Smart Contracts in Action

Dave Murray-Rust, Design Informatics | Gothenburg 2019

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design informatics

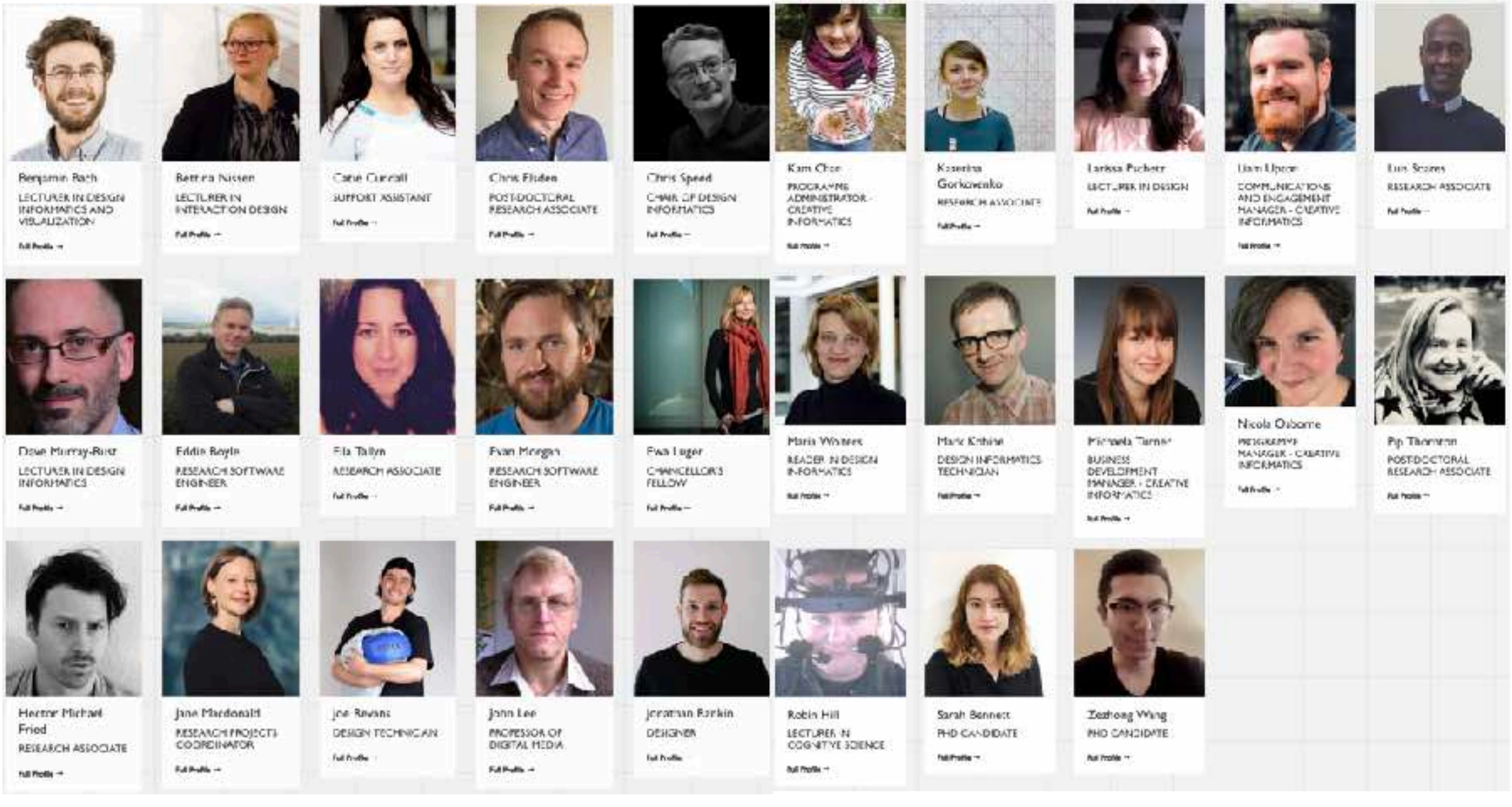
THE UNIVERSITY of EDINBURGH
Edinburgh College of Art

What's in this talk

- Context - Design Informatics, Prototyping Digital Infrastructures
- Context - a bit about myself
- Making blockchains tangible
- GeoCoin
- GeoPact - Smart Contracts in Action
- Challenges for Public Services

design informatics

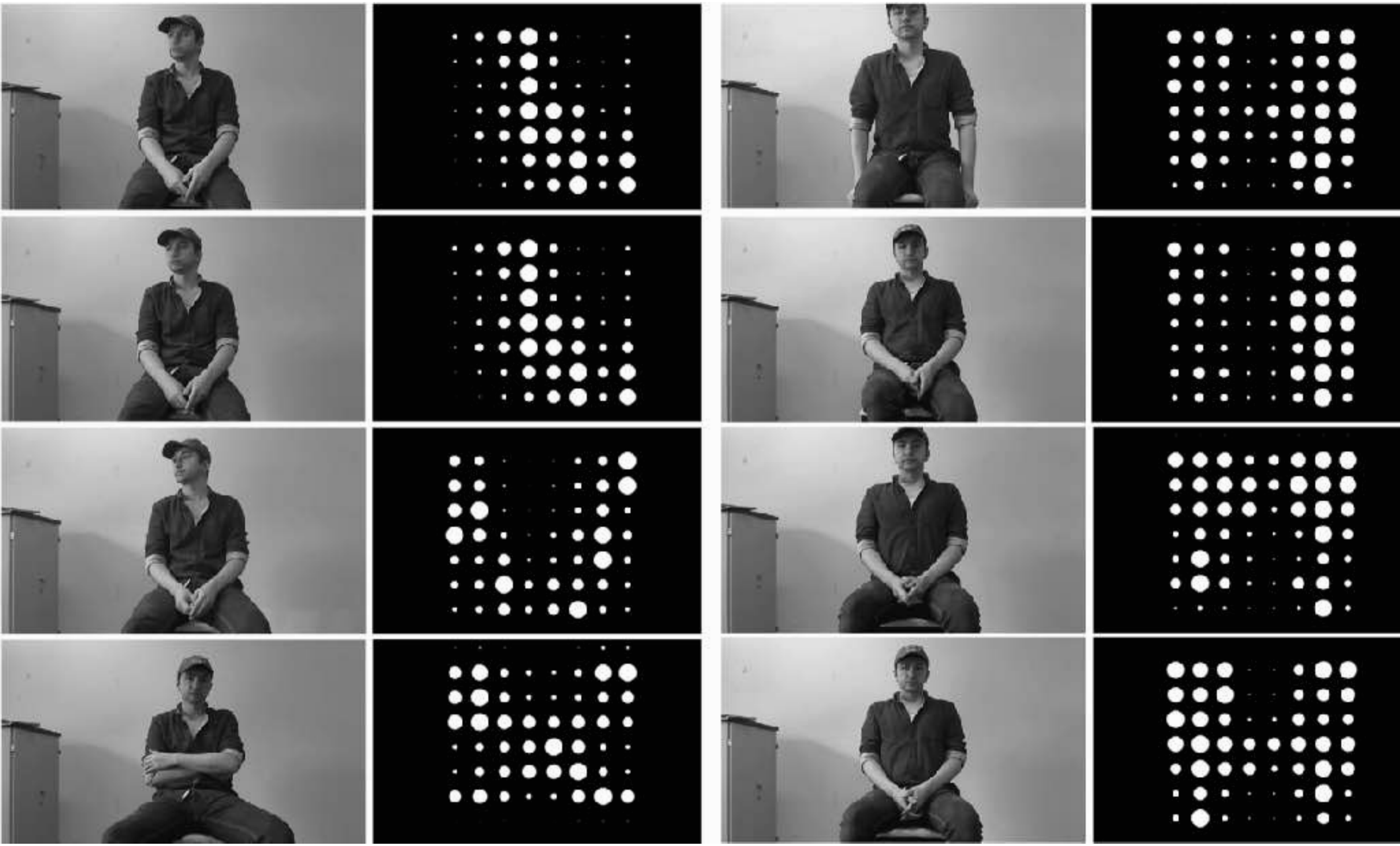
Data driven innovation is transforming society and the economy. In the Centre for Design Informatics, we design systems for better human data interaction, in diverse settings such as health, culture, mobility and finance. We explore design from, with, and by data: the central concern is the design of flows of data which sustain and enhance human values. Relevant technologies range from the internet of things, through blockchains, to robotics, speech recognition, data visualisation, interaction design, and social computing.



Larissa Pschetz / Gigbliss - autonomous devices negotiating for energy

Louis Souza / Blockchain Breakfast - manifesting crypto architectures

Bettina Nissen / Trustball - delegating decisions about data sharing



Mark Williams - Quantified Body Language

→ Participants hand-drawing map tiles of Edinburgh at the City Selfie Workshop, part of the Edinburgh Art Festival 2014.

→ Body paper prototyping during the Design Meets Synthetic Biology workshop 2016.

← Last minute updates to the BitBarista, a Bitcoin coffee machine, at the Edinburgh Digital Entertainment Festival 2016.

↑ Placing a brick onto the first block in the chain during a Block Exchange workshop.

specialize in ethics, consent, and privacy; neuropolitics; anthropology; user experience; human geography; and digital cultures, underpinned by a designer and two software engineers who help bring everything together into meaningful experiences. The research lab is also the heart of M.A. and M.Sc. programs in design informatics, and a Ph.D. community of designers and computer scientists.

Briefly describe a day in the life of your lab. The highly interdisciplinary team collaborates across research projects that involve organizations such as international charities, banks, museums, and galleries. On any given day, the team will be trying to understand the social, economic, and environmental implications for the flow of data between humans, machines, and designed artifacts. More than likely you will find the team huddled around a device such as the BitBarista, a hacked domestic coffee machine that only accepts Bitcoin and that insists on asking coffee drinkers where it should buy its next bag of coffee. Someone will be trying to understand the environmental and social impact of the material and digital economies of the coffee machine, while someone else will be hacking the software to allow a designer to provide an interface that makes the user aware of the data-value chains involved in ordering a cup of coffee.

What is one feature of your lab that you could not do without? The mix of people. All experts in their own fields, they offer different insights into every action that we make and offer new tactics when we get stuck with a particular material or method. Sometimes you'll find a designer and software engineers projecting into a near future, but you need the anthropologist and the human geographer to offer pause for reflection to calibrate ethical issues. On other occasions, projects slow down due to complex social and philosophical discussions, and the imagination of the designers allows us to turn ideas into experiences to better understand an issue. We need the mix of people to develop the criticalities around action and reflection.

What is one feature of your lab you want and do not have? Children, older people, and animals. As a relatively young department in a large university, we find ourselves surrounded by people of the same age range and genetic makeup. We have the city of Edinburgh and the many participants in the projects to keep us grounded, and we are part of a Living Lab project with the Edinburgh City Council. But the chance to have different perspectives on being human and more than human in the lab would certainly lead to more diverse outcomes.

What is the one thing you see as most important about the work you do there? Given the complex digital entanglements in which we find ourselves, we consider the exploration of human-centered approaches to data interactions to be of great importance. By developing ways to design from, with, and by data, we think that an interdisciplinary approach can bring data science into the design studio and into design research.

http://www.designinformatics.org

DOI: 10.1145/3047400

*"We explore design **from, with,** and **by** data: the central concern is the design of flows of data which sustain and enhance human values."*

Photo - Ihnatowitz's *Senster* - early cybernetic artwork

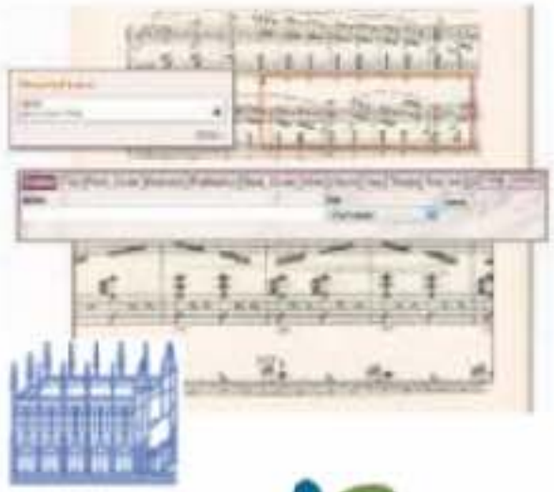
me: Human-Algorithm Interaction

How do people interact with algorithms?

(all the messy bits between people and technology)

What's the score at the Bodleian?

SOCIAM
SOCIAL MACHINES



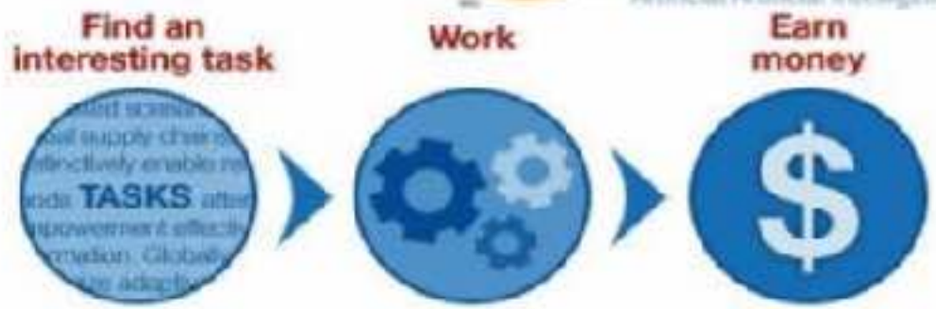
Ushahidi

github
SOCIAL CODING

fo'dit
Solve Puzzles for Science

WIKIPEDIA

amazonmechanical turk
Artificial Artificial Intelligence



iSpot

edX

climateprediction.net

hubzero

ZOONIVERSE
REAL SCIENCE ONLINE

media commons
a digital scholarly network

stackoverflow

LIFEGUIDE
COMMUNITY WEBSITE

UBhave

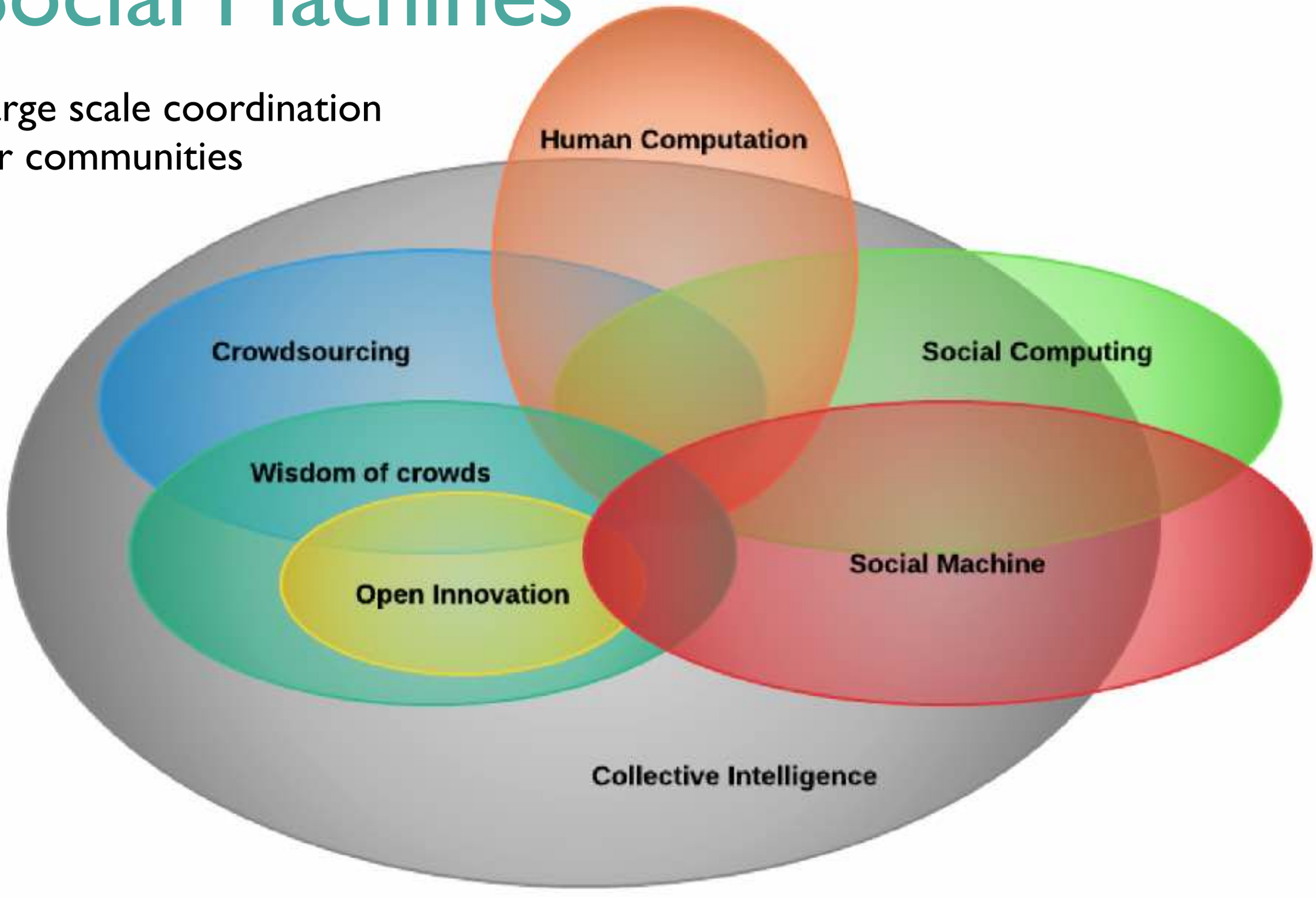
patientslikeme

my experiment

SOCIAM: The Theory and Practice of Social Machines is funded by the UK Engineering and Physical Sciences Research Council (EPSRC) under grant number EPJ017728/1 and comprises the Universities of Southampton, Oxford and Edinburgh. See sociam.org

Social Machines

Large scale coordination
for communities



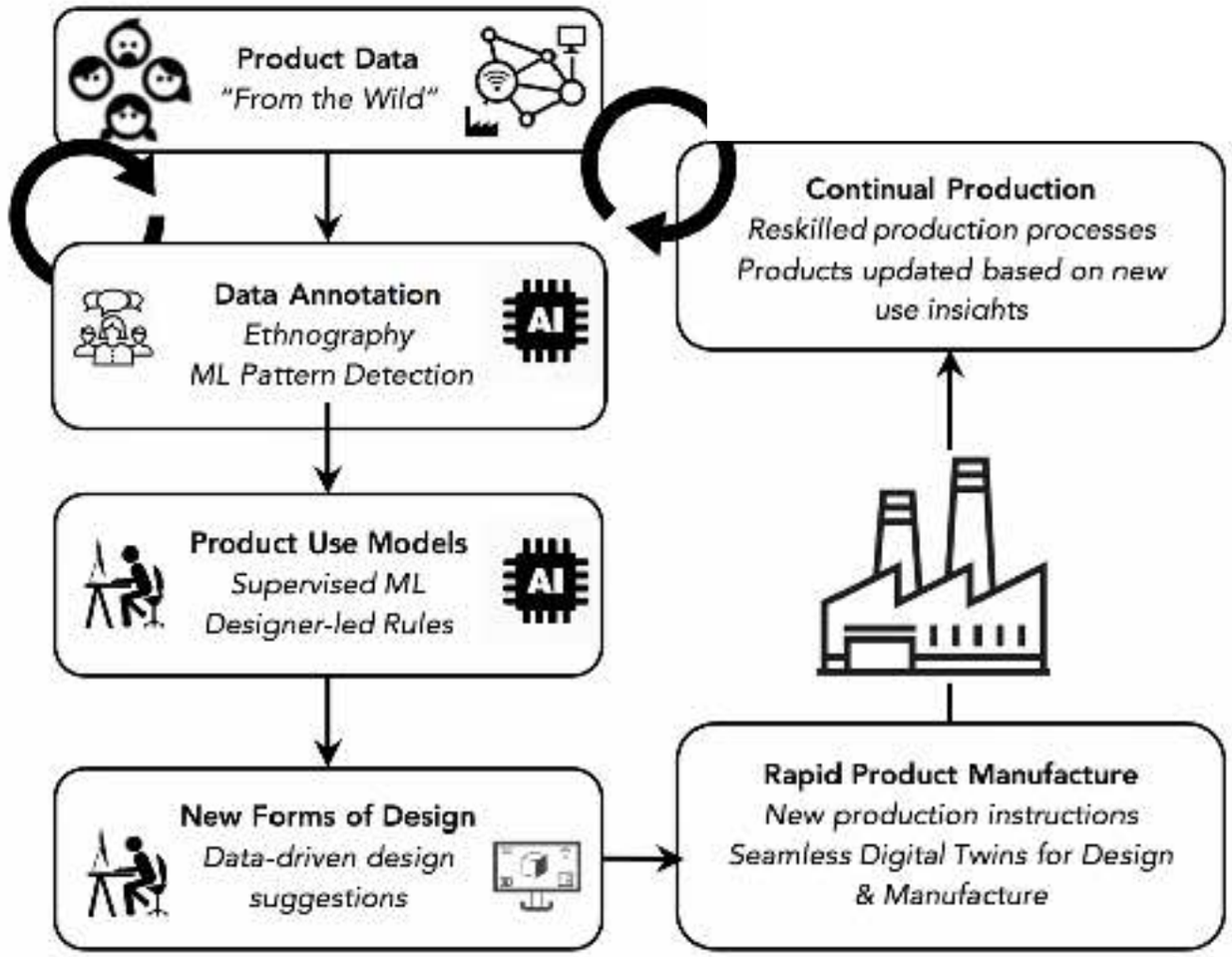
N. Shadbolt, D. Smith, E. Simperl, M. Van Kleek, Y. Yang, and W. Hall, "Towards a classification framework for social machines," in SOCM2013: The Theory and Practice of Social Machines, 2013.

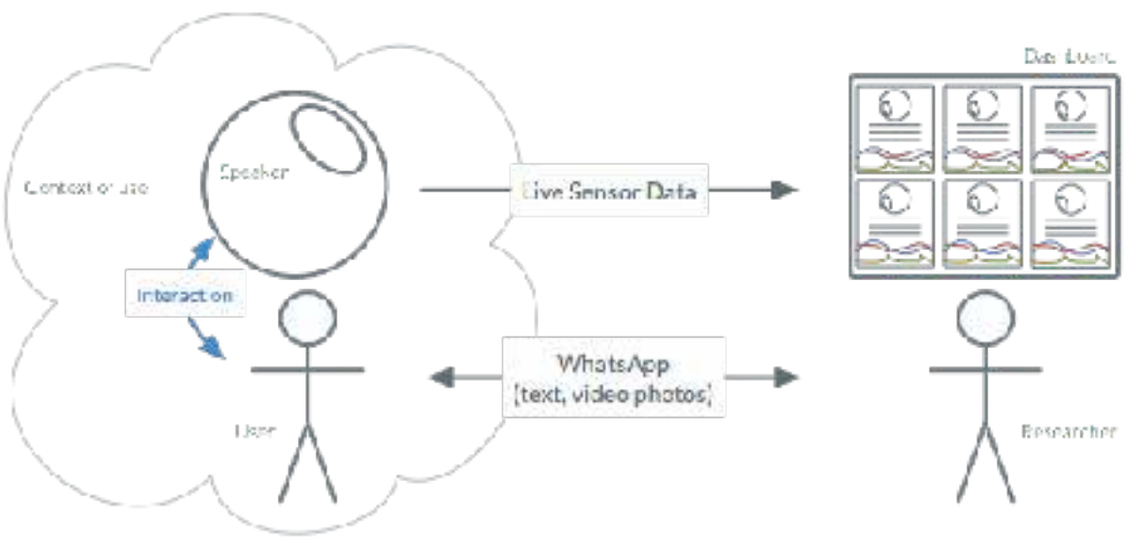
Human-machine inter-agencies

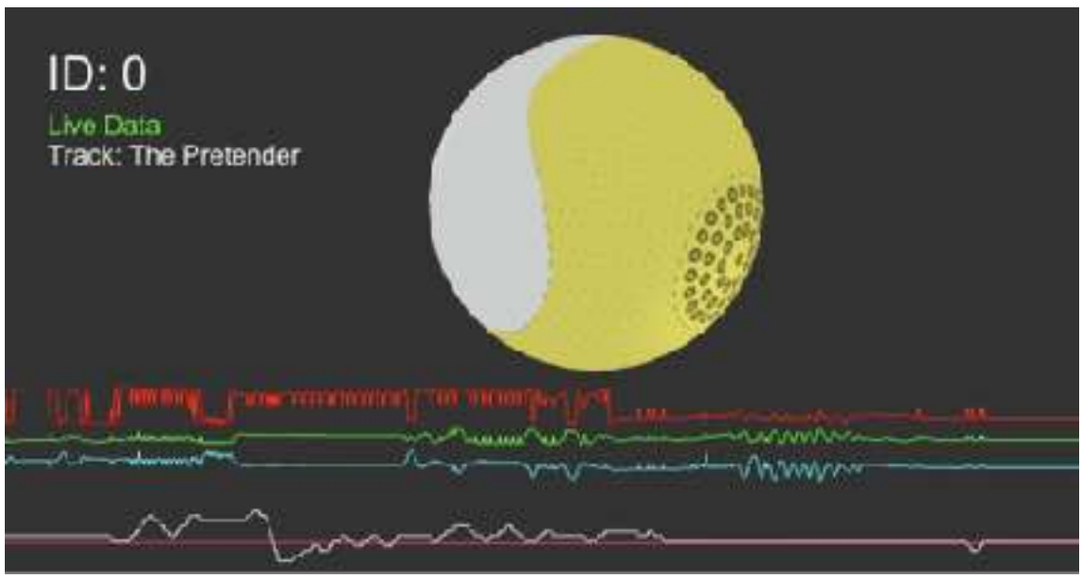
Murray-Rust, Dave, and Rocio von Jungenfeld. "*Thinking through robotic imaginaries.*" Research Through Design, 2017.

CHATTY FACTORIES

- Products in the wild
- Understanding interactions with people
- Use based design

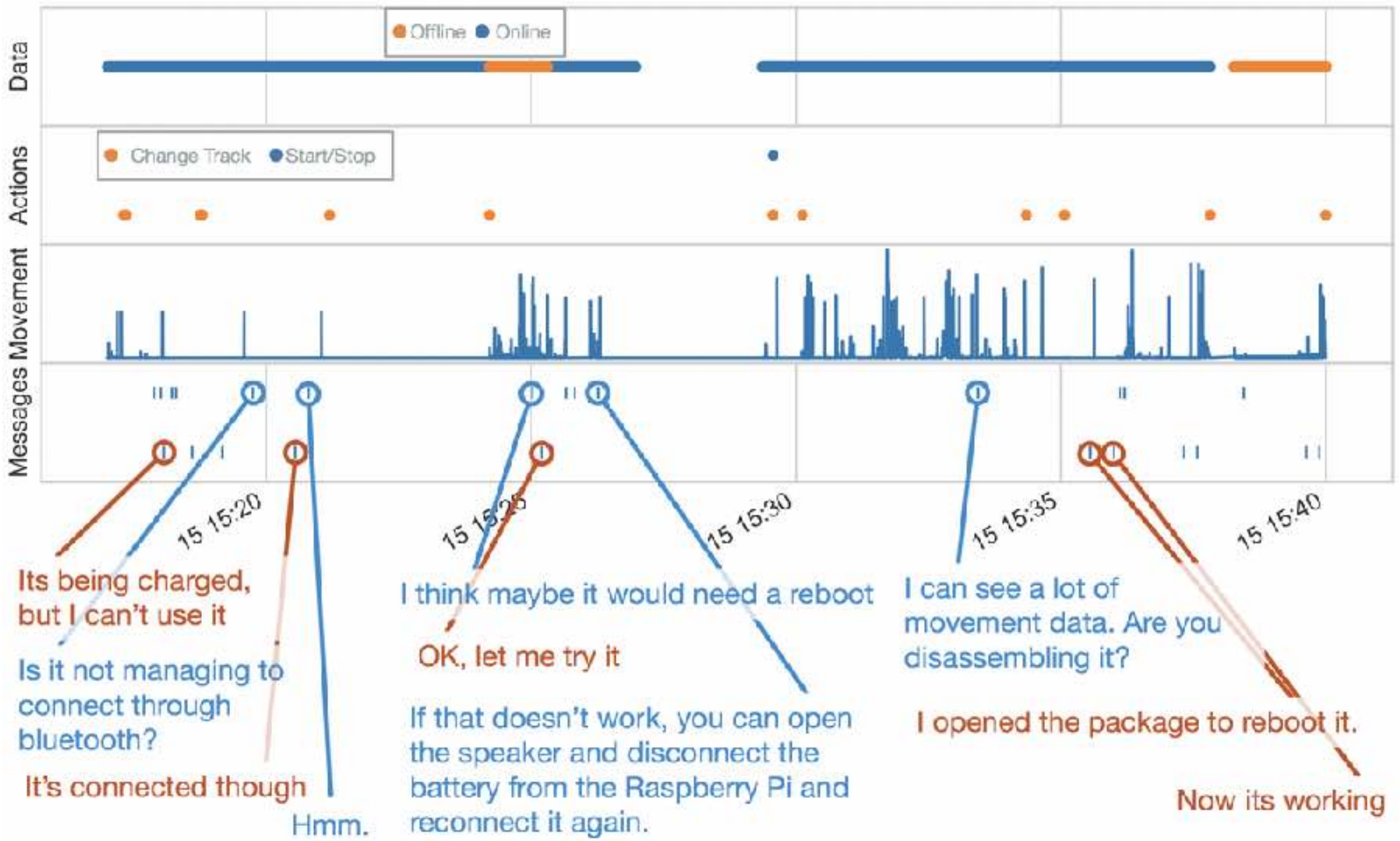






Burnett, D., Thorp, J., Richards, D., Gorkovenko, K. and Murray-Rust, D., "*Digital twins as a resource for design research*". In Proceedings of the 8th ACM International Symposium on Pervasive Displays (p. 37). ACM.

Chatty Factories - continuous digital ethnography

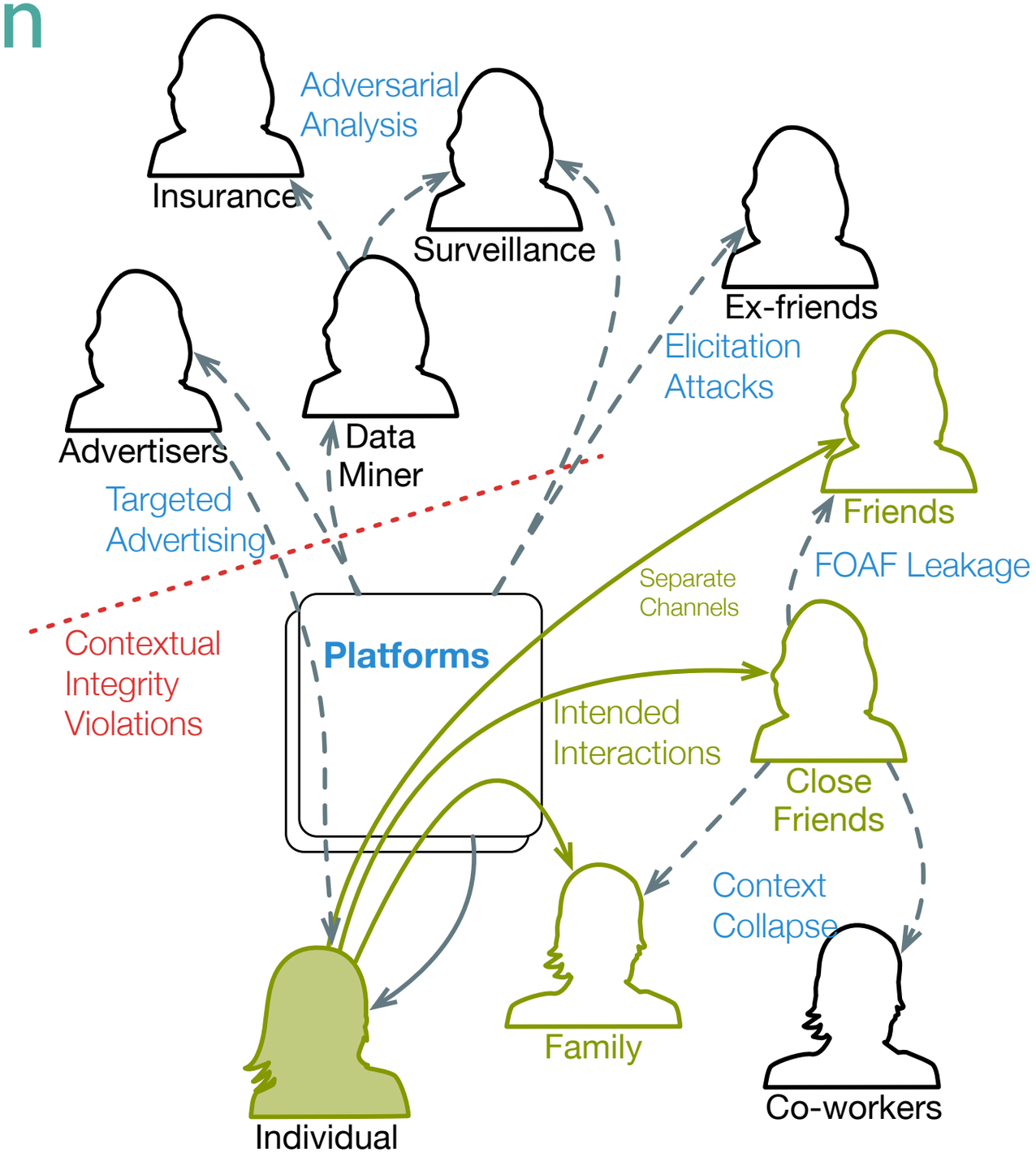

Data
Offline
Online
Actions
Change Track
Start/Stop
Messages Movement
15 15:20
15 15:25
15 15:30
15 15:35
15 15:40
Its being charged, but I can't use it
Is it not managing to connect through bluetooth?
It's connected though
Hmm.
I think maybe it would need a reboot
OK, let me try it
If that doesn't work, you can open the speaker and disconnect the battery from the Raspberry Pi and reconnect it again.
I can see a lot of movement data. Are you disassembling it?
I opened the package to reboot it.
Now its working

Pro-Social Deception

In the networked society, you never know the context you're speaking in.

Polite 'white lies' become difficult.

Can algorithms help?



Van Kleek, M., Murray-Rust, D., Guy, A., O'Hara, K., & Shadbolt, N. "*Computationally mediated pro-social deception.*" Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems. ACM, 2016.

lieMoves

If I'm in the Red Lion in Kettering, report my activity as:

Total Honesty

- Walking 15 mins
- In the Red Lion Pub
- Walking 10 mins

Pretend to be [Healthy ▾]

- Walking 15 mins
- In the Vegan Cafe *(near the Red Lion)*
- Walking 10 mins

Medium Grain

- Walking 15 mins
- Kettering High Street
- Walking 10 mins

Coarse Grain

- Walking 15 mins
- Kettering
- Walking 10 mins

Multiple Possibilities

- Walking 15 mins
- In the Red Lion, or in the Vegan Cafe or in the Ballet studio
- Walking 10 mins

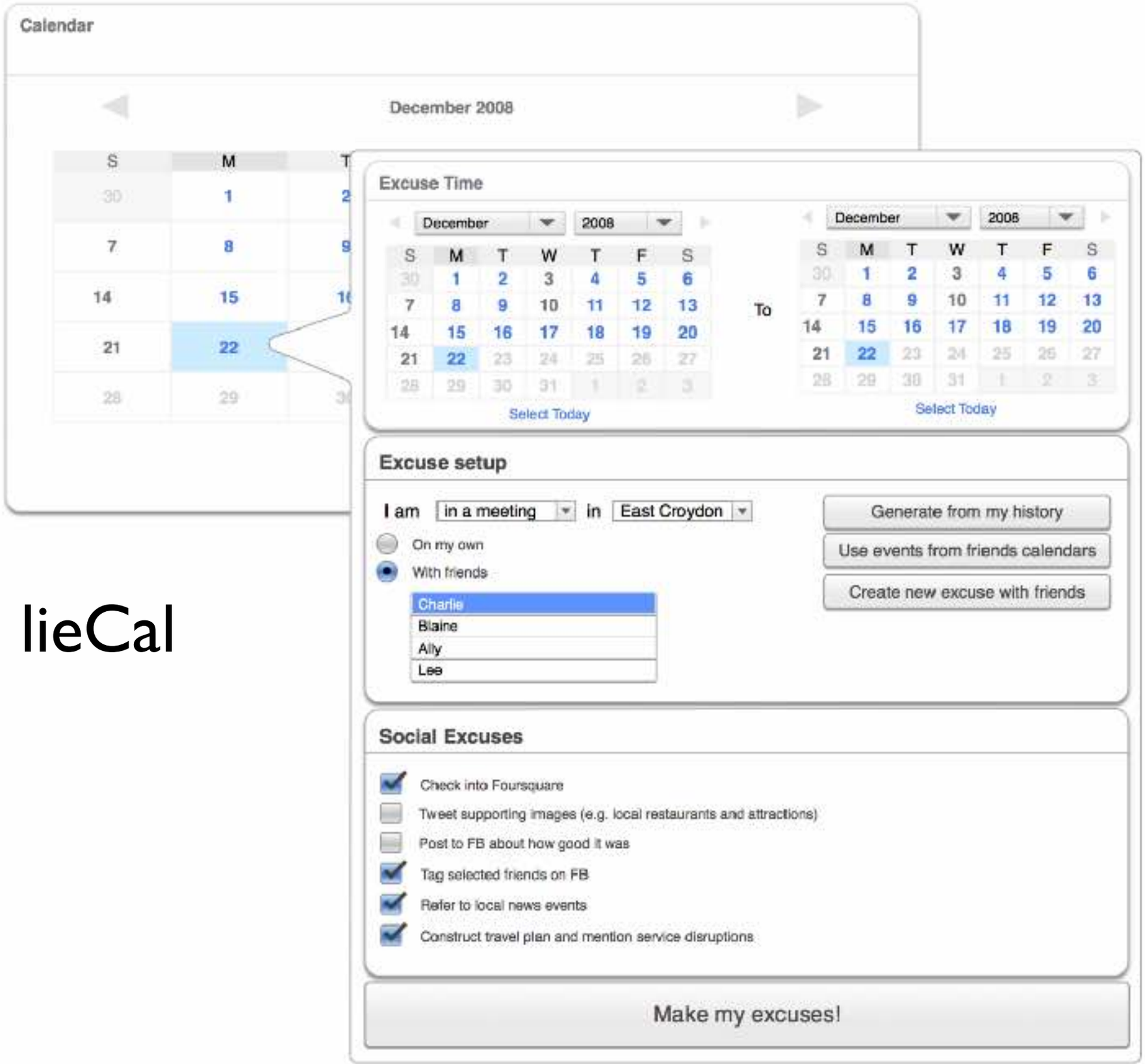
Colocation with [Jo ▾]

- Walking 15 mins
- Whatever Jo is doing
- Walking 10 mins

Simulate Normality

- Walking 15 mins
- Whatever I normally do on Thursday afternoons
- Walking 10 mins

lieCal



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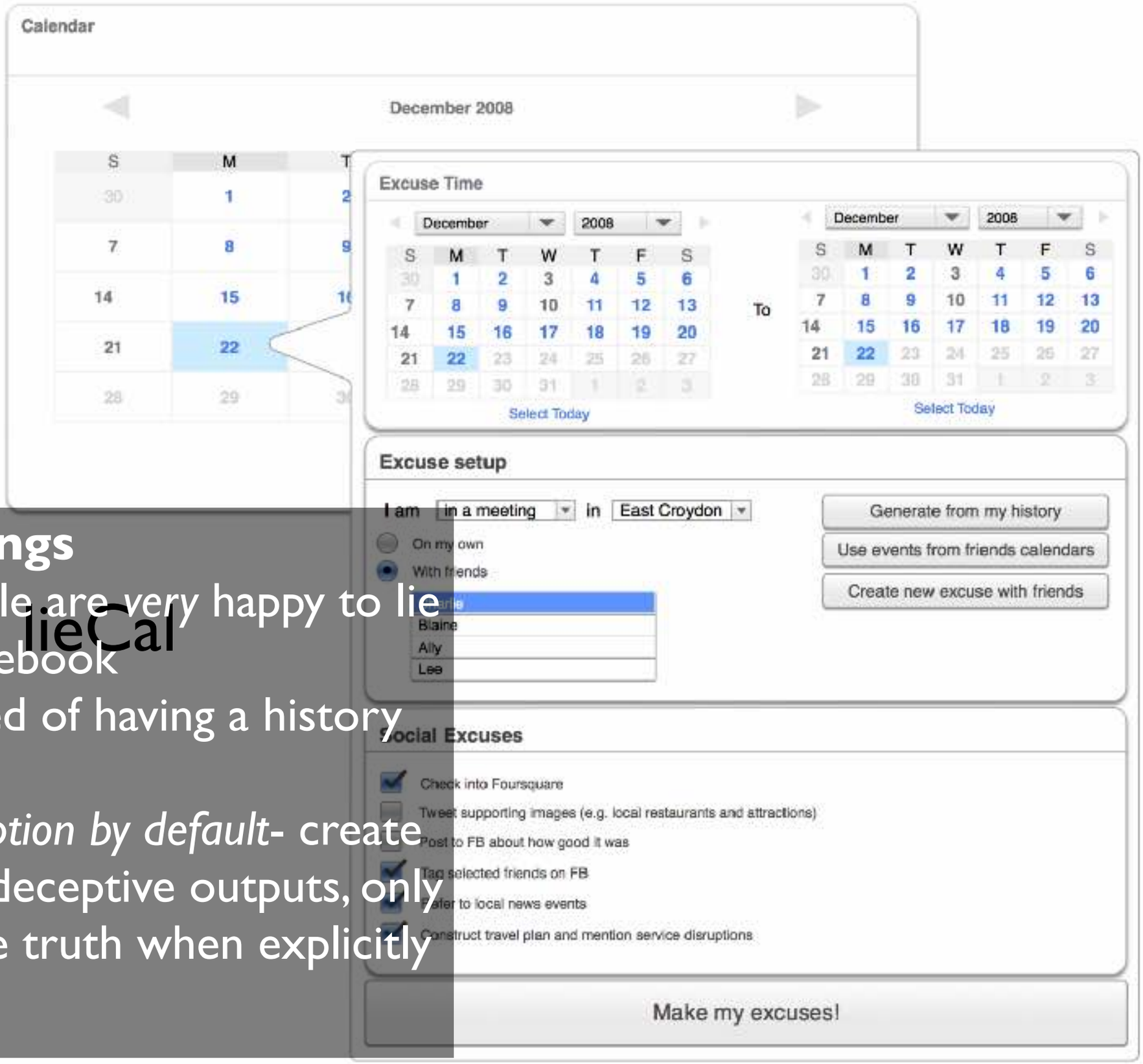


Findings

- people are *very* happy to lie to Facebook
- scared of having a history of lies
- *deception by default*- create many deceptive outputs, only tell the truth when explicitly told

TieCal

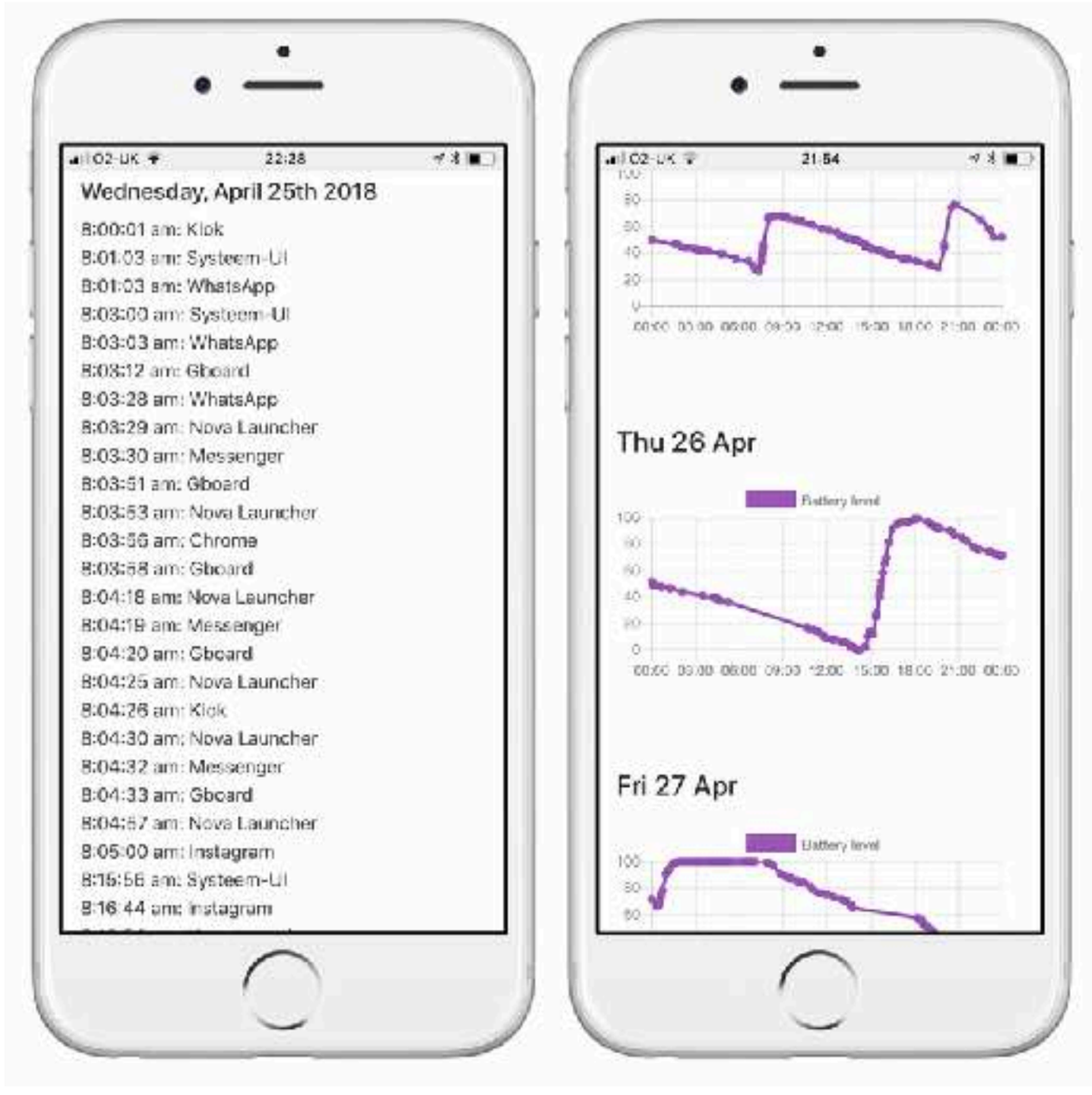
Van Kleek, M., Murray-Rust, D., Guy, A., O'Hara, K., & Shadbolt, N. "*Computationally mediated pro-social deception.*" Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems. ACM, 2016.

Acceptability of Digital Phenotyping

"I don't care if you know about my battery"

How do we understand the *acceptability* of large scale data collection?

- How do people feel about the technology?
- How burdensome is it?
- Is it ethical?
- Do people understand what the technology does?
- What do people have to give up to work with the technology?
- Do they think the technology works? Can people make use of it?
- Theoretical Framework for Acceptability



Rooksby, John, Alistair Morrison, and Dave Murray-Rust. "*Student Perspectives on Digital Phenotyping: The Acceptability of Using Smartphone Data to Assess Mental Health.*" Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems. ACM, 2019.

Blockchain?

Dodgy stock photo from https://pixabay.com/illustrations/blockchain-cryptography-bitcoin-3944194/

A future-artefact of a time before the blockchain changed the world. This interdisciplinary book includes artistic, theoretical and documentary engagements with the technology some have described as the new internet.

With contributions by Jaya Klara Brekke, Theodoros Chiotis, Ami Clarke, Simon Denny, Design Informatics Research Centre, Max Dovey, Mat Dryhurst, Rachel O'Dwyer, César Escudero Andaluz, Primavera De Filippi, Rory Gianni, Peter Gomes, Elias Haase, Juhee Hahm, Max Hampshire, Kimberley ter Heerdt, Holly Herndon, Helen Kaplinsky, Paul Kolling, Eli Kurus, Nikki Loef, Rob Myers, Martin Nadal, Noemata (Bjørn Magnhildeen), Edward Picot, PWR Studio, Paul Seidler, Surfatial, Hito Steyerl, Lina Theodorou, Pablo Velasco, Ben Vickers, Mark Waugh, Cecilia Wee, Martin Zellinger.

'Furtherfield and Torque have brought us a collection of writings and art that cut through the mainstream blockchain hype and reveal the diverse creative visions that can be embedded into the technology. The book strikes a great balance between technical explanation of blockchains, cryptocurrency and smart contracts and the broader politics, culture and philosophy that surrounds the innovations. Above all, it inspires us to believe we can still invent our own futures and grow the technologies that we need to realise them.' – Brett Scott, author of *The Heretic's Guide to Global Finance: Hacking the Future of Money*

'This book is on a mission to make one of the most influential yet unknown technologies of today intelligible for each and every one of us.' – Josephine Bosma, author of *Nettitudes – Let's Talk Net Art*

ISBN 9780993248757

Artists Re:Thinking the Blockchain : Edited by Ruth Catlow, Marc Garrett, Nathan Jones & Sam Skinner

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Artists Re:Thinking the Blockchain

Edited by Ruth Catlow, Marc Garrett, Nathan Jones & Sam Skinner

(free download: https://torquetorque.net/wp-content/uploads/ArtistsReThinkingTheBlockchain.pdf)

FinBook

Home

Documentation

Fictions

Theory

FinBook: Literary content as digital commodity

Authors: Rory Gianni, Hadi Mehrpouya, Dave Murray-Rust, Bettina Nissen, Shaune Oosthuizen, Chris Speed, Kate Symons

Keywords: Economics, Markets, Agency, Distribution, Publishing

First 100 words: This short essay explains the significance of the FinBook intervention, and invites the reader to participate. We have associated each chapter within this book with a financial robot (FinBot), and created a market whereby book content will be traded with financial securities. As human labour increasingly consists of unstable and uncertain work practices and as algorithms replace people on the virtual trading floors of the worlds markets, we see members of society taking advantage of FinBots to invest and make extra funds. Bots of all kinds are making financial decisions for us, searching online on our behalf to help us...

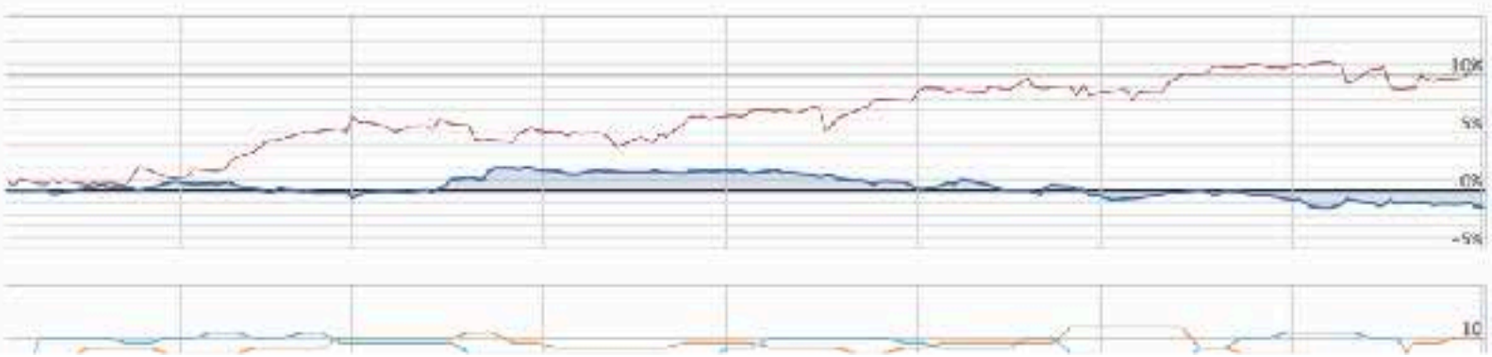
Behaviour

Total value: $ 494,565.77

Change

Portfolio & Trading

Total Returns	Benchmark Returns	Alpha	Beta	Sharpe	Sortino	Volatility	Max Drawdown
-1.51%	11.1%	-0.00	-0.14	-0.65	-0.93	0.03	-3.51%

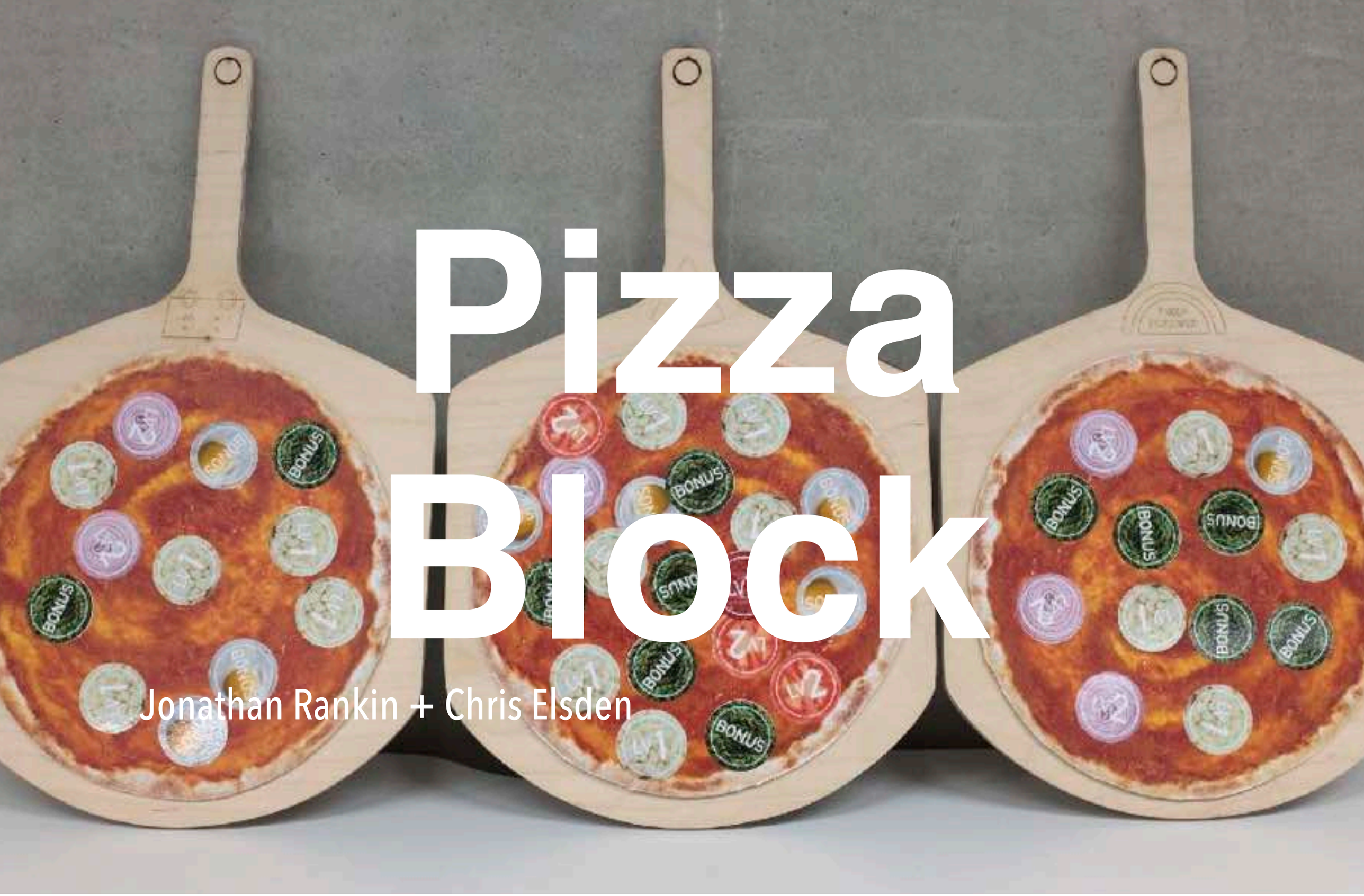


www.pwc.com/us/en/technology-forecast/blockchain/digital-business.html

Seismic Seesaw

#ConditionalGiving

0XCHAIN



Pizza Block

Jonathan Rankin + Chris Elsden

THE UNIVERSITY of EDINBURGH
Northumbria University NEWCASTLE
Lancaster University
EPSRC
Engineering and Physical Sciences Research Council

Jonathan Rankin + Chris Elsden

Public ledger

Enterprise record

Private ledger

BitBarrista - Larissa Pschetz, Ella Tallyn, Rory Gianni, Chris Speed

Pschetz, Larissa, Ella Tallyn, Rory Gianni, and Chris Speed. "*Bitbarista: Exploring perceptions of data transactions in the internet of things*." In Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems, pp. 2964-2975. ACM, 2017.

BitBarrista

Fig. 2. Left, shows Bitcoin payment being made with a mobile phone. Right, shows the Bitbarista offering a reward for emptying the coffee grinds

Tallyn, E., Pschetz, L., Gianni, R., Speed, C., & Elsden, C. (2018). "*Exploring Machine Autonomy and Provenance Data in Coffee Consumption: A Field Study of Bitbarista*". Proceedings of the ACM on Human-Computer Interaction, 2(CSCW), 170

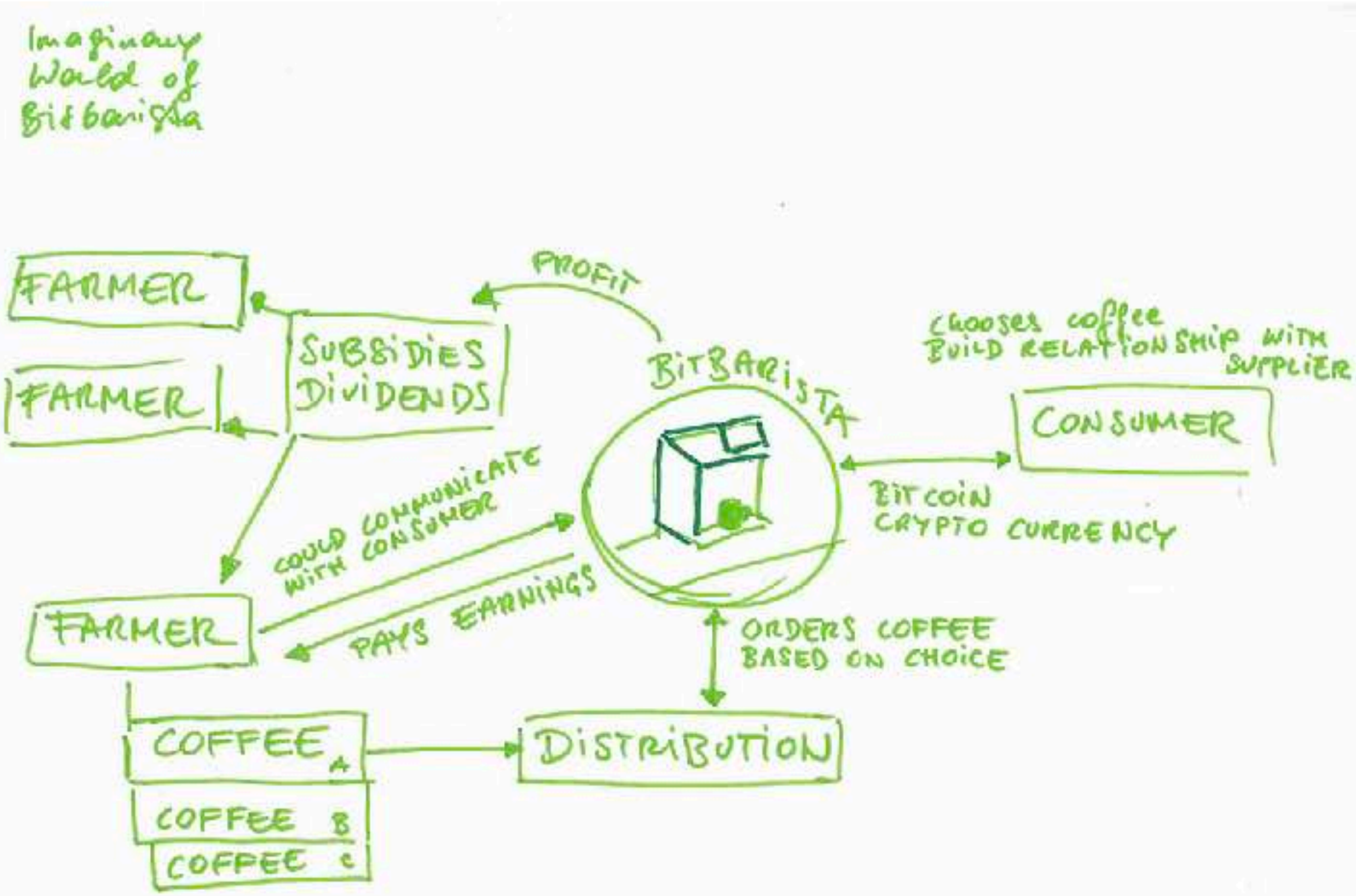


Fig. 5. P11 diagram of her imagined world of the Bitbarista, showing Bitbarista paying out dividends to all participating farmers

Tallyn, E., Pschetz, L., Gianni, R., Speed, C., & Elsden, C. (2018). "*Exploring Machine Autonomy and Provenance Data in Coffee Consumption: A Field Study of Bitbarista*". Proceedings of the ACM on Human-Computer Interaction, 2(CSCW), 170

Workshop 1 - Block Exchange

Understanding blockchains as a way to exchange value

- Setup, Exchanges
- Transactions
- Extended Values

http://blockexchange.designinformatics.org/

Workshop I - Block Exchange

Understanding blockchains as a way to exchange value

- Setup, Exchanges
- **Transactions**
- Extended Values

Mining and recording transactions

Workshop 1 - Block Exchange

Understanding blockchains as a way to exchange value

- Setup, Exchanges
- Transactions
- **Extended Values**

Workshop 2 - GeoCoin

Exploring location in the blockchain

- Warm up (BlockExchange)
- **Guided Experience**
- Ideation
- Prototyping

- Credit zones (green) give you money
- Debit zones (red) take money away
- Prizes (black) give money to the first person who reaches them

Nissen, Bettina, Pschetz, Larissa, Murray-Rust, Dave, Mehrpouya, Hadi, Oosthuizen, Shaune and Chris Speed. "*GeoCoin: Supporting Ideation and Collaborative Design with Smart Contracts*" In Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems, ACM, 2017.

Findings

- infrastructure matters, new phones work faster
- blockchain transaction delays are very visible
- need road safety briefings for real-world games
- leave space for stories - what do the zones *represent?*

Workshop 2 - GeoCoin

Exploring location in the blockchain

- Warm up (BlockExchange)
- Guided Experience
- **Ideation**
- **Prototyping**

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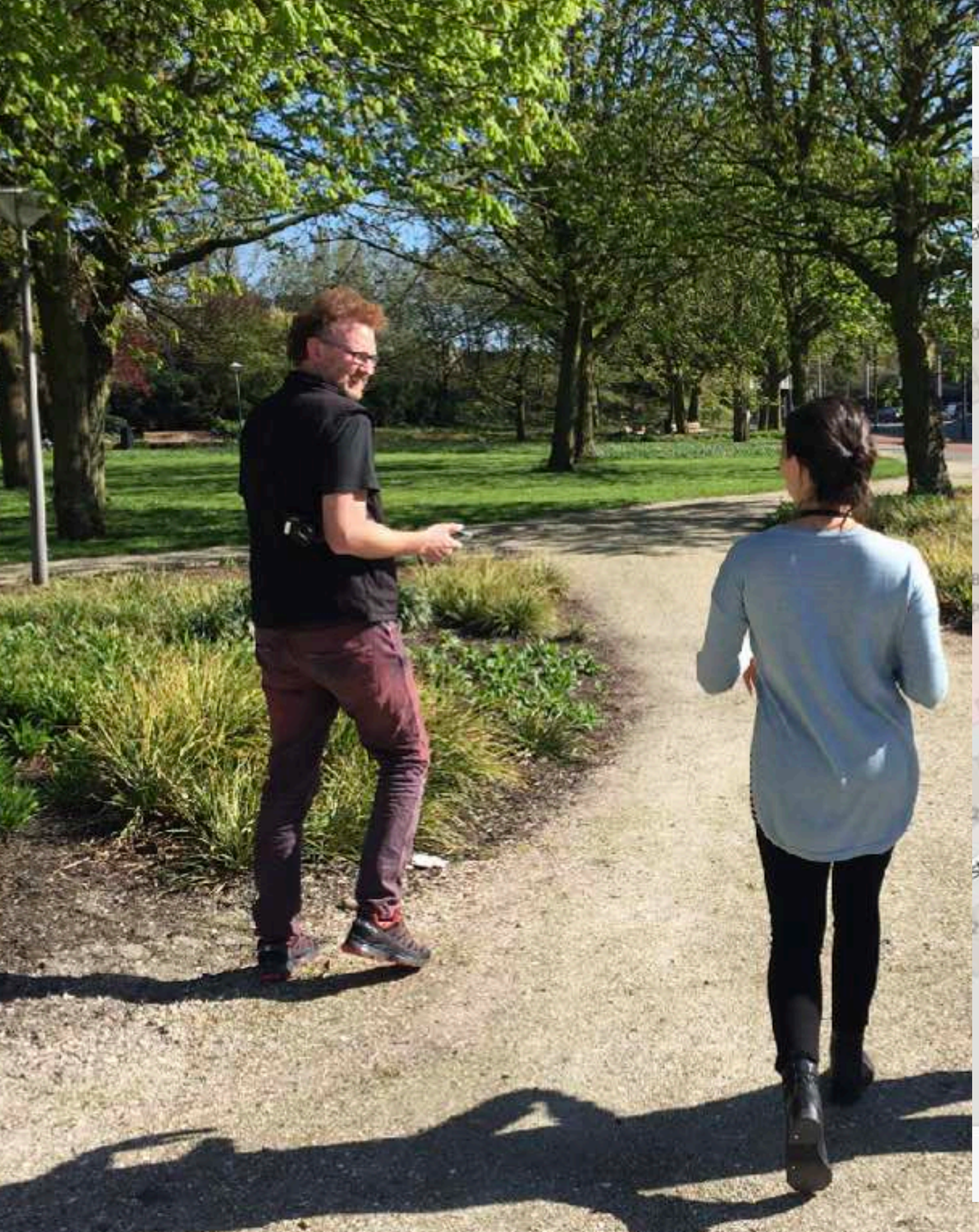


●●●●● KPN NL 3G 16:57 38%

geocoin.eca.ed.ac.uk

HandFastr - short term marriages on the blockchain.

In collaboration with James Stewart, Max Dovey & Corina Angheloiu.

Video www.vimeo.com/163565402.

Findings

- prototyping is really important
- being ‘just real enough’
- blockchain gives a space to rethink how things are

Location Based Smart Contracts

Create *agreements* about things, place and space

What is a smart contract?

- A way to make an agreement?
- A distributed program?
- A new way to structure society?

What is a smart contract?

- Digital promises and conditions
- Code that 'does things' - self executing, defined actions in response to conditions
- What's special? Security, trust, identity, distribution, certainty (and money).
- What do they look like?
  - if (some condition) then (some action)

What is a smart contract?

Lots of work here - payments, change of ownership etc.

if (some condition) then (some action)

Less work here
(outside of the blockchain)

Examples (with a transport bias)

- if(Liverpool win the football) then (I pay you £5) otherwise (you pay me £2)
- if(the train is a bit late) then (partial refund)
- if(the train is very late) then (full refund)
- if(10 active journeys) then (free bike service)
- if(I leave my car here) then (release a bike for 2 hours)
- if(I drive through here) then (charge me £2)

Smart contracts and the world

- Smart contracts work very well for ‘on chain’ events - transactions, messages etc.

- Connecting to the physical world is difficult - unreliable information, multiple points of entry

- Location is a good example of this - important, fundamental, hard to do well

What's important to people about location?

- Values - scarcity, memory/history, comfort, territory
- Types: physical places, co-location, located event - temporal, types of place, hard/soft boundaries
- Consequences: registration, class attendance
- What does it take to be there? Effort, permission, transport
- Surveillance: who checks ID, who checks location, who knows?

Location Cards: Bettina Nissen + Ella Tallyn

Use Cases - active travel

- GeoLockBox: location aware lockable bike basket - if you want to deliver a parcel near my home, make a contract with my bike lockbox and pop it in while I'm at work!

- Participatory Infrastructure: the City Council offers a smart contract - if we can show that several people in the building cycle, and are prepared to contribute, they will pay half of a bike rack in front of the building.

- Bike Bus: taking kids to school in a train, with a cyclist at the front and back - the "drivers" have to be close to all the kids, and get them to school on time.

- Care Workers move from house to house. They have to phone in when they get there to prove location. When the system goes wrong, they have no recourse - need a bottom up system to prove their location (easily!)

GEO PACT

SMART CONTRACTS IN ACTION

PETRAS

EPSRC
Pioneering research and skills

Interreg
North Sea Region
BLING
European Regional Development Fund

EUROPEAN UNION

design informatics

THE UNIVERSITY of EDINBURGH
Edinburgh College of Art

GEO PACT

SMART CONTRACTS

1

Box 1

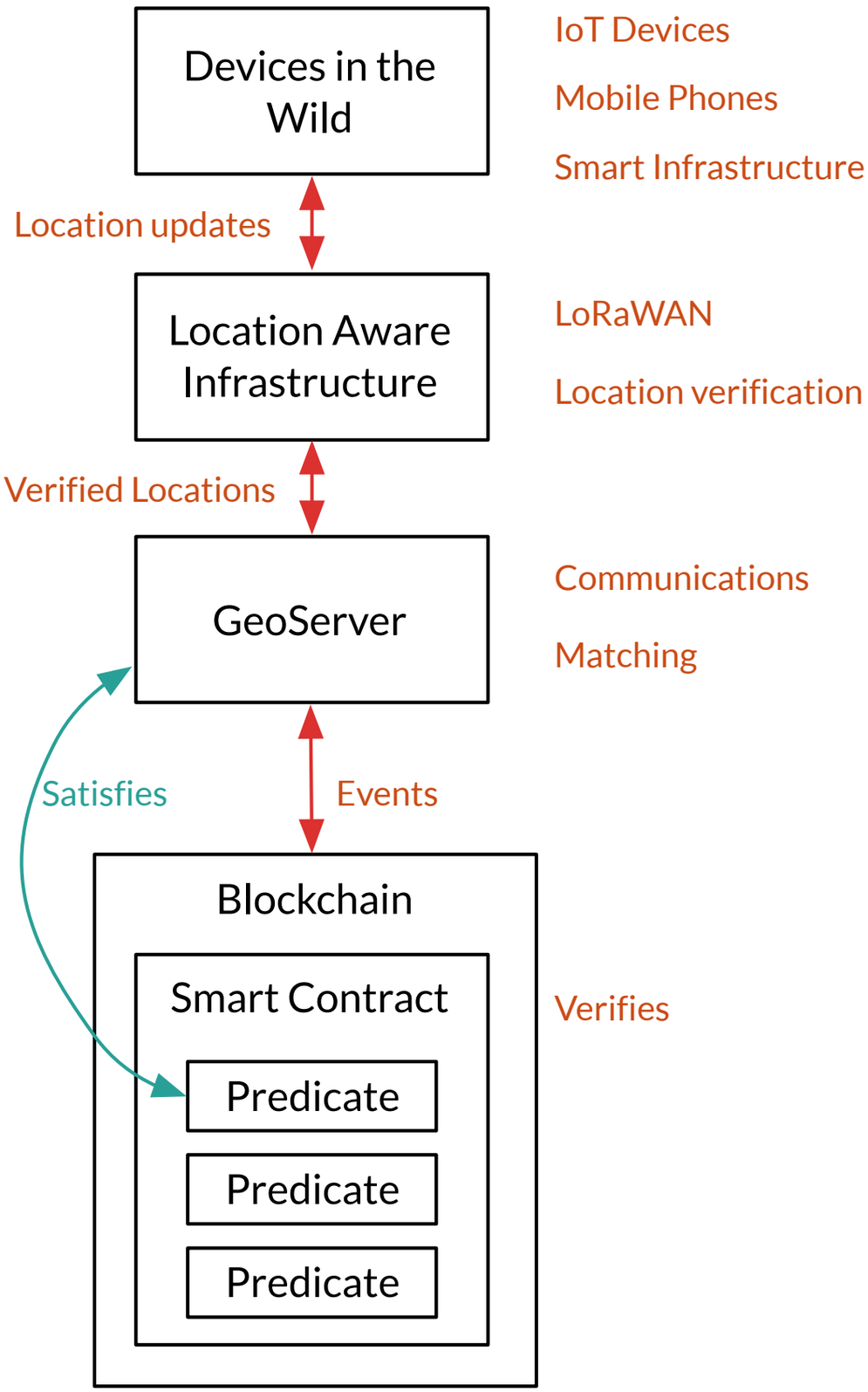
Welcome to Geopact

locked

unlocked

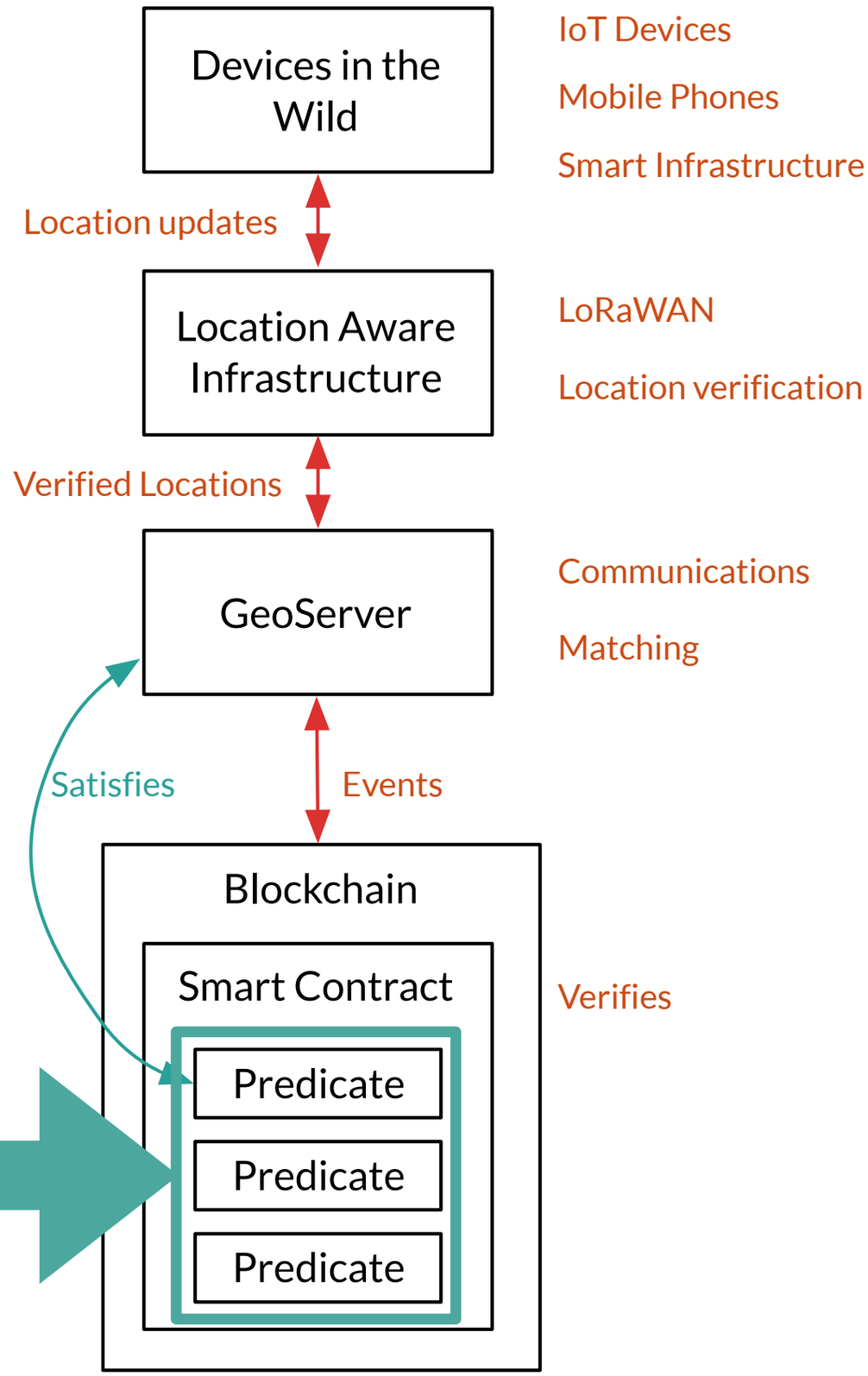
System Overview

- Location Verification System
- Location “Predicates” - building blocks
- Smart Contract Library
- Off-chain server for matching and connecting



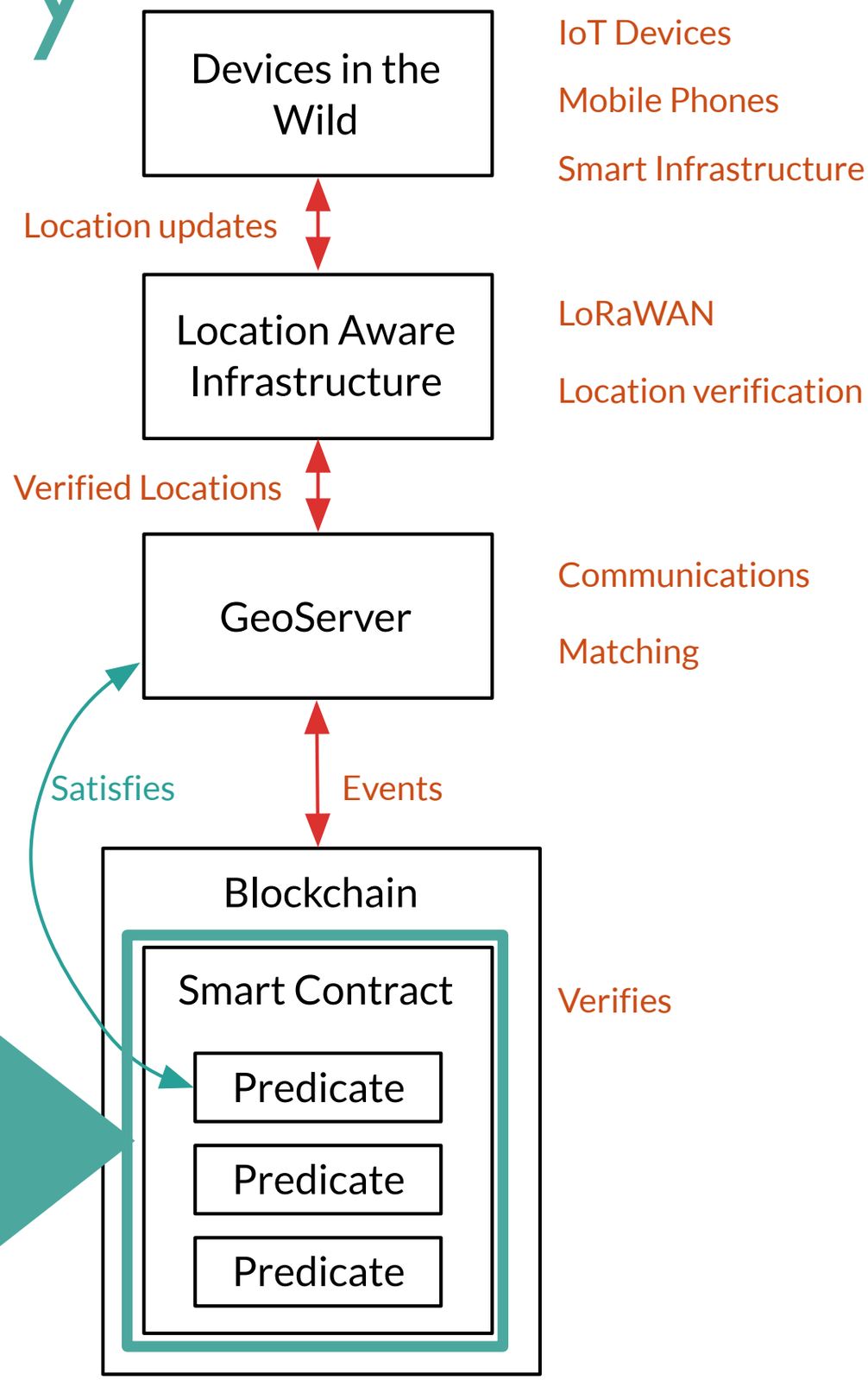
Location Predicates

- Key ways to look at location
- A person is in a place
- *Any* person is in a place - e.g. race, treasure hunt
- Two people are in the same place (wherever it is) - privacy preserving
- Can become *true* at some point
- Can have constraints about time, how close, who and what is involved



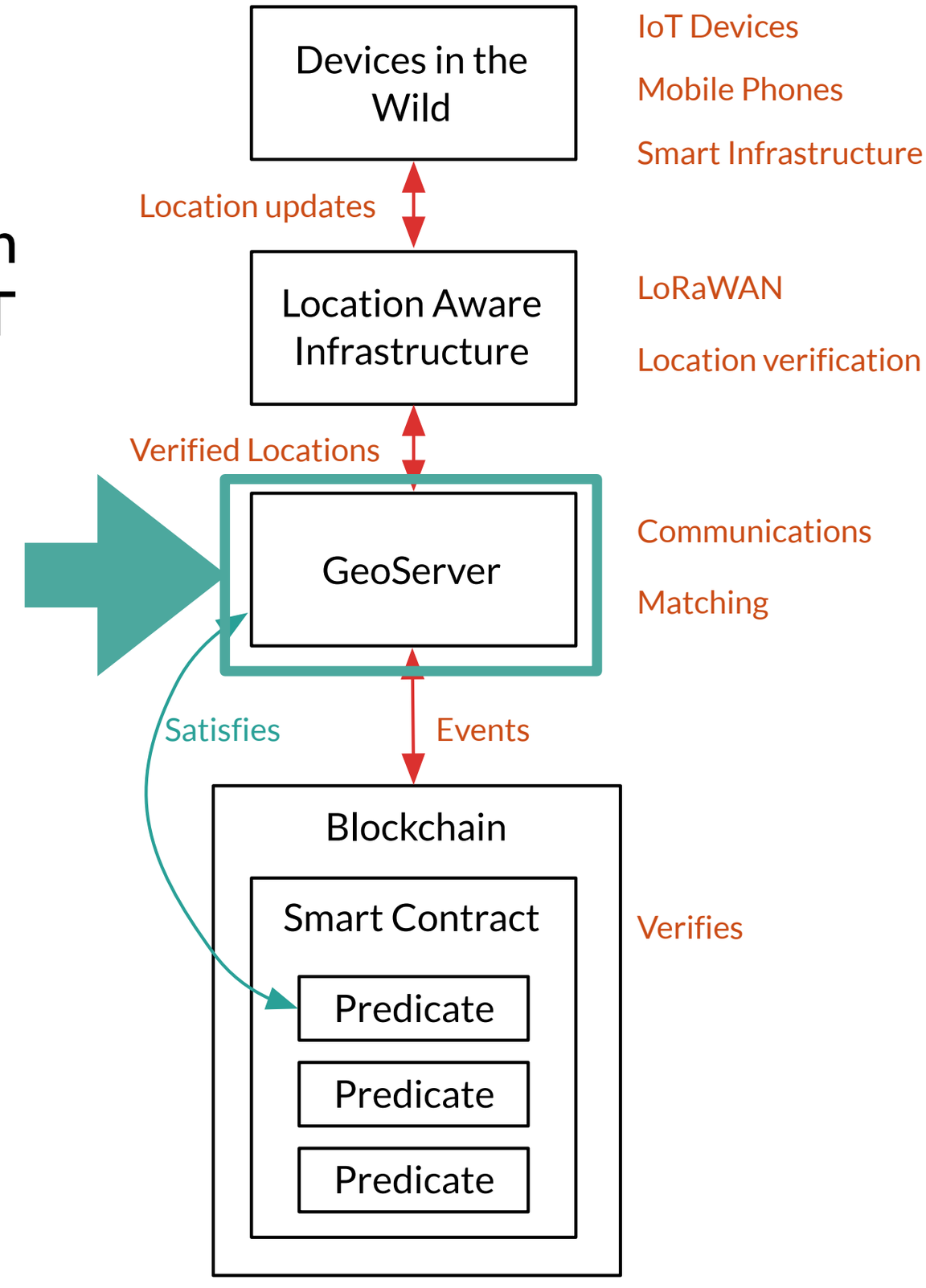
Smart Contract Library

- If (…) then (…)
- if(p_colocated(Dave, Courier)) then action(open_box)
- Checks predicates against *evidence* - verified locations fed into the contract
- Checking evidence is *on chain* and publicly visible
- (but only shows the locations actually necessary)
- Has Events for all the things you need to work with predicates



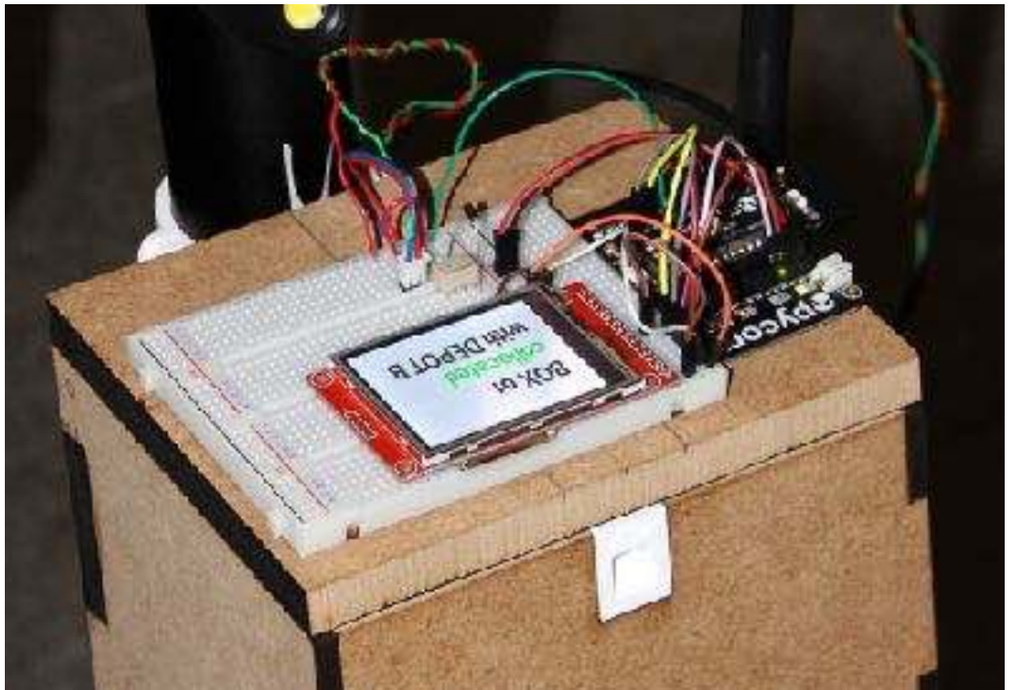
Location Server

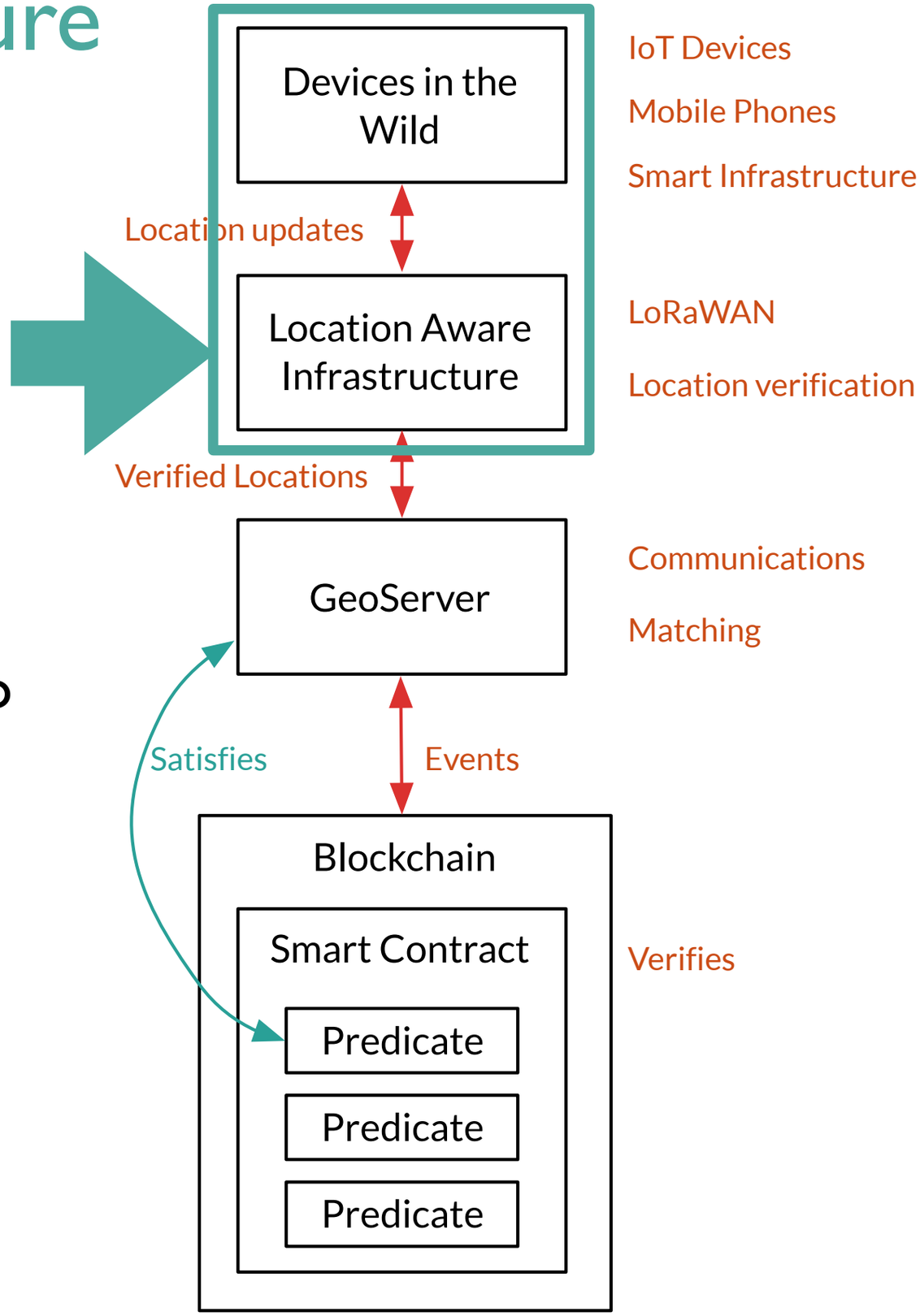
- Connects between the blockchain and the rest of the world (e.g. IoT Infrastructure)
- Listens to Location Based Smart Contracts - what predicates are they interested in?
- Tries to find location updates from the network that satisfy the predicates, and pass them in to the contract (computationally expensive!)

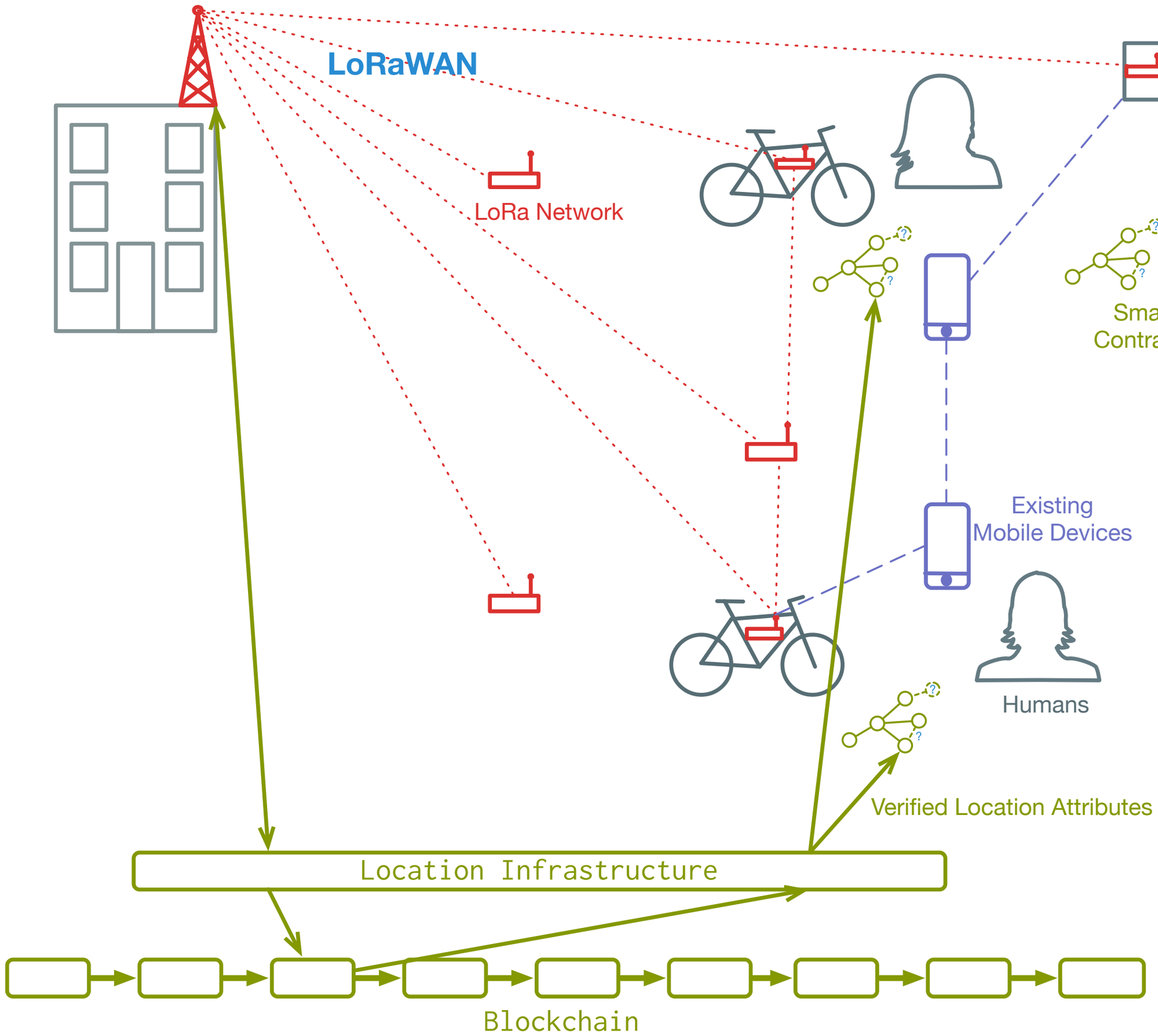


Location Aware Infrastructure

- Mobile devices that use GPS, Bluetooth Proximity and triangulation to send location updates
- Network can help verify (e.g. LoRaWAN can triangulate messages)
- Can send messages *back* to objects to do something in response to Smart Contracts






LoRaWAN
LoRa Network
Smart
Contracts
Existing
Mobile Devices
Humans
Verified Location Attributes
Location Infrastructure
Blockchain

WORLD

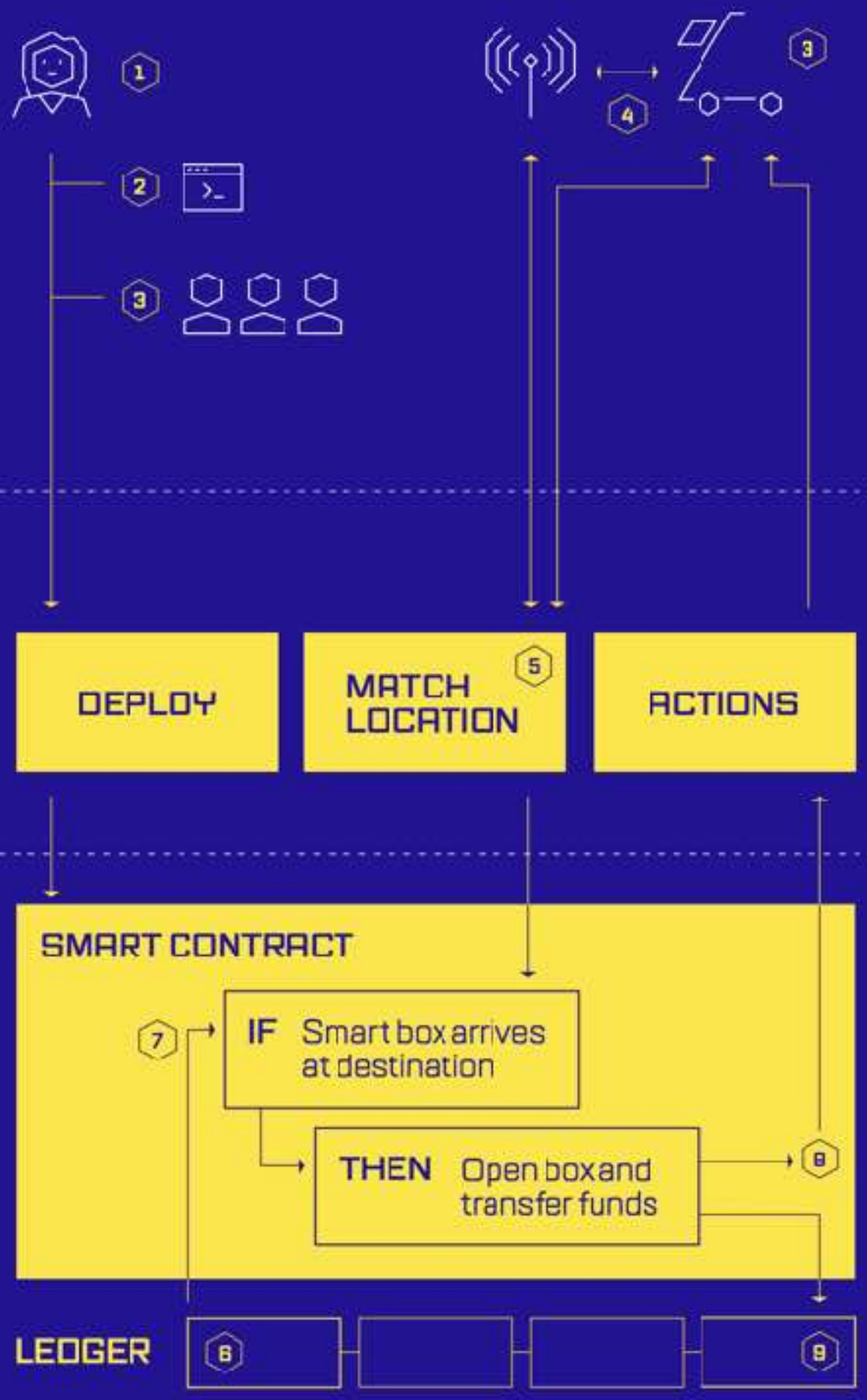
People want to use the location of smart objects securely as part of real-world activities

GEOSERVER

The Geoserver processes data coming from smart objects in the world, and matches this with smart contracts

BLOCKCHAIN

Verified location data is stored here securely, ready for use in smart contracts that run on the Blockchain



EXAMPLE SCENARIO

1 Alice creates a system that uses electric scooters and smart boxes to transport people and objects around

2 Alice writes a smart contract to say how the system should work

3 She creates smart boxes, connects them to the scooters, and people take part

4 As people move the boxes around the boxes share and verify their locations

5 The Geoserver matches location of beacons and boxes. It feeds this into Alice's smart contract

6 Verified locations are stored in the Blockchain

7 Verified locations are used in the smart contract

8 Smart contracts can transfer money between participants and perform actions in the world, like unlocking the smart box

9 Everything that happens is verified and backed by the Blockchain

The aim of the GeoPact demonstration was to help experts to engage with these technological concepts and to explore how they might open up location data for new uses

GeoPact LockBox - Revans, Morgan, Tallyn, Murray-Rust

Object exchanges with GeoPact Boxes

GeoPact Scooter Box

Participatory workshop with GeoPact

Contract: CouriersAtTheTate

Contract Status

Collect the tires

Location Match	`Courier: Box 1` is at `C: TireStore`	active
Action	`Courier: Box 1` will `unlock`	inactive
Verification	Verify `button` on `Courier: Box 1`	inactive
Action	`Courier: Box 1` will `verify-button`	inactive
Action	`Courier: Box 1` will `lock`	inactive

Chassis Collection

Location Match	Colocation between `Courier: Box 1` and `BodyWorks: Box 2`	inactive
Action	`Courier: Box 1` will `unlock`	inactive
Action	`BodyWorks: Box 2` will `unlock`	inactive
Verification	Verify `button` on `Courier: Box 1`	inactive
Action	`Courier: Box 1` will `verify-button`	inactive
Action	`Courier: Box 1` will `lock`	inactive
Action	`BodyWorks: Box 2` will `lock`	inactive

Motor Collection

Location Match	`Courier: Box 1` is at `E: Top Motors`	inactive
Location Match	`Supervisor: Box 3` is at `E: Top Motors`	inactive
Action	`Supervisor: Box 3` will `unlock`	inactive
Action	`Courier: Box 1` will `unlock`	inactive

Verify Motor Collected

Boxes

Box 2

Location	Last Seen
D: BodyWorks	20:32:51

Message

Box 1

Location	Last Seen
no location	

Message

Please collect tires from the Tire Store at C

Blockchain Events

[20:32:45]	Location	Box 2 at D: BodyWorks
[20:32:47]	**Deploy**	CouriersAtTheTate deployed
[20:32:51]	Location	Box 2 at D: BodyWorks
[20:32:54]	Position	Activated (found): `Box 1` is at `C: TireStore`
[20:32:54]	Status	Collect the tires

Contract: CouriersAtTheTate

Contract Status

Collect the tires

Location Match	`Courier: Box 1` is at `C: TireStore`	active
Action	`Courier: Box 1` will `unlock`	inactive
Verification	Verify `button` on `Courier: Box 1`	inactive
Action	`Courier: Box 1` will `verify-button`	inactive
Action	`Courier: Box 1` will `lock`	inactive

Chassis Collection

Location Match	Colocation between `Courier: Box 1` and `BodyWorks: Box 2`	inactive
Action	`Courier: Box 1` will `unlock`	inactive
Action	`BodyWorks: Box 2` will `unlock`	inactive
Verification	Verify `button` on `Courier: Box 1`	inactive
Action	`Courier: Box 1` will `verify-button`	inactive
Action	`Courier: Box 1` will `lock`	inactive
Action	`BodyWorks: Box 2` will `lock`	inactive

Motor Collection

Location Match	`Courier: Box 1` is at `E: Top Motors`	inactive
Location Match	`Supervisor: Box 3` is at `E: Top Motors`	inactive
Action	`Supervisor: Box 3` will `unlock`	inactive
Action	`Courier: Box 1` will `unlock`	inactive

Verify Motor Collected

Boxes

Box 2

Location	Last Seen
D: BodyWorks	20:32:51

Message

Box 1

Location	Last Seen
no location	

Message

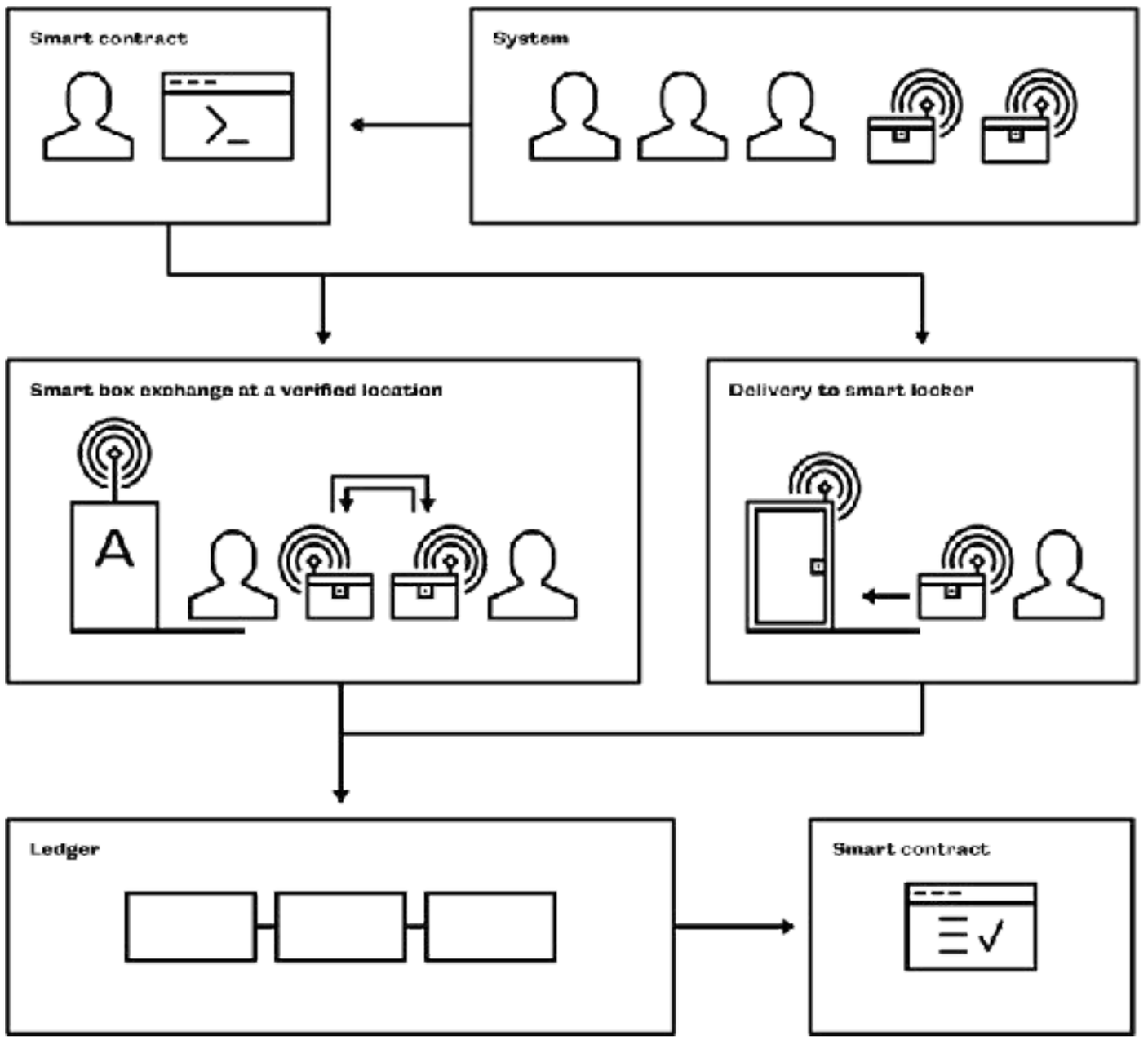
Please collect tires from the Tire Store at C

Blockchain Events

[20:32:45]	Location	**Box 2 at D: BodyWorks**
[20:32:47]	**Deploy**	**CouriersAtTheTate deployed**
[20:32:51]	Location	**Box 2 at D: BodyWorks**
[20:32:54]	Position	**Activated [found]: `Box 1` is at `C: TireStore`**
[20:32:54]	Status	**Collect the tires**

Demo Scenario

- Courier assembling a car - being paid to collect all of the parts for a third party
- Explore different kinds of location based security



Alice writes a smart contract for a system that smart boxes to move goods around.

As people move the boxes around, the a server verifies the locations of smart boxes by triangulating signals from beacons at known locations.

When the box arrives at its destination, it unlocks so the delivery can be completed.

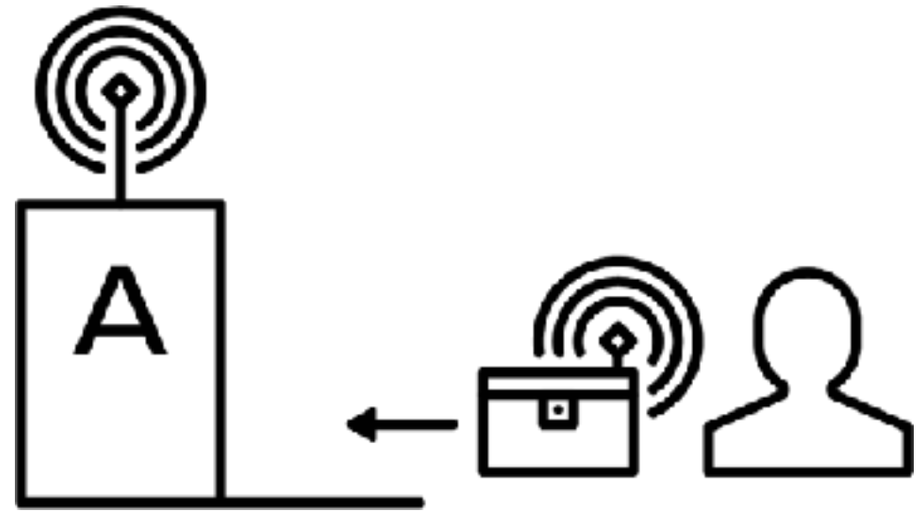
Everything that happens is verified and backed by the Blockchain.

Collect the tires

Tires are relatively low value

When the courier is in the right place, their box opens, and they load the tires in

Then *verify* using the button that they have made the collection



Collect the tires

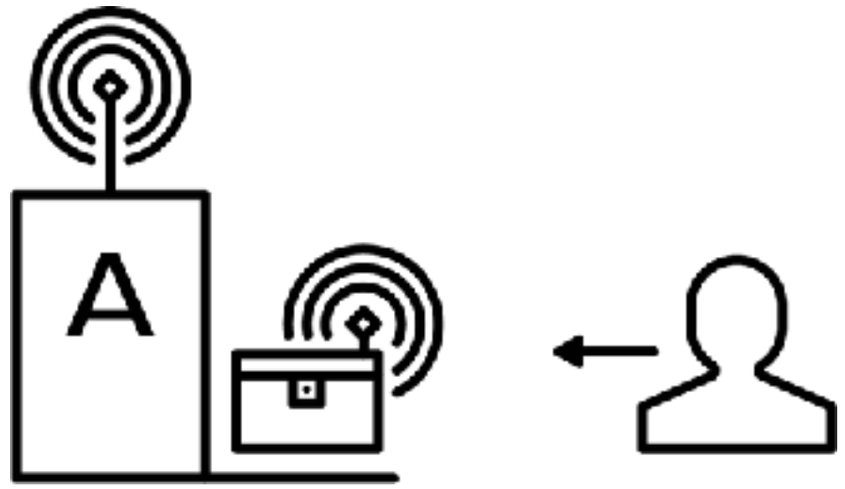
Location Match	`Courier: Box 1` is at `C: TireStore`	active
Action	*`Courier: Box 1`* will *`unlock`*	inactive
Verification	Verify `button` on `Courier: Box 1`	inactive
Action	*`Courier: Box 1`* will *`verify-button`*	inactive
Action	*`Courier: Box 1`* will *`lock`*	inactive

Collect the chassis

The chassis is higher value - stored in a locked, automated facility

When the courier is in the right place, the smart store opens, and they can load in the chassis

(Then *verify* using the button that they have made the collection)



Chassis Collection

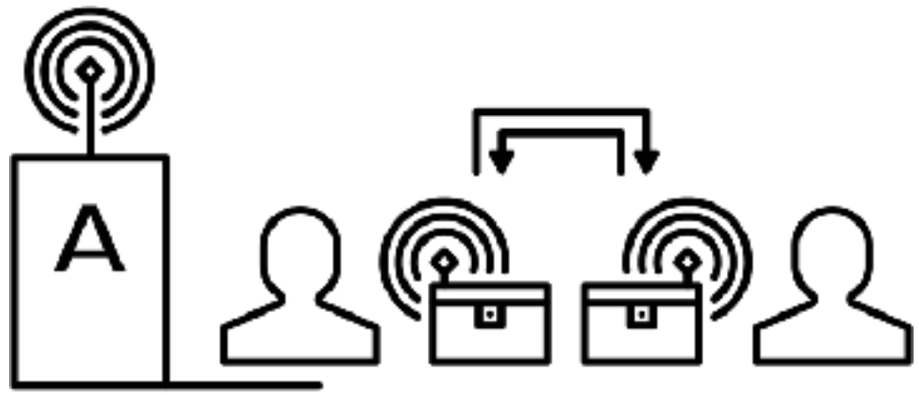
Location Match	Colocation between `Courier: Box 1` and `BodyWorks: Box 2`	inactive
Action	`Courier: Box 1` will `unlock`	inactive
Action	`BodyWorks: Box 2` will `unlock`	inactive
Verification	Verify `button` on `Courier: Box 1`	inactive
Action	`Courier: Box 1` will `verify-button`	inactive
Action	`Courier: Box 1` will `lock`	inactive
Action	`BodyWorks: Box 2` will `lock`	inactive

Collect the engine

The engine is high value and sensitive - managed handover

When the courier is in the right place, and so is the engine supervisor, both boxes open

After the switch, *both* verify before moving on



Motor Collection

Location Match	Courier: Box 1 is at E: Top Motors	inactive
Location Match	Supervisor: Box 3 is at E: Top Motors	inactive
Action	*Supervisor: Box 3* will *unlock*	inactive
Action	*Courier: Box 1* will *unlock*	inactive

Verify Motor Collected

Verification	Verify button on Courier: Box 1	inactive
Verification	Verify button on Supervisor: Box 3	inactive
Action	*Courier: Box 1* will *verify-button*	inactive
Action	*Supervisor: Box 3* will *verify-button*	inactive
Action	*Courier: Box 1* will *lock*	inactive
Action	*Supervisor: Box 3* will *lock*	inactive

Contract: CouriersAtTheTate

Contract Status

Collect the tires

Location Match	`Courier: Box 1` is at `C: TireStore`	active
Action	`Courier: Box 1` will `unlock`	inactive
Verification	Verify `button` on `Courier: Box 1`	inactive
Action	`Courier: Box 1` will `verify-button`	inactive
Action	`Courier: Box 1` will `lock`	inactive

Chassis Collection

Location Match	Colocation between `Courier: Box 1` and `BodyWorks: Box 2`	inactive
Action	`Courier: Box 1` will `unlock`	inactive
Action	`BodyWorks: Box 2` will `unlock`	inactive
Verification	Verify `button` on `Courier: Box 1`	inactive
Action	`Courier: Box 1` will `verify-button`	inactive
Action	`Courier: Box 1` will `lock`	inactive
Action	`BodyWorks: Box 2` will `lock`	inactive

Motor Collection

Location Match	`Courier: Box 1` is at `E: Top Motors`	inactive
Location Match	`Supervisor: Box 3` is at `E: Top Motors`	inactive
Action	`Supervisor: Box 3` will `unlock`	inactive
Action	`Courier: Box 1` will `unlock`	inactive

Verify Motor Collected

Boxes

Box 2

Location	Last Seen
D: BodyWorks	20:32:51

Message

Box 1

Location	Last Seen
no location	

Message

Please collect tires from the Tire Store at C

Blockchain Events

[20:32:45]	Location	**Box 2 at D: BodyWorks**
[20:32:47]	**Deploy**	**CouriersAtTheTate deployed**
[20:32:51]	Location	**Box 2 at D: BodyWorks**
[20:32:54]	Position	**Activated [found]: `Box 1` is at `C: TireStore`**
[20:32:54]	Status	**Collect the tires**

Contract: CouriersAtTheTate

Contract Status

Collect the tires

Location Match	`Courier: Box 1` is at `C: TireStore`	active
Action	`Courier: Box 1` will `unlock`	inactive
Verification	Verify `button` on `Courier: Box 1`	inactive
Action	`Courier: Box 1` will `verify-button`	inactive
Action	`Courier: Box 1` will `lock`	inactive

Chassis Collection

Location Match	Colocation between `Courier: Box 1` and `BodyWorks: Box 2`	inactive
Action	`Courier: Box 1` will `unlock`	inactive
Action	`BodyWorks: Box 2` will `unlock`	inactive
Verification	Verify `button` on `Courier: Box 1`	inactive
Action	`Courier: Box 1` will `verify-button`	inactive
Action	`Courier: Box 1` will `lock`	inactive
Action	`BodyWorks: Box 2` will `lock`	inactive

Motor Collection

Location Match	`Courier: Box 1` is at `E: Top Motors`	inactive
Location Match	`Supervisor: Box 3` is at `E: Top Motors`	inactive
Action	`Supervisor: Box 3` will `unlock`	inactive
Action	`Courier: Box 1` will `unlock`	inactive

Verify Motor Collected

Boxes

Box 2

Location	Last Seen
D: BodyWorks	20:32:51

Message

Box 1

Location	Last Seen
no location	

Message

Please collect tires from the Tire Store at C

Blockchain Events

[20:32:45]	Location	**Box 2 at D: BodyWorks**
[20:32:47]	**Deploy**	**CouriersAtTheTate deployed**
[20:32:51]	Location	**Box 2 at D: BodyWorks**
[20:32:54]	Position	**Activated [found]: `Box 1` is at `C: TireStore`**
[20:32:54]	Status	**Collect the tires**

Contract: CouriersAtTheTate

Contract Status

Collect the tires

Location Match	`Courier: Box 1` is at `C: TireStore`	active
Action	`Courier: Box 1` will `unlock`	inactive
Verification	Verify `button` on `Courier: Box 1`	inactive
Action	`Courier: Box 1` will `verify-button`	inactive
Action	`Courier: Box 1` will `lock`	inactive

Chassis Collection

Location Match	Colocation between `Courier: Box 1` and `BodyWorks: Box 2`	inactive
Action	`Courier: Box 1` will `unlock`	inactive
Action	`BodyWorks: Box 2` will `unlock`	inactive
Verification	Verify `button` on `Courier: Box 1`	inactive
Action	`Courier: Box 1` will `verify-button`	inactive
Action	`Courier: Box 1` will `lock`	inactive
Action	`BodyWorks: Box 2` will `lock`	inactive

Motor Collection

Location Match	`Courier: Box 1` is at `E: Top Motors`	inactive
Location Match	`Supervisor: Box 3` is at `E: Top Motors`	inactive
Action	`Supervisor: Box 3` will `unlock`	inactive
Action	`Courier: Box 1` will `unlock`	inactive

Verify Motor Collected

Boxes

Box 2

Location: D: BodyWorks
Last Seen: 20:32:51
Message:

Box 1

Location: no location
Last Seen:
Message: *Please collect tires from the Tire Store at C*

Blockchain Events

[20:32:45]	Location	**Box 2 at D: BodyWorks**
[20:32:47]	**Deploy**	**CouriersAtTheTate deployed**
[20:32:51]	Location	**Box 2 at D: BodyWorks**
[20:32:54]	Position	Activated [found]: `Box 1` is at `C: TireStore`
[20:32:54]	Status	**Collect the tires**

Contract: CouriersAtTheTate

Contract Status

Collect the tires

Location Match	Courier: Box 1 is at C: TireStore	active
Action	Courier: Box 1 will unlock	inactive
Verification	Verify button on Courier: Box 1	inactive
Action	Courier: Box 1 will verify-button	inactive
Action	Courier: Box 1 will lock	inactive

Chassis Collection

Location Match	Colocation between Courier: Box 1 and BodyWorks: Box 2	inactive
Action	Courier: Box 1 will unlock	inactive
Action	BodyWorks: Box 2 will unlock	inactive
Verification	Verify button on Courier: Box 1	inactive
Action	Courier: Box 1 will verify-button	inactive
Action	Courier: Box 1 will lock	inactive
Action	BodyWorks: Box 2 will lock	inactive

Motor Collection

Location Match	Courier: Box 1 is at E: Top Motors	inactive
Location Match	Supervisor: Box 3 is at E: Top Motors	inactive
Action	Supervisor: Box 3 will unlock	inactive
Action	Courier: Box 1 will unlock	inactive

Verify Motor Collected

Boxes

Box 2

Location	Last Seen
D: BodyWorks	20:32:51

Message

Box 1

Location	Last Seen
no location	

Message

Please collect tires from the Tire Store at C

Blockchain Events

[20:32:45]	Location	Box 2 at D: BodyWorks
[20:32:47]	Deploy	CouriersAtTheTate deployed
[20:32:51]	Location	Box 2 at D: BodyWorks
[20:32:54]	Position	Activated (found): Box 1 is at C: TireStore
[20:32:54]	Status	Collect the tires

Contract: CouriersAtTheTate

Contract Status

Collect the tires

Location Match	`Courier: Box 1` is at `C: TireStore`	active
Action	`Courier: Box 1` will `unlock`	inactive
Verification	Verify `button` on `Courier: Box 1`	inactive
Action	`Courier: Box 1` will `verify-button`	inactive
Action	`Courier: Box 1` will `lock`	inactive

Chassis Collection

Location Match	Colocation between `Courier: Box 1` and `BodyWorks: Box 2`	inactive
Action	`Courier: Box 1` will `unlock`	inactive
Action	`BodyWorks: Box 2` will `unlock`	inactive
Verification	Verify `button` on `Courier: Box 1`	inactive
Action	`Courier: Box 1` will `verify-button`	inactive
Action	`Courier: Box 1` will `lock`	inactive
Action	`BodyWorks: Box 2` will `lock`	inactive

Motor Collection

Location Match	`Courier: Box 1` is at `E: Top Motors`	inactive
Location Match	`Supervisor: Box 3` is at `E: Top Motors`	inactive
Action	`Supervisor: Box 3` will `unlock`	inactive
Action	`Courier: Box 1` will `unlock`	inactive

Verify Motor Collected

Boxes

Box 2

Location	Last Seen
D: BodyWorks	20:32:51

Message

Box 1

Location	Last Seen
no location	

Message

Please collect tires from the Tire Store at C

Blockchain Events

[20:32:45]	Location	Box 2 at D: BodyWorks
[20:32:47]	**Deploy**	CouriersAtTheTate deployed
[20:32:51]	Location	Box 2 at D: BodyWorks
[20:32:54]	Position	Activated (found): `Box 1` is at `C: TireStore`
[20:32:54]	Status	Collect the tires

Possibly the youngest person ever to participate in a smart contract

Current State

- demo works very nicely
- just using Bluetooth proximity

Findings

- scenarios really help to make sense of the technology
- what happens when it goes wrong?

Next Steps

- take it outside with GPS + LoRaWAN
- bring phones into the network
- make it easy for people to write smart contracts

Findings

- working with publics is a crucial challenge for blockchain systems

- contextualisation is crucial - same contract + different story = feels different

- imaginaries - how to people conceive of things?

- degree of reality is very important

- what happens when things go wrong?

- decentralisation promises democratisation, but democratisation is not easy!

- blockchains let Things have wallets

- the world is messy!

- blockchain gives a space to rethink how things are (hype can be useful)

Thanks for listening

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https://www.designinformatics.org/research_project/biot/