below*	***Unlimited*** **See below*
Contracts	*No*	*Yes (code)*	*No*	*No*	*Yes (code)*	*Yes (code)*	*No*	***Yes (config)***	*Yes (code)*
Language	*C++*	*Solidity*	*C++*	*C++*	*C++*	*Haskell*	*Java*	***LAMP***	*Js / Fabric*
Permissioned	*No*	*No*	*Yes*	*Yes*	*Yes (?)*	*Yes (?)*	*Yes*	***Yes***	*Yes*
multichain	*No*	*No*	*Interledger*	*No*	*No*	*No*	*No*	***Universal API***	*In discussion*

* block time is mostly irrelevant in SKYE (or HL) as it is an enterprise (permissioned) DLT. This means *computing cost* is technically (CPU/GPU) rather than artificially limited.

SKYE block time is inversely proportional to infrastructure TPS performance, which is very high yet asymptotically limited for CPU (see adjacent diagram), however **unlimited with GPU** (parallel distribution of tasks particularly relevant to blockchain propagation).

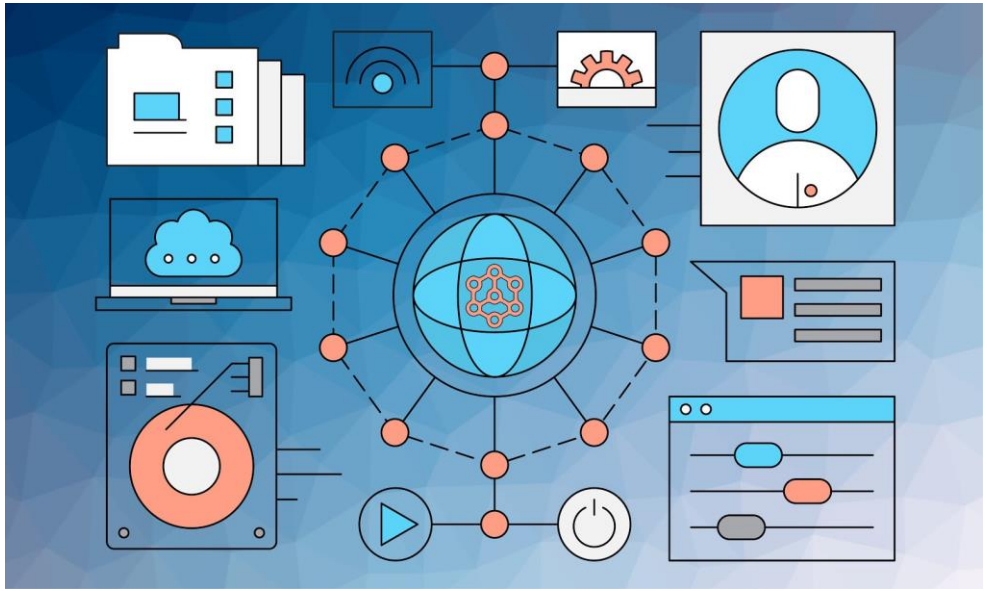
For CPU's, TPS depends on which type of VM or metal server/s each DLT node (especially MSP propagators) are running on. The adjacent diagram provides a notion of possible TPS for different types of VM/server CPU based on number of cores. In SKYE case, for an average 10 x Merkle leaves per block (each SKYE block being a discrete transaction), TPS by CPU might start from 20k equating to 20k ms for a 4-cores divided by 10 leaves per block. This could evolve to 80k for a 16-cores CPU, and scale-up beyond this with higher-specs.

But, in reality, SKYE TPS is **virtually unlimited** as, in addition to KEYSTONE built-in sharding, a GPU setup would trivialise single CPU's performances to negligible factors.

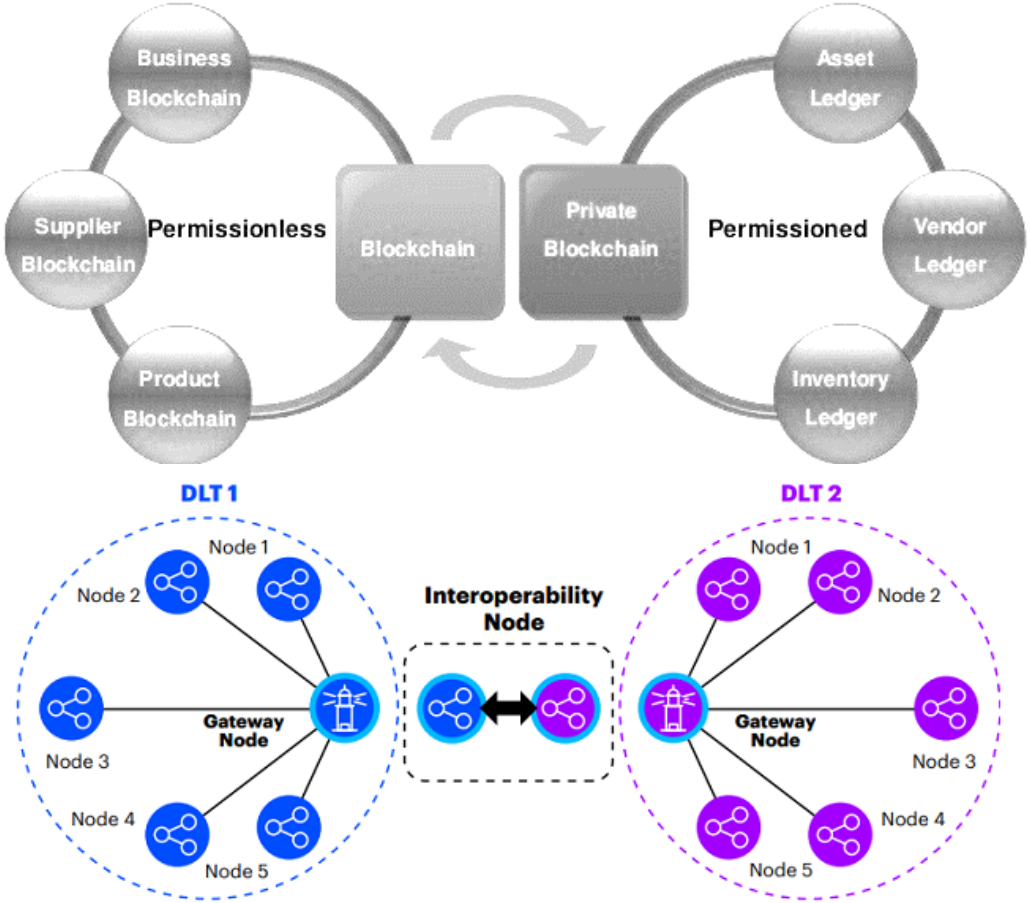


the on-chain vs off-chain debate

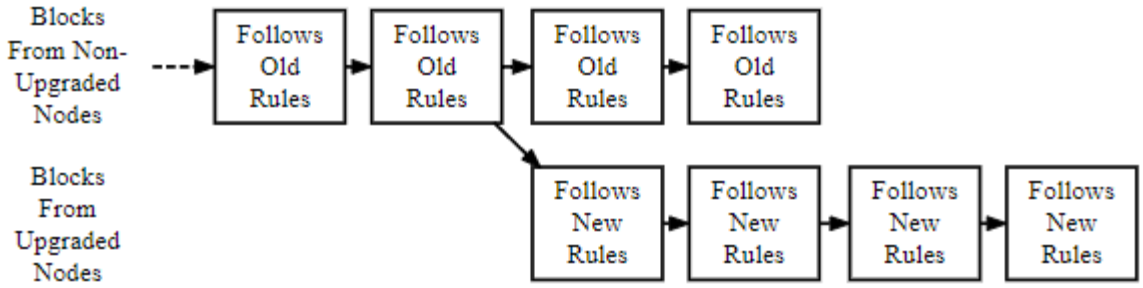
1. What goes on the ledger? Does everything need to go on the ledger?
2. What is a transaction? Is a transaction always a financial transaction?
3. Shall all transactional data, financial or not, be on-chain?



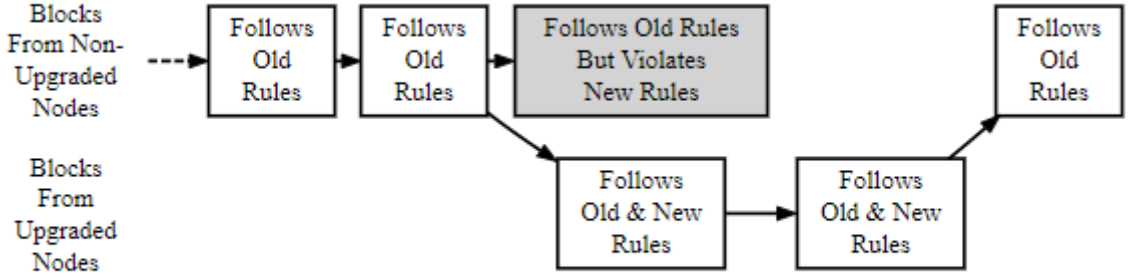
the protocol interoperability debate



the forking debates

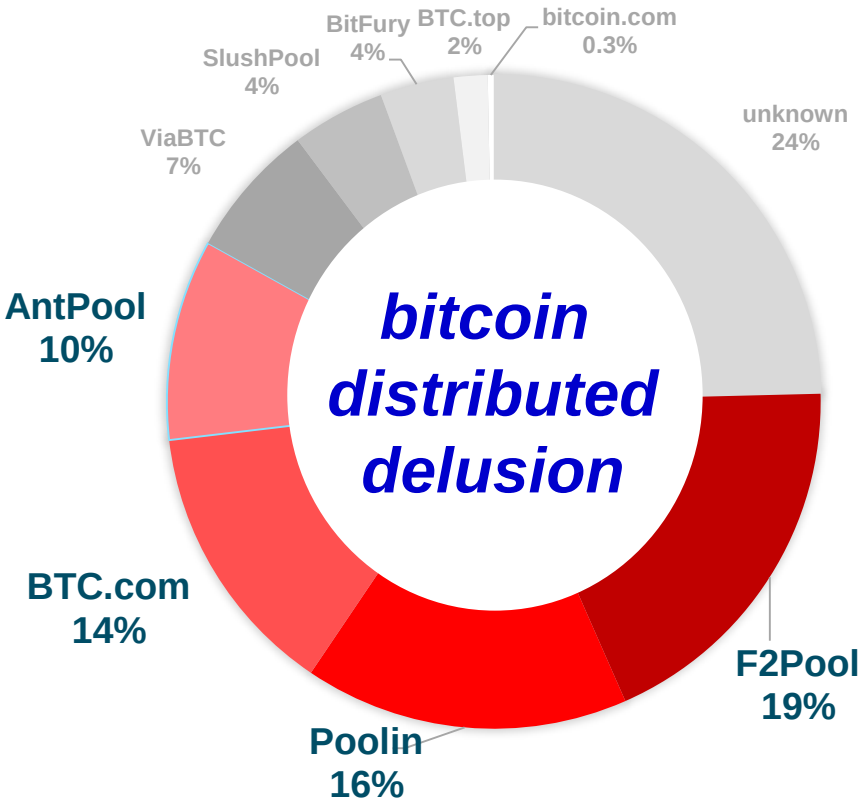


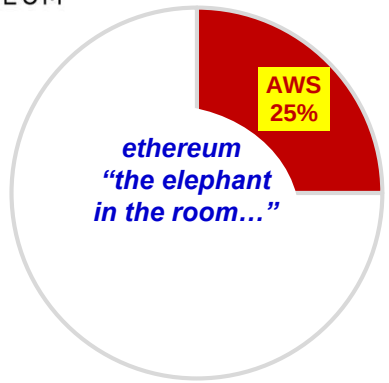
A Hard Fork: Non-Upgraded Nodes Reject The New Rules, Diverging The Chain



A Soft Fork: Blocks Violating New Rules Are Made Stale By The Upgraded Mining Majority

the ecosystem governance debate





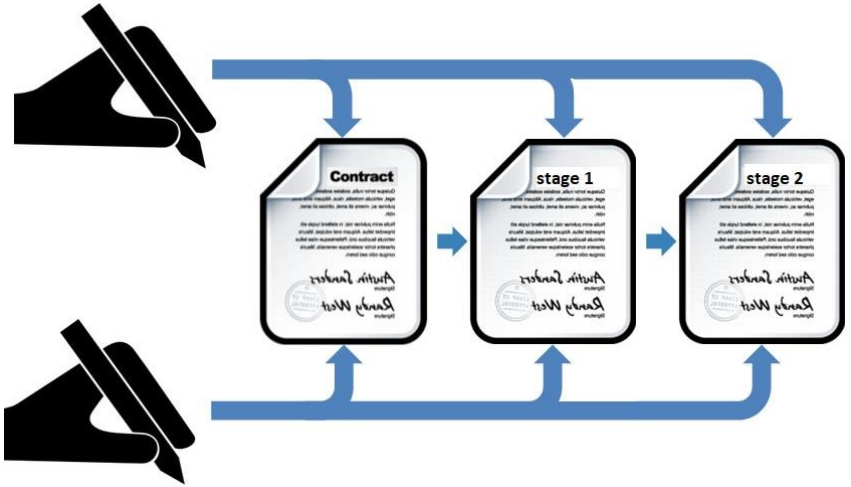
- 2019 QuadrigaCX US$ 190m in asset losses
- 2016 Ethereum DAO hard-fork US$ 60m fallout
- 2019 Facebook Libra DOA (Dead-On-Arrival) fallout

smart contracts vs DLT ecosystems

smart contracts *vs* DLT ecosystems

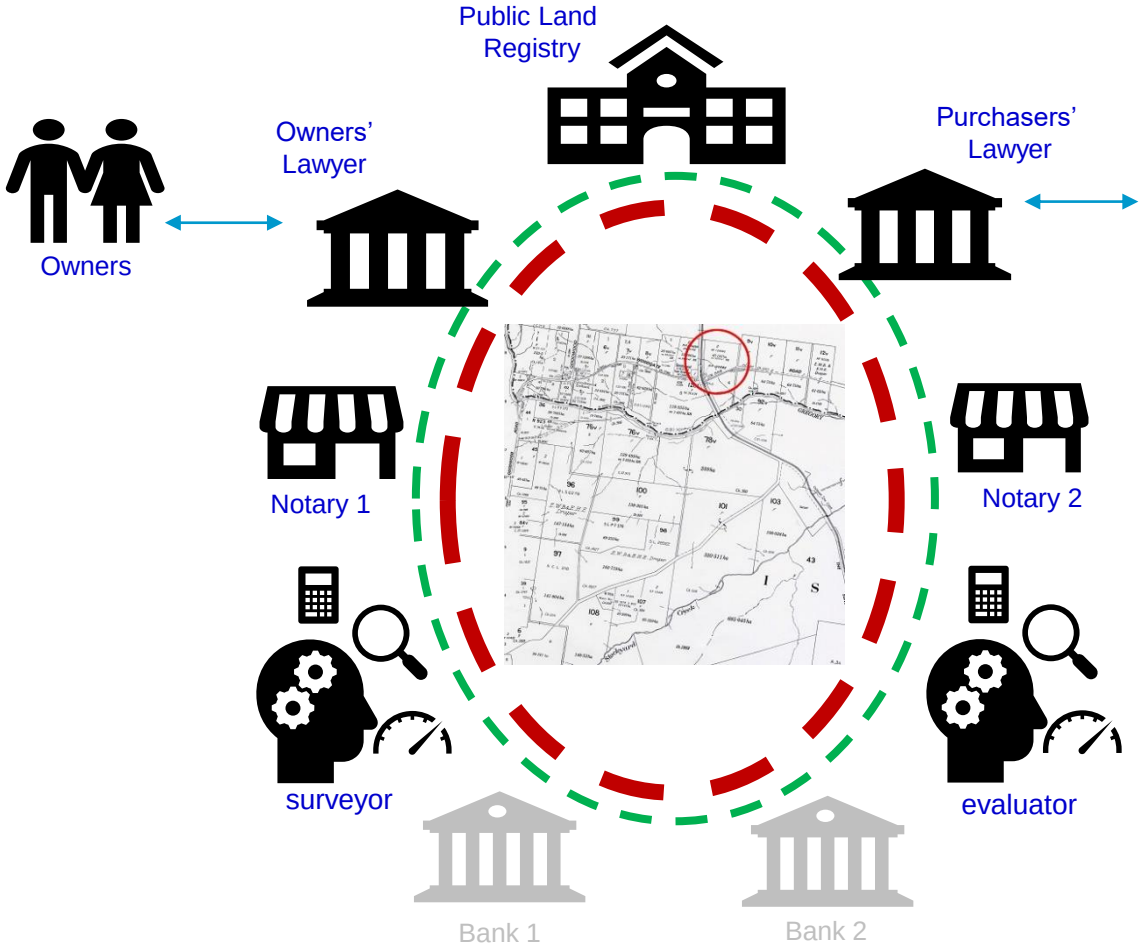
multi-stage smart contract options

- actions achieved via ***delayed*** document / action:
  - content published, invoice issued, payment triggered, stock released, etc.



- *floor level* workflows activate action/s on a:
  - "**unanimity**" basis | (100%) all stakeholders, or
  - "**quorum**" basis | *n*% (a few) stakeholder/s, or
  - "**first**" basis | (0%) 1st party to set floor level

real estate title exchange | PoC demo



Goverment Of India

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	Process steps
1	Purchaser checks public registry
2	Purchaser makes offer to owner
3	Preliminary offer acceptance
4	Owner contacts lawyer 1 and Notary 1
5	Purchaser contacts lawyer 2 and Notary 2
6	Lawyer 1 setups draft contract and organise owner and notary 1 access
7	Lawyer 2 confirms draft contract and organise purchaser and notary 2
8	Surveyor research and verification
9	Bank mortgage preparation
10	Insurance, financial research, encumbrances
11	Confirming the milestone Completing the contract

session 1 recap

- *blockchain history & concepts*
- *hashing*
- *baseline merkle tree*
- *ever-growing merkle tree*
- *proof of work, stake, importance*
- *open vs private DLT ecosystems*
- *smart contracts vs DLT ecosystems*

any questions so far?

module 2
DLT use cases

hundreds of DLT use cases...

Here's a snapshot grouped by a few core domains

gov / regtech (accreditations)

consumer electronics
dangerous goods
pharmaceuticals
building trades
evidence law
automotive
aerospace
healthcare
insurance
electrical
finance
food

The newest strongest
data integrity standard

operations

recalls
API trivialisation
complex value chains
consortium trivialisation
authenticity / provenance

orgtech

hybrid organisational structures
cBM (cluster business model)
distributed organisations
nomadic organisations
franchise optimisation
dematerialisation
decartelisation

analytics

clustering
risk analysis
segmentation
benchmarking
market baskets
pooled research
product categorisations

public/private registries

self-regulatory records
governance breaches
industry standards
academic records
electoral records
medical records
criminal records
land, titles, wills
board minutes
credit records
life events
patents

fintech

exchanges
hot / cold wallets
tokenisation / tokenomics
disruptive mining (e-sports)
distributed models (energy)
cryptocurrencies, ICO / TAP

a need for **independent** parties to **operate together** under a safe, streamlined **tamper-proof ecosystem**

value chains

Identity, information authenticity & copy rights

- authorship & digital identity
- provenance & ownership
- reputational systems
- proof of authenticity
- credibility tracking
- incentivized truth
- fact-checking
- traceability
- forensics

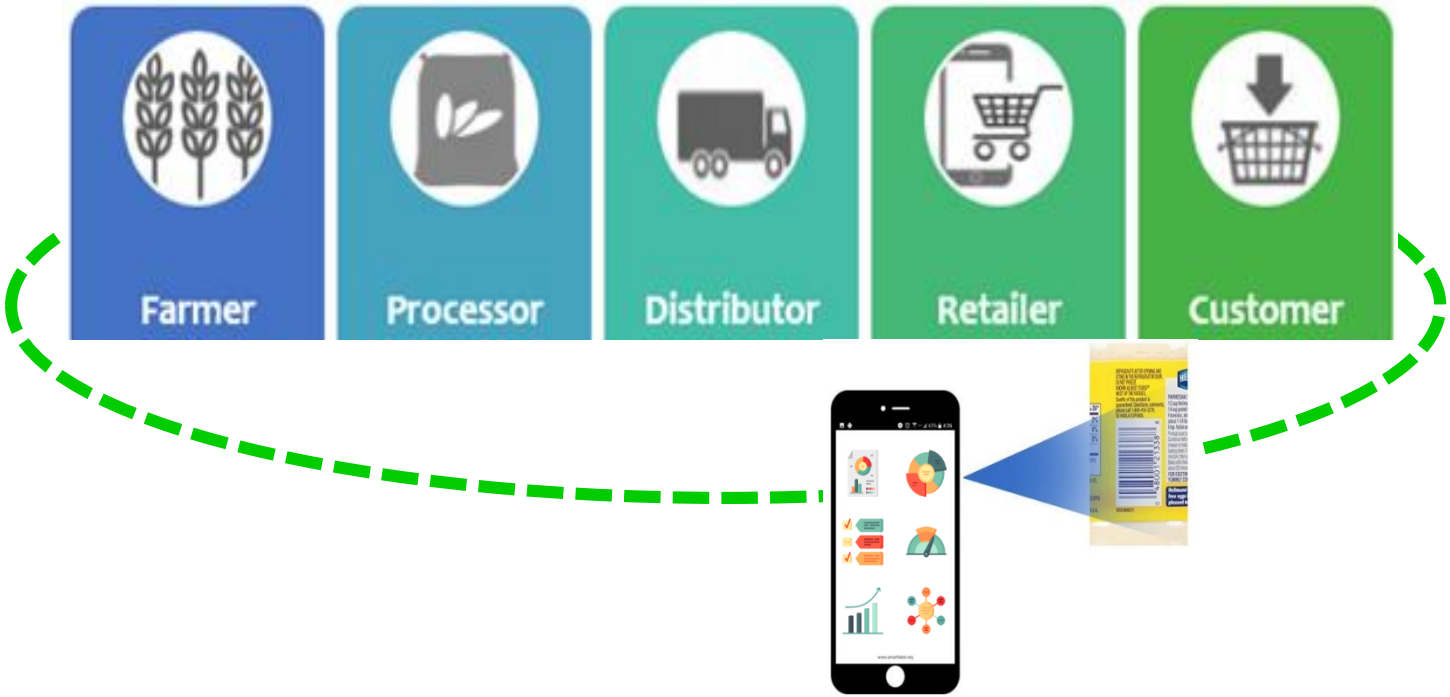
Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

solving the *deep/fake news* &
***identity theft* social epidemic**

TANZANIA

granular transparent value chain

recalls, provenance



MAERSK LINE

Walmart

BRITISH AIRWAYS

BLOCKVERIFY

GOBIERNO DE MÉXICO

UNITED STATES AIR FORCE

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valenciaport
Autoridad Portuaria de Valencia

FEDERAL GOVERNMENT OF NIGERIA

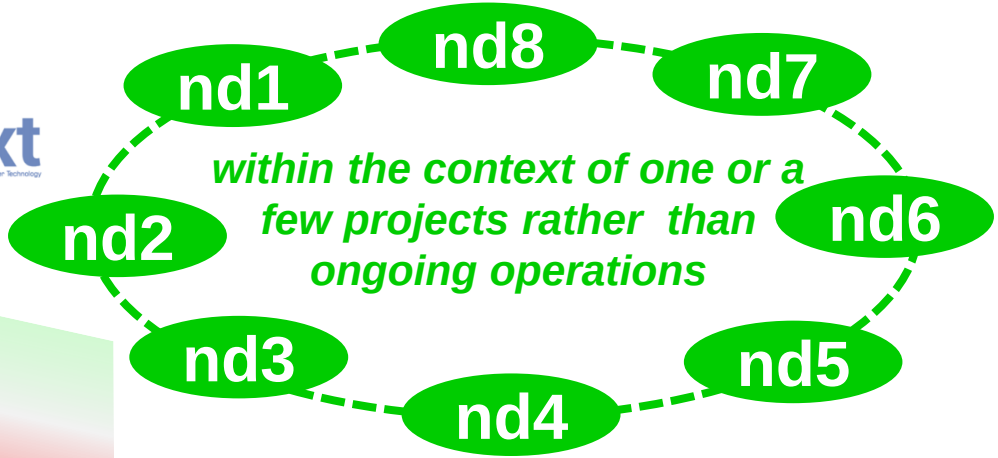
Republic of Korea

consortium trivialisation

Bankchain · B3i RETHINKING INSURANCE · CLOUDY BOSS CERTIFIED partner · Next Enterprise Distributed Ledger Technology

Global Shipping Blockchain Network (GSBN)

CMA CGM, Costco Shipping, Hutchinson Ports, Port of Qingdao, PSA International, Shanghai Port



Until now, consortiums formed when 1 supplier alone could not enter a large tender (and related project).

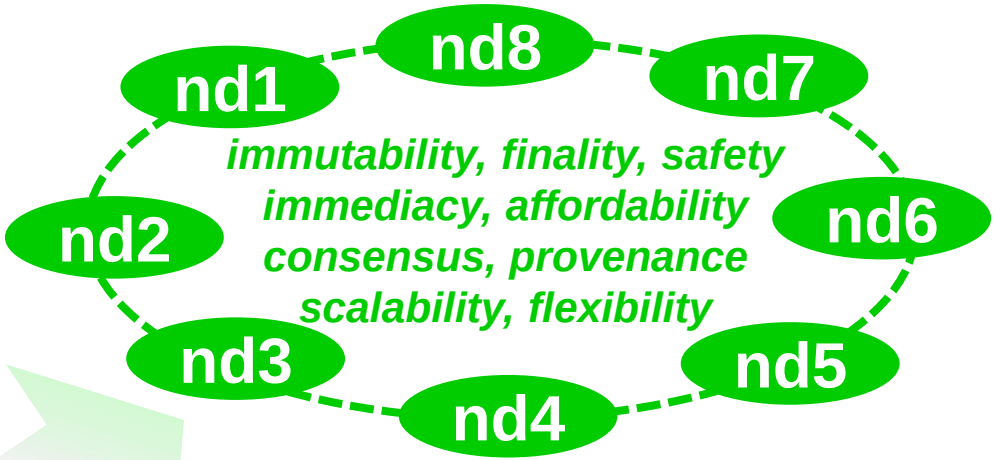
A consortium pools capabilities from different independent parties and distributes risk exposures.

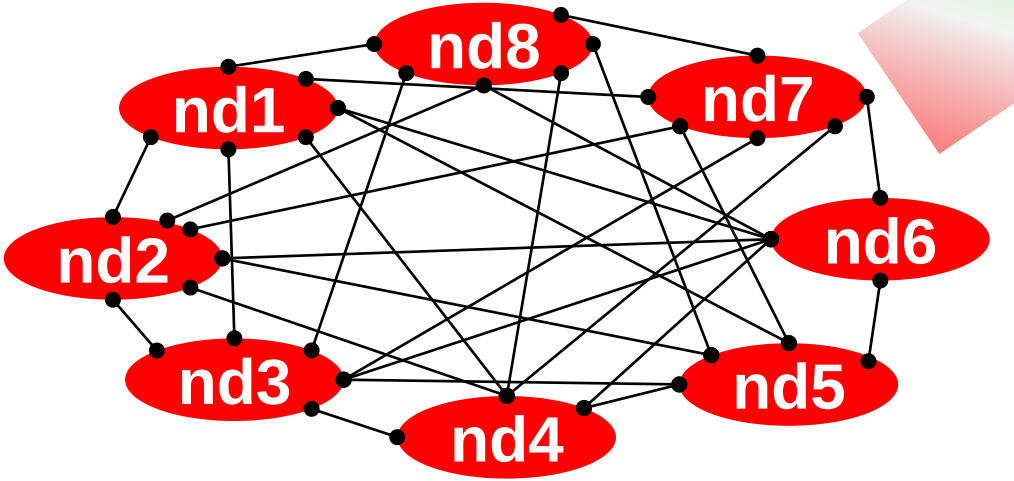
Commercial lawyers tend to get involved in the drafting of complex MOU and other legal documents.*

*smart contracts trivialise consortiums allowing pooling and risk mitigation on **any-value projects anywhere**, especially where the parties do not know each other.*

** MOU = Memorandum of Understanding*

API business trivialisation

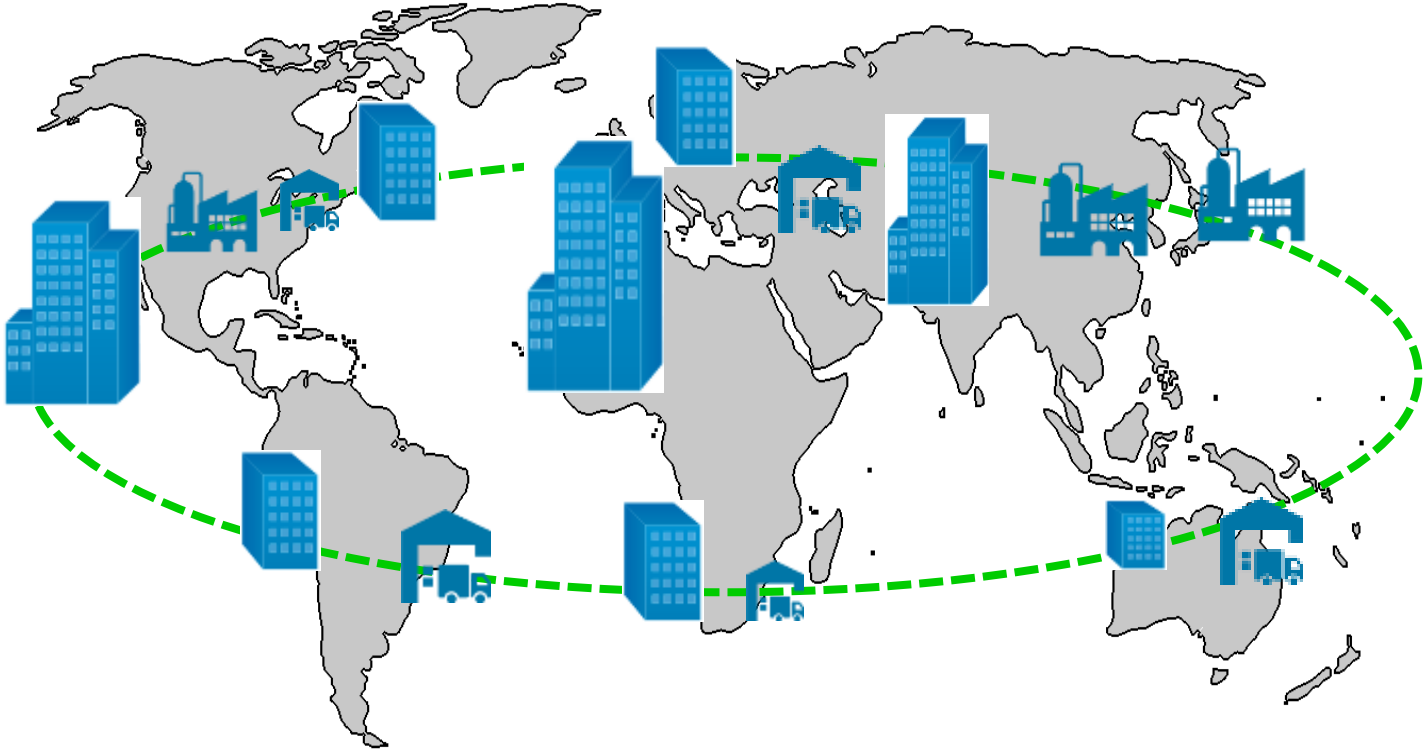




inefficient, expensive, vulnerable,
scale poorly, inflexible

OrgTech

distributed (virtual or not) organisational structures



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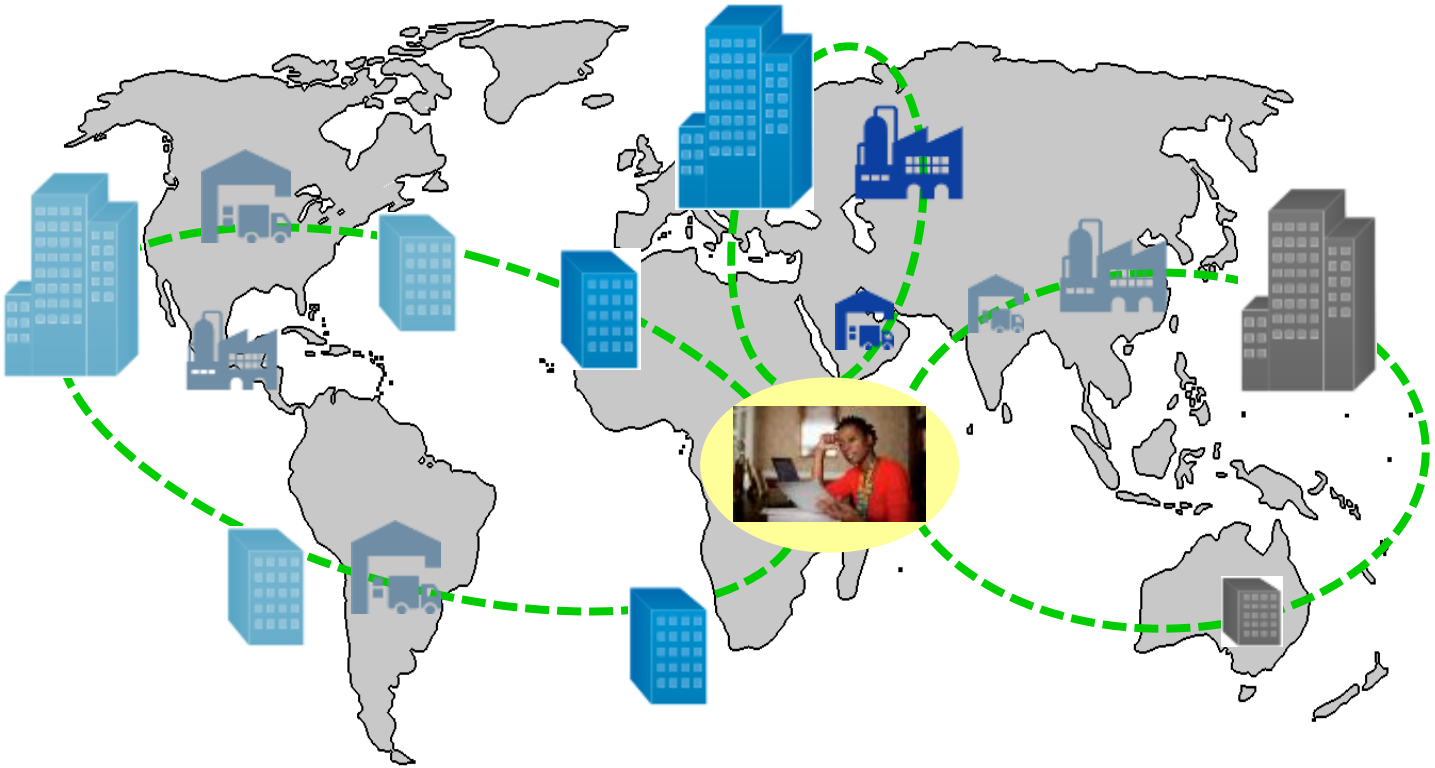
SAP

innovative distributed organisational structures

MaaS (Multinational as a Service)



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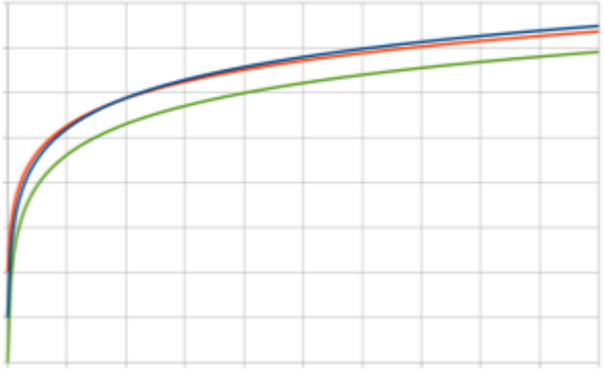
DLT-based franchising organisational model

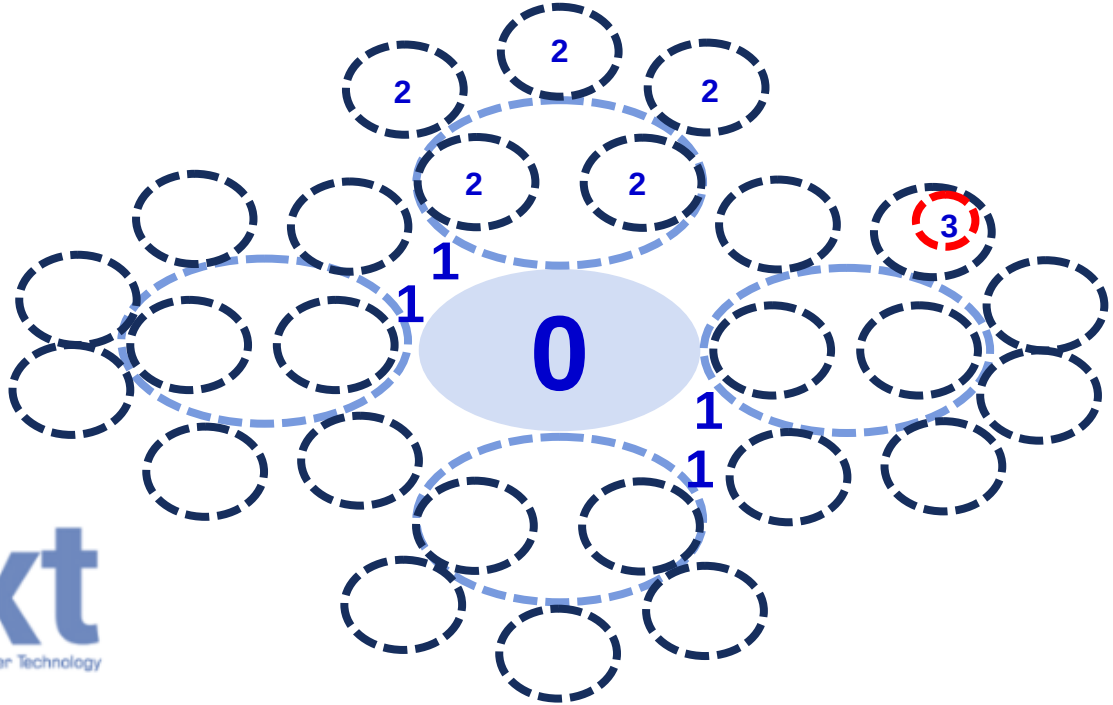
enhanced efficiencies | decreased complexity

If you are a franchisor yet to consider DLT, ***your peers already are !***

MLM (multi-level marketing) vs cBM (cluster business model)

asymptotic margin control
via ring level (or generation) + level factor





CLOUDY BOSS CERTIFIED partner

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- *more **relevant to hyper-connected world** than old-school geo-segmentation*
- *scale-neutral **distributed fairness** + **infinite returns** at any level*
- ***asymptotic margin control** via ring level factor*

Industry 4.5

VĮ KLAIPĖDOS VALSTYBINIO JŪRŲ UOSTO DIREKCIJA

- physical asset tokenisation
- machine-as-a-service
- factory-as-a-service

KN

Factory as a Service

FaaS

KLAIPĖDOS LAISVOJI EKONOMINĖ ZONA

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Rexroth
Bosch Group

PropTech

blockchain in real estate

- physical asset tokenisation (higher liquidity)
- greater transparency and fraud prevention
- more reliable data @ lower costs
- faster collection & due diligence
- more secure property rights
- project management
- real-time transaction
- new renting models

LawTech

TCP/IP is NOT BF* tolerant

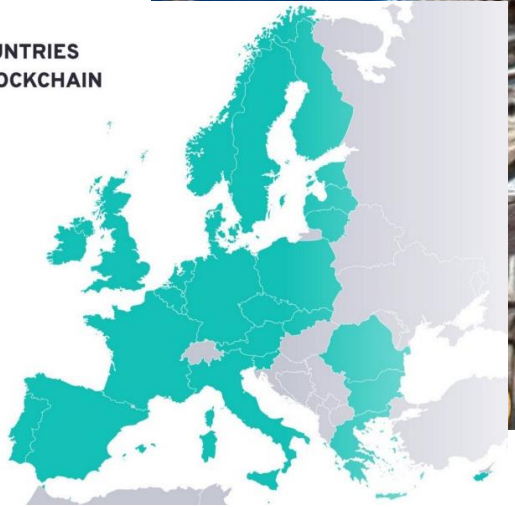
*as it sets a new **highest standard** on data integrity, **blockchain** unveils pitfalls with all sub-standard protocols, and **challenges all existing legislations on digital evidences**.*

** BF = Byzantine Fault*

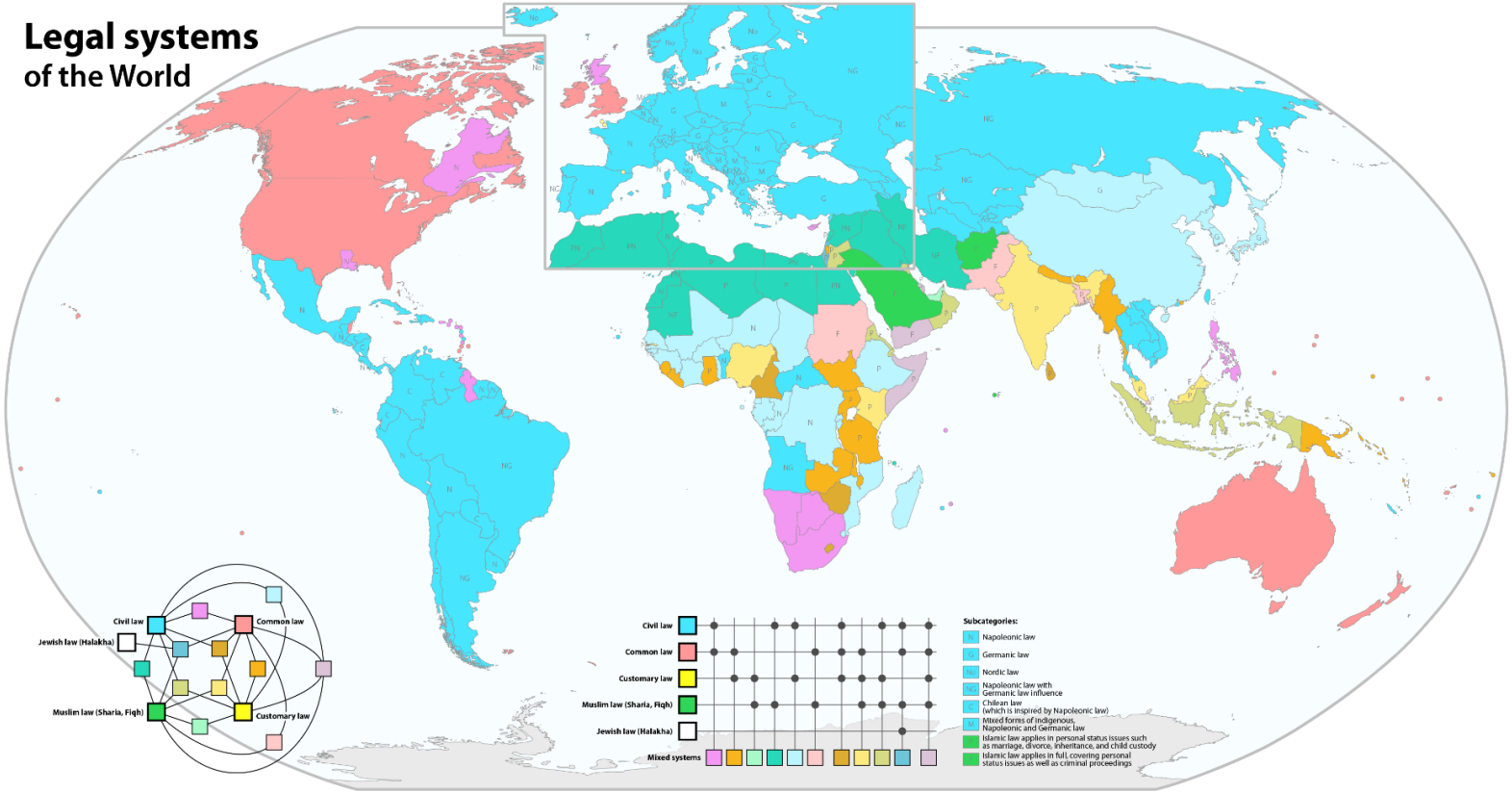
ITALY first mover on new DLT laws

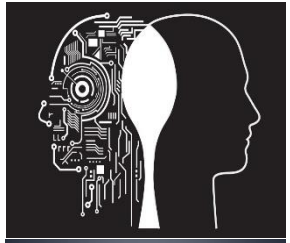
CURRENT LIST OF COUNTRIES IN THE EUROPEAN BLOCKCHAIN PARTNERSHIP:

Austria
Belgium
Bulgaria
Czech Republic
Denmark
Estonia
Finland
France
Germany
Ireland
Latvia
Lithuania
Luxembourg
Malta
Netherlands
Norway
Poland
Portugal
Slovakia
Slovenia
Spain
Sweden
UK
Greece
Romania
Italy
Cyprus



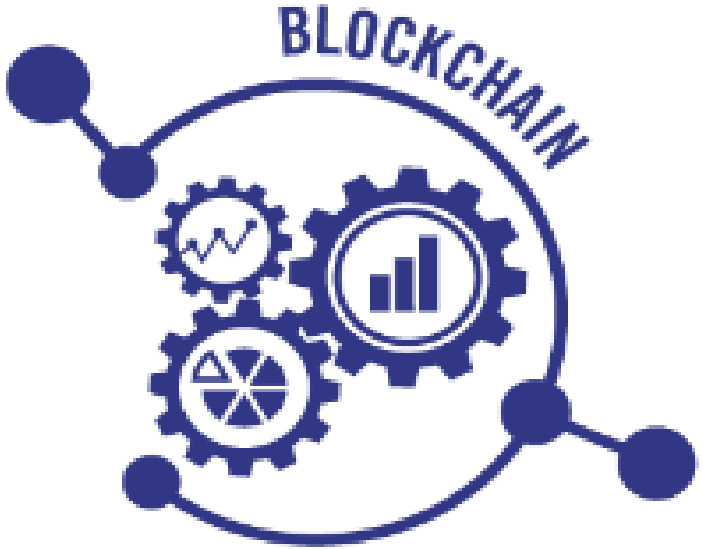
co-created law and DLT





Open Government Partnership

RegTech



The newest strongest
data integrity standard

constituencies expect any government to adopt the ***highest possible standards of governance*** *and provide absolute assurance on the integrity of any type of public records*

GovTech | Significant Life Event Registry

Birth

Marriage

Death

Government of Canada / Gouvernement du Canada

Canada

सत्यमेव जयते

Goverment Of India

Next

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GovTech | electoral registry

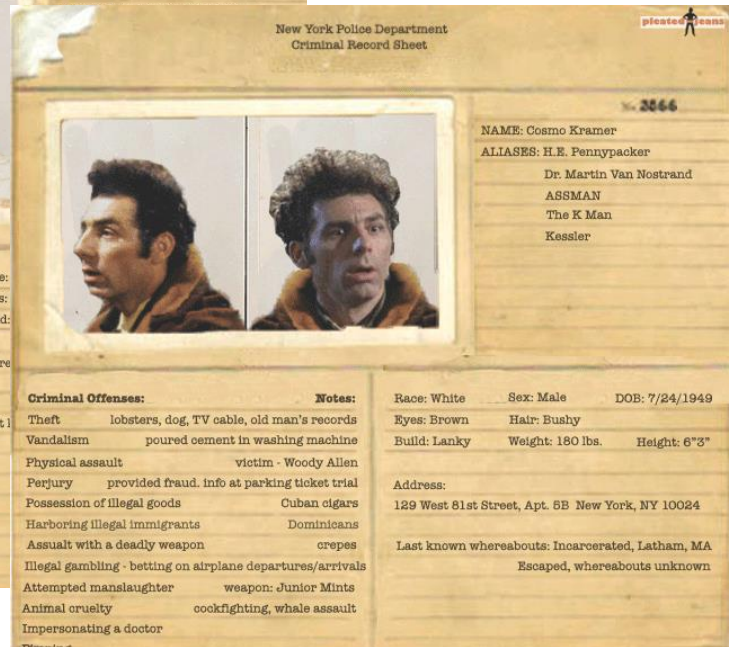
DENMARK

REPUBLIC OF ESTONIA
GOVERNMENT OFFICE

सत्यमेव जयते
Goverment Of India

Government of South Australia

GovTech | criminal records & unbiased legal system



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GovTech | immutable academic records

GOVERNMENT OF MALTA

GovTech | patent records, digital rights management

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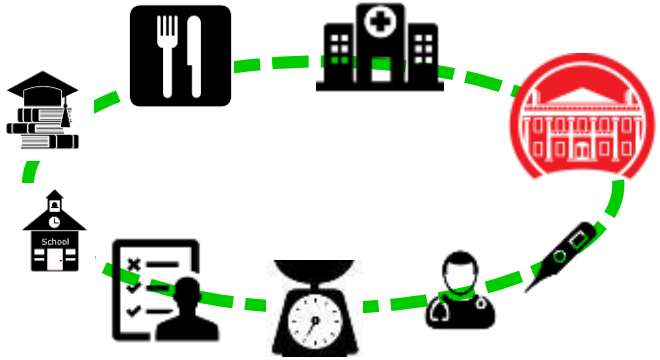
KODAK

GovTech | credit report

Government of Sierra Leone

UNITY FREEDOM JUSTICE

GovTech | standards and measures



GovTech | industry breaches and incidents

accreditation and compliance

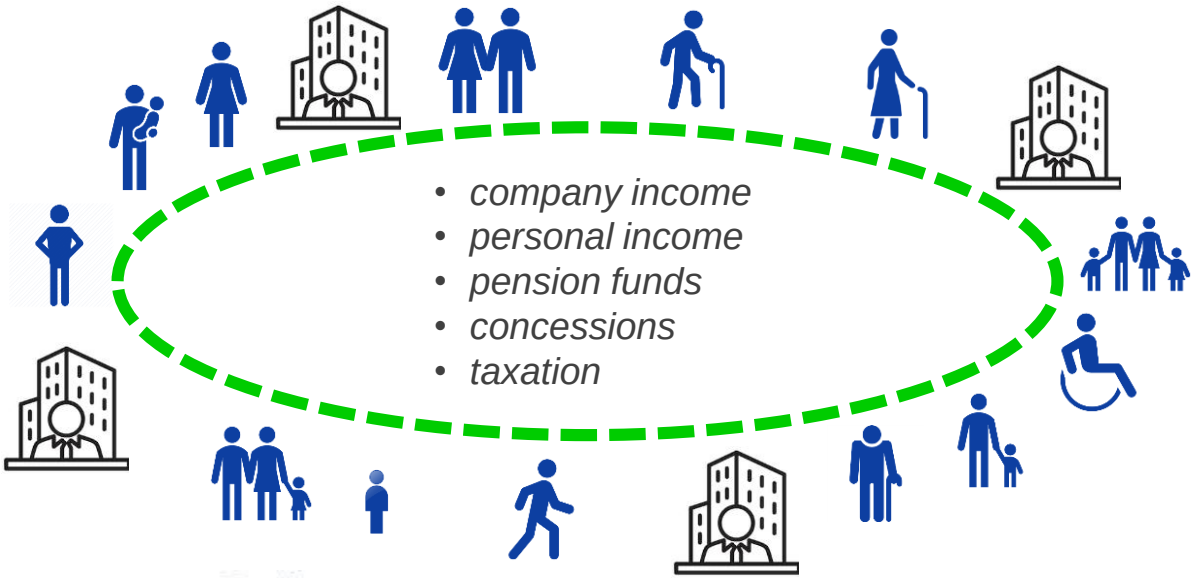
- *dangerous goods*
- *pharmaceuticals*
- ***building trades***
- ***electricals***
- *financials*
- *food products*
- *automotive*
- *aerospace*
- *healthcare*
- *estate*

Queensland Government
Department of Energy

Australian Government
Department of the Environment and Energy

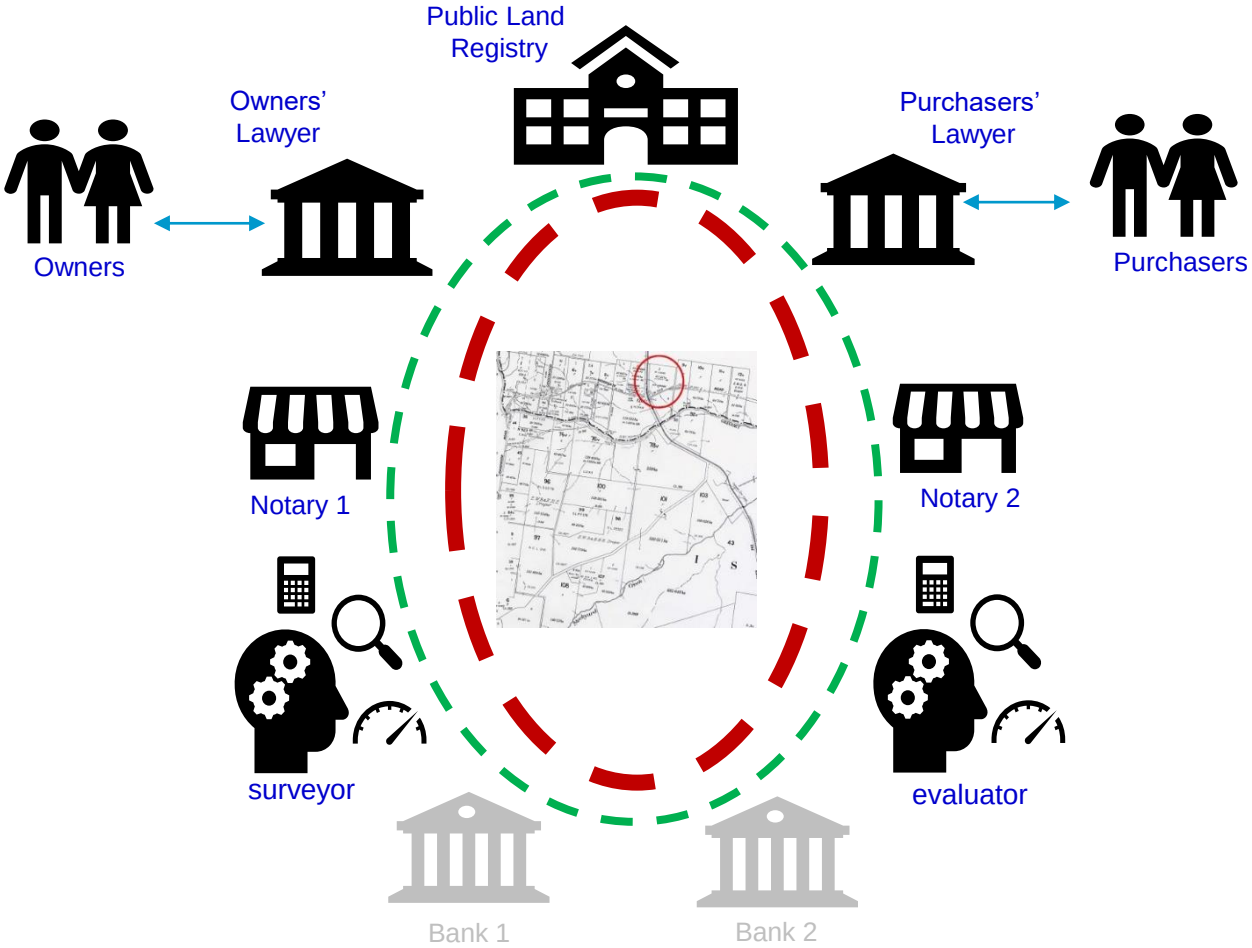
IEEE

taxation compliance & streamlining



Government of Maharashtra

land & titles registry



GOVERNMENT OF RWANDA
gov.rw

REPUBLIC OF GHANA

Georgia

सत्यमेव जयते
Goverment Of India

REPUBLIC OF SOUTH AFRICA

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Government Offices of Sweden

Uganda

distributed EMR

1. Unleash AI-driven preventative health by learning from EMR *ecosystem*
2. Neutralise all data threats via compliance with GDPR principles
3. Empower end-users with user-centred EMR

EU GDPR COMPLIANT

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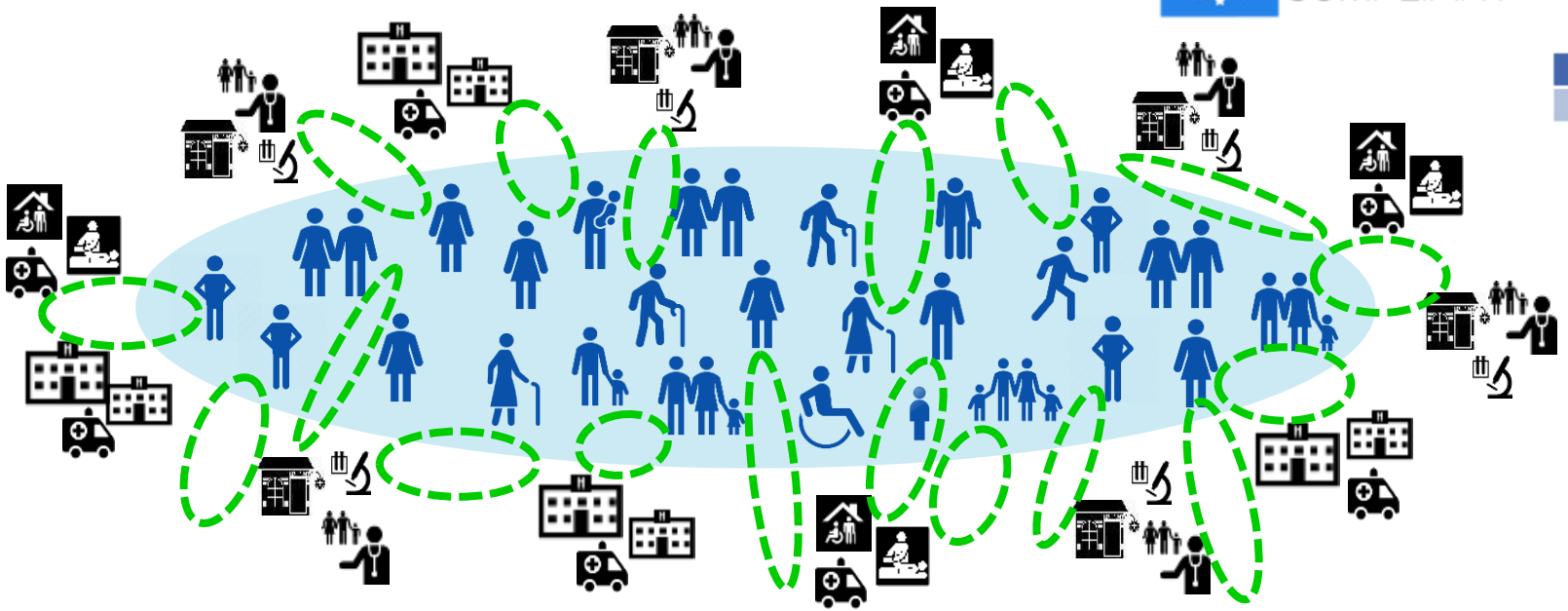
MEDREC
Blockchain for EMRs
pubpub.org/pub/medrec



InsurTech

from actuarial to IoT / p2p models

big-data risk analysis, personalised, pooled, p2p, smart supply

Next guardtime MAERSK LINE B3i RETHINKING INSURANCE DYNAMIS Lemonade COBRA AXA teambrella

new data-driven revenues and efficiencies

data marketplaces, AI inaccuracy risks, user education
greater return on float via smart contract efficiencies

COBRA
CloudyBoss Omni-currency Banking Rotation Account

teambrella

analytics

disintermediated market research

unbiased benchmarking, segmentation, categorization, baskets

Next
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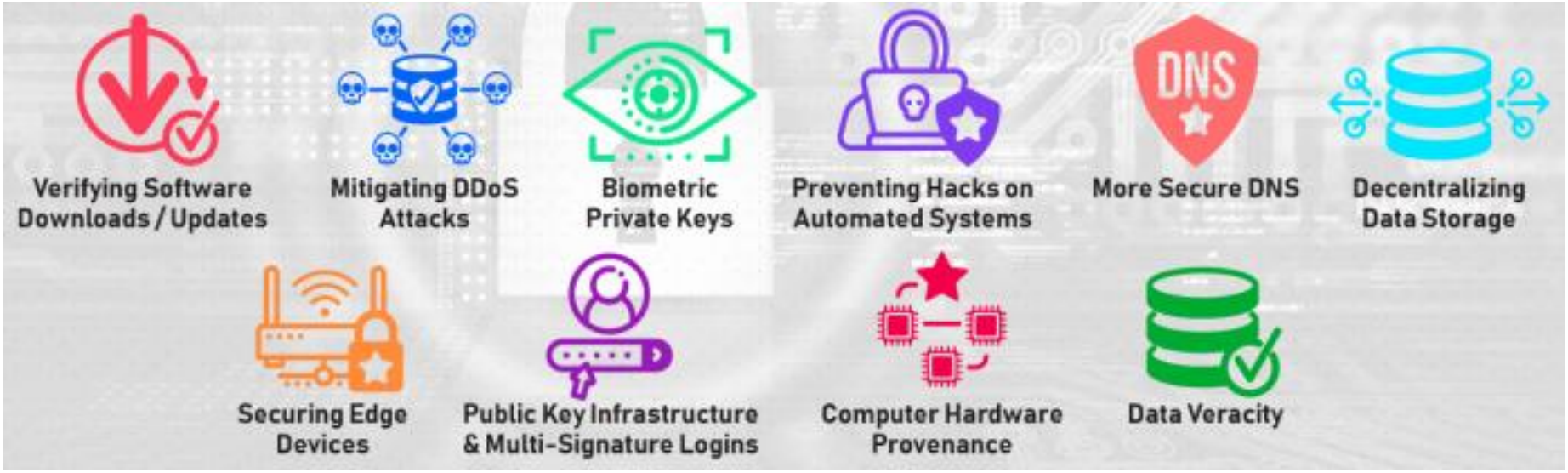
cyber-security

cybersecurity shield



DARPA

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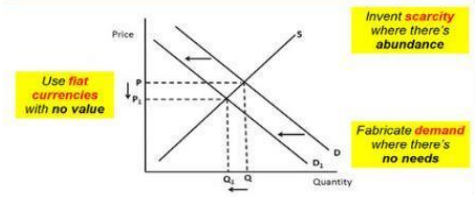
REMME

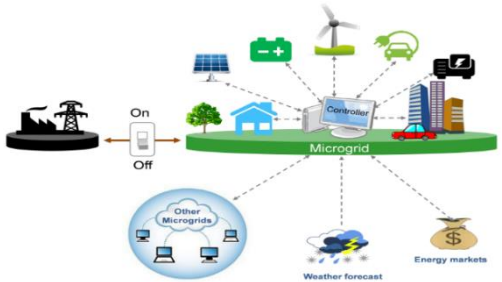
guardtime

tokenomics

neo-economics via generalised tokenisation

- knowledge economics
- distributed economics
- **assets tokenisation**
- shared economics
- social enterprising
- AI taxation & UBI
- p2p economics
- AI tokenomics

old *broken lines* economy	new *knowledge* economy
	
1 + 1 < 1	**1 + 1 > 2**



JUXTIT codeless coinless smart contracts

DLT-based data marketplace

1. Usage value
2. Asset value
3. Future value

Massachusetts Institute of Technology

FinTech

cryptos and related tools

exchanges, hot/cold wallets, ICOs, STOs, TAPs

new sustainable emerging mining models

leveraging 3b gamers worldwide to mine cryptos

CBDC's (Central Bank Digital Currencies)

Central banks working on CBDC's

- *BIS (Bank of International Settlement)*
- *Sveriges Riksbank (Bank of Sweden)*
- *European Central Bank*
- *Bank of Switzerland*
- *Bank of Singapore*
- *Bank of England*
- *Bank of Canada*
- *Bank of Japan*
- *Bank of China*

session 2 recap

- *value chain*
- *orgTech*
- *propTech*
- *lawTech*
- *regTech*
- *insurTech*
- *analytics*
- *cybersecurity*
- *tokenomics*
- *finTech*

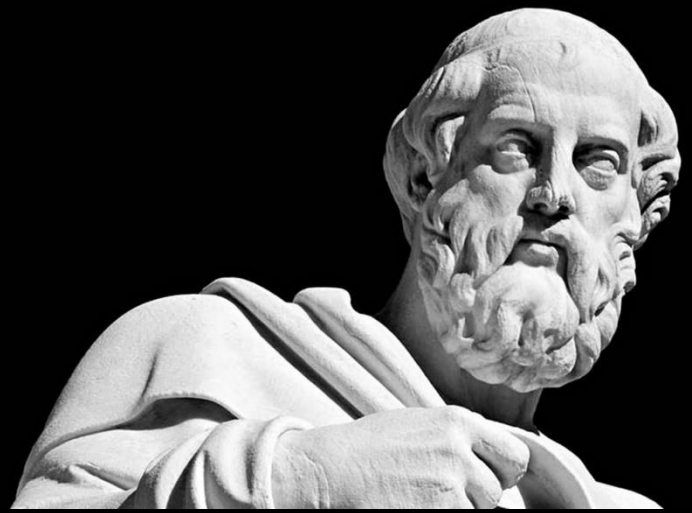

any DLT
use cases
suggestions?

morning break

module 3 technology convergences

convergences

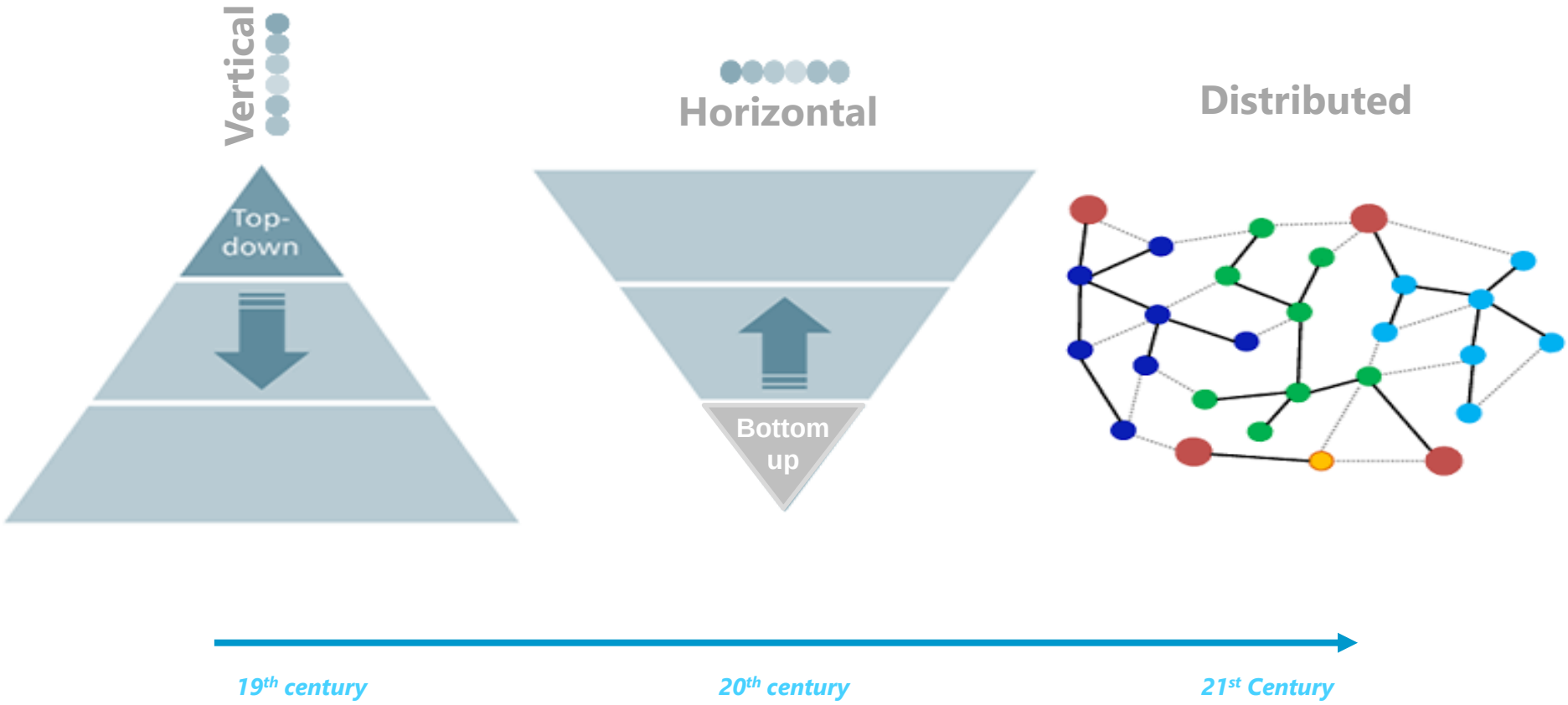
How AI, IoT and DLT are redefining management platforms



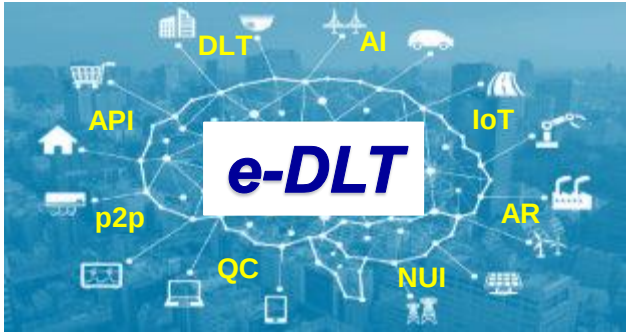
“Necessity : mother of all inventions”

~ Plato

organizational models over time



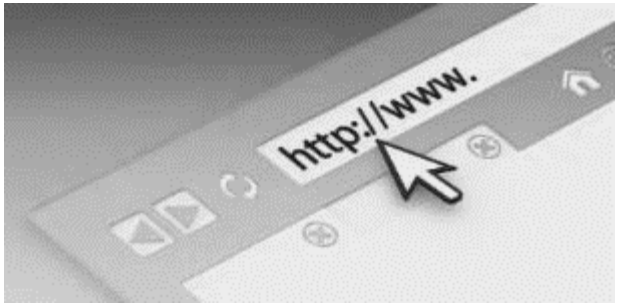
management platforms over time



90's 00's 10's

UI (User Interface) / UX (User eXperience) models over time

browser



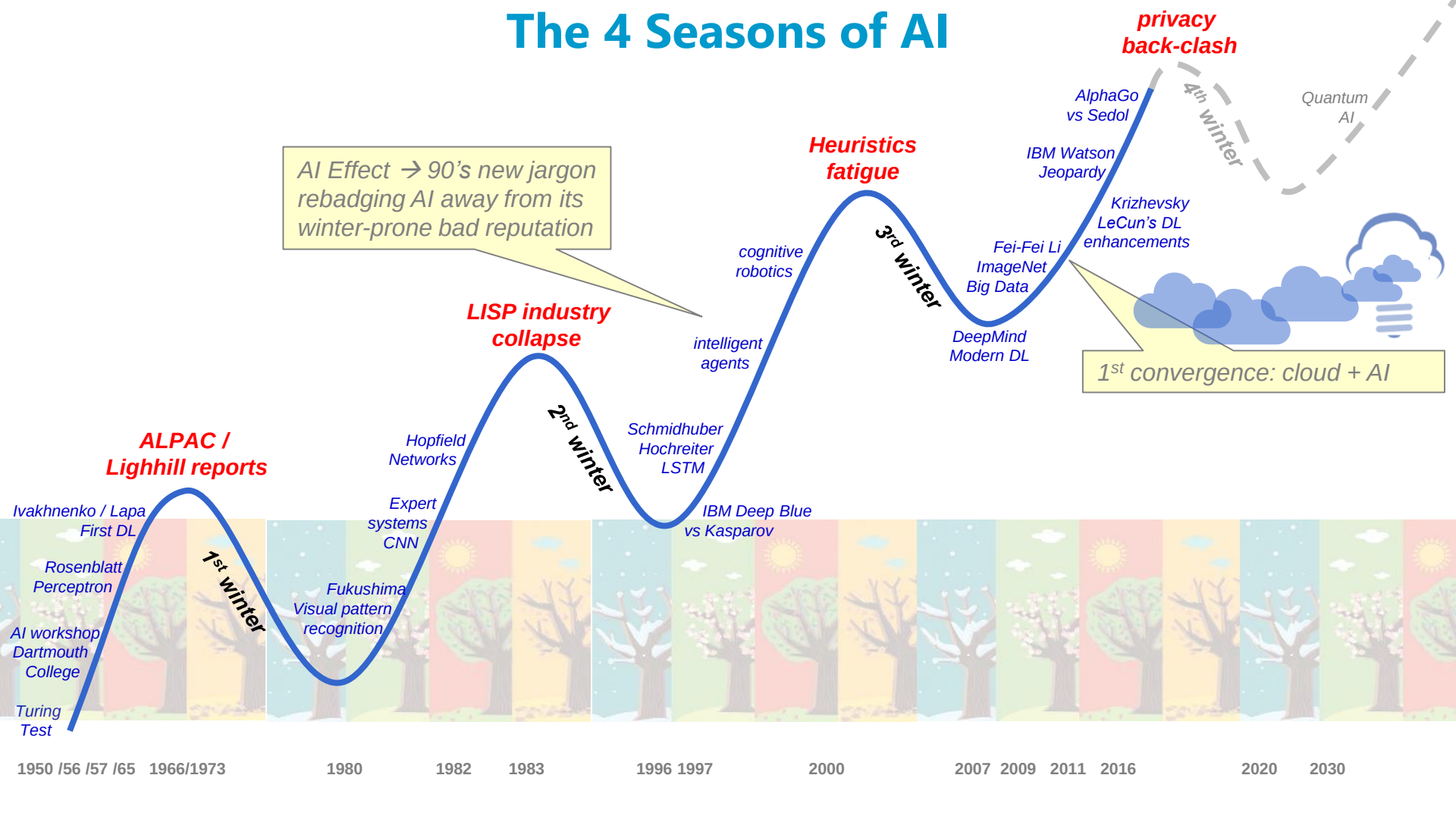
app

chatbot

90's *00's* *10's*

1. Artificial intelligence

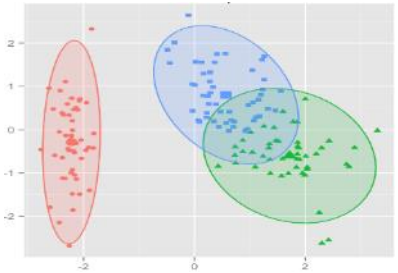
The 4 Seasons of AI



narrow AI scope

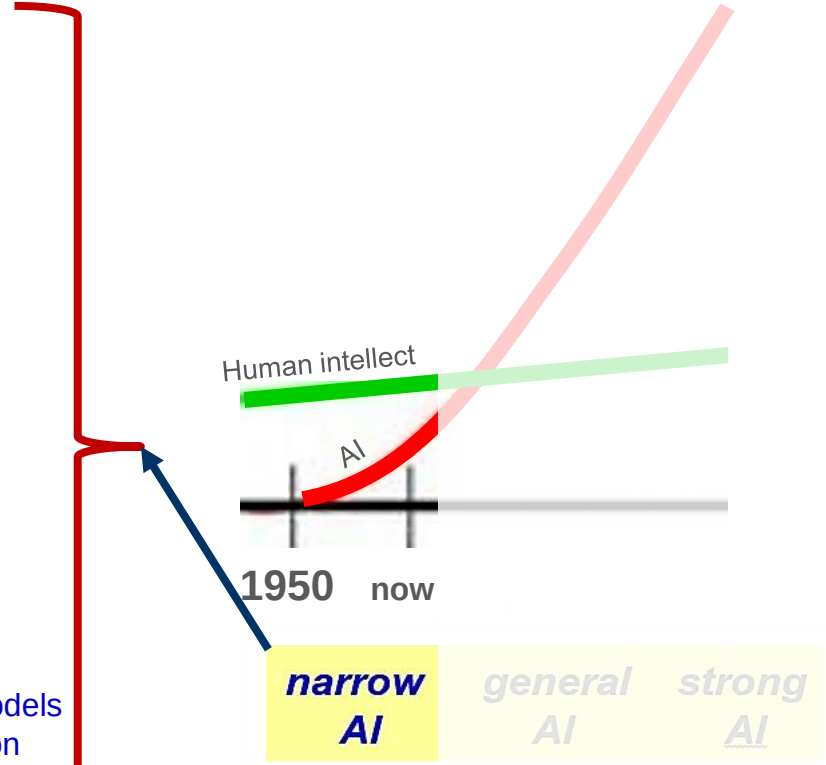
Speech-to-text (video / real time)
Text-to-speech (raw waveform)
Natural Language Analysis
Language translations


Visual identification
Image analysis
Video analysis



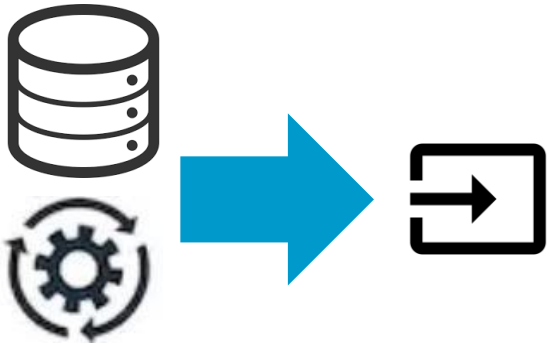
Socio-demographics analysis
Mood / sentiment analysis
Data patterns recognition
Insights uncovering
Personality insights
Tone analysis

Trends analysis / predictive business models
Value (demand/supply) chain optimisation
Bots, RPA (Robotic Process Automation)
Tailored nano-marketing
Fraud detection

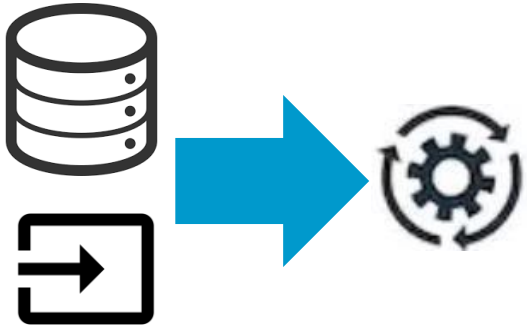


ML basics | what

feed machines with training data
so that they learn how to do something
without explicitly programming them to do it

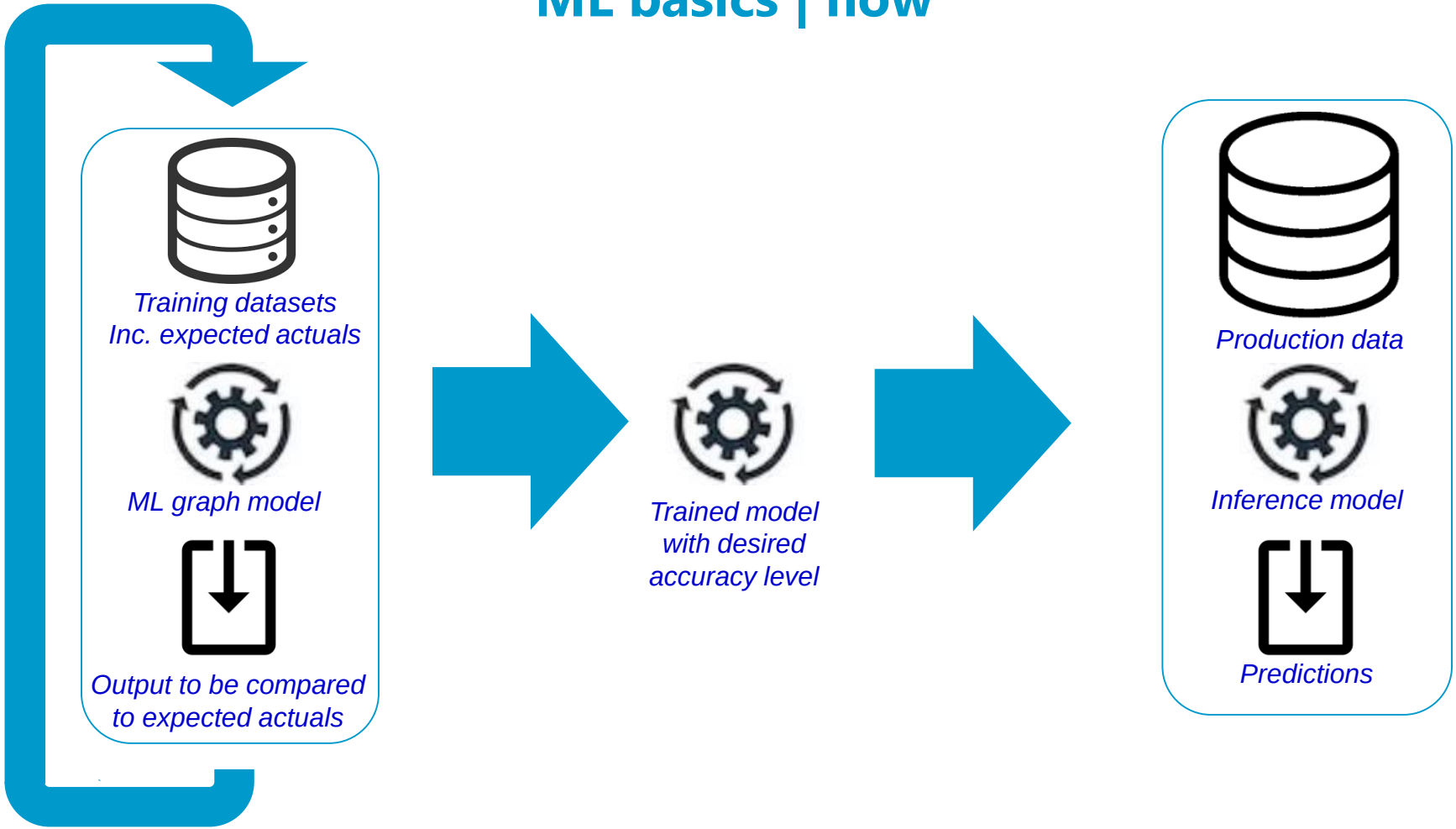


Conventional computing



Machine learning

ML basics | how



ML tools clustered by type

Neural Net

Generative adversarial Network
Radial Basis Function Network
Convolutional Neural Network
Deep Adversarial Network
Deep Boltzmann Machine
Stacked Auto-Encoders
Deep Belief Networks
Back-Propagation
Capsule Network
Hopfield Network
Perceptron

Clustering

K-Means
K-Medians
K-Nearest Neighbor
Self-Organizing Map
Hierarchical Clustering
Expectation Maximization
Locally Weighted Learning
Learning Vector Quantization

Regression

Elastic Net
Ridge Regression
Linear Regression
Logistic Regression
Stepwise Regression
Least-Angle Regression
Ordinary Least Squares Regression
Locally Estimated Scatterplot Smoothing
Multivariate Adaptive Regression Splines
Least Absolute Shrinkage & Selection Operator

Decision tree

Chi-squared Automatic Interaction Detection
Classification and Regression Tree
Conditional Decision Trees
Iterative Dichotomiser 3
Decision Stump
Digital twin
Simulation
M5

Toolboxes

CNTK
MXNet
TensorFlow
PyTorch
AutoML

Others

Q-Learning
Lean learning
Inductive logic
Explainable AI
Eclat algorithm
Apriori algorithm
Transfer learning
Probabilistic coding
Temporal Difference
Augmented data learning
Support Vector Machines

Bayesian

Naive Bayes
Bayesian GAN
Hybrid Learning
Bayesian Network
Gaussian Naive Bayes
Bayesian Belief Network
Bayesian Deep Learning
Multinomial Naive Bayes
Bayesian conditional GAN
Averaged 1-Dependence Estimators

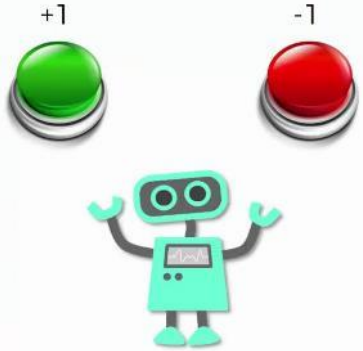
Dimensionality reduction

Partial Least Squares Regression
Principal Component Regression
Quadratic Discriminant Analysis
Principal Component Analysis
Flexible Discriminant Analysis
Mixture Discriminant Analysis
Linear Discriminant Analysis
Multidimensional Scaling
Sammon Mapping
Projection Pursuit

Ensemble

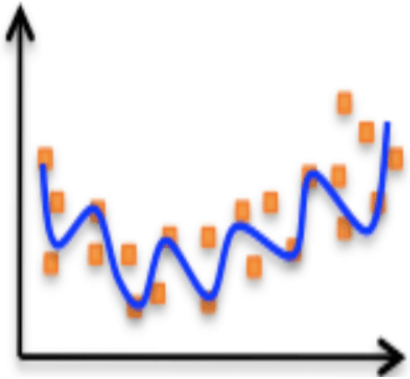
Boosting
XGBosst
CatBoost
AdaBoost
Light GBM
Random Forest
Gradient Boosting Machines
Stacked Generalization (blending)
Gradient Boosted Regression Trees
Bootstrapped Aggregation (Bagging)

learning types

supervised	unsupervised	reinforcement
labelled data	unlabelled data	(re)actions & rewards
predictions, inferences	uncover patterns	autonomous systems
support vector machines logistic regression linear regression …	association rules clustering K-mean …	temporal differences decision trees Q-learning …
		
ranking, classification	marketing segmentation	recommendation system

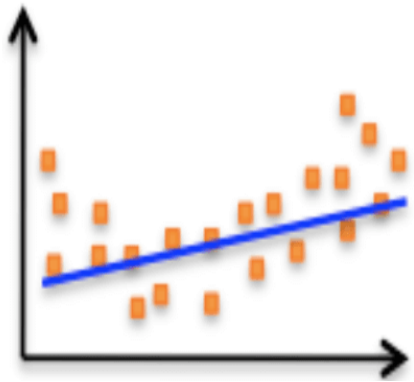
challenges

1. AI trust
2. AI risks
3. data bias
4. data value
5. data accuracy
6. data ownership
7. AI performance
8. AI ethics/ acceptance



overfitting

- low bias
- high variance



underfitting

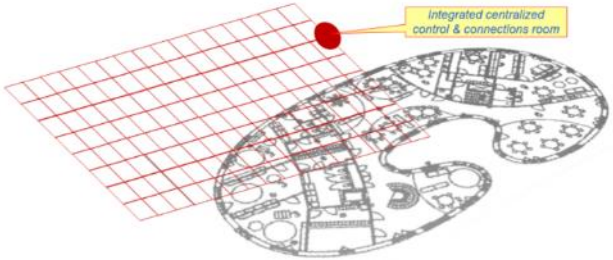
- high bias
- low variance

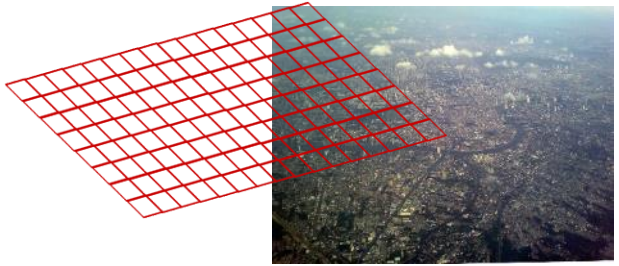
2. internet of everything

what moves, spins, senses, conducts or collects

- machines, sensors, actuators, wearables, end-devices

- smart grids (energy, data, comms) @ site & city levels

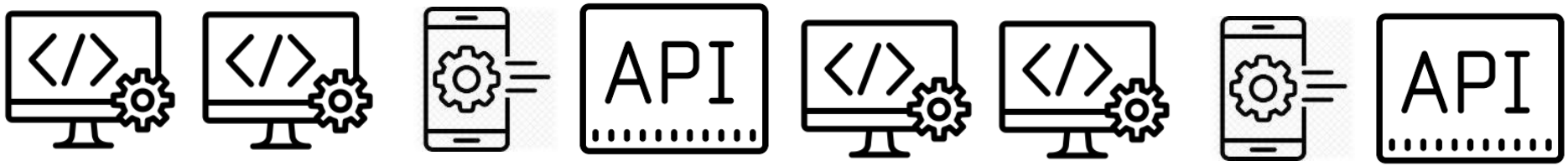




- smart information, AR[1] vs KVM[2] and DLT[3] ecosystems

[1] AR=Augmented Reality, [2] KVM=Keyboard-Video-Mouse, [3] DLT=Distributed Ledger Technology

IoE protocol neutrality, security & integrity



EDGE X FOUNDRY

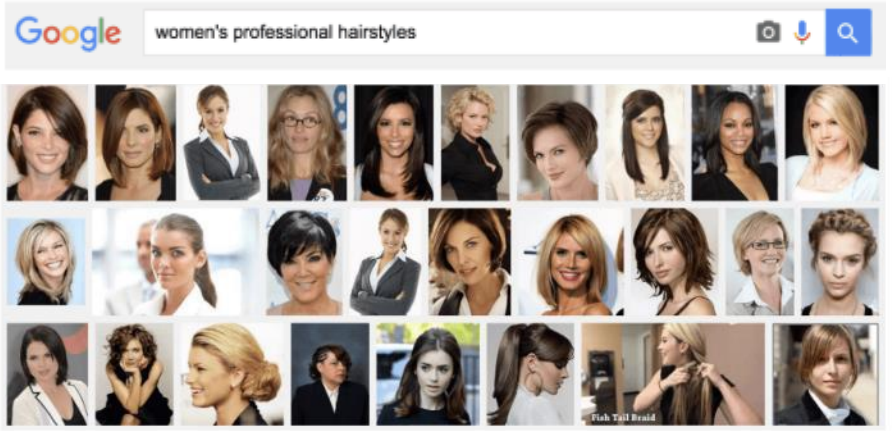
case study

DLT + IoT *vs* ***AI biases***

“For centuries scissors were designed by right-handed people… It took someone to recognize that bias against left-handers”

~ Fei Fei Li

bias challenge



Australian eldercare industry

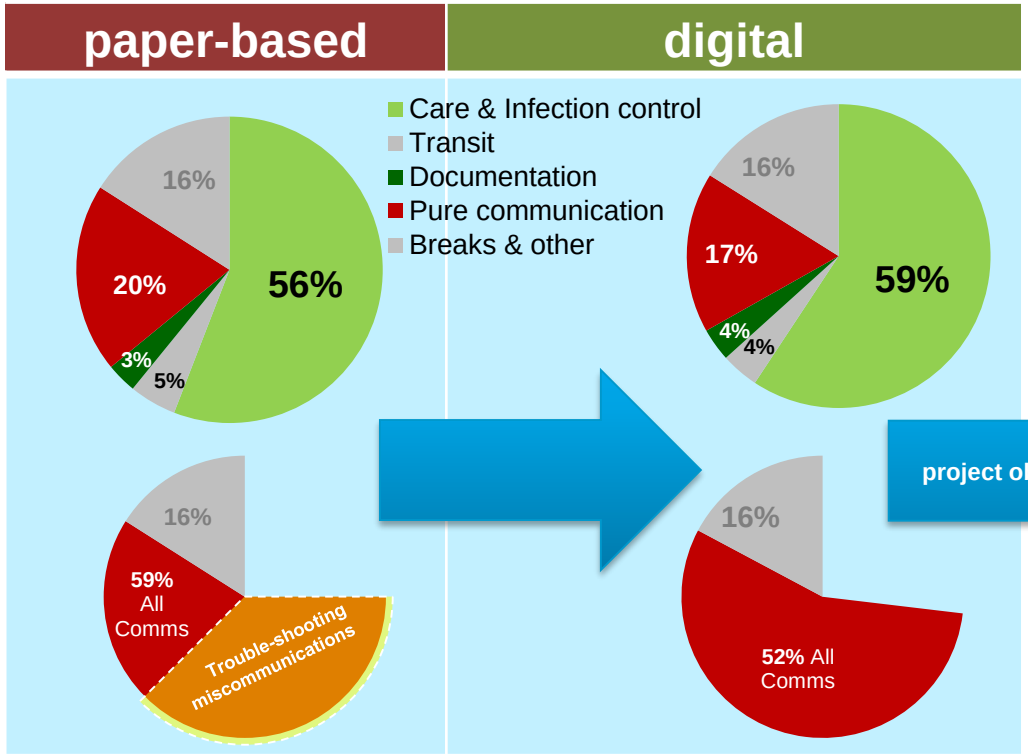
case study

- 250k employed
- high staff attrition (16%)
- pervasive low staff morale
- ***millennial cliff*** (25%) attrition by 2030
- **pervasive data quality and integrity issues**

objectives (care worker time analysis)

case study

Yesterday *today* ***NEXT***



Nil / positive impacts on residents and staff well-being at all levels

75%

staff / resident ratio

1-to-**10** → **1**-to-**20**

Source: 2011 ARCI-sponsored Research | University of Wollongong, Internal research

pervasively inject life into building

case study

24/7 automated clinical monitoring *(IoT / DLT)*

case study

1. enhanced security / integrity (DLT notifications)
2. greater privacy / comfort / dignity (no humans)
3. more accuracy (automated recording)
4. more clinical monitoring data (24/7)
5. more accuracy (multiple sources)
6. more accuracy (cross-validation)
7. more efficiencies (no data entry)
8. real-time monitoring

necessary shift to continuous model of care

case study

24/7 IoT monitoring + **Machine Learning engine** =

- real-time care strategy adjustment
- Predictive risk analysis
- Incident avoidance

Shift to CNR = AR + NUI (Natural User Interface) | voice, gesture, touch

case study

Audio

location services

AR glasses

Gesture NUI

wearables

1. DLT eliminates intermediary steps and ensure data integrity / immutability
2. Smart Info routes itself to right user in the right place at the right time
3. CNR + AI prioritizes and serves smart information
4. AI ensures location-based data security
5. IoT replaces and boosts data entry

outcomes

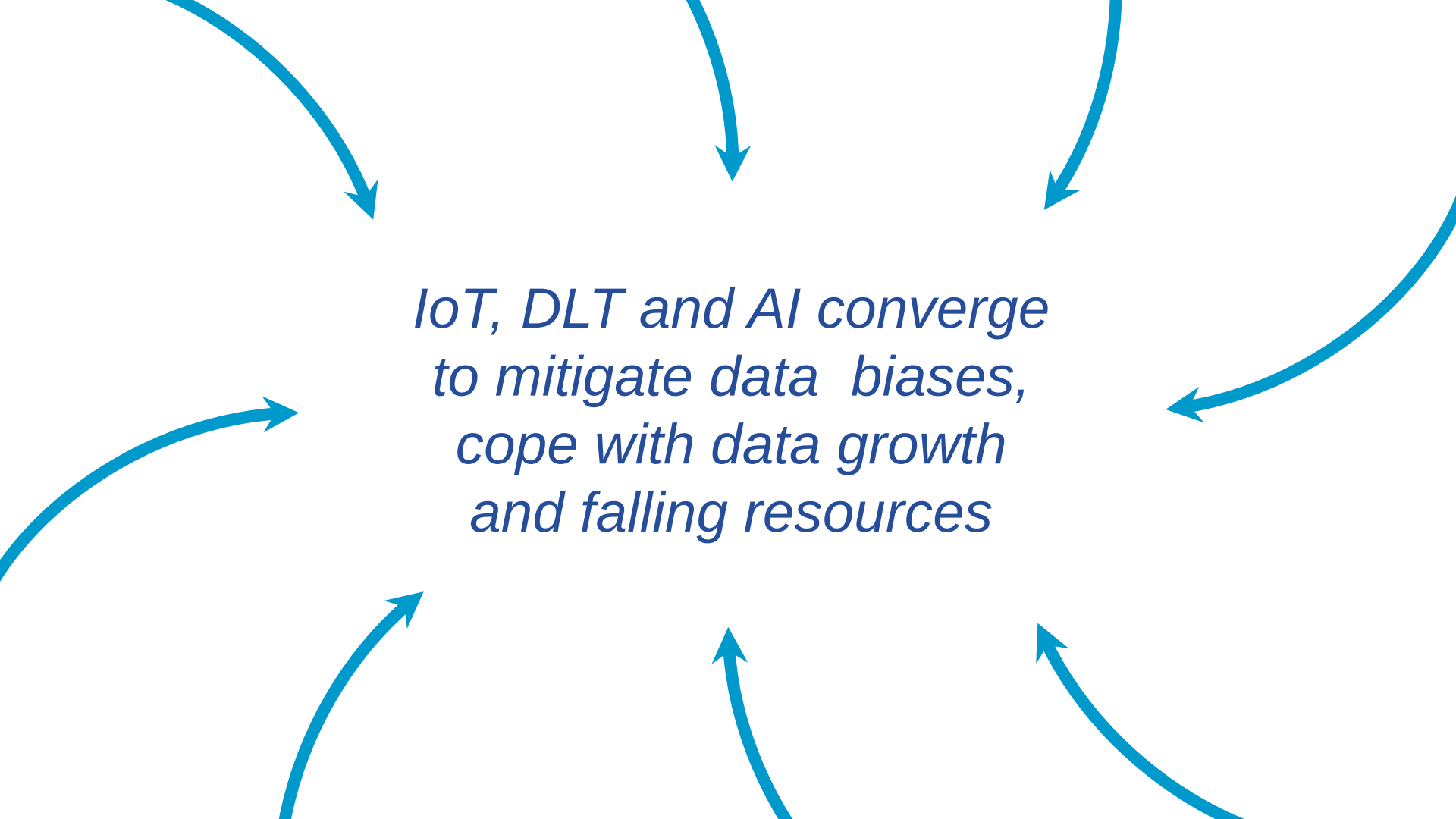
case study

86.2%

58.6%

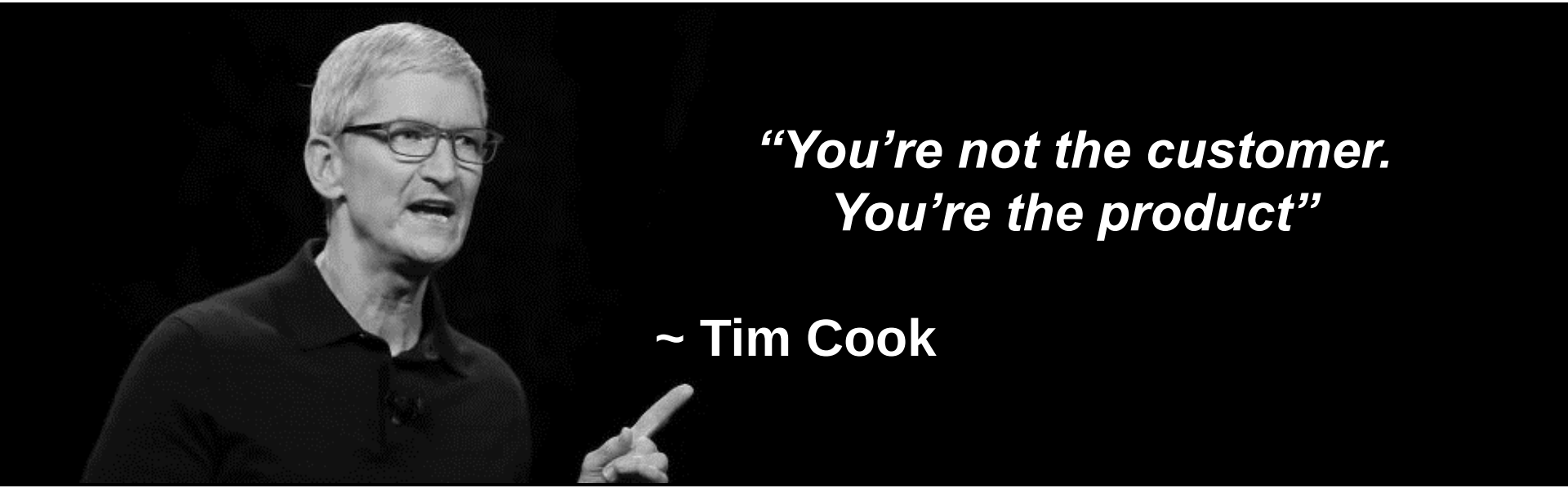
Annual organizational workforce climate survey
Employee satisfaction level KPI *(top-2 scale-6)*

+28% enduring morale boost
+16~18% staff efficiencies
+8~10% revenue growth
(4~6%) attrition rate
30+ sites adopting


IoT, DLT and AI converge
to mitigate data biases,
cope with data growth
and falling resources

case study

DLT vs AI cartelisation


“You’re not the customer.
You’re the product”
~ Tim Cook

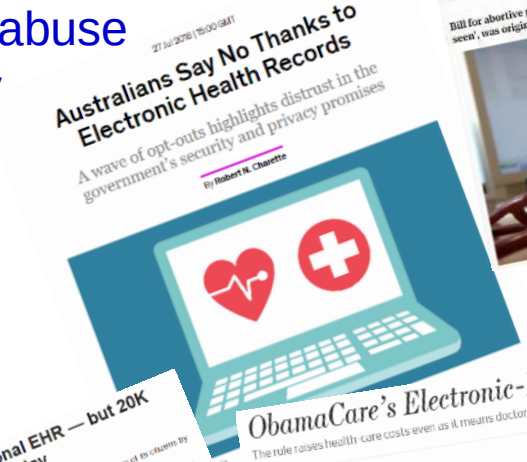
data ownership

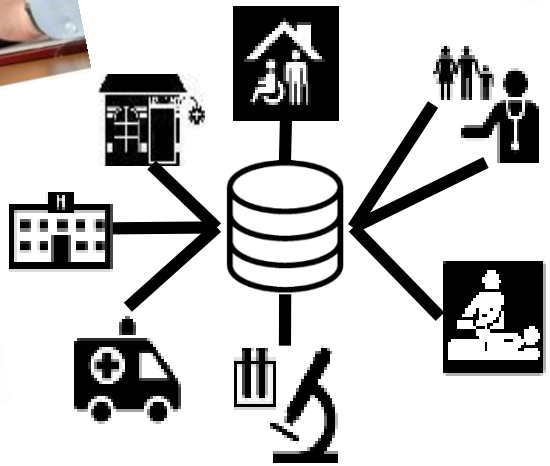
- data cartelisation risks / privacy breaches / stolen identity
- propaganda / social manipulation at scale
- data ownership

centralised EMR

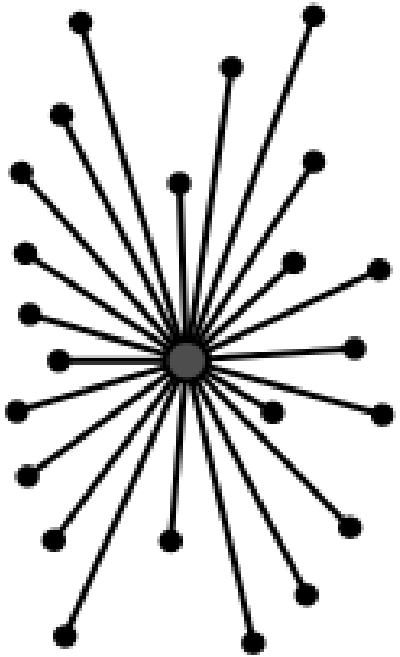
1. Promote reactionary more than preventative medicine
2. Low-level of interoperability (heterogeneous systems)
3. Prohibit user empowerment and preventative health
4. Single database vulnerability (potential data losses)
5. API and localisation multiple points of failure
6. Frequent human arbitration
7. Centralisation power abuse
8. Prevent transparency
9. Compromise privacy
10. Not client-centred
11. Poor traceability
12. GDPR breaches
13. Data ownership
14. Un-auditable
15. Error-prone

…

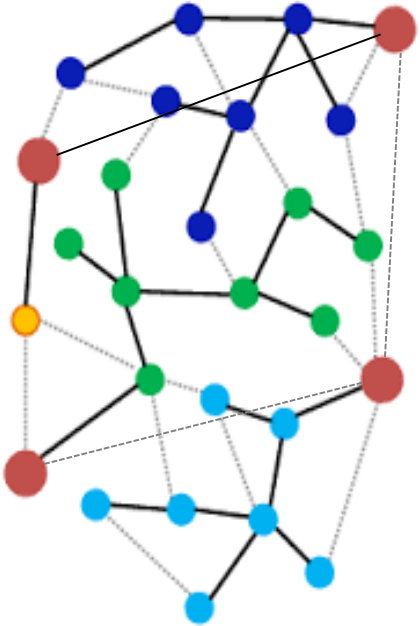




the middle way



centralised model



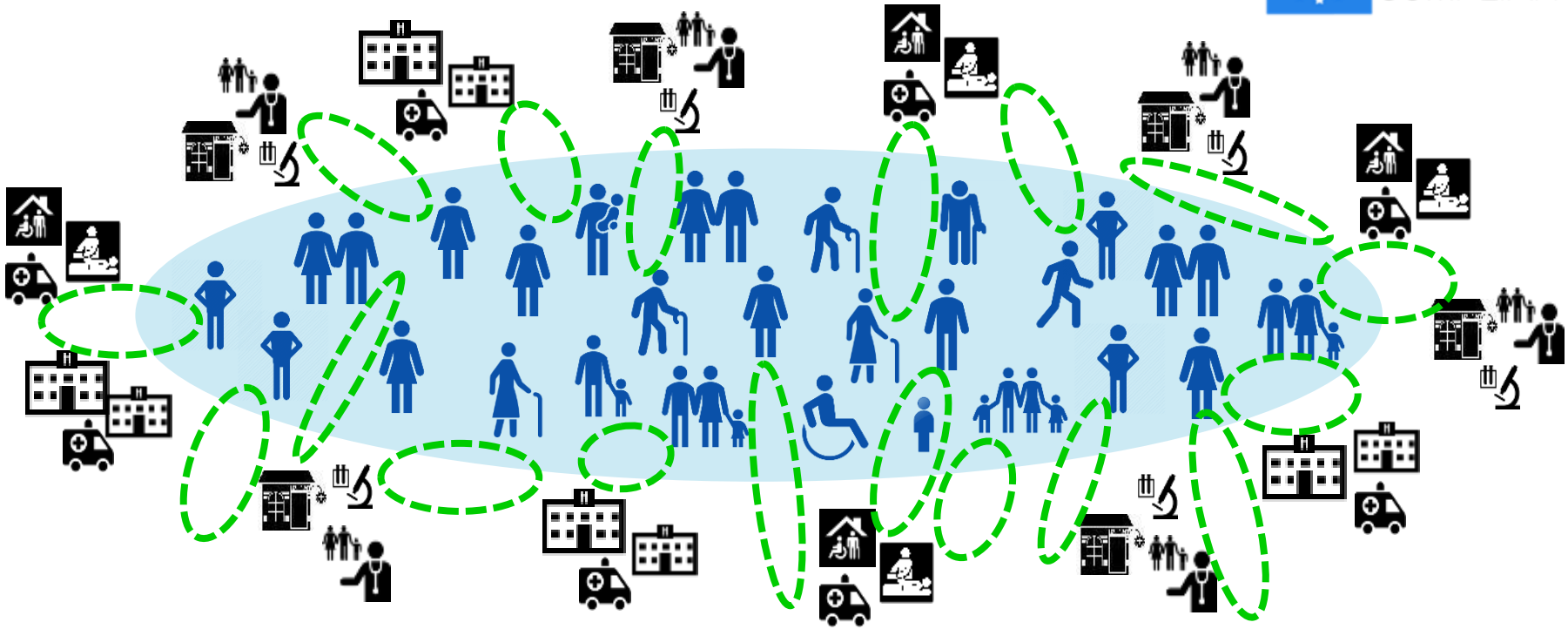
distributed model

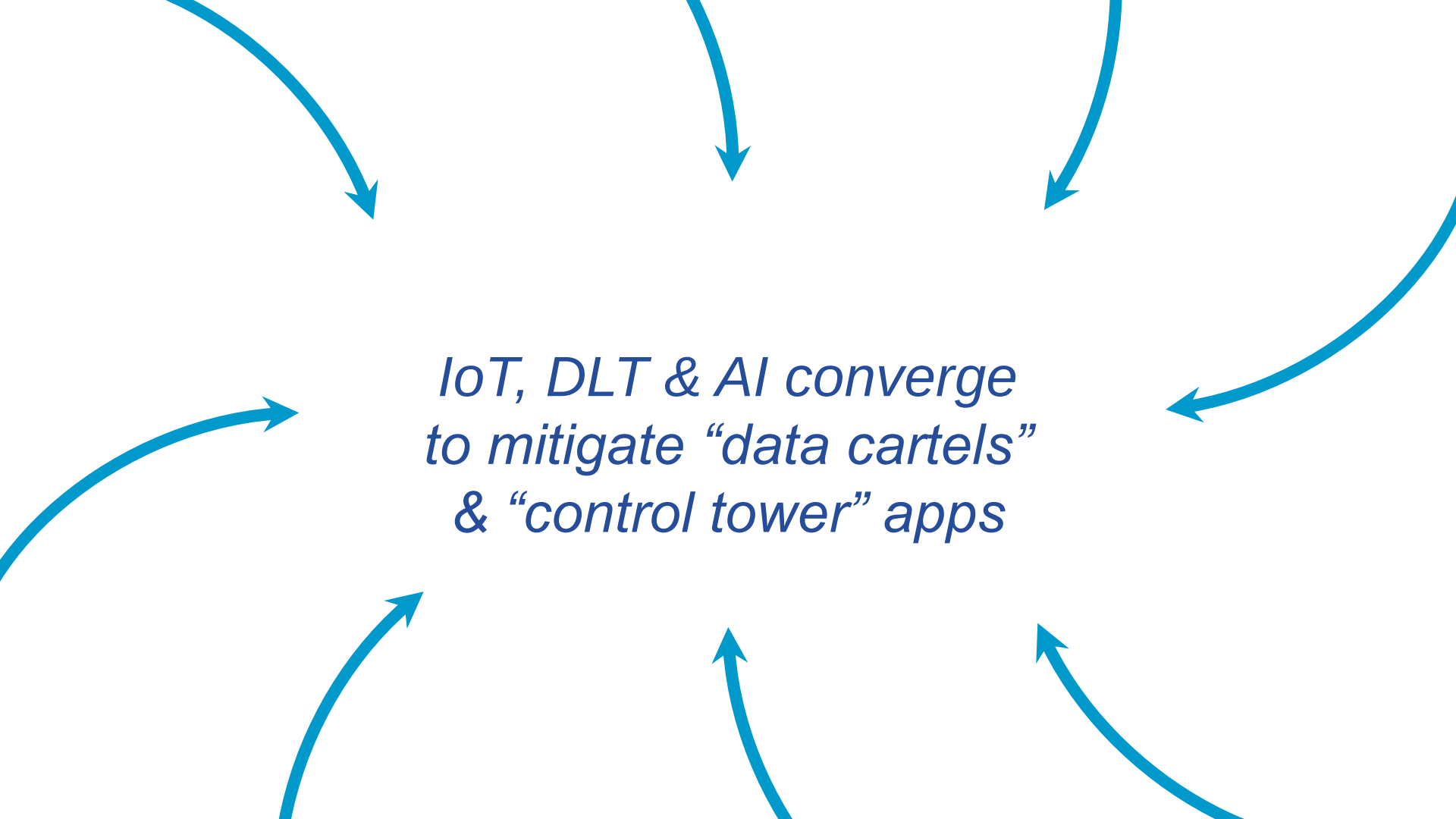
AI at the edge

distributed EMR

1. Unleash AI-driven preventative health by learning from EMR *ecosystem*
2. Neutralise all data threats via compliance with GDPR principles
3. Empower end-users with user-centred EMR

EU GDPR COMPLIANT




IoT, DLT & AI converge
to mitigate “data cartels”
& “control tower” apps

case study

ethical new economics

“a safe driverless world would prove catastrophic for GEICO business …”

~ Warren Buffet

smarter mobility





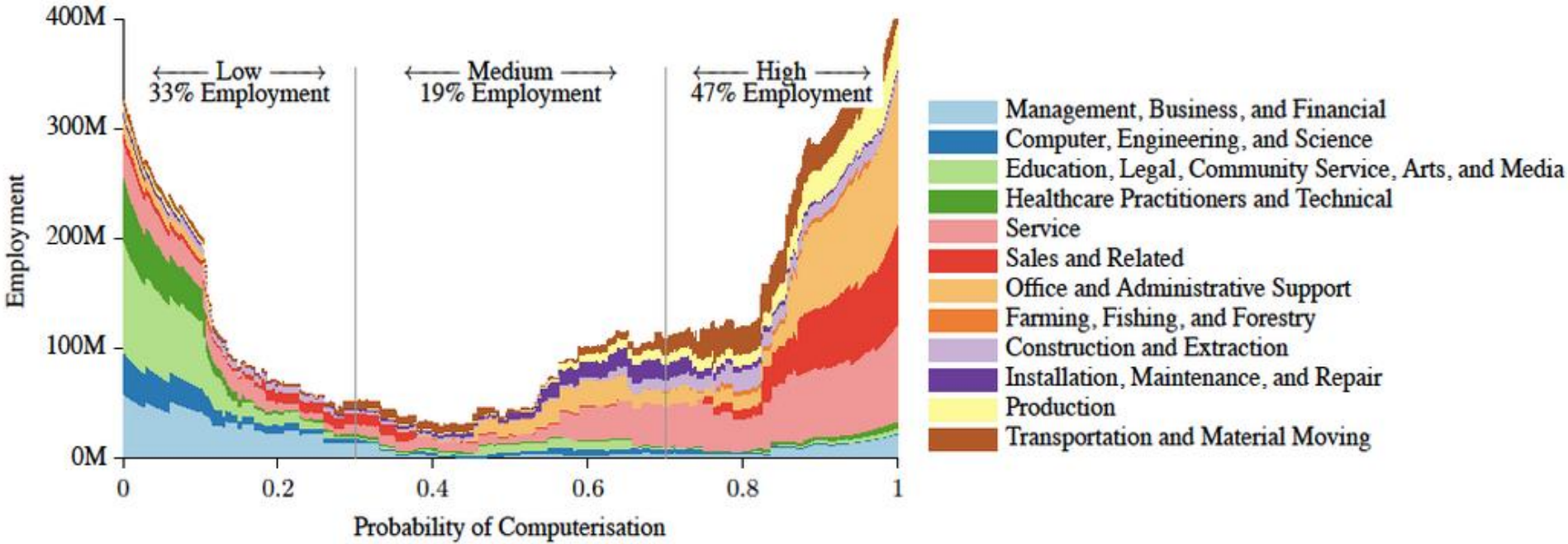


last-mile logistics
enhanced mobility
99.99% road safety[1]
recover parking space[1]
enhanced transfer times[1]
use-tailored vehicle choice
pooling + predictive forecasts
more reliable → less disruption
new real estate value dynamics
recover cars' **92% unused**[2] value
300% more infrastructure efficiency[1]
long-route non-stop 365 x 24 x 7 goods

[1] 2011 ABC Google driverless car project

[2] 2014 Stanford Energy Institute research

50% of all jobs to be automated



Source: 2013 C. Benedikt Frey & M. A. Osborne, Oxford University

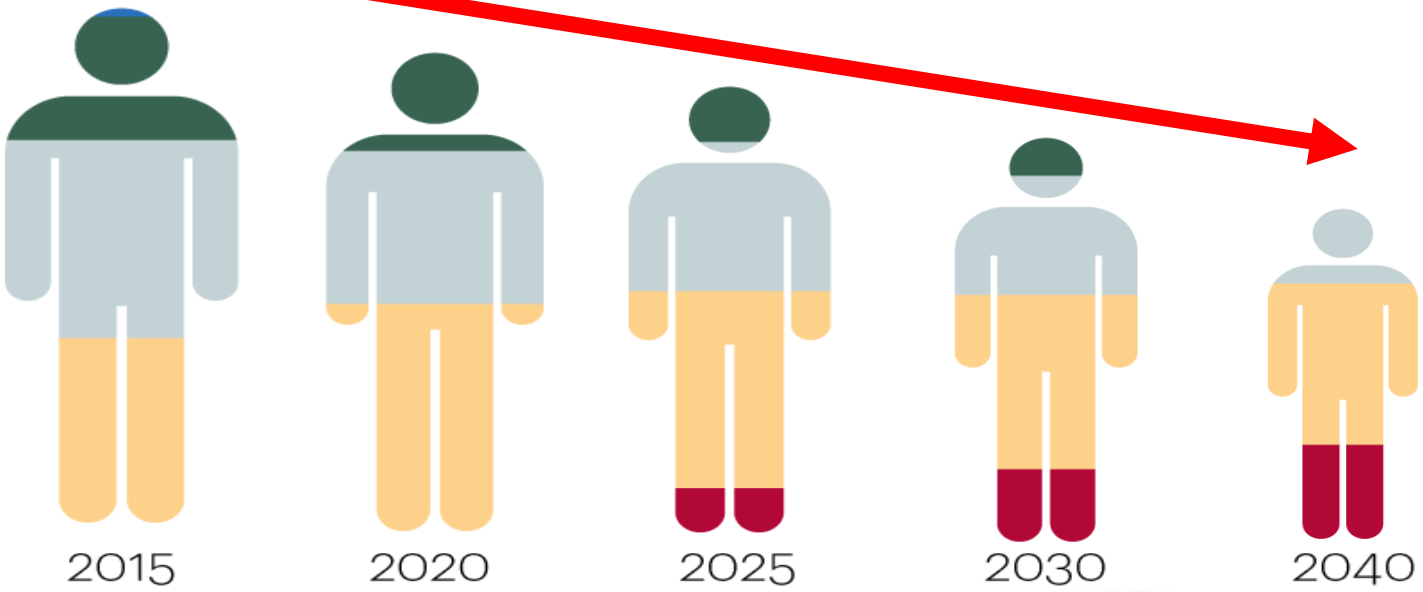
ageing population and major fiscal imbalance risks

worker (15 to 64) to retiree (64+) dependency ratios

Source: UN, Department of Economic & Social Affairs, 2016

workforce proportional contraction & generational shift

the millennial cliff



Builders
Baby Boomers
Generation X
Generation Y
Generation Z

Impression based

Expression based

new forms of industrial risks

2014. South Korean ferry disaster
Pilot was inexperienced 28 years-old

2013. San Francisco airline disaster
both pilots in the plane in training

2014. Heartbleed crash. *PhD student compromises 17% of internet with a bug in open source cryptography extension code*

2019. Boeing MAX Malaysian / Ethiopian disasters.

2019. Paris Notre-Dame fire

2018. BHP Pilbara 3km train derailment.

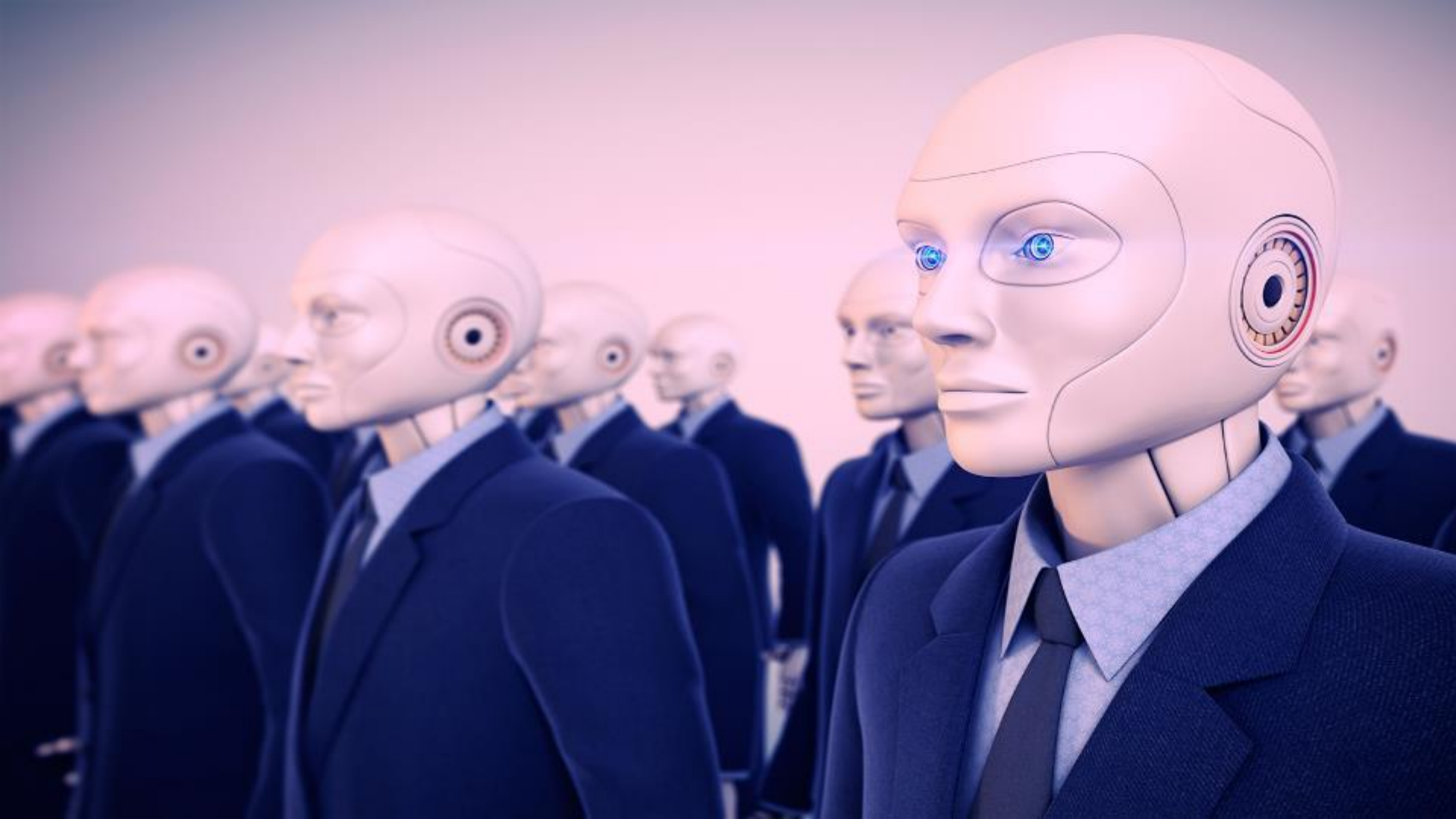
A nursing home in Japan: Social security outlays have ballooned over the past two decades, forcing the government to borrow to sustain the system. (Photo by Akira Kodaka)

ASIA INSIGHT

Asia's worst aging fears begin to come true

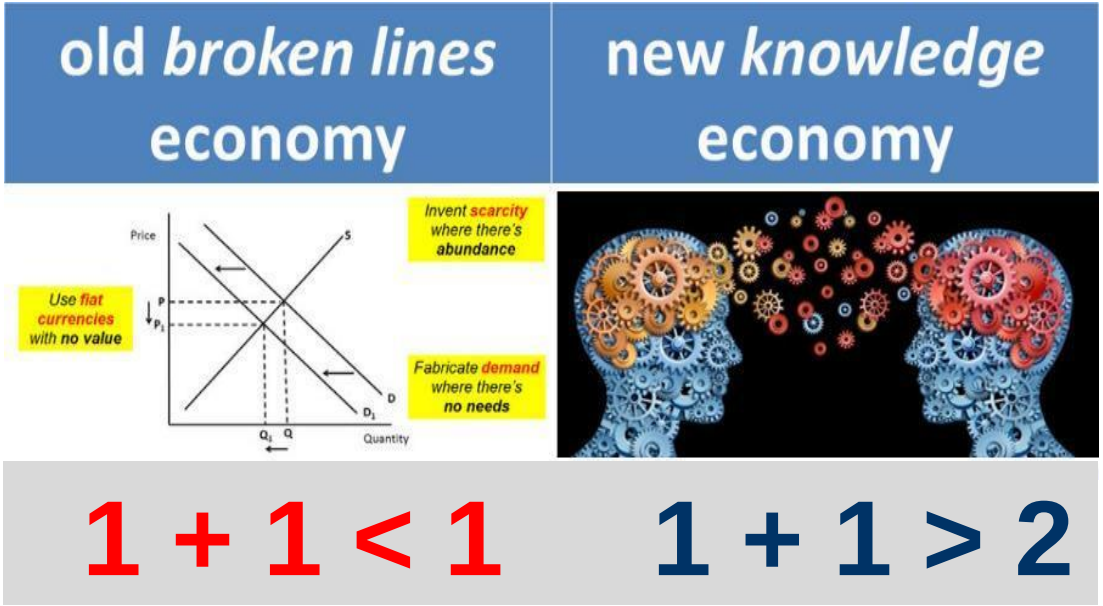
Policymakers in South Korea, China and Japan stare into demographic abyss

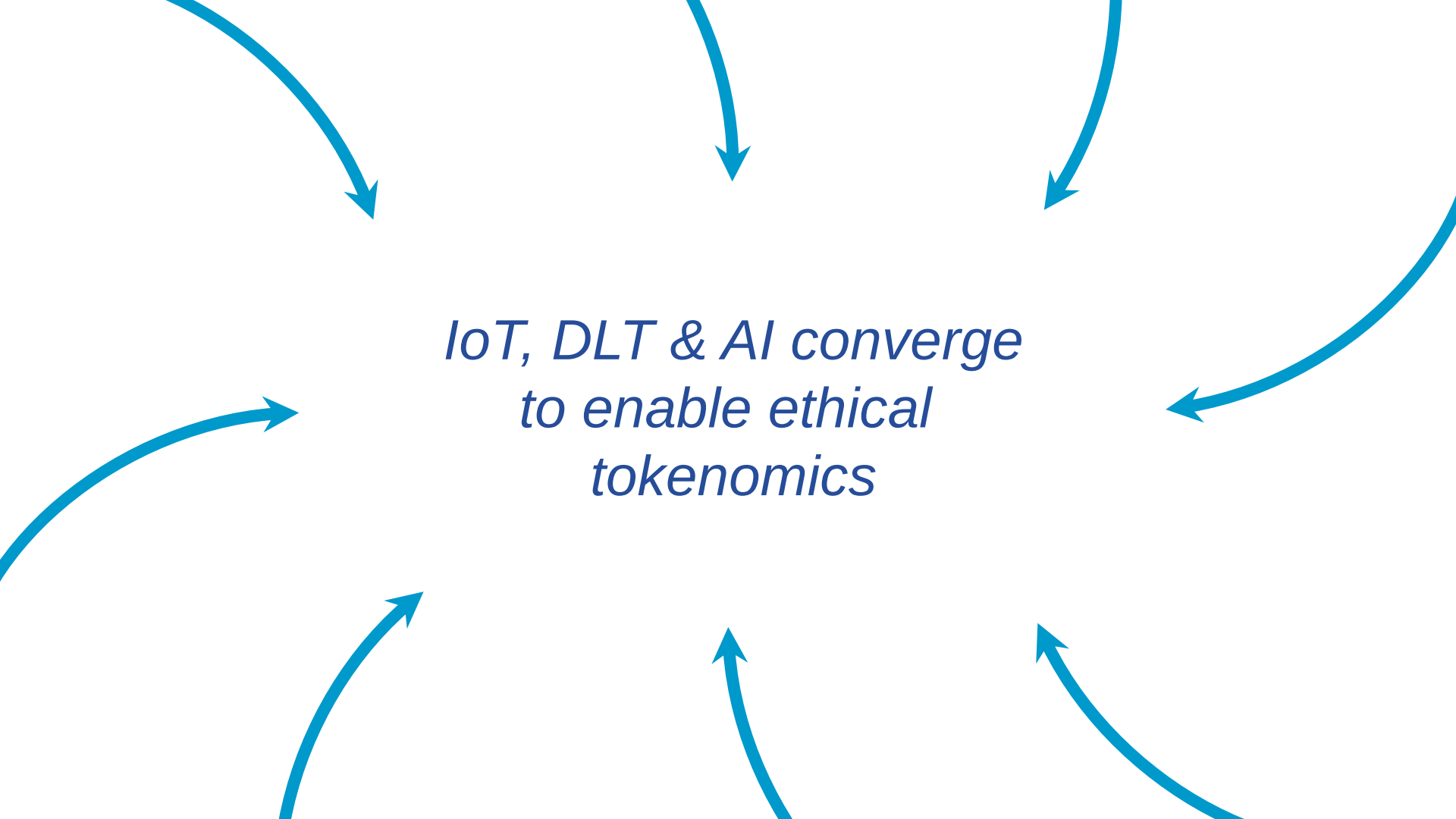
NIKKEI ASIAN REVIEW



neo-economic models

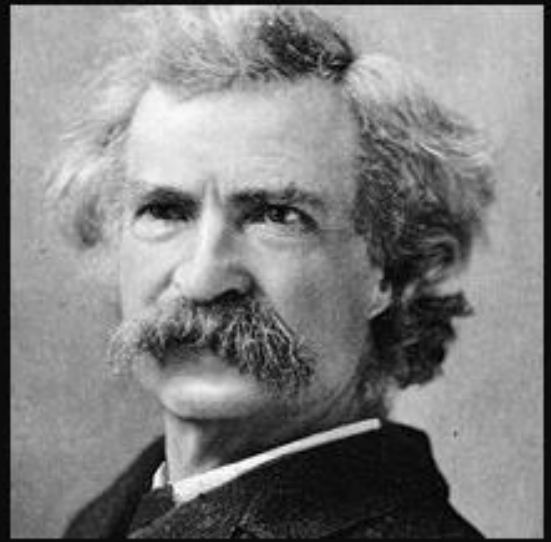
- long-span (multi-decade) nomadic virtual g/local entrepreneurship
- social entrepreneurship (3P measurements, CSR)
- knowledge economics
- shared economics
- taxable AI / UBI
- bio economics
- **tokenomics**




IoT, DLT & AI converge to enable ethical tokenomics

case study

new business models



“They did not know it was impossible so they did it”

~ Mark Twain

Next Enterprise Distributed Ledger Technology

autoPILOT

case study

- corrective actions preparation
- monitoring + evaluation
- notifications

BUT

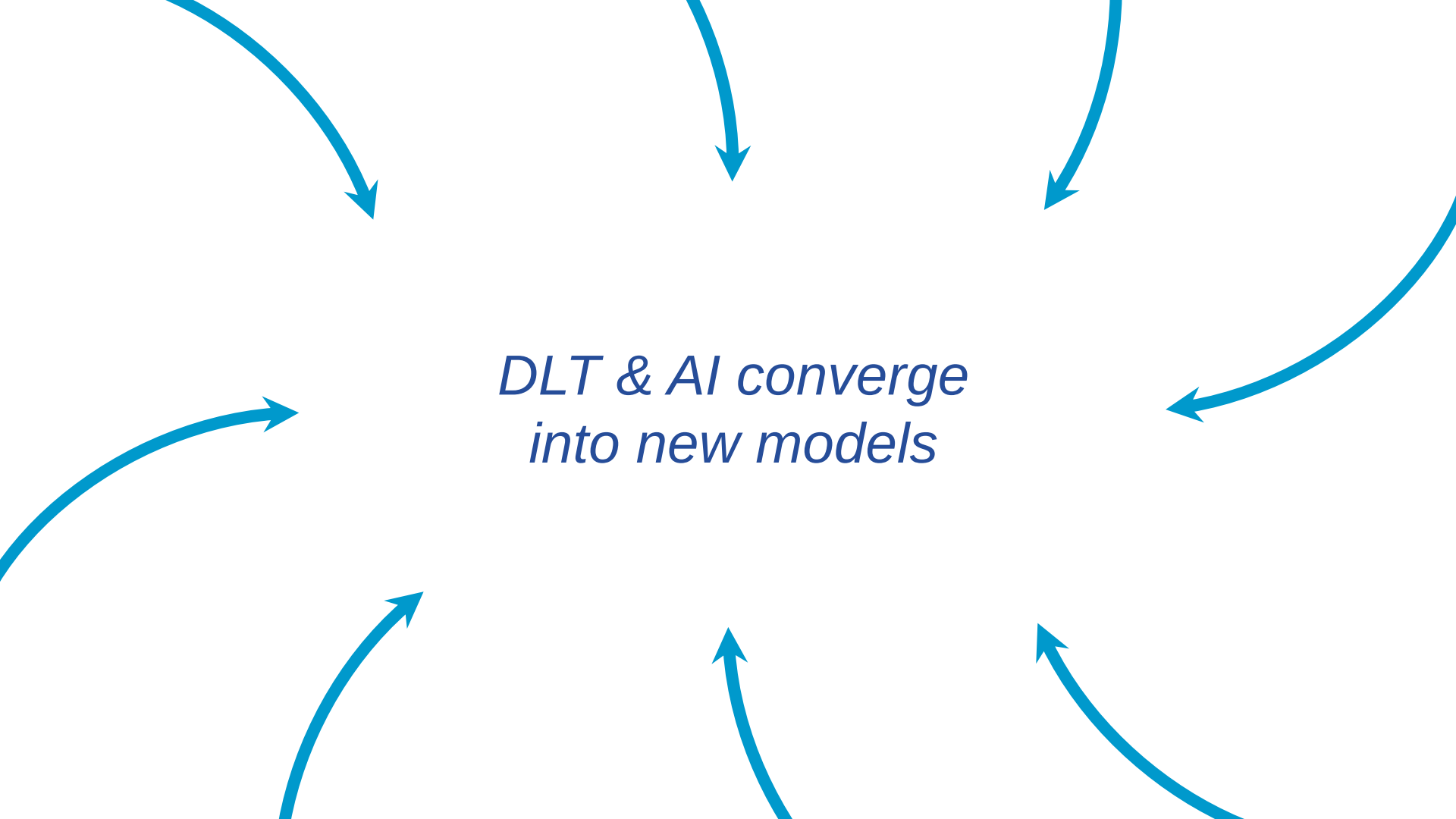
start-ups do not have any data to start with

DLT-based data marketplace

case study

1. Usage value
2. Asset value
3. Future value

Massachusetts Institute of Technology


DLT & AI converge
into new models

case study

QC, AI & unchained DLT** vs **blockchain

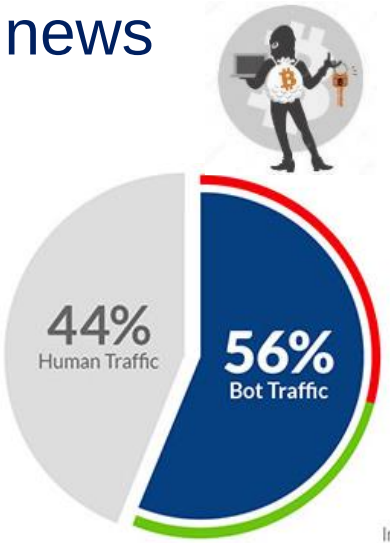
“There are 2 types of companies:
those that have been hacked,
and those that will be.”

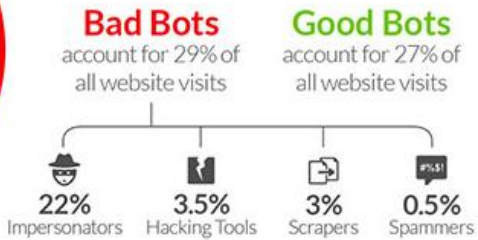
~ Robert Mueller

the “single internet“ global vulnerability

- **pervasive cyber-threat environment**
- internet environmental disaster[1]
  - SPAM global yearly CO_2 footprint = 3.1m cars burning 7.6b ltr of gasoline
- cartelisation+fraud[2]+fake news
- TCP/IP ≠ BF-tolerant[3]
- QC[4]-trivialised PKE[5]

Activity	CO2 emission
single email	*.02 gr*
with attachment	*.50 gr*
web search	*.20 ~ 4.50 gr*





Source: [1] https://phys.org/news/2015-11-carbon-footprint-email.html#jCp, [2] 2016, Association of National Advertisers + WhiteOps, [3] BF = Byzantine Fault, [4] QC = Quantum Computing, [5] PKE = Public Key Encryption

Quantum Computing (QC) hyper-net

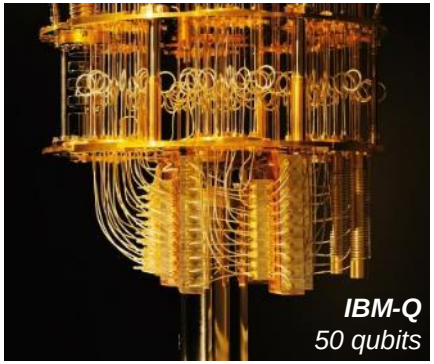
QC hardware

QC network

QC apps

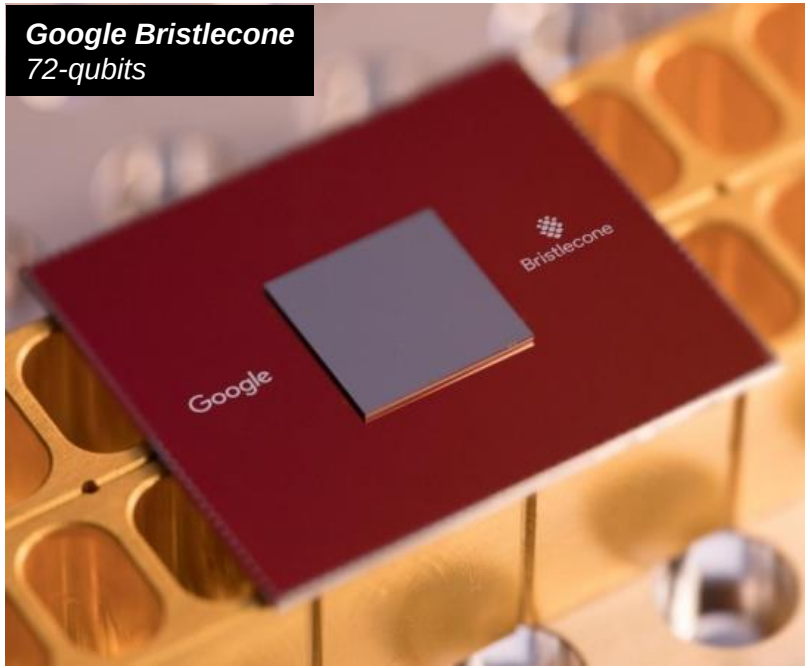
QC hardware: the race is on

mastering superposition, entanglement and decoherence at scale



IBM-Q
50 qubits

D-wave
2000 qubits

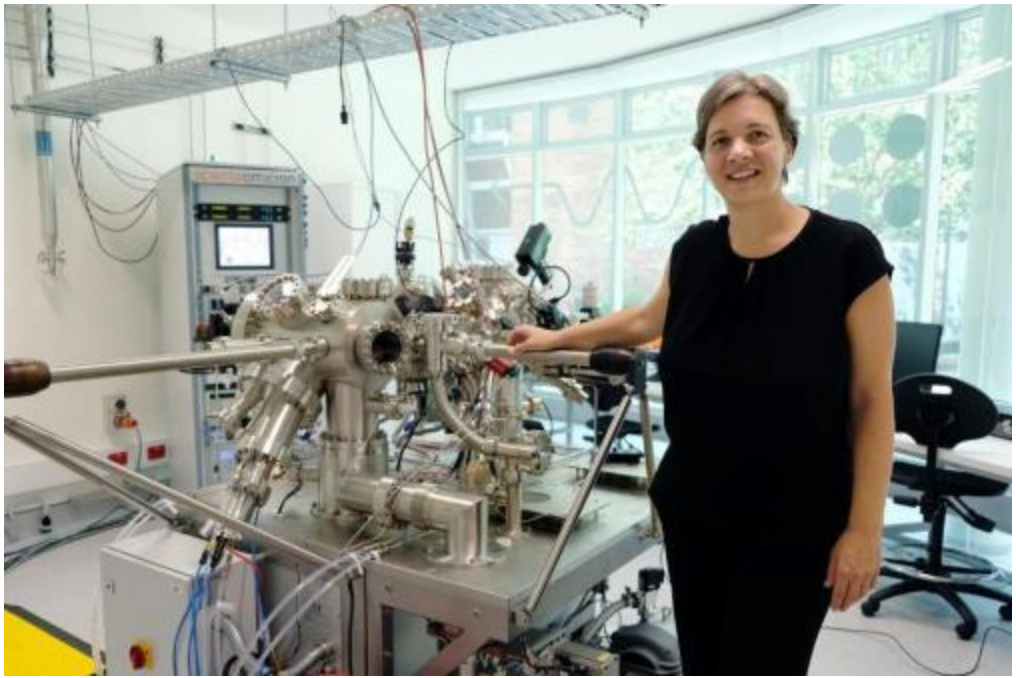


Google Bristlecone
72-qubits

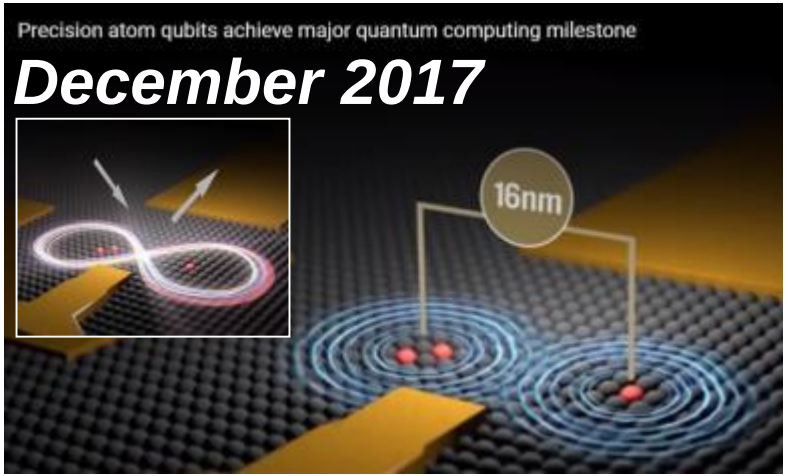
Physical systems for qubits
Bose-Einstein condensate
Magnetic resonance
Electrons-on-helium
Metallic nanosphere
Josephson junction
Phosphorus donor
Molecular magnet
Transistor trap
Quantum wire
Linear optical
Optical lattice
Trapped ion
Spatial dot
Cavity ED
Fullerene
Diamond
Dopants
Spin dot

quantum annealing *(system evolution toward its lowest energy state)*

QC hardware on silicon a reality



2018 Australian of the Year ***Scientia Prof Michelle Simmons***
UNSW (Sydney – Australia) | CQC²T



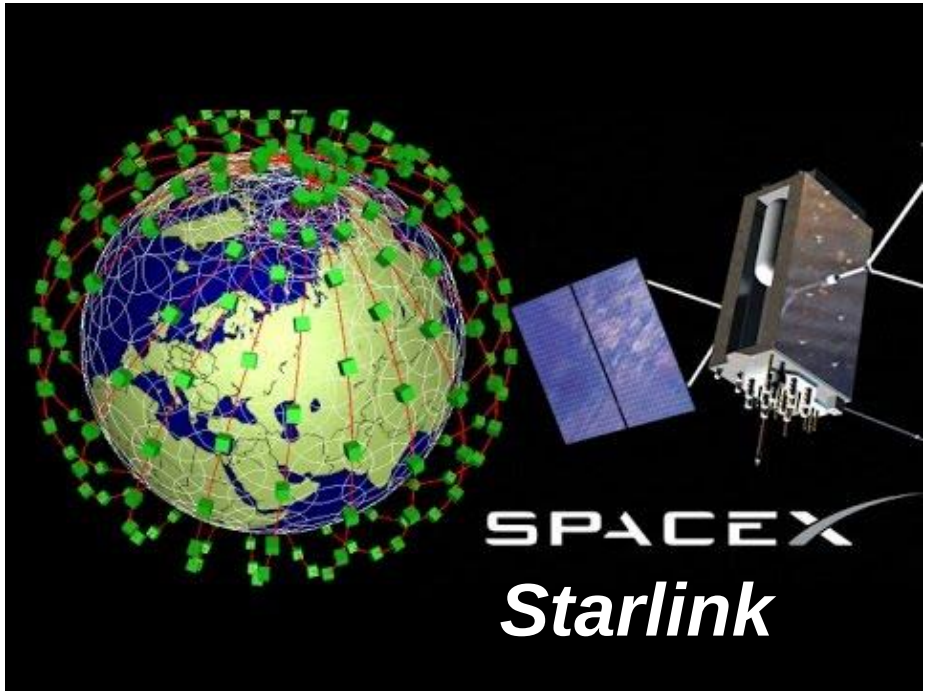
Scientia Prof Sven Rogge

PhD candidate Sam Gorman

Scientia Prof Andrew Dzurak

Pioneering low-noise long-life (30 secs) QC nano-manufacturing

the “LEO* space internet” race is on

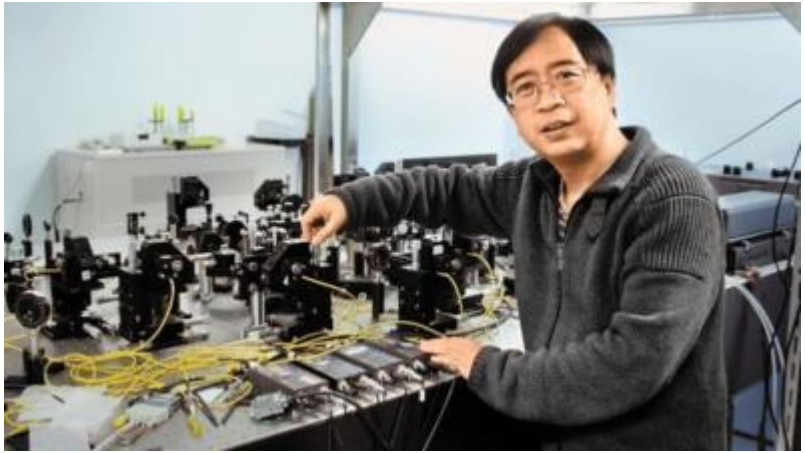


OneWeb

** LEO = Low Earth Orbit*

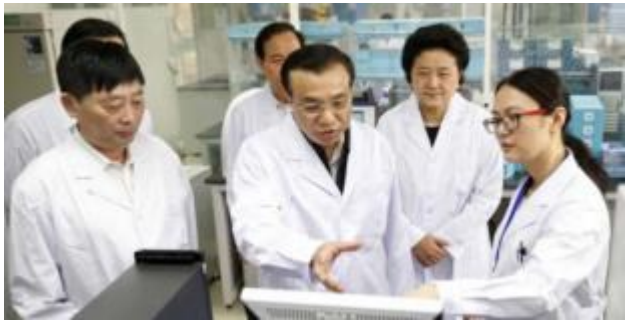
changing the rules with QC communications

Lead scientist Pan Jianwei



and his research team @ QUESS | China

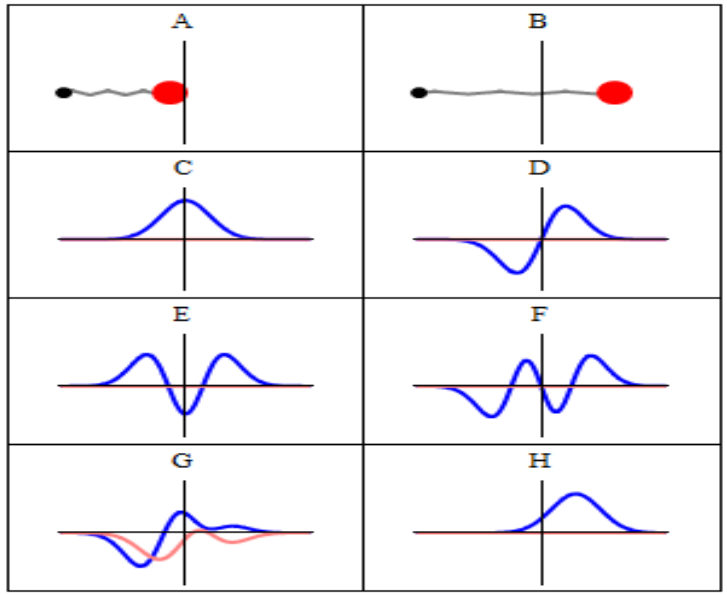
Quantum Experiments at Space Scale



- *long-distance (1200 km) message transmission*
- *one-time pad **QKD** (Quantum Key Distribution)*
- ***detectable** attempts to intercept / **eavesdrop***
- *basis for a **quantum-secure** commercial net*
- *integrated satellite QC + ground QC nets*

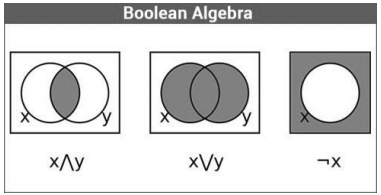
post-Boolean QC

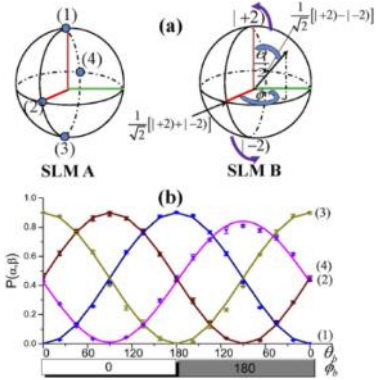
- qu**bit** is an unfortunate name, especially the **bit** part
- a **bit** (binary digit) is either **true** or **false** (0 or 1)
- … but a **qubit** is described by a **wave function**
- **conventional software methods limit QC**
- **QC** needs **post-Boolean** algebra



George Boole
1815-1864

time to retire…





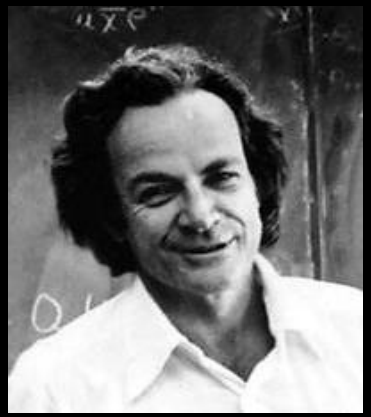
$5t IT industry

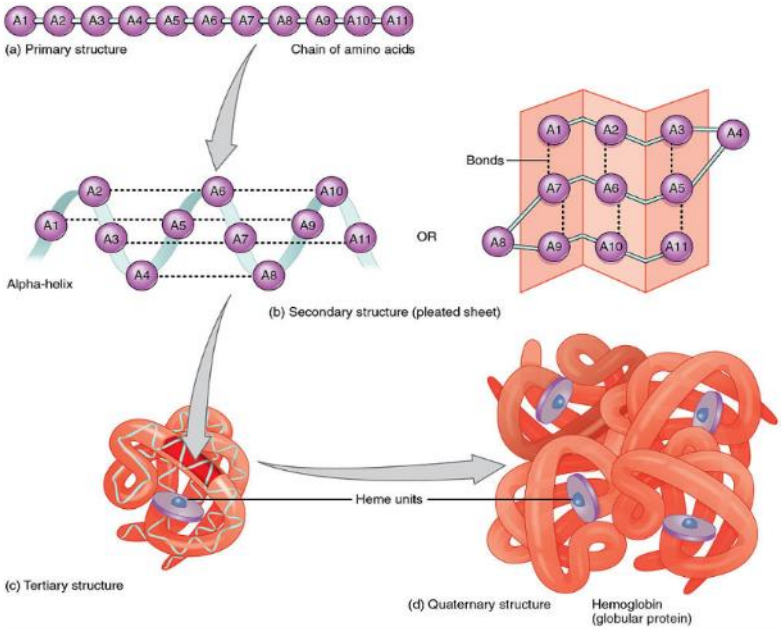
quantum AI

- Similarities between ML phases and QC solutions mantra to classes of hard problems
- ***Protein folding*** or ***quantum simulations*** are examples of hard problems
- Typical QC mantra for classes of hard problems consists in:
  1. *state preparation (data feed)*
  2. *QC system time evolution*
  3. *sought property readout*

"I would rather have questions that can't be answered than answers that can't be questioned"

~ Richard P. Feynman





unchained quantum-based DLT


Kiran Chandrasekaran

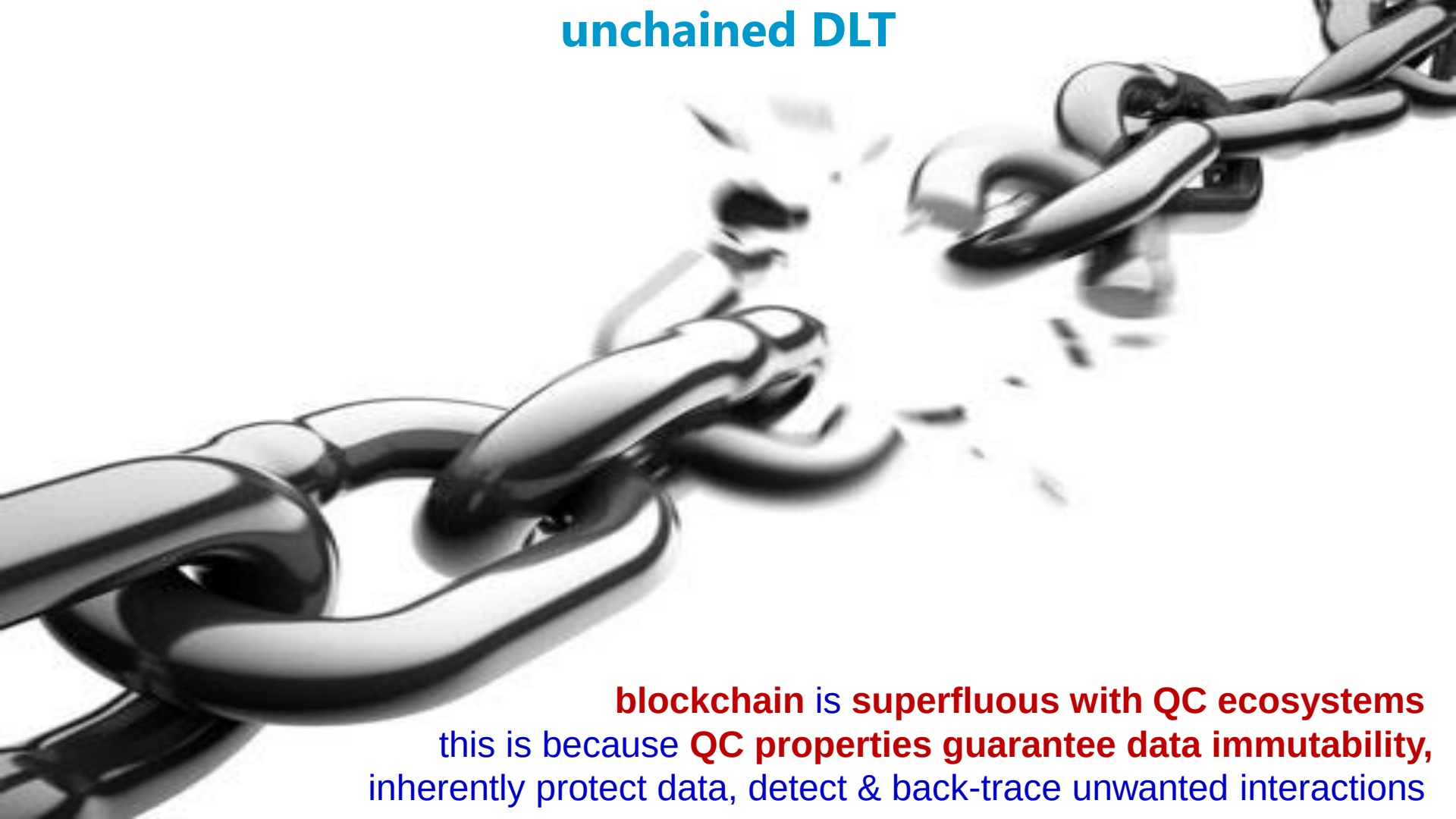

Raghav Bhatnagar


Tanya Shrivastava


Giovanni Di Noto


Uta Beyer

unchained DLT



blockchain is **superfluous with QC ecosystems**
this is because **QC properties guarantee data immutability,**
inherently protect data, detect & back-trace unwanted interactions

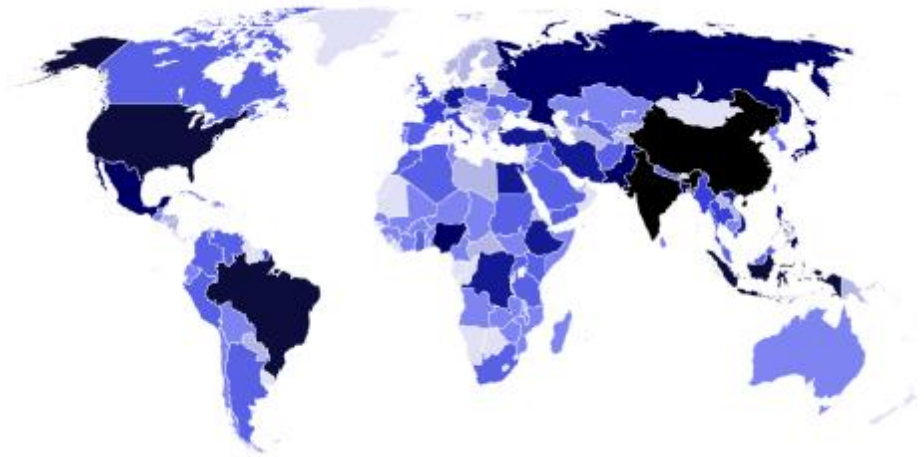
session 3 recap

- *ML (Machine Learning) & AI*
- *IoT (Internet of Things)*
- *Tech convergences*

any other technologies convergence?

module 4
DLT challenges & opportunities

g/localisation



~200 x top-down **nations**

~3m x bottom-up **smarter cities**

the long route future

automated driverless long and mid route logistics

more reliable → less disruptions

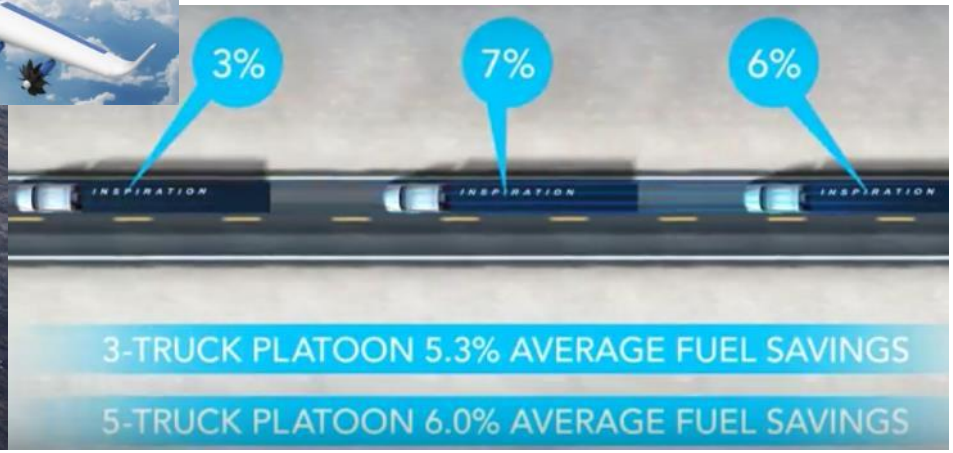
non-stop 365 x 24 x 7 human-less

pooling + predictive forecasts

multi-modal road + sea + air

fuel-efficient 45mph speed

fuel-efficient platooning



congestion-free last-mile short circuits

pitch for 2D MaaS

- enhanced mobility
- **99.999%** road safety[1]
- recover parking space[1]
- enhanced transfer times[1]
- usage-tailored vehicle choice
- new real estate value dynamics
- recover cars' **92% unused**[2] value
- **300**% more infrastructure efficiency[1]

BUT…

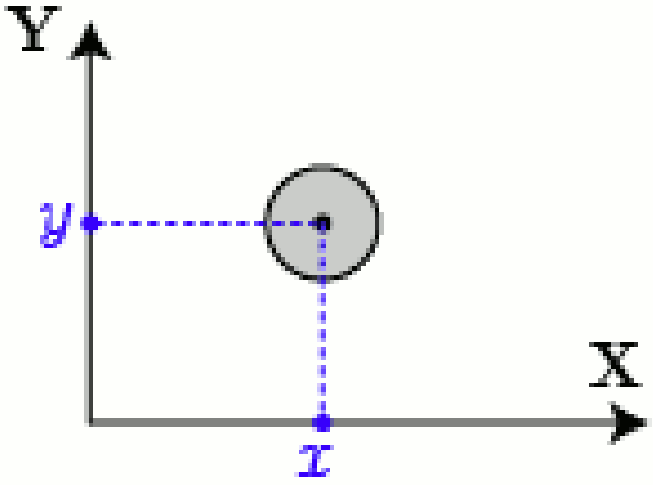
[1] 2011 ABC Google driverless car project

[2] 2014 Stanford Energy Institute research

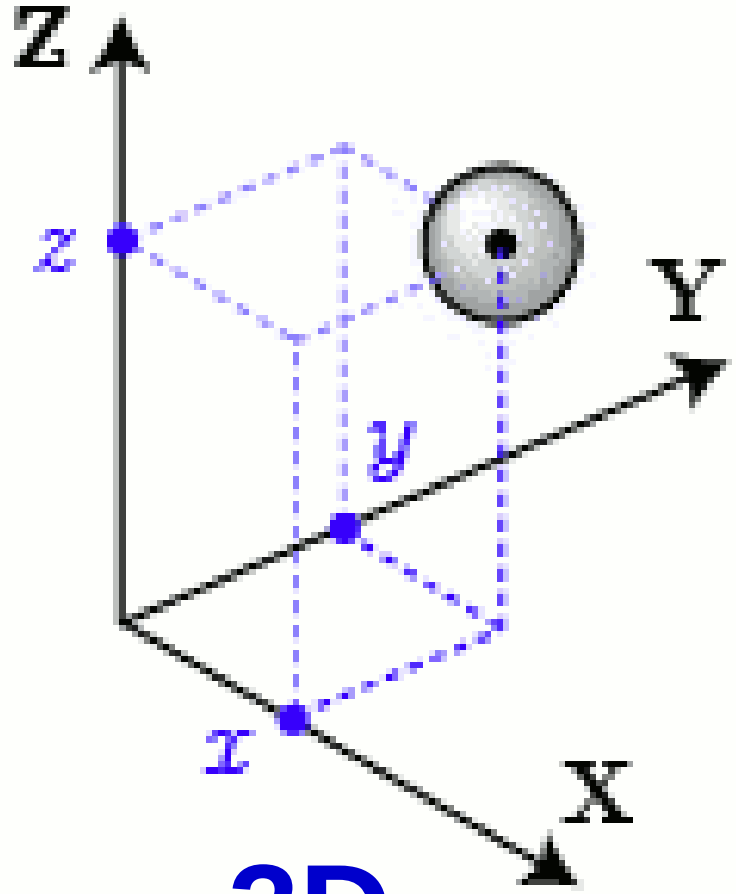
2D MaaS might worsen congestion short-term

+

=



2D

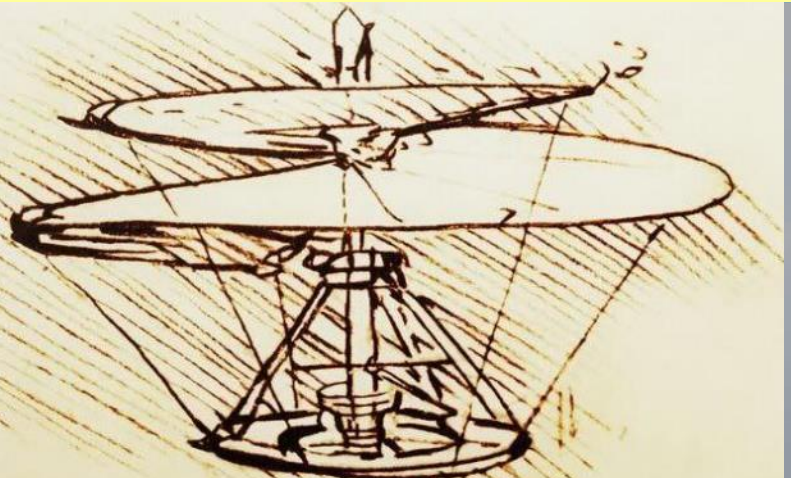


3D

China | Ehang

US | Uber / NASA

the new urban passenger MaaS battle-ground is up in the air



Germany | Lilium

decongestion via grid of 3D-pad smart buildings

Rooftop land, recharge and self-storage pad for driverless 3D foldable passenger hop-pods

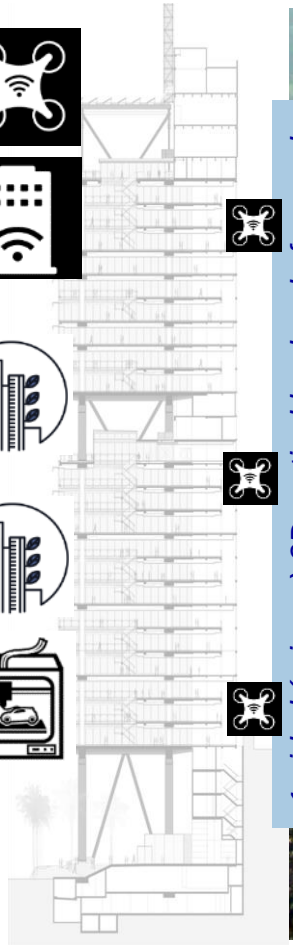
co-working | residential layer

Vertical in-door farming layer

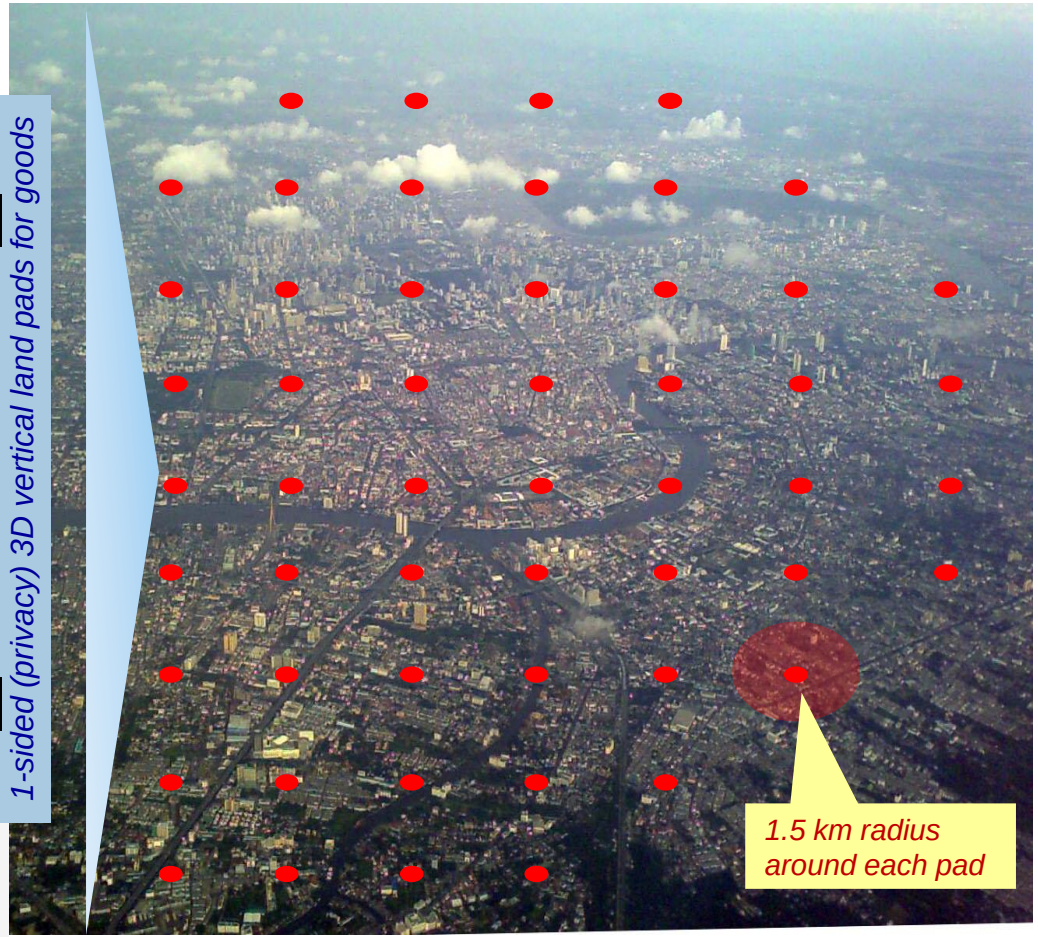
Retail & 3/4D printing factory layer

Interchange public transport & last-mile transport layers (metropolitan railway, bike-sharing, pedestrian, 2D MaaS, parking)

Integrated control layer (data, comms, energy storage/grid, security, HVAC, emergency)



1-sided (privacy) 3D vertical land pads for goods



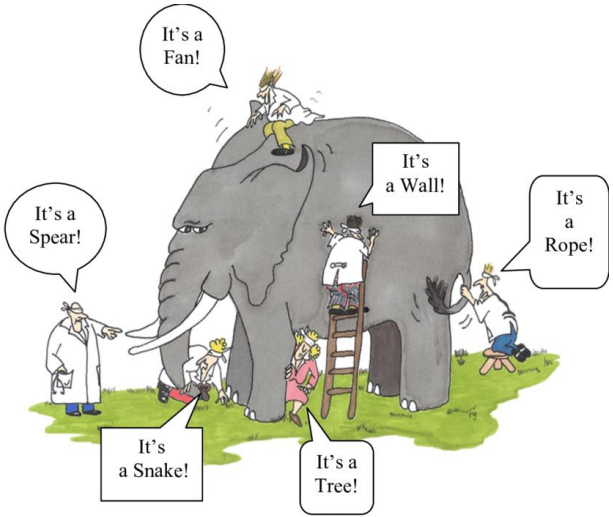
DLT challenges & opportunities in supply chain / logistics

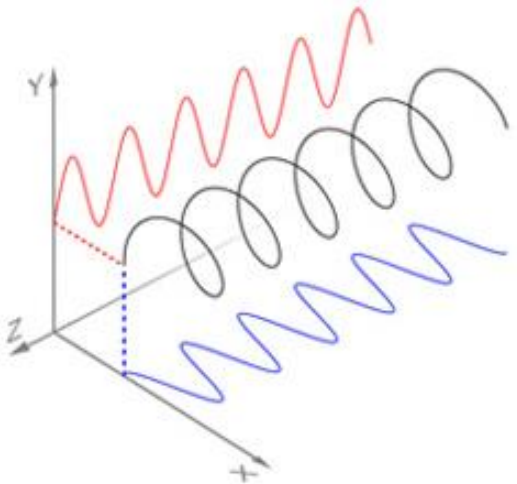
1. wrong lenses on ROI
2. complexity
   - **complex implementation**
   - **architectural complexity**
3. nodes asymmetry
4. power nodes & interoperability

Learn about critical eDLT implementation aspects pertinent to large enterprise projects in supply chain →

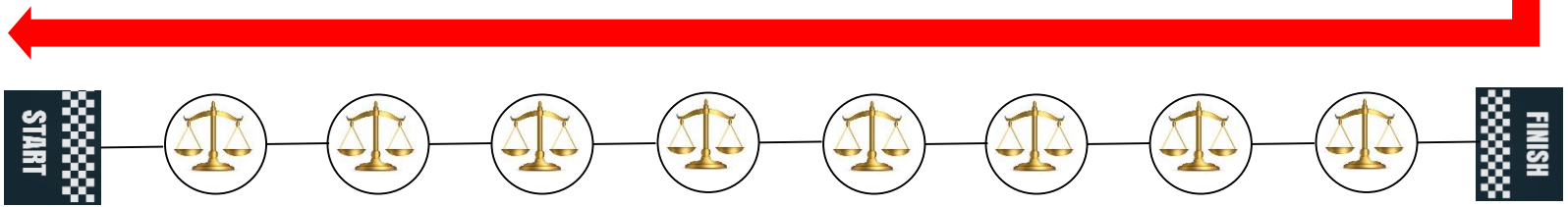
https://www.linkedin.com/pulse/solving-4-core-issues-enterprise-dlt-supply-chain-projects-di-noto?published=t

ROI perspective | the wrong node-centered lenses

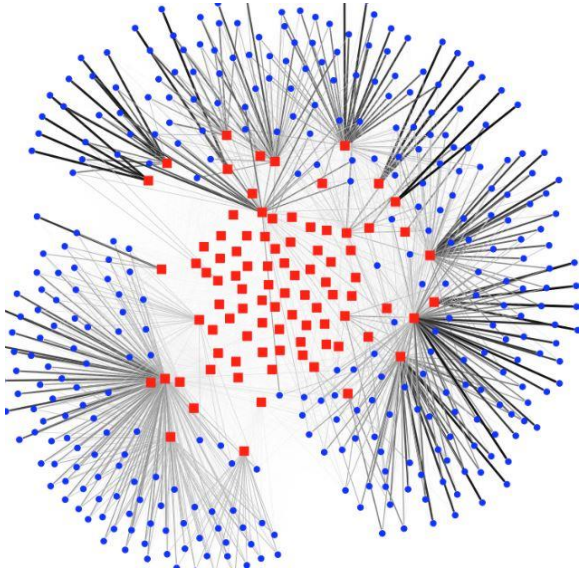




Start here



complex implementations



Pims Contract Management
Planning, tendering, award and ongoing management of contracts

Pims Cost Management
Estimate, budget and control project cost and performance

Pims Quality Management
Plan audits and follow up non-conformances to elevate project standards

Pims Document Control
Manage project documents and ensure efficient workflow

Pims Risk Management
Identify, address and control project risks

Pims Experience and Benchmarking
Analyze project experience and improve decision making

Pims Team Documents
Collaborate, share workspaces and elevate communication

Pims Completion Management
Define project-wide strategies to achie smooth handover of systems

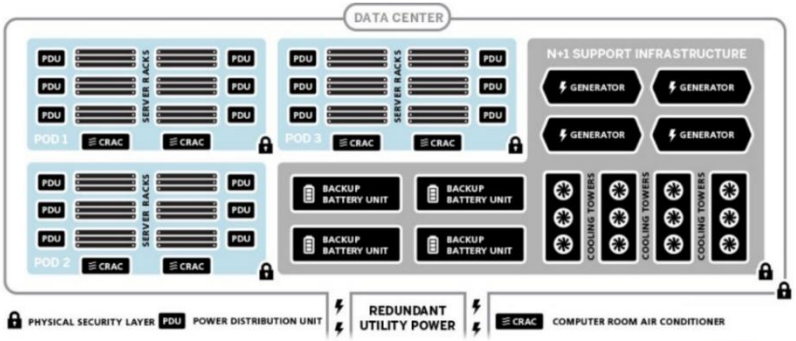
Pims Interface Management
Identify and implement interface solutions for efficient information exchange

Pims Health and Safety
Increase safety, reduce risk, and ensure compliance

omega

complexity | security architectural aspects

1. infrastructure provider periodic selection
   - *systemic provision mitigation, geo-distribution*
2. systematic "*Chinese walls*" foundations at infrastructure level
   - *X-site redundancy, geo-fencing, reputation, SOE, AV, DDoS protection, VMS layer*
3. physical security
   - *physical site access, redundant energy / HVAC*
4. vulnerability detection & cyber-defence
5. DLT-based cyber-hunting
6. data management
   - *"Chinese walls" data segregation, geo-fencing, privacy/security by-design, anti-leakage Db docs*
7. code integrity
   - discrete environments for development, testing & production, multi-horizon versioning, Chinese walls coding segregation, peer-reviews
8. quality assurance
   - *continuous automated testing, smoke, regression, load, peak, stress, code, Db*
9. user management
   - *AI-driven activity tracking / auditing, granular security, injection prevention*
10. systematic multi-encryption from client-side UI to server-side database
    - *protocols, certificates, key data hashing, salting & peppering, SSL, opacification, Db encryption, DLT permission keys, storage*
11. multi-tier data validations
    - *client-side browser, client-side IoT, server-side phishing/injection detection, server-side M2M, server-side data integrity*
12. credential certificates & DLT permissions
13. processes documentation / risk analysis
14. security profiles & risk surface analysis
15. segregation of duties / "*Chinese walls*"



ISO · ISO 27001 · ISO 22301

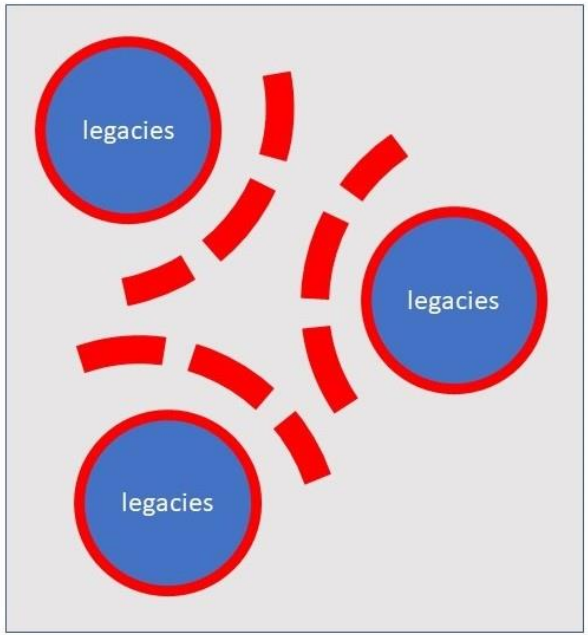
PCI DSS COMPLIANT

EU GDPR COMPLIANT

SendGrid

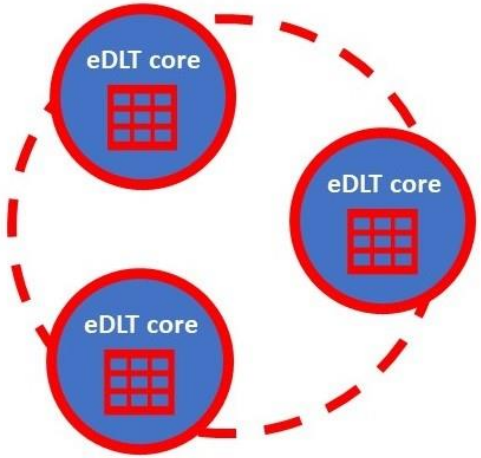
SiteLock

complexity | DLT optimal risk surface



Connecting DLT protocol

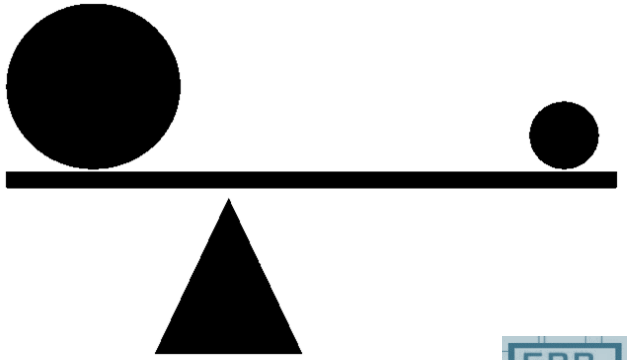
vs

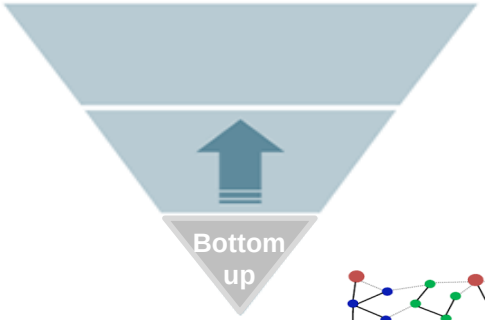


DLT at the core

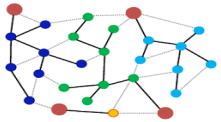
Next
Enterprise Distributed Ledger Technology

DLT nodes asymmetry





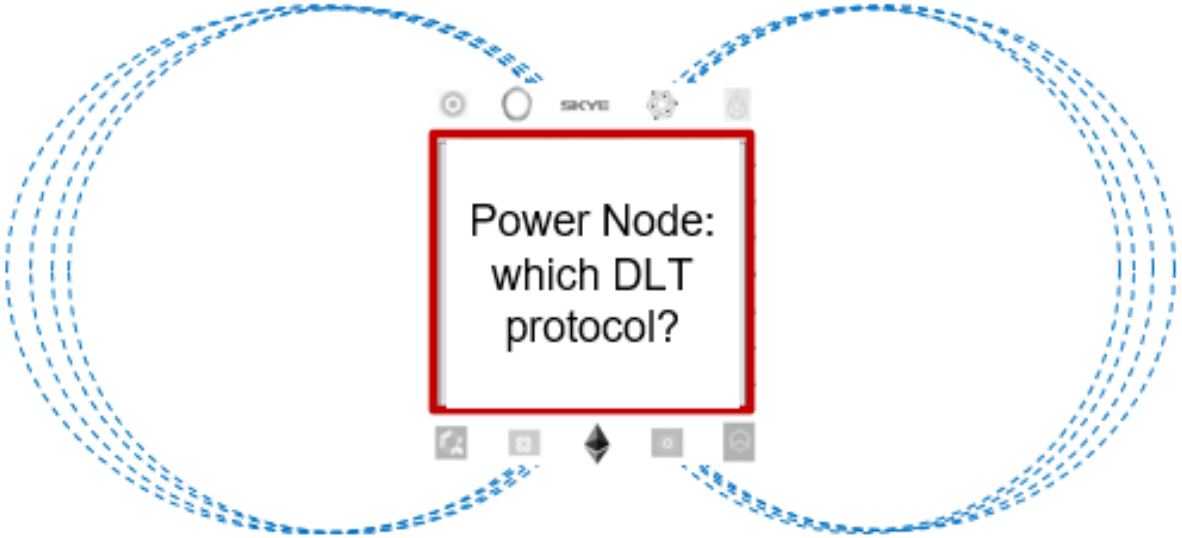
Next

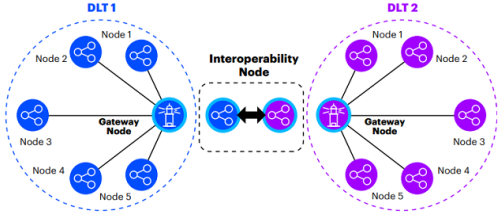


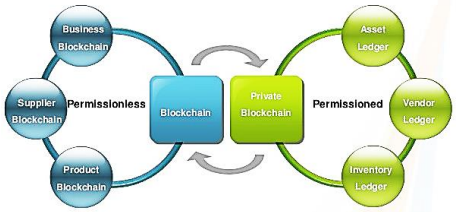
Distributed

Bottom up commercial design

power nodes | the interoperability challenge

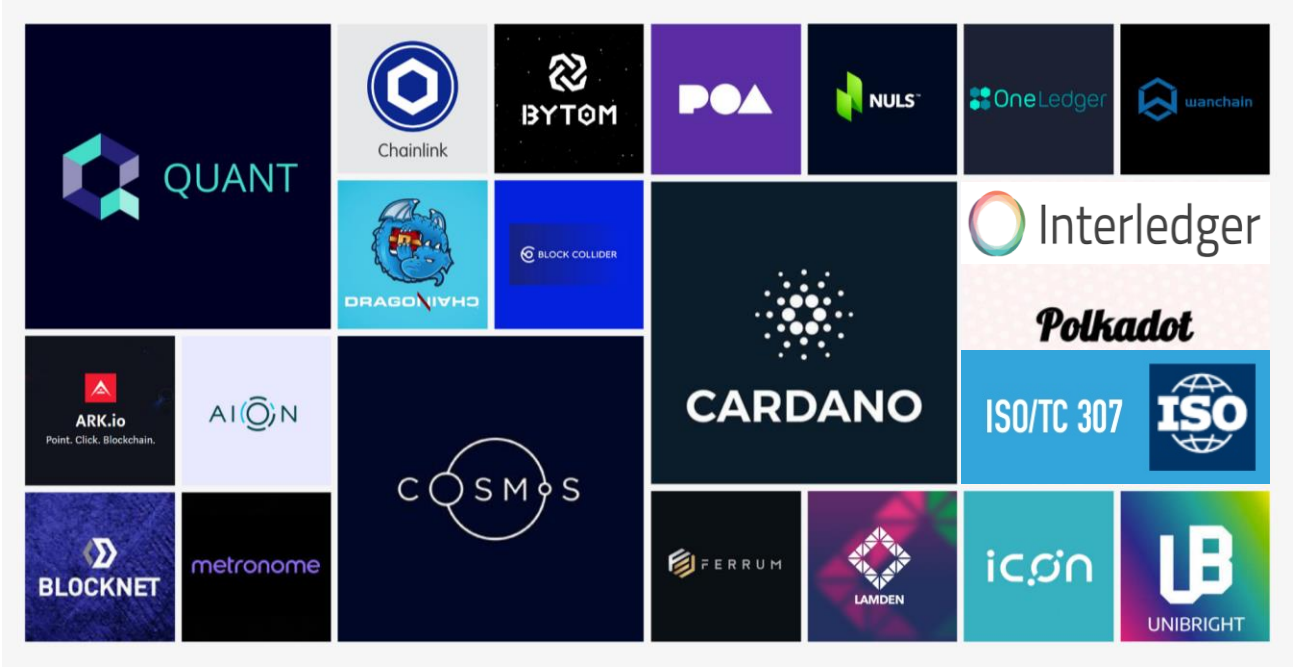






failing attempts to solve DLT protocol interoperability

the SMTP (Simple Mail Transfer Protocol) syndrome

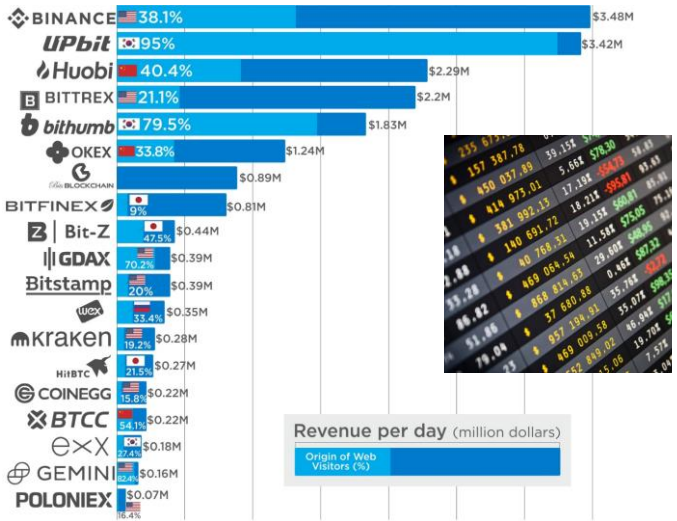


… and many more meta-chains, almost as many as DLT protocols

alternative solution to DLT interoperability

In the FinTech world →

regulated cryptocurrencies exchanges



In the non-FinTech space →

regulated DLT-data exchanges, i.e. DLT Data Port Authorities

?

DLT projects | recommendations

1. Address any decision-makers baseline technology knowledge gaps
2. Plan, scope & instantiate with the right (sector-level) lenses
3. If required, phase & secure 3rd-party DLT orchestrator
4. Tool-up (“***complex project***” management tools)
5. Champion, support change & risk-mitigate

session 4 recap

- *ROI perspective*
- *implementation complexity*
- *architectural complexity*
- *node asymmetry*
- *power nodes & interoperability*

Recap + Q&A

Module 1 | core concepts and underpinning technologies

hashing, merkle trees, blockchain ecosystems, consensus, open vs permissioned DLT

Module 2 | DLT use cases

orgTech, lawTech, regTech, govTech, healthTech, medTech, finTech, propTech, insurTech, supply chain, registries, operations

Module 3 | AI, IoT & DLT technologies convergence

why these technologies are organically converging and how this convergence redefines management systems?

Module 4 | industry DLT challenges & opportunities

ROI perspective, implementation complexity, architectural complexity, nodes asymmetry, power nodes & interoperability

Thank You

giovannid@omega.no

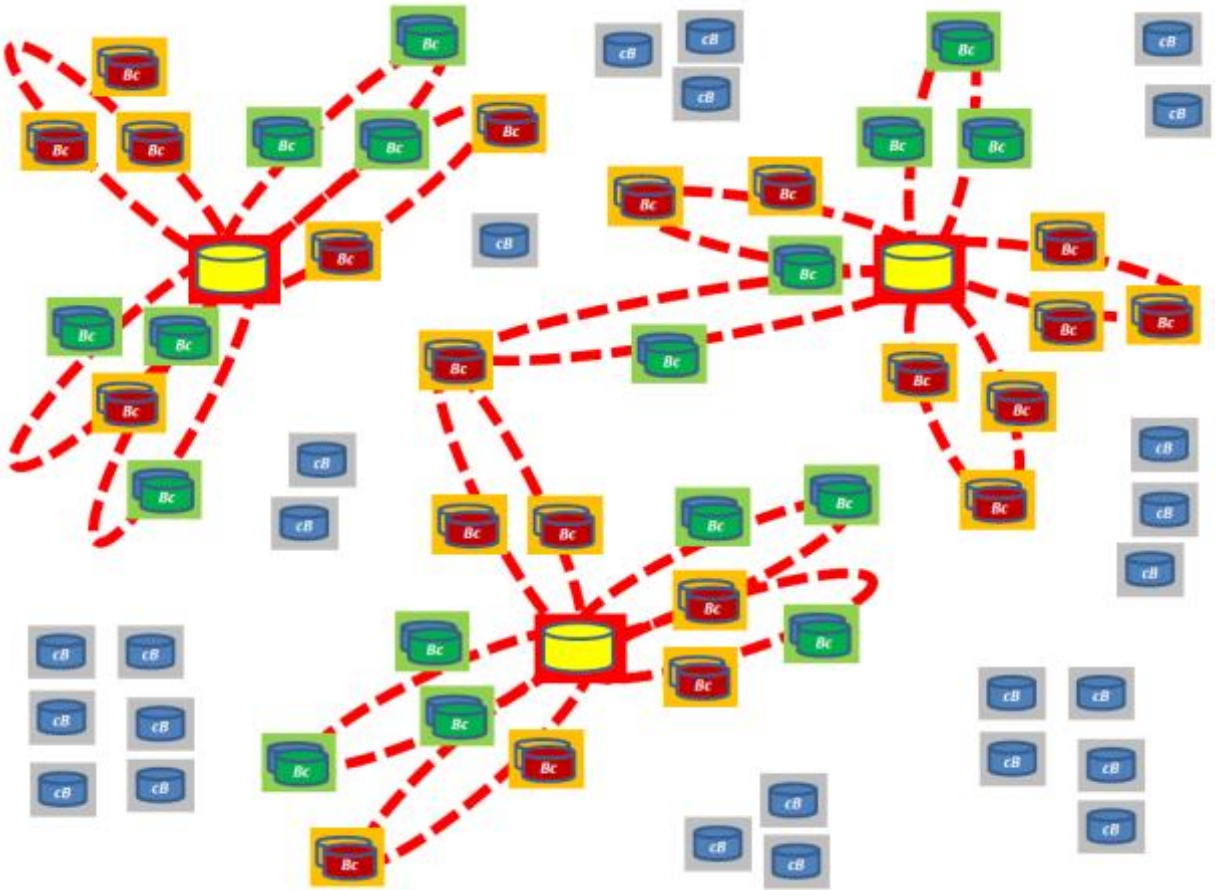
Demo

optional

legend

- genesis node (ring MSP)
- ring of nodes (cluster)
- baseline ring node
- permitted ring node
- independent node

cloudyBoss environment



SKYE rings

- *1 node belongs to 0 or more rings*
- *1 ring has min 3 or more nodes*
- *1 ring has 1 or more modules*

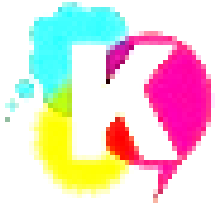
node data

- *Any node (ring or not) data can be encrypted*
- *Authorised users see encrypted data*
- *Ring data is immutable (chained)*
- *Permitted ring data is encrypted*
- *Permitted nodes see ring data*

creating a SKYE DLT ring takes seconds

SKYE ring

RGA



DEMO 1

nd1

1. *organisations **nd1** and **nd2** agree to form **RGA***
2. ***nd1** initialises **RGA***
3. ***nd1** refers **nd2** and asks **nd2** for a reference*
4. ***nd2** refers **nd1***
5. ***aut** confirms/activates once (genesis, BFT) **RGA***

nd2

aut

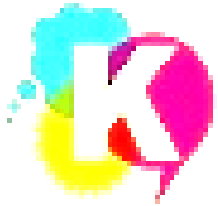
SKYE minimum workflow levels

- all cB transactions are subject to workflow
- SKYE workflow floor level triggers propagation
- SKYE workflow floor level depends on each module

propagating data across a SKYE DLT ring

SKYE ring

RGA



DEMO 2

nd1

1. ***nd1*** *creates a record with a low workflow*
2. *the record exists only in* ***nd1***
3. *the record workflow is set to a cluster floor level*
4. *the record now propagates across all nodes*
5. ***nd2*** *and all other nodes see the new record*

nd2

nd*x*…