Distributed Futures

An open source research programme for Smart Ledgers and new technologies

Timestamping Smart Ledgers
Comparable, Universal, Traceable, Immune

Long Finance Webinar

Friday, 07 September 2018, 15:00 to 15:30 BST

(presentation starts at 15:02)

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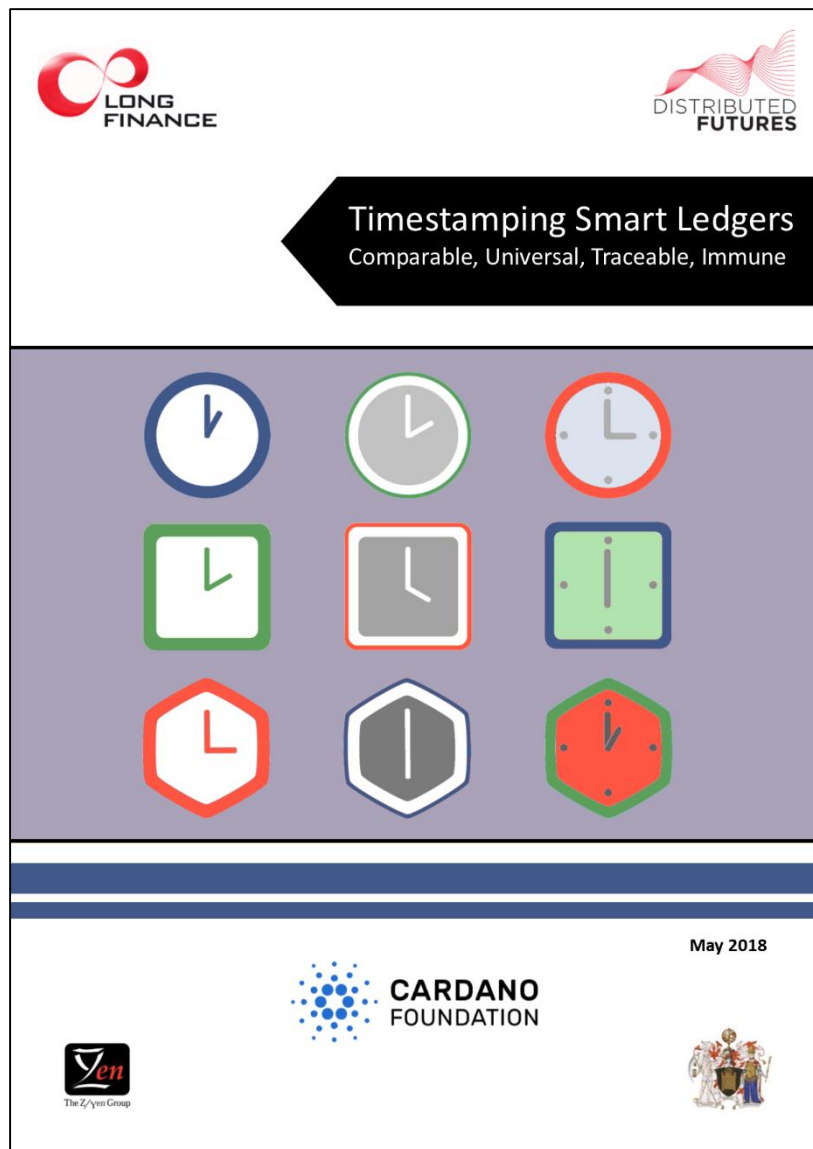# Introduction

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Agenda

15:00 – 15:05   Welcome & Introduction
15:05 – 15:20   Presentation
15:20 – 15:25   Questions
15:25 – 15:30   Concluding Remarks

Report

Read the report at:

https://bit.ly/2MRYmSd

Z/Yen Group

- **Special** – City of London's leading commercial think-tank
- **Services** – projects, strategy, expertise on demand, coaching, research, analytics, modern systems
- **Sectors** – technology, finance, voluntary, professional services, outsourcing

➢ Independent Publisher Book Awards Finance, Investment & Economics Gold Prize 2012 for *The Price of Fish*
➢ British Computer Society **IT Director of the Year** 2004 for PropheZy and VizZy
➢ DTI **Smart Award** 2003 for PropheZy
➢ *Sunday Times* Book of the Week*, Clean Business Cuisine*
➢ £1.9M **Foresight Challenge Award** for Financial £aboratory visualising financial risk 1997
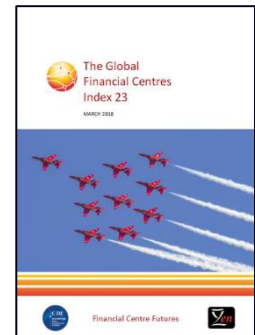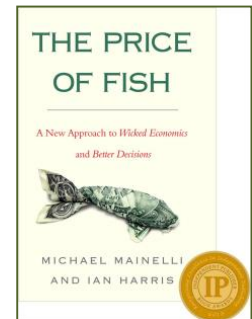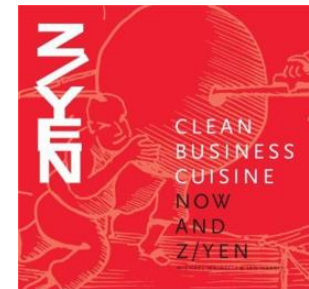
Distributed Futures Programme

We work in partnership with many stakeholders to learn together and build the vital infrastructure needed to make Smart Ledgers a success.

Our research is structured around four themes:
- Societal
- Technological
- Economic
- Political

Directed at four outcomes:
- Expanding frontiers
- Changing systems
- Delivering services
- Building communities

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Distributed Futures Research

The Missing Links In The Chains?
Mutual Distributed Ledger (aka Blockchain) Standards
November 2016

Responsibility Without Power?
The Governance Of Mutual Distributed Ledgers (aka Blockchains)
July 2016

Smart Ledger Geostamping
Steps Towards Interoperability & Standards
December 2017

The Quantum Countdown
Quantum Computing And The Future Of Smart Ledger Encryption
February 2018

Get Smart About Scandals
Past Lessons For Future Finance
March 2018

Liquidity Or Leakage
Plumbing Problems With Cryptocurrencies
March 2018

The Economic Impact Of Smart Ledgers On World Trade
April 2018

Pensions and Distributed Ledgers
April 2018

Timeline

2017 | 2018 — 2018 | 2019

EXPANDING FRONTIERS

Human Adjudication In Smart Ledgers	Artificial Intelligence – The Risks
Pensions & Distributed Ledgers ❹	
Smart Ledger Geostamping ❻	Fractal Characteristics & Measures
Cryptocurrency Liquidity ❷	Money Supply Rules, Algorithms & Liquidity
Economic Impact Of Smart Ledgers On World Trade ❼	Industry Pilot – Shipping
General Data Protection Regulation & Governance	Green Ledgers & Sustainability Certificates – Forestry & Fish

CHANGING SYSTEMS

Get Smart About Scandals ❸	Provability In 'Smarts'
The Quantum Countdown ❶	Inter-Exchange Operability On A Smart Commodities Ledger
Timestamping – Accuracy & Comparability ❺	Taxonomies & Classifications Of Smart Ledgers
	Prior Smarts – The Origins Of Smart Ledger Technology
IP Rights On Smart Ledgers – Music	Voting Structures On Smart Ledgers – Equities
	Cryptocurrency Energy Consumption
	WIR Revisited
Smart Ledger Surveillance Techniques	Cyber-Catastrophe Insurance Linked Security Pilot
Taxation & Smart Ledgers	

DELIVERING SYSTEMS

Directory Services	Smart Data Structures & InterPlanetary C#ASMs
Architectures For Tokenless Ledgers	Visualising Smart Ledgers
Audit & Accounting For Smart Ledgers	Online Simulation For Tokens & Cryptocurrencies
Economics Of Competing Currencies	Certificate Authenticity & Management
	Protection & Indemnity Mutuals
Survey Of The Regulatory Landscape For Smart Ledgers	

BUILDING COMMUNITIES

Games & Fun	Online Micro Courses
Standards & Interoperability	Technical Fora
Ledger Learnings & Simulations	Performance Benchmarking
RegTech	Regulatory Consultations

Terminology Evolving

◆ **ledger** – a record of transactions

◆ **distributed** – divided among several or many, in multiple locations

◆ **mutual** – shared in common, or owned by a community

◆ **mutual distributed ledger (MDL)** - a record of transactions shared in common and stored in multiple locations

◆ **mutual distributed ledger technology** – a technology that provides an immutable record of transactions shared in common and stored in multiple locations

◆ **blockchain** - "a transaction database shared by all nodes participating in a system based on the Bitcoin protocol"

◆ **smart ledger** – MDL with embedded, executable code

Smart Ledgers Hold Immense Promise

Area	Possible Applications
Financial instruments, records, models	Currency, private and public equities, certificates of deposit, bonds, derivatives, insurance policies, voting rights associated with financial instruments, commodities, derivatives, trading records, credit data, collateral management, client monies segregation, mortgage or loan records, crowd-funding, P2P lending, microfinance, (micro)charity donations, account portability, airmiles & corporate tokens, etc.
Public records	Land and property titles, vehicle registries, shipping registries, satellite registries, business license, business ownership/incorporation/dissolution records, regulatory records, criminal records, passport, birth/death certificates, voting ID, health and safety inspections, tax returns, building and other types of permits, court records, government/listed companies/civil society, accounts and annual reports, etc.
Private records	Contracts, ID, signature, will, trust, escrow, any other type of classifiable personal data (e.g. physical details, date of birth, taste) etc.
Semi-private/semi-public records	High school/university degrees and professional qualifications, grades, certifications, human resources records, medical records, accounting records, business transaction records, locational data, delivery records, genome and DNA, arbitration, genealogy trees, clinical trials, etc.
Physical keys	Key to home, hotel, office, car, locker, deposit box, mail box, Internet of Things, etc.
Intellectual property	Copyrights, licenses, patents, digital rights management of music, rights management of intellectual property such as patents or trademarks, proof of authenticity or authorship, etc.
Other records	Cultural, historical events, documentary (e.g. video, photos, audio), (big) data (weather, temperatures, traffic), SIM cards, archives, geostamping, etc.

Presentation

Timestamping Smart Ledgers
Comparable, Universal, Traceable, Immune

Sam Carter
Author

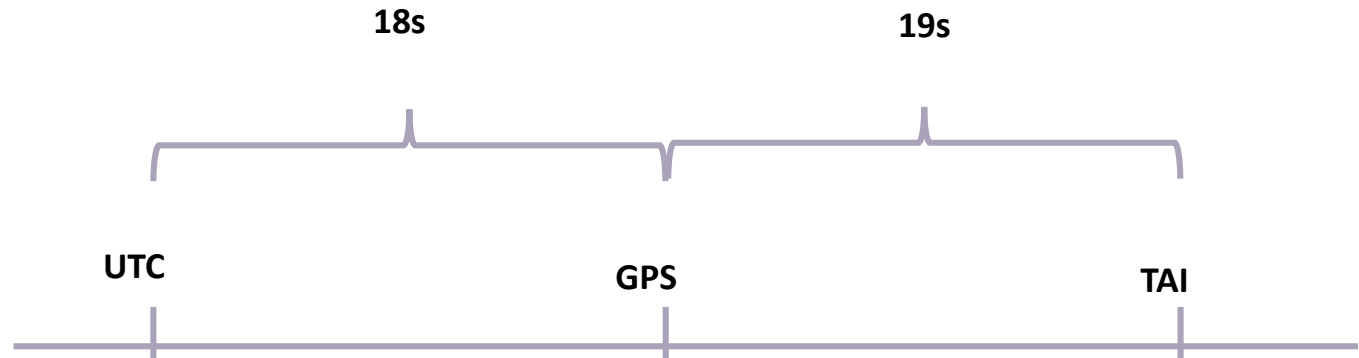# Summary

- Time Keeping, Time Broadcast

- Synchronisation & Security

- CUTI

- Precision & Accuracy

- Smart Ledgers & Timestamping

- Finance & Regulation

- Smart Ledgers & Finance

- Further Questions

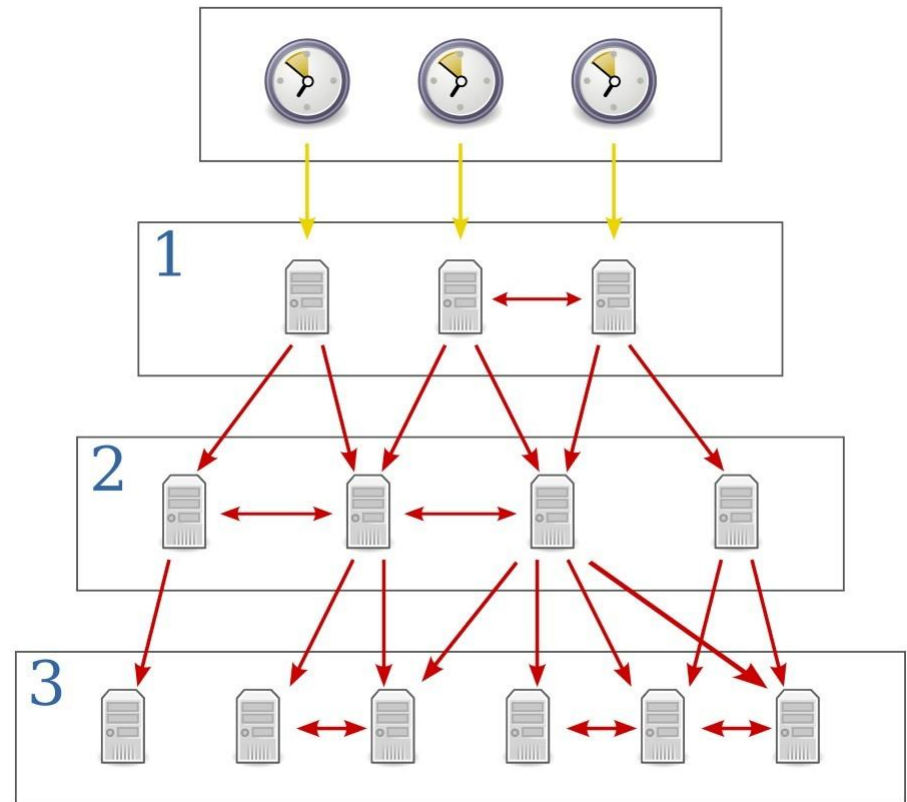# Time Keeping & Time Broadcast

Standards:

- **TAI**
- **UTC**
- **GPS**

18s   19s

UTC   GPS   TAI

Broadcast:

- **"Time from NPL" from Anthorn**
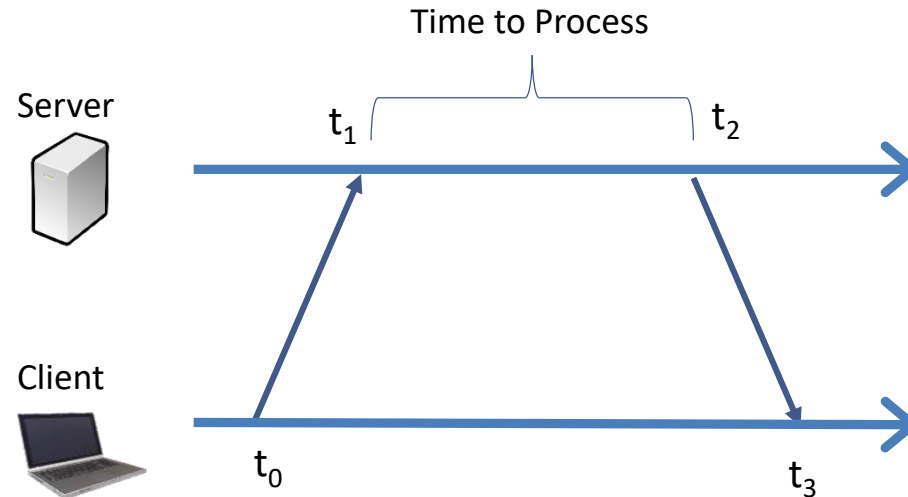- **GPS**
- **NPLTime™**

Time Synchronisation I

Synchronise every machine's clock:

♦ **Network has a time entry point**

♦ **Distribute time to all machines**
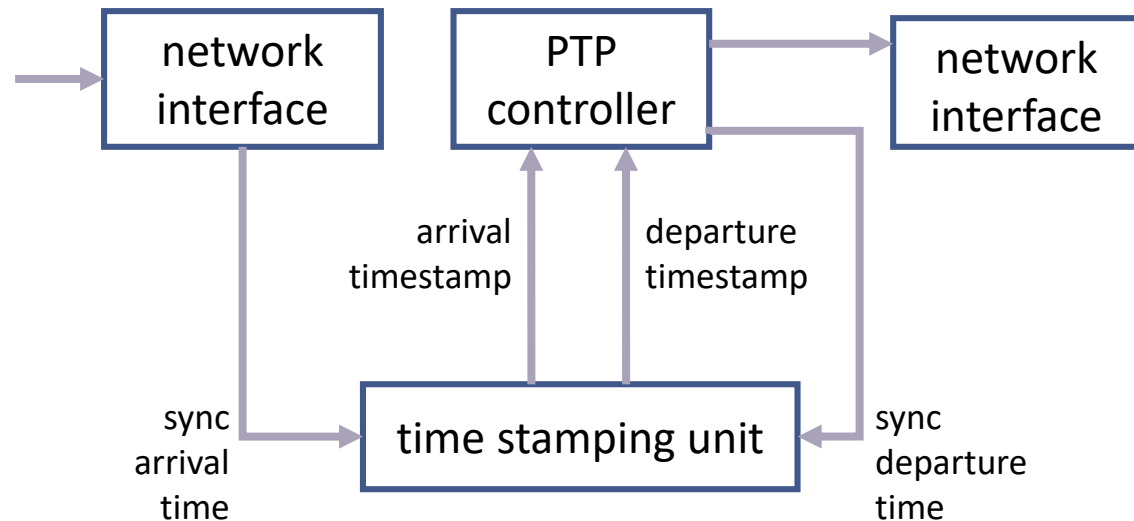
♦ **Each machine drifts – recalibration required**

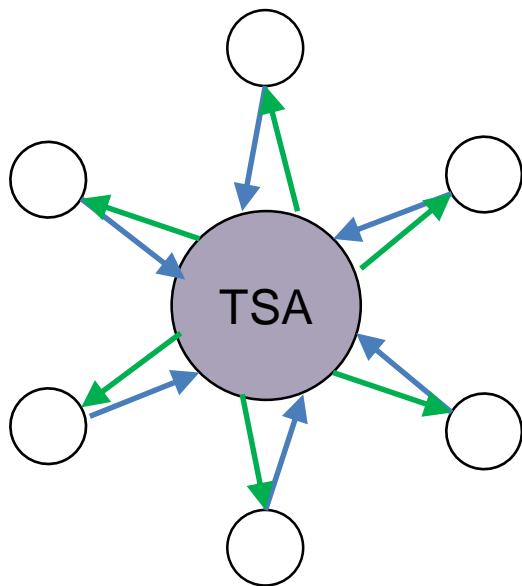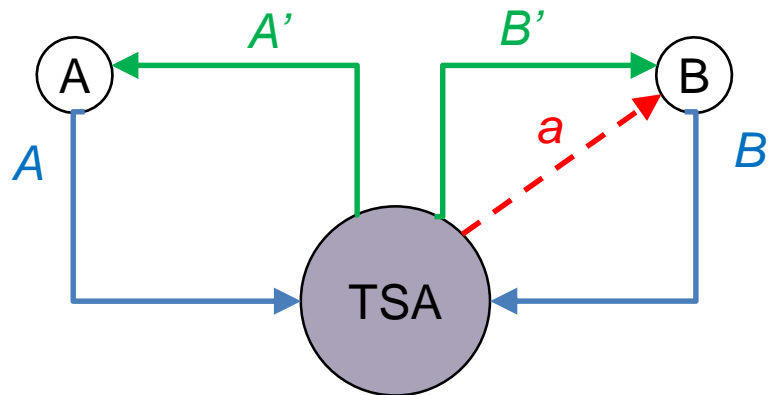# Time Synchronisation II

- **NTP**

- **PTP**

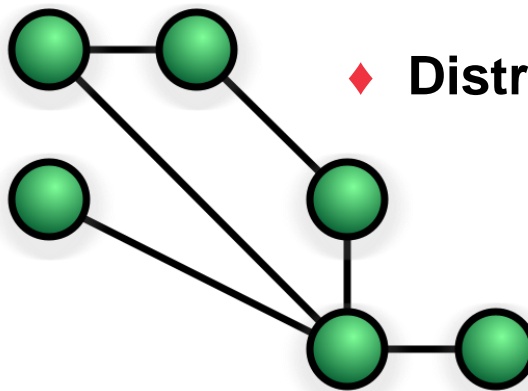# Secure Timestamping

♦ Central

♦ Central Linked

♦ Distributed

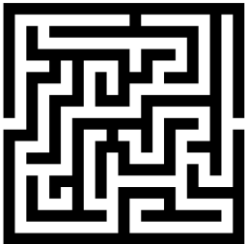# CUTI

♦ **C**omparable

♦ **U**niversal

♦ **T**raceable

♦ **I**mmune

Precision & Accuracy

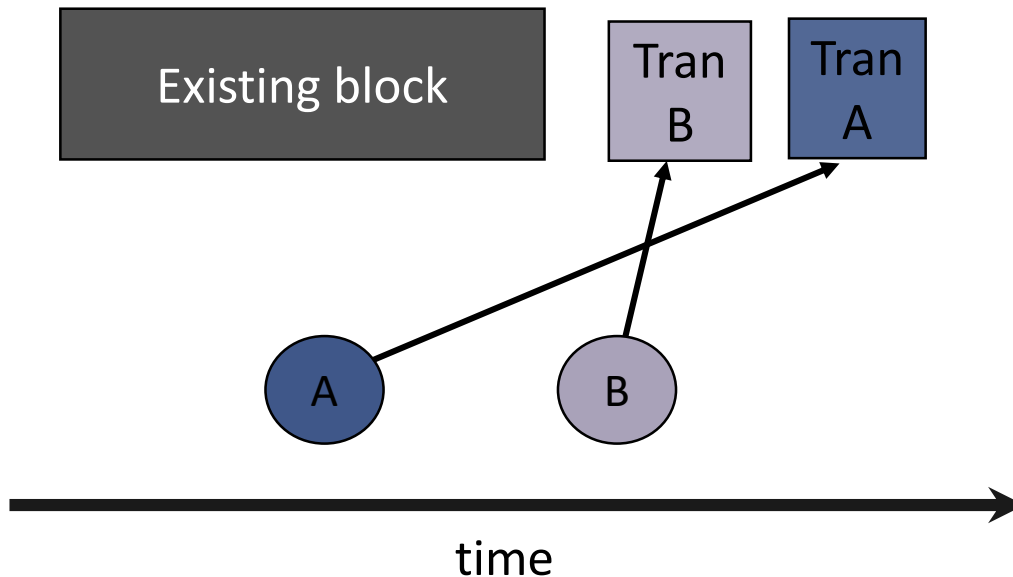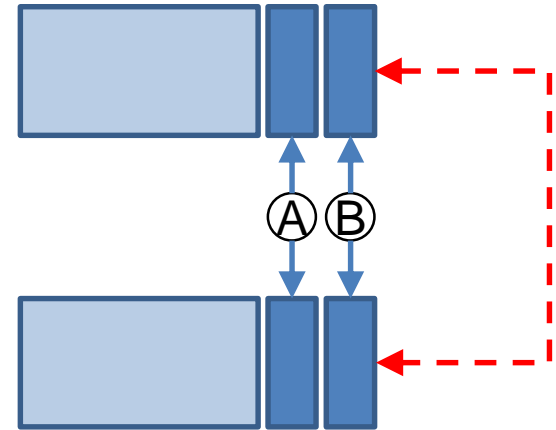|	Not Precise	Precise
Not Accurate		
Accurate		
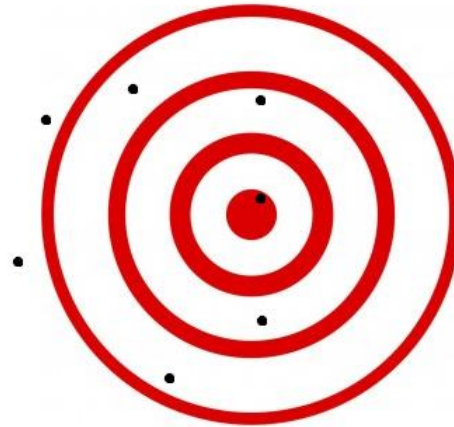
Smart Ledgers & Timestamping

When is a Smart Contract "posted"?

♦ **Networks and Latency**

♦ **Time of Event vs Consensus Time**

Smart Ledgers & CUTI

Property	Comments	Score
Comparable	This depends on two major factors: precision and accuracy.	Average
Universal	Easy to agree a standard within one ledger. Cross-ledger comparison still an issue.	Good
Traceable	If distributed ledger does the timestamping, every node on the system will have to be guaranteed traceable – and traceable on aggregate!	Good
Immune	The super audit trail and consensus model ensures nobody can change a timestamp.	Very Good

Financial Regulation

Credit Crunch:

UK economic growth
www.economicshelp.org | Source: ONS IHYQ

Article 50 & RTS-25:

♦ **Cross-market synchronisation.**

♦ **Precision.**

♦ **Reconstructability of past events.**

♦ **Auditability of infrastructure.**
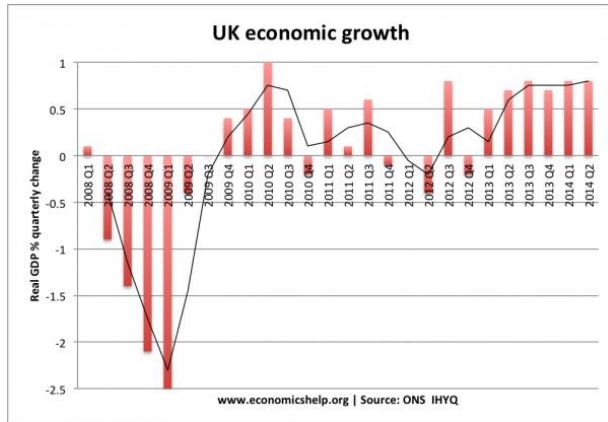
MiFID II – Goals:

♦ **Unbundling charges**

♦ **Moving OTC markets to exchanges**

♦ **Increasing focus on the buy-side**

♦ **Higher levels of surveillance**

High-Frequency Trading

Informal HFT Characteristics:

♦ **Arbitraging price differences with sheer speed.**

♦ **Orders *reach the exchange* as fast as possible.**

♦ **Reduce latency between the system and the exchange:**
  o **Co-location**
  o **Proximity hosting**
  o **High-speed electronic access.**

Formal ESMA definition:

♦ **At least two algorithmic trades per second in the same liquid instrument, or…**

♦ **At least four messages per second across all instruments traded over a given venue.**

Regulation and Timestamping

Required level of accuracy for trading venues:

Gateway-to-gateway latency	Max divergence from UTC	Granularity of the timestamp
> 1 millisecond	1 millisecond	1 millisecond or better
<= 1 millisecond	100 microseconds	1 microsecond or better

Required level of accuracy for trading participants:

Type of trading activity	Max divergence from UTC	Granularity of the timestamp
High-frequency algorithmic trading	100 microseconds	1 microsecond or better
Voice trading systems	1 second	1 second or better
Any other trading activity	1 millisecond	1 millisecond or better

Smart Ledgers and Finance

3 separate spheres to consider:

◆ Internal Recordkeeping

◆ Cross-entity Reconciliation

◆ Trading

Timestamping: Food For Thought

1. Regulation cannot help but make assumptions about existing technology. What regulation could the new technology of smart ledgers make obsolete?

2. Why aren't the industry jumping at the chance of a central trade repository? It would remove their obligation to record everything on their own systems.

3. Could central trade timestamping break the semi-monopoly held by data providers (Bloomberg/ Reuters/ etc.) ?

4. What other sectors could benefit from having central time-stamping?

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Questions

Concluding Remarks

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Thank you!

"Get a big picture grip on the details."
Chao Kli Ning