



2018

**Transactive
Energy
Systems**

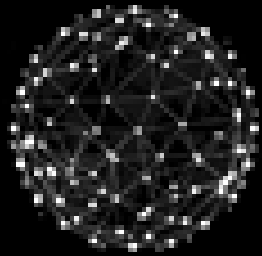
CONFERENCE & WORKSHOP

June 12-14, 2018
MIT, Cambridge, MA

Introduction to Blockchain

Session: The Power of Blockchain

Tony Giroti
Chairman
Energy Blockchain Consortium



ENERGY BLOCKCHAIN CONSORTIUM

A non profit consortium of Utilities, Coops, Munis, Manufacturers and Service provider organizations and professionals

who are committed to leveraging Blockchain technology to solve the most compelling problems in the Energy industry.

The Consortium is developing an Open Energy Blockchain Framework with use cases, interoperability standards and reference architecture.

energy-blockchain.org

HOW BLOCKCHAIN STARTED ?



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BEGINS
Dec 2007



ENDS
Jun 2009

THE FINANCIAL CRISIS of 2007-2008

2007

2008

2009

Apr 2007

Mar 2008

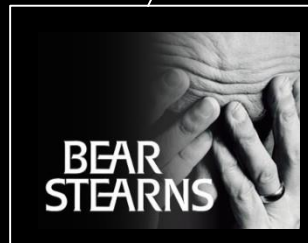
Sep 15 2008

1

2

3

4



1

2

3

4

Aug 18th 2008: Bitcoin.org domain was formed

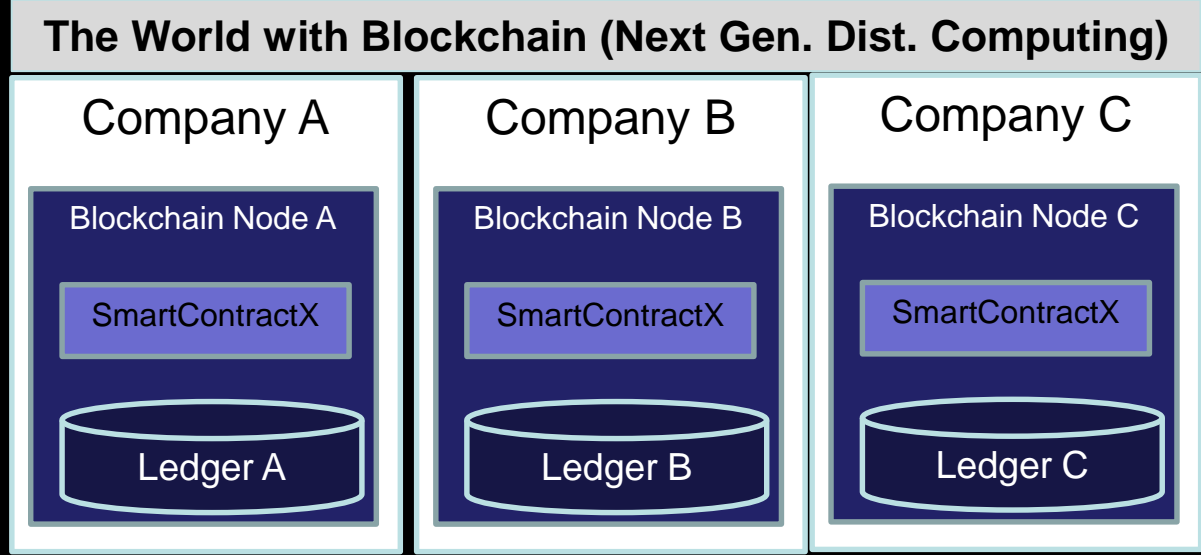
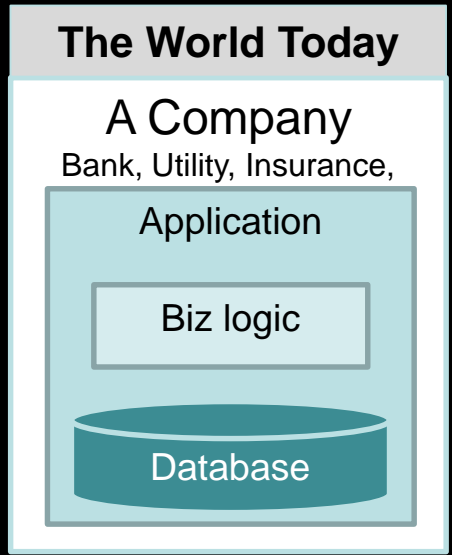
Oct 2008: Satoshi Nakamoto published Bitcoin paper

Jan 3rd 2009: Bitcoin started

May 22nd 2009: 1st Pizza bought 10,000 BTC

- **Blockchain & Bitcoin are **not** the same**
 - Blockchain = ‘technology’, Bitcoin = ‘app’
- **Bitcoin is a cryptocurrency – a digital asset**
 - Digital Currency. Fixed supply 21M coins (rarity of Gold)
 - Blockchain & Cryptography to control its creation & management
 - A ‘Fiat’ currency \$, € etc.
- **Today: Blockchain for Tracking and Buying & Selling of any Goods or Assets**
 - Payments are not always necessary
 - Supports Transactive Energy Use Cases
 - Technology itself provides trust so intermediaries are not needed

HOW IS BLOCKCHAIN DIFFERENT?



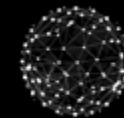
Centralized Control

- Data: Company has 1 or more databases
- Biz Logic: Company runs biz process
- Control: Company controls Data & App
- Trust: The Company is the Trusted Party
 - Decisions: Made by The company
 - History: The Company knows it
 - Changes: Made by The Company
 - Transactions: In Company's DB

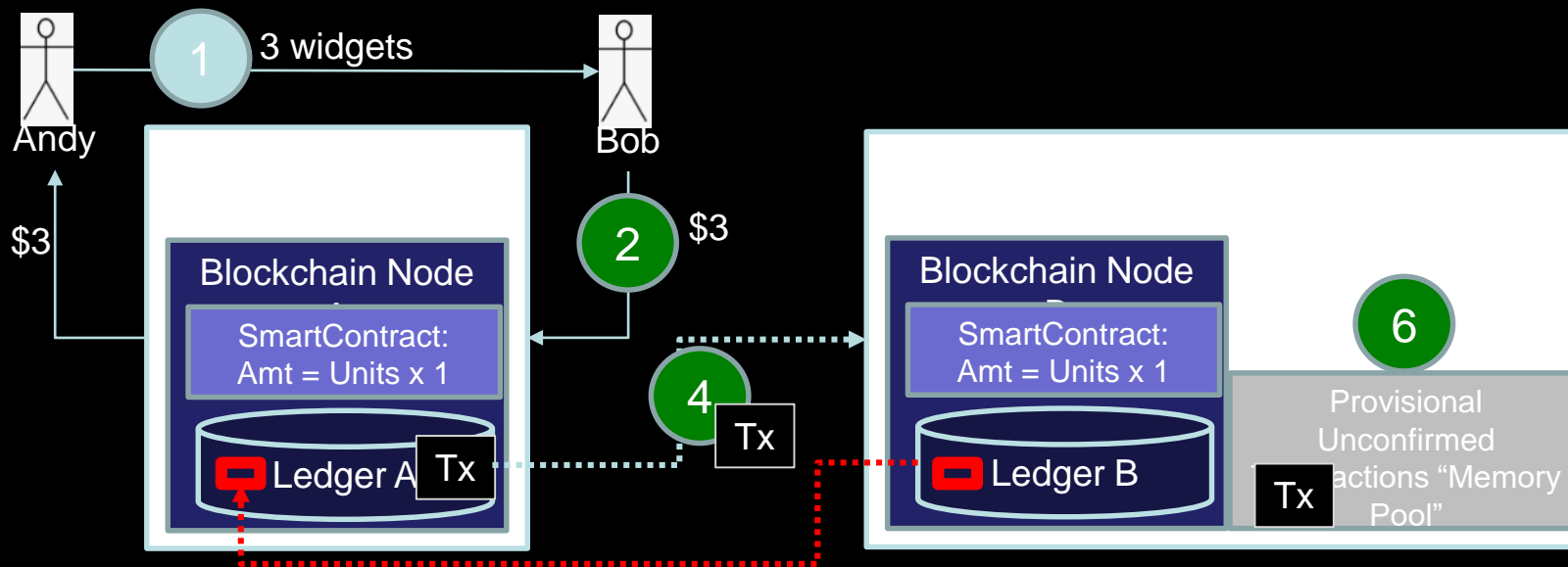
De-Centralized Control (Nodes in P2P Network)

- Data in multiple 'databases' i.e. in 'distributed' Ledgers
- Biz Logic: Same SmartContract runs in multiple companies
- Control: 1 Company DOES NOT Control Data & App.
- Trust: Blockchain technology is the Trusted Party & NOT company
 - Decisions: All Participants agree on Validity (CONSENSUS)
 - History: All Participants know lineage of (PROVENANCE)
 - Changes: Data & SmartC cannot change (IMMUTABILITY)
 - Transactions: Completion of transaction (FINALITY)

HOW BLOCKCHAIN WORKS



Example: Andy sold 3 widgets to Bob. Rate is \$1 per unit .



3 Node A Creates a digitally signed TRANSACTION
 (a) 3 Widgets from Andy to Bob
 (b) \$3 from Bob to Andy



5 Node B: VERIFICATION of Transaction
 (a) Does it comply with Blockchain rule
 (b) Is its Digital Signature ok
 (c) Are there any conflicts with prev transactions

8

7 Periodically VALIDATORS create Blocks
 (a) If Node B was a "VALIDATOR" it creates a BLOCK in Ledger B
 (b) VALIDATOR is rewarded (from transaction charge)

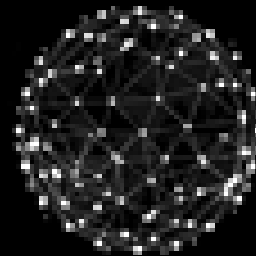
9 Like Transactions, BLOCKS also Propagated from Node to Node and linked as a Chain. Hence BLOCKCHAIN

Link to Prev Hash	Hash: 32 bytes unique ID of	
	Time Stamp	A set of Transactions
		Tx Ty

- Peer to Peer Energy Trading
- Wholesale Market Settlement
- Energy Data Management
- Energy Forecasting
- Energy M&V
- Net Energy Metering
- DER Service Coordination

- Grid Security
- Customer Data & Service
- Retail Billing
- EV Charging
- Energy Storage
- Microgrid Network operator
- REC & Carbon Trading
- Price Responsive DR

Thank You



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