

Blockchain in Industry 4.0 - How the Oil and Gas Industry is Utilizing these Emerging Technologies*

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Abstract

Industry 4.0 is now an accepted term for the ten (plus or minus) technologies that are emerging or have been emerging from the Information Age and the era of Computer Automation. These technologies include autonomous robots, digital twins, cloud computing, augmented reality, blockchain, big data, industrial internet of things, cybersecurity, and system integration/artificial intelligence.

As these technologies become more accepted into mainstream life, for instance how many are now using cloud computing and big data, the other parts of Industry 4.0 will also be looked at more closely for applicability and acceptance.

Because of the magnitude of an industrial shift, it is imperative that education and information about these elements are addressed as they are adopted. Using both big data and cloud computing as a springboard, this discussion will introduce the role which blockchain is set to play in the upcoming years as we undergo the transition.

It is important to engage these issues and topics with relevance within a discipline that we can understand. In this particular presentation it is focused on primarily what blockchain is, how is it applied in oil and gas, case studies specific to oil and gas and finally what the State of Wyoming is doing in response to this emerging technology.

In the simplest form, a blockchain is a series of packets of information that rely on both the other information blocks as well as users to ensure security, verification, and acceptance of changes to the dataset. Through this multistep process the blockchain becomes an easy way to provide transparency, verification and a chain of custody that, when constructed correctly, becomes difficult to counterfeit and replicate.

These characteristics make its ability to provide exploration, production, processing, transportation, shipping, refining, and marketing unique and integral means within Industry 4.0.

Blockchain are being implemented globally and Wyoming is moving into a position to address these changes. There have been 13 blockchain bills enacted during the 2018/2019 legislative session and the creation of a Wyoming Blockchain Task Force. This infrastructure will allow for up to five blockchain banks to be established in Wyoming. These banks will address underserved financial markets.

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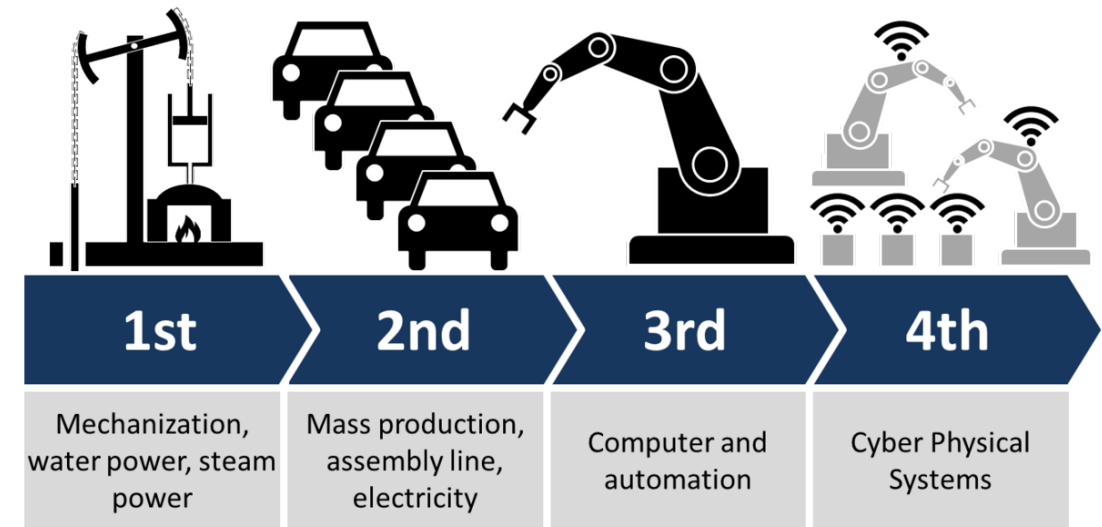
BLOCKCHAIN IN INDUSTRY 4.0

HOW THE OIL AND GAS
INDUSTRY IS UTILIZING THESE
EMERGING TECHNOLOGIES

MIKE BINGLE-DAVIS
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AAPG EMD ROCKIES COUNCILOR
WYOMING GEOLOGICAL ASSN.

INDUSTRY 4.0

- Industry 1.0 : Steam, Mechanization
- Industry 2.0 : Electrification, Mass Production
- Industry 3.0 : Information, Computer Automation
- Industry 4.0 : Intelligence, Cyber Physical Systems
 - Ten Central Technologies to Industry 4.0
 - Autonomous Robot
 - Digital Twin
 - Cloud Computing
 - 3-D Printing
 - Augmented Reality
 - **Blockchain Technology**
 - Big Data
 - Industrial Internet of Things (IIoT)
 - Cybersecurity
 - System Integration / Artificial Intelligence



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FOCUS ON BLOCKCHAIN

- Industry 4.0 : Intelligence, Cyber Physical Systems
 - Ten Central Technologies to Industry 4.0
 - **Blockchain Technology**
 - What is Blockchain?
 - Applications in Oil and Gas
 - Case Studies of Currently Applied Blockchain



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WHAT IS BLOCKCHAIN –

1

- Data
- Hash
- Hash of Block



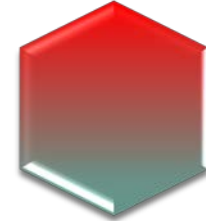
2

- Data
- Hash
- Hash of Previous Block



3

- Data
- Hash
- Hash of Previous Block



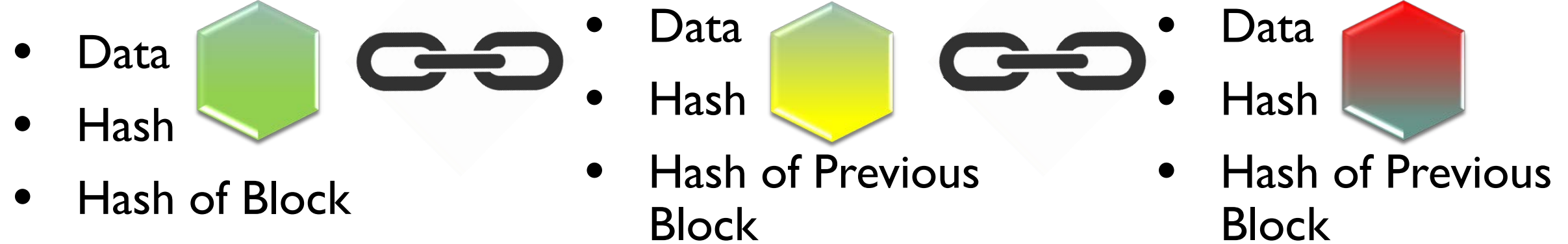
SIMPLY – A CHAIN OF BLOCKS THAT CONTAIN INFORMATION

WHAT IS BLOCKCHAIN – DISTRIBUTED LEDGER

1

2

3



INFORMATION ON BLOCK DIFFICULT TO CHANGE

WHAT IS BLOCKCHAIN – INDIVIDUAL BLOCK



- Data
- Hash
- Hash of Previous Block

FROM:

TO:

AMOUNT:



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INFORMATION ON BLOCK DIFFICULT TO CHANGE

WHAT IS BLOCKCHAIN – INDIVIDUAL BLOCK HASH



- Data
- **Hash**
- Hash of Previous Block



shutterstock - 130123046

HASH:
JGHCNMNI29305
JI23I2FDAVAE563
6

INFORMATION ON BLOCK DIFFICULT TO CHANGE

WHAT IS BLOCKCHAIN – INDIVIDUAL BLOCK HASH



- Data - changes
- Hash - changes
- Hash of Previous Block



shutterstock - 130123046

HASH:
JGHCXZNI29305J
I2442FDAVAE567
6

INFORMATION ON BLOCK DIFFICULT TO CHANGE

WHAT IS BLOCKCHAIN – CONTINUITY OF HASHES

1

2

3

- Data 
- 1z8f 
- Previous Hash: 0000

- Data 
- 6bql 
- Previous Hash: 1z8f

- Data 
- 3h4q
- Previous Hash: 6bql

INFORMATION ON BLOCK DIFFICULT TO CHANGE

WHAT IS BLOCKCHAIN – ALTERING DATA BLOCK ALTERS HASH

1

2

3

- Data 
- lz8f 
- Previous Hash: 0000

- Data 
- 4gh8 
- Previous Hash: lz8f

- Data 
- 3h4q
- Previous Hash: 6bql

ANY CHANGES WILL BE DETECTED BY THE CHAIN

WHAT IS BLOCKCHAIN – ALTERING DATA BLOCK ALTERS HASH

1



- Data
- 1z8f
- Previous Hash: 0000

2



- Data
- 4gh8
- Previous Hash: 1z8f

3



- Data
- 3h4f
- Previous Hash: 4gh8

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ANY CHANGES WILL BE DETECTED BY THE CHAIN

WHAT IS BLOCKCHAIN – ADDED SECURITY, PROOF OF WORK

1

2

3

- | | | | | |
|---|---|---|---|---|
| <ul style="list-style-type: none"> • Data  • 1z8f • Previous Hash: 0000 |  | <ul style="list-style-type: none"> • Data  • 6bql • Previous Hash: 1z8f |  | <ul style="list-style-type: none"> • Data  • 3h4q • Previous Hash: 6bql |
|---|---|---|---|---|

IT TAKES APPROXIMATELY 10 MINUTES TO CREATE A BLOCK

WHAT IS BLOCKCHAIN – TIME TO REBUILD CHAIN AFTER CHANGE

1

2

3

- Data 
- 1z8f
- Previous Hash: 0000



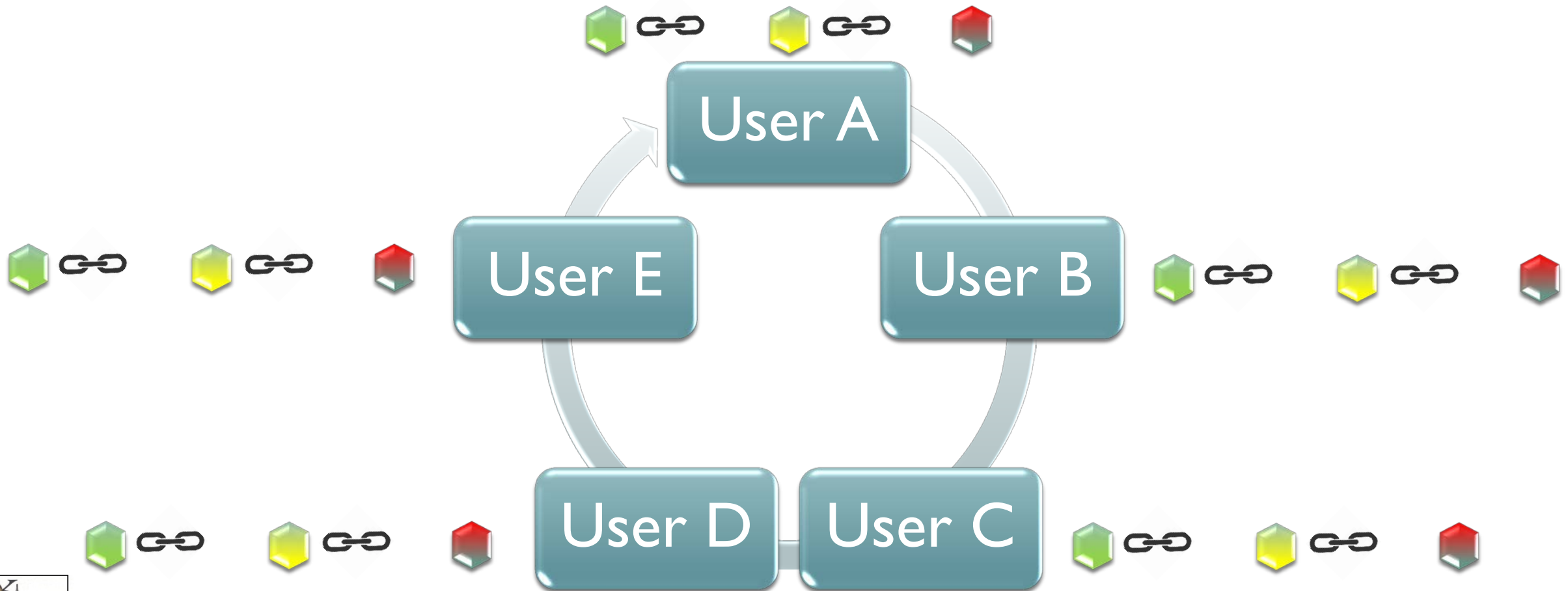
- Data 
- 6bql
- Previous Hash: 1z8f



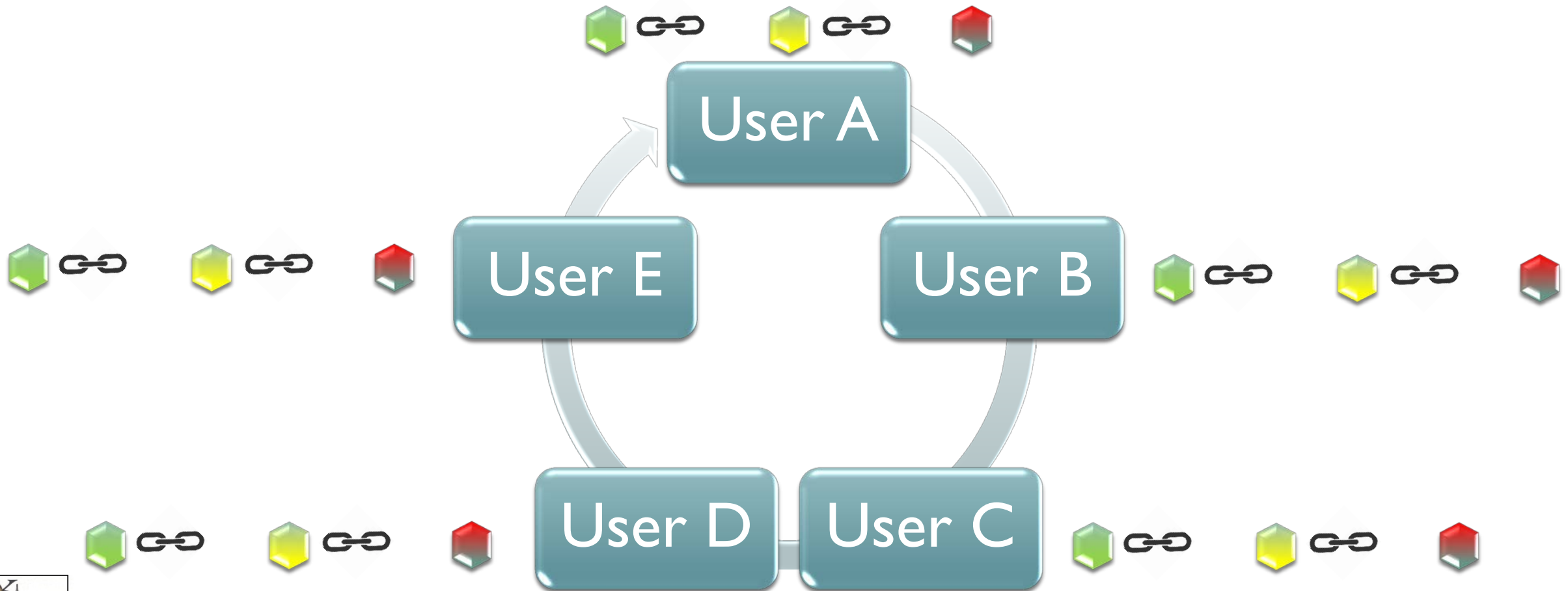
- Data 
- 3h4q
- Previous Hash: 6bql

20 MINUTES TO RECREATE THIS 3 LINK BLOCKCHAIN

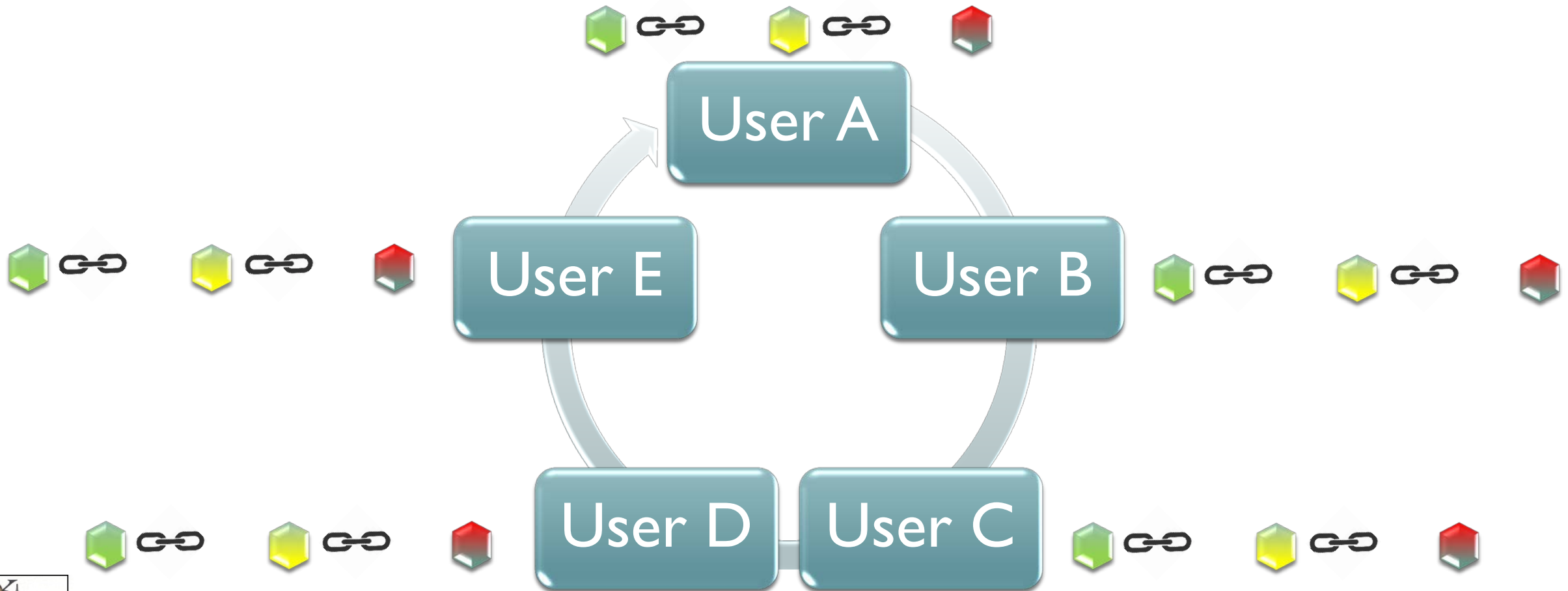
WHAT IS BLOCKCHAIN – SECURITY PEER TO PEER NETWORK



WHAT IS BLOCKCHAIN – CHANGES GO TO ALL IN P2P



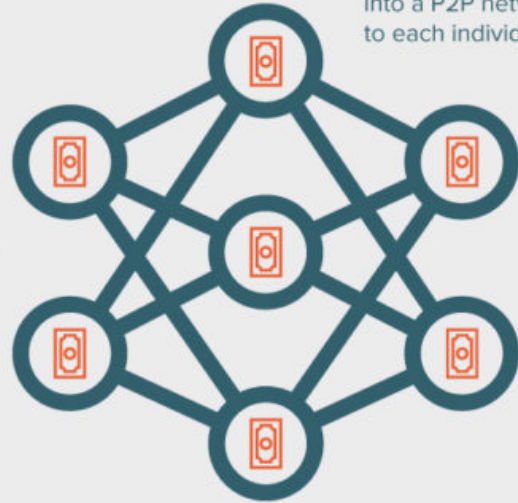
WHAT IS BLOCKCHAIN – >50% NEED TO APPROVE TO CHANGE



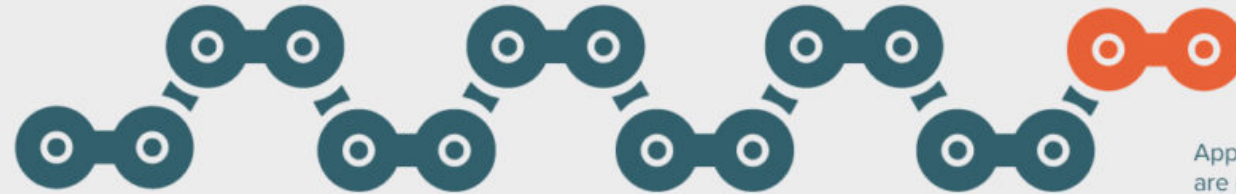


HOW DOES BLOCKCHAIN WORK?

One party requests a transaction.

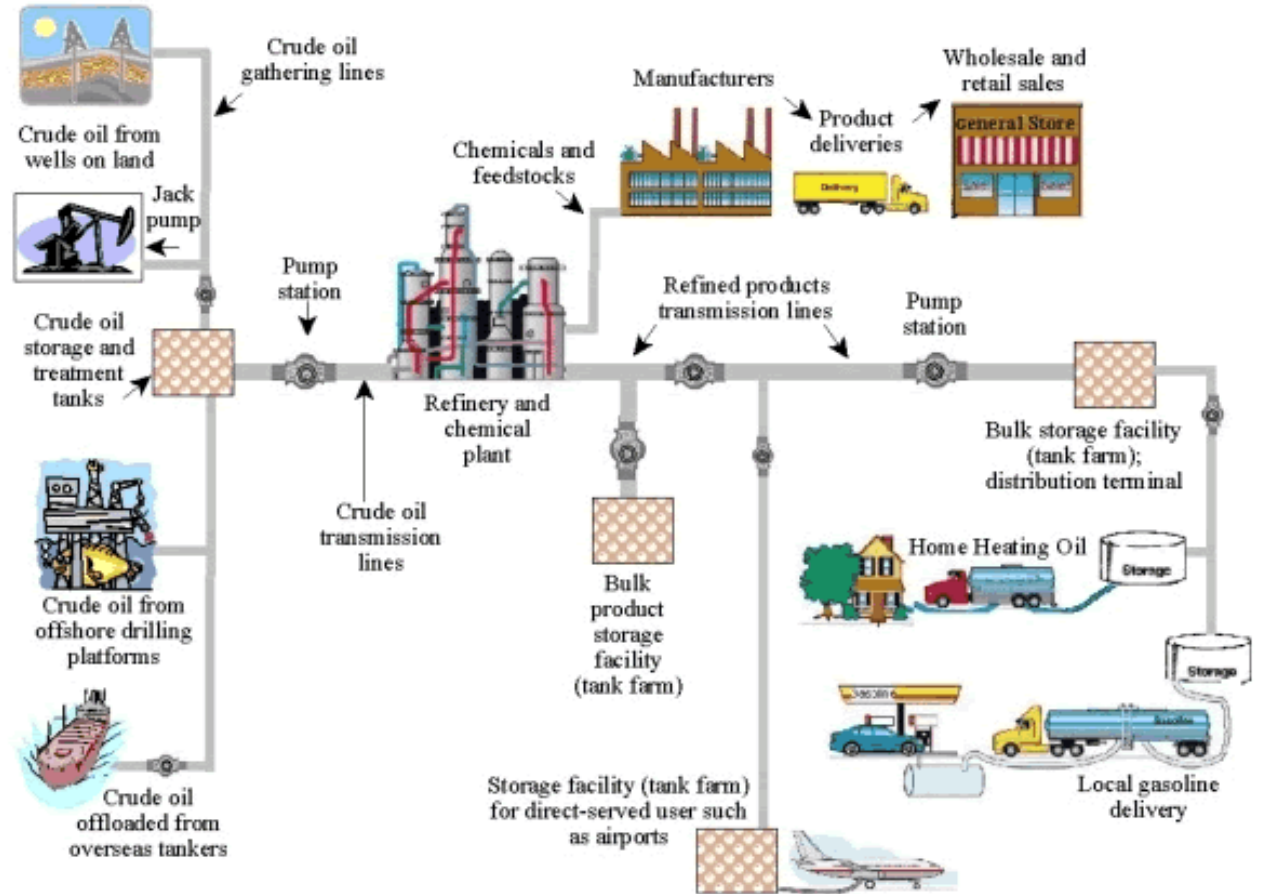


Once the block is added to an existing chain, transactions are complete and permanent.



APPLICATIONS OF BLOCKCHAIN IN OIL AND GAS INDUSTRIES

- Oil and Gas Industry Value Chain
 - Upstream
 - Exploration, Production and Processing
 - Midstream
 - Transportation and Shipping
 - Downstream
 - Refining, Gasification and Marketing



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APPLICATIONS OF BLOCKCHAIN IN OIL AND GAS INDUSTRIES

Market	Issue	Course	Consequence
Upstream	Equipment tracking Data loss	Device volume is large, imperfect management Differences in generation, storage, processing locations	Human error, supervisor fines Wrong data, wrong decisions
Midstream	Data handling and replication	Third party transactions, duplicate contracts	Increased operating costs, transaction errors or delays
Downstream	Integrity and security	Vulnerability to external attacks	Fraud, trust loss

H. Lu et al: Blockchain Technology in the Oil and Gas Industry, IEEEAccess, 3/2/2019



APPLICATIONS OF BLOCKCHAIN IN OIL AND GAS INDUSTRIES

Continent	Location	Gas/Oil	Stage (Q3 2019)	Name/Company	Remarks
Asia	Xiamen, China	Oil	Test	Sinochem Group	Gas export simulations
Asia	Abu Dhabi	Oil & Gas	Test	ADNOC & IBM	O&G prod. Automation
N. America	Houston, TX	Gas	Test	S&P Global Platts	Transaction conf. prices
Europe	London, UK	Oil	Pre-Launch	Vakd	Post Trade cost Cut
Europe	Hamburg, EU	Gas	Pre-Launch	Enerchain	P2P Wholesale trading
Europe		Gas	Pre-Launch	OneOffice (BTL)	Post Trade cost Cut
Asia	Fujairah	Oil	Live	FOIZ, S&P Global Platts	Oil Terminal stock reports
Africa		Oil	Test	Mercuria, ING, SocGen	Digital docs in transport
S. America	Chile	Oil & Gas	Live	Energia Abierta	Regulate data tracking
Europe	UK,EU	Oil & Gas	Live	Interbit	O&G Trading
N. America	US	Oil & Gas	Live	PetroBLOQ	O&G Supply chain manag.
	EU	Oil & Gas	Live	Komgo SA	Trading platform

NATIXIS, IBM AND TRAFIGURA INTRODUCE FIRST-EVER BLOCKCHAIN SOLUTION FOR U.S. CRUDE OIL MARKET

- **NEWYORK - 28 Mar 2017:** Natixis, IBM (NYSE: [IBM](#)) and Trafigura have pioneered the first blockchain solution in commodity trade finance for US crude oil transactions. The distributed ledger platform, built on the Linux Foundation open source [Hyperledger Fabric](#), allows major steps in a crude oil transaction to be digitized on the blockchain, ensuring improved transparency, enhanced security, and optimized efficiency.
- By having the buyer, seller and their respective banks all on the same ledger, all parties can simultaneously view and share data on the status of a transaction, from the time a new trade is confirmed and validated, to when the crude oil is inspected, to its final delivery and cancellation of the letter of credit.
- Key benefits of the solution include reduced cash cycle times, improved efficiency via lower overhead costs and fewer cost intermediaries, increased transaction visibility to help reduce the threat of tampering, fraud and cyber-crim



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BITCOIN MINING HELPS OIL COMPANIES REDUCE CARBON FOOTPRINT



- Natural gas acquired as a byproduct of oil extraction has become synonymous with wasted energy.
- In certain areas, drilling companies are unable to find a profitable market for the excess fuel. It's often vented into the atmosphere.
- Startups are now offering on-site systems that utilize the surplus to mine cryptocurrencies. This new business is growing in regions where shale oil and gas extraction are major industries.

BITCOIN MINE

- The Bitcoin mining industry consumes 22.5 TWh of energy annually, which amounts to 13,239,916 barrels of oil equivalent.
- With 12.5 bitcoins being mined every 10 minutes, that means the average energy cost of one bitcoin would equate to 20 barrels of oil equivalent.
- Mining Bitcoin has the potential to be a wildly lucrative business, with a single Bitcoin now valued at more than 100 barrels of oil.
- That kind of price makes it one of the most valuable commodities on the planet and, just like oil, this commodity is increasingly valuable to mine if the energy costs can be kept down.



WYOMING BLOCKCHAIN STAMPEDE



- College of Engineering and Applied Science (CEAS)
- Department of Computer Science
- We're holding the WyoHackathon in Laramie as part of a larger, even more inclusive event. On September 19-22, 2019, the Wyoming Blockchain Stampede will comprise
 - Wyoming blockchain taskforce
 - Stampede developers conference
 - Wyo hack-a-thon
 - Stampede business conference
 - Sandcastle challenge

WYOMING BLOCKCHAIN ACCEPTANCE

- The State of Wyoming enacted 13 trail-blazing blockchain bills during its 2018/2019 legislative sessions garnering international attention.
- The Wyoming Blockchain Task Force will host its third meeting of the year as part of the Wyoming Blockchain Stampede. The Task Force is a bi-partisan group whose job is to draft proposed blockchain bills for consideration by the Wyoming legislature. It consists of three members of Wyoming's House of Representatives, three Wyoming Senators, and three civilians who were appointed by Governor Mark Gordon. At this meeting the Task Force will review drafts of proposed legislation for consideration during the 2020 legislative session and solicit feedback from interested members of the public.



WYO HACK-A-THON

D'CENT Biometric Wallet Video Competition
\$10,000 in prizes!

COMPETITION

PRIMARY OBJECTIVE	Show how easy it is to use a D'CENT Wallet to trade.
SECONDARY OBJECTIVE	Compare the D'CENT Wallet against competitors.
SUBMISSION LENGTH	Make the video length 60 seconds.
MINIMUM VIDEO QUALITY	4K / 60 FPS
AUDIO/VIDEO FORMAT	AAC Audio / H.264 CODEC
VIDEO ASPECT RATIO	1:1 and 16:9

REGISTRATION

Applicants are required to register for the competition at <https://wyohackathon.io>. The competition will be limited to the top 20 registrants. Applicants may register as a team. One hardware wallet per team. Registrants are required to submit a portfolio of previous work. Shipping outside the US is not covered.

TIMELINE

September 16th	Submission deadline.
September 22nd	Prizes awarded.

JUDGING

Submissions are judged on the following three criteria:

1. Creativity (40%)
2. Quality (30%)
3. Virality (30%)

PRIZES

- | | |
|------------------|---------------|
| 1st Place | \$6000 |
| 2nd Place | \$2500 |
| 3rd Place | \$1500 |

- A full day of technical speakers and workshops helping attendees prepare for the WyoHackathon Challenges and get acquainted with new technologies, concepts and emerging standards.
- We expect to have roughly 400+ developers from all over the world participate in this hackathon. With the help of sponsors, we will be able to offer an engaging workspace, workshops, and prizes as well as food, drinks, and giveaways.
- Last year we awarded over \$100K in bounties and prizes. We hope to offer even more toward innovations in 2019.
- We are openly accepting papers and presentation suggestions.

STAMPEDE BUSINESS CONFERENCE

- A full day of speakers and workshops helping attendees understand the Wyoming legislative environment, business opportunities of blockchain and use cases applicable to Wyoming and worldwide.
- Hosted by the University of Wyoming the Business Conference at the Wyoming Blockchain Stampede will bring together business leaders, entrepreneurs, and students in addition to the 400+ developers creating technology solutions that will need go-to-market expertise.
- With interest-specific tracks, roundtable discussions and networking sessions, attendees will create new solutions, win prizes, start to change the world and walk away with actionable knowledge of how to use blockchain to drive results, efficiency and transparency. We are openly accepting papers and presentation suggestions



SANDCASTLE INVITATIONAL CHALLENGE



- Some winners of WyoHackathon 2019 will join other vetted blockchain startups in the [Sandcastle Invitational Challenge](#).
- Sandcastle is seeking the best and most promising blockchain startups the world over to compete during Dubai2020 in the finale Sandcastle Challenge. Two winners from the Wyoming Blockchain Stampede will earn two of the 16 slots to compete in EXPO2020 Dubai.

FUTURE OF BLOCKCHAIN?

■ Everything ...

8:54 32%

Gillette News Record

Legislators look to add real estate, banking to blockchain laws

By Mark Wilcox Wyoming Business Report Via Wyoming News Exchange
8 hrs ago 0

LARAMIE — The state's Blockchain Task Force will meet in Laramie on Thursday and Friday to discuss potential legislation that could further shape Wyoming's landmark blockchain laws. If enacted, the laws under consideration could change the landscape for real estate, banking and energy, among other industries.

The premier legislation stemming from the task force passed in the 2019 legislative session, allowing the establishment of banks that could take custody of cryptocurrency assets much like a digital safety deposit box. This year, the task force is looking at refining...

8:55 32%

Wyoming Leads Nation In Development Of Blockchain Infrastructure

The state of Wyoming is at the leading edge of a relatively new database technology called Blockchain, most commonly associated with the crypto currency known as Bitcoin. Kaitlin Long is with the Wyoming Blockchain Coalition, an advocacy group for Blockchain technology. She recently explained to Basin Radio what blockchain technology is...

0:00 / 0:14

The Wyoming Legislature in it's most recent session passed 13 new laws allowing for the use and continued development of the technology. One area where Long says it can be applied is supply chain...

0:00 / 0:09

Long says that concept is also applicable

8:55 32%

Five 'blockchain banks' may open soon in Wyoming

By Mark Wilcox Wyoming Business Report
4 hrs ago 0

LARAMIE — About five new "blockchain banks" could bring as much as \$20 billion in assets into Wyoming by summer 2020 as applications open for the new type of bank charter Oct. 1.

Lawmakers are currently working to refine the law passed in 2019 that allows for "Special Purpose Depository Institutions" in Wyoming, a national first that has put Wyoming on the map for "underserved" financial markets like cryptocurrency, blockchain, coal, paycheck lending and firearms.

"I heard a fun phrase this week that an East Coast state is aspiring to copy us and be the 'Wyoming of the East' for digital assets," wrote Caitlin Long in an email to the Business...