Blockchain Opportunities

Trust, Privacy and Utility for the Consumer Electronics & Vehicular Technology Industries

Peter Corcoran, NUI Galway, peter.corcoran@nuigalway.ie
James Irvine, University of Strathclyde in Glasgow, j.m.irvine@strath.ac.uk
Who am I (Presenter)?

- **Professional Volunteer (Electronic & ICT Engineer)**
  - Board Member of IEEE Consumer Electronics Society *(6 years)*
  - Editor-in-Chief of IEEE Consumer Electronics Magazine *(2010-2016)*
  - IEEE Fellow in 2010 *(Contributions to Digital Camera Technology)*
  - IEEE Distinguished Lecturer, Conference Chair, Editor & Reviewer

- **Day Job(s):**
  - University Professor & Former Vice-Dean *(Research & Grad Studies)*
  - Active Researcher *(currently 10 PhD & 3 PostDoctoral researchers)*
  - Entrepreneur, Inventor & Technologist
  - Industry Consultant
Some CE Use Cases (1)

*Products & Manufacturing*
Supply Chain Management

- CE Industry projected to grow at CAGR of 5% to $1.8 trillion by 2023, with smartphones leading the way
- The industry relies on complex supply chain management to support manufacturing of today’s CE devices
- Increasing emphasis on
  - ethical sourcing for manufacturing;
  - management of product lifecycle for environmental
  - legal & taxation issues that span jurisdictions; e.g. 13 billion in taxes owed by Apple to Irish government, but enforced by EU
- Blockchain provides much needed traceability and transparency
Counterfeit Components

- Costs the semiconductor industry 75B USD per annum; 3B for automotive industry but increasing;

- Counterfeit components & subsystems don’t have safety & compliance certification so represent a high risk to manufacturers

- Difficult to detect where and how they enter the supply chain
  - generally cannot be distinguished from original components; often originate from the same factory but from a batch that failed safety or compliance tests;
  - many competitive pressures within the supply chain; counterfeit components allow cost savings; often mixed with genuine components
  - human element is difficult to control;

- Blockchain provides much needed traceability and transparency for the semiconductor & CE industry sectors
Fake Consumer Products

- Globalization has led to an even bigger problem – completely fake products that are almost identical to the original!

- AliBaba handles around 1.7B in fake products (2017 figure); a huge problem for its credibility as a global online retailer

- Globally the market for fake electronic products is estimated at 30-50B; (500B for all categories of product!)

- Solution: a public blockchain for product registration and tracking – from manufacturer to consumer and beyond (e.g. verification of device repair & refurbishment).
Some CE Use Cases (2)

System-on-Chip Challenges
The System-on-Chip is the Device

- Modern SoC combines multiple hardware engines & processing units from multiple vendors
- SoC Intellectual Property is highly valuable, requiring many man-years of engineering effort; many new companies are ‘fabless’, relying on their IP-Core designs for commercial success
- Increasing challenges for the industry wrt
  - Protecting IP-Core designs from theft & piracy; can occur at various stages in the design & manufacturing pipeline;
  - Verifying the inclusion of IP in production systems; how many units shipped, etc ...
  - Protecting IP from reverse engineering without compromising performance and silicon area
- Blockchain can provide solutions
Some VT Use Cases (1)

Connected Vehicles Challenges
The Environment

- Connected vehicles must work in many different environments, without relying on central trust
  - Visiting other jurisdictions
  - Provenance of infrastructure
  - Unconnected highways

- Connected vehicles must interact – at high speed – with many other vehicles
  - Safety systems must operate with very low latency
  - Provenance of sensor data
  - Provenance of vehicle intentions

- Blockchain can avoid the requirement for a central trusted authority

- Blockchain can allow control to be devolved and work offline
Some VT Use Cases (2)

Vehicle Charging Challenges
Vehicle Charging

- Electric vehicles must work in many different environments, without relying on central trust
  - Visiting other jurisdictions
  - Provenance of infrastructure
  - Payment for charge – in both directions

- Electric vehicles have the potential to revolutionise energy storage in a smart grid
  - Load balancing in place
  - Geographic load balancing

- Blockchain can avoid the requirement for a central trusted authority
  - Except in an automotive environment, we have options for trusted parties
  - Energy distribution network could be used for auditing/scalability
More CE Use Cases (3)

Devices & Data
The Age of the Smartphone

▸ (Almost) Everyone has one now – it is the most ubiquitous personal device and a pinnacle of consumer electronics

▸ The smartphone is the gateway to wealth of personal & private data; and “data is the new gold” …

▸ It is the bridge between CE and the Cloud …

▸ But this raises many challenges:
  – How to protect user privacy?
  – How to manage & share personal/semi-private data? (e.g. pictures & video)
  – How to manage cross-jurisdictional issues (e.g. safe-harbour between US and EU)
  – Smartphone & user biometrics
Some articles to consider ...

*These aren’t about blockchain; rather then outline problems where blockchain can offer a potential solution ...

- **Privacy & Smartphones**

- **Biometrics**
Some CE Use Cases (4)

The Internet of Things
The Internet of Things (IoT) - 1

- Multiple connected devices are invading your home ...
  - Smart-TV
  - Smart Speakers (Alexa, Google Home, etc ...)
  - Cameras (security, baby monitor, doorbell, TV, tablets, phones, etc ...)
  - connected HVAC systems (NEST, etc ...)
- Multiple networking technologies & command protocols ...
- Many devices connected to Cloud/Web services ...
- Multiple Challenges:
  - Security & Privacy of the Household?
  - Management of all these devices?
  - Prevention & Detection of Cyber-attacks?
    - Pen-Testing the Home?
  - Transactions between devices, services and your bank a/c?
- How to establish Consumer Trust in such a complex environment?
“I Am Game of Thrones”

About the risks of our digital lives being ‘stolen’ as easily as a certain hit TV-Series ...

IEEE Consumer Electronics Magazine

July 2015 Issue –

The Dark Side of IoT

Editorial –
Three key benefits of using blockchain for IoT

**Build trust**
- Build trust between parties and devices
- Reduce risk of collusion and tampering

**Reduce costs**
- Reduce costs by removing overhead associated with middlemen and intermediaries

**Accelerate transactions**
- Reduce settlement time from days to near instantaneous
Some thoughts on disruptions in Consumer Space ...

(These reflects some more ‘personal’ interests ...)
1. Biometrics, Smartphones & Blockchain ...
Biometrics & Smartphones

Smartphones can solve the problem of cancellable biometrics …

Soapbox Article – IEEE Consumer Electronics Magazine – April 2013

Biometrics and Consumer Electronics: A Brave New World or the Road to Dystopia?

By Peter M. Corcoran

Biometric systems confirm a person’s identity by extracting and comparing patterns in their physical characteristics against computer records of those patterns. Examples include scans of the face, iris, or retina; measurements of hand geometry, palm or finger vein patterns; fingerprints, ear structure, voice patterns, or any other characteristic of the physical person that represents a unique attribute. The extracted patterns are matched against previously registered patterns, and, within certain tolerances, a confirmed match can be used to authenticate an individual’s identity. In most practical systems, there is a need processed to provide a unique identifying formula for each police offender.

First introduced into practical use in 1882, Bertillon’s system was used in 1884 to confirm 241 repeat offenders in the Paris area. Its use was then widely adopted by the French police force. Although the system was later shown to be flawed because different police...

People are generally suspicious of biometrics and, if biometrics are not introduced carefully into a particular space and the placement of objects in it.

Fingerprinting is one of the earliest biometric techniques. In fact, fingerprints were used as signatures in ancient Babylon. However, the first scientific research began in the 17th and 18th centuries. Nehemiah Grew (1641–1712) published the first scientific paper to describe the ridge structure of the skin covering the fingers and palms [16]. A century later, in 1788, the German anatomist Johann Mayer (1747–1801) recognized that fingerprints are unique to each individual.

In modern times, fingerprints were first used as a form of legal authentication…
Which is more secure?

Remember – your device can constantly authenticate you!

Vs
But for Biometrics to Work ... 

- ... you can’t store the ”Biometric” in a centralised database ...
- IT is too attractive for Cyber-criminals ..
But you could BLOCKCHAIN it with a bit of help from our smartphones ...

- Blockchain enables new forms of distributed software architecture where agreements on shared state for decentralised and transactional data can be established in a network of peers – this can be a key enabler for secure & ubiquitous "cancellable Biometrics" …
2. Big Data, Consumer Content & Blockchain ...
Growth in Data Traffic on Internet

The Age of the Zetabyte (Yottabyte?) …

- Total data approaching 0.2 ZB per month …
- 70%-80% is Video Data
- Mobile Data CAGR is c.50%
- Consumers are now major generators of content …
When you are THE World’s DATA HUB …

… You need the World’s Biggest Data Center to store all that Cloud Data!
But Governments aren’t the only ones who want you to trust them with your data …
Today Big Corporations Control the Data Flow ... & the $$$

- User content attracts viewers and advertisers ... 

- Corporations keep the Lion’s share of profits ... 

- The people who create the content get the crumbs ...
But BLOCKCHAIN could commodotise the management & monetisation of content distribution ...

- Blockchain enables new forms of distributed software architecture where agreements on shared state for decentralised and transactional data can be established in a network of peers – this can be a key enabler for an open marketplace for data & content ...
Summary/Conclusions

Something Old, Something New, Something Borrowed, Something Green ...

- Supply Chains & Manufacturing both in CE & VT Ecosystems
  - Something we would have expected ...
- Some Interesting New Ideas for Application of Blockchain
  - Security, Privacy & Trust challenges in relation to both our Automobiles and our Smartphones!
  - Vehicular Charging
  - Biometrics Infrastructure
  - Blockchain to manage & monetise ‘user-generated’ content?
- Challenges
  - Blockchain requires ‘energy’ to enable all these wonderful opportunities
  - And it requires a broad adoption to enable a sufficiently large consensus for any of these use cases to be successful
I’m Done ...

????? Any Questions ... ????

Center for Cognitive, Connected and Computational Imaging
College of Engineering, Science & Informatics, NUI Galway