



TITANIUM and Early Results

Dr. Ross King

CoU Cybercrime Workshop

Brussels, 2017-12-06



TITANIUM Project

Project Data



TITANIUM: Tools for the Investigation of Transactions in Underground Markets

<https://www.titanium-project.eu>

- H2020 SEC-12-2016-2017
- Research and Innovation Action
- 3 Years (May 2017 – April 2020)
- 15 Partners



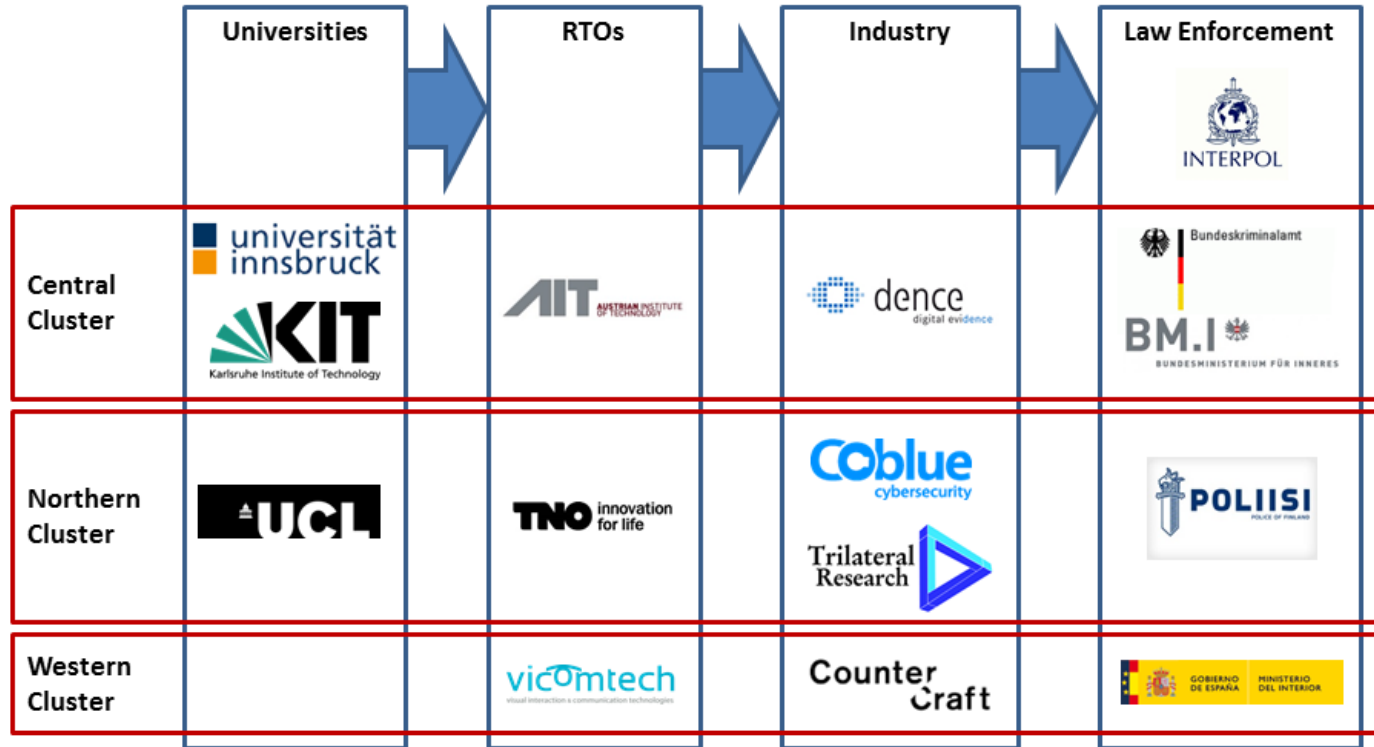
This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 740558.

Project Consortium



Participant organisation name	Short name	Country
AIT Austrian Institute of Technology GmbH	AIT	AT
Nederlandse Organisatie voor Toegepast Natuurwetenschappelijk Onderzoek	TNO	NL
Universität Innsbruck	UIBK	AT
Karlsruher Institut für Technologie	KIT	DE
University College London	UCL	UK
Fundacion Centro de Tecnologias de Interaccion Visual y Comunicaciones Vicomtech	VICOM	ES
Coblue Cybersecurity	COB	NL
dence GmbH	DEN	DE
Trilateral Research Ltd.	TRI	UK
Countercraft S.L.	CCR	ES
Bundeskriminalamt	BJA	DE
The International Criminal Police Organization	INT	FR
National Bureau of Investigation	NBI	FI
Bundesministerium für Inneres	BMI	AT
Ministerio del Interior	MIR-PN	ES

Project Consortium – Value Chain





*“...virtual currencies such as Bitcoin establish themselves as **single common currency for cybercriminals**”*

*“Bitcoin is [...] accounting for **over 40% of all identified criminal-to-criminal payments.**”*

– Europol 2015 Internet Organized Crime Threat Assessment Report

Project Objectives – Summary



1. Analyse legal and ethical requirements.
2. Analyse technical characteristics of typical forms of IOCT (Internet Organized Crime and Terrorism) activities.
3. Develop tools for the automated collection of multi-modal data.
4. Provide novel algorithmic methods and tools for the automated analysis of aggregated or simulated data.
5. Deploy developed forensic tools and services to the associated Law Enforcement Agency stakeholders, evaluate their usage in a realistic configuration, and validate their effectiveness in reducing cost and effort in criminal investigations.
6. Provide training to improve the capabilities of LEAs across Europe through innovative curricula, training and joint exercises used to facilitate the EU-wide take-up of TITANIUM tools, methodologies, and technologies.

Work Package Structure



WP8: Project Coordination

Lead: AIT

WP3: Tool and Service Ecosystem

Lead: University of Innsbruck

WP4: Data Provisioning

Lead: TNO

WP5: Analysis Algorithms and tools

Lead: University College London

WP6: Field Labs, Testing, and Validation

Lead: National Bureau of Investigation

WP1: Ethics Requirements

Lead: AIT

WP2: Legal, Societal, and Ethical Aspects

Lead: KIT

WP7: Dissemination, Training, and Exploitation

Lead: Trilateral Research Ltd.



TITANIUM

How big is Bitcoin?

Bitcoin – Market Capitalization



Market Cap ▾

Trade Volume ▾

Trending ▾

Tools ▾

Search Currencies

Q

All ▾

Coins ▾

Tokens ▾

USD ▾

Next 100 →

View All

#	Name	Market Cap	Price	Volume (24h)	Circulating Supply	Change (24h)	Price Graph (7d)
1	Bitcoin	\$163,226,128,986	\$9,766.87	\$7,442,830,000	16,712,225 BTC	-5.48%	
2	Ethereum	\$41,000,000,000	\$431.00	\$1,552,450,000	96,062,348 ETH	-3.37%	
3	Bitcoin Cash	\$2,000,000,000	\$1,313.97	\$1,010,370,000	16,831,713 BCH	-5.42%	
4	Ripple	\$1,000,000,000	\$0.241434	\$211,485,000	38,622,870,411 XRP *	-2.68%	
5	Dash	\$1,000,000,000	\$15.00	\$1,000,000,000	66,666,667 DASH	0.59%	
6	Bitcoin	\$1,000,000,000	\$15.00	\$1,000,000,000	66,666,667 BTC	-4.67%	
7	Litecoin	\$1,000,000,000	\$15.00	\$1,000,000,000	66,666,667 LTC	-5.40%	
8	IOTA	\$1,000,000,000	\$15.00	\$1,000,000,000	66,666,667 IOTA *	-5.15%	
9	Cardano	\$1,000,000,000	\$15.00	\$1,000,000,000	66,666,667 ADA *	12.74%	
10	Monero	\$1,000,000,000	\$15.00	\$1,000,000,000	66,666,667 XMR	-3.62%	
11	Ethereum Classic	\$1,000,000,000	\$15.00	\$1,000,000,000	66,666,667 ETC	-0.25%	
12	NEO	\$2,188,673,500	\$33.67	\$94,789,700	65,000,000 NEO *	1.20%	
13	NEM	\$1,956,528,000	\$0.217392	\$13,683,100	8,999,999,999 XEM *	-5.88%	

Up from 3G\$ since last year

Up from 14G\$ since January!

Up from 3G\$
since last year

Up from 14G\$
since January!

- ▶ Presently 1320 currencies tracked
 - ▷ January: 642
 - ▷ September: 865
- ▶ Total Market Capitalization: ca. 293 G\$
 - ▷ January: 11 G\$
 - ▷ last year 4 G\$

<http://coinmarketcap.com/>
2017-12-01



Bitcoin – How big is it?



- ▶ Number of Addresses: 296.862.000
- ▶ Number of Address Clusters: 30.645.400
- ▶ Number of Transactions: 249.408.600
- ▶ Viewed as a transaction graph
 - ▷ nodes (=addresses): 296.862.000
 - ▷ edges (=aggregated transactions): 1.567.227.800

(numbers from September 2017)



Bitcoin – Big Data Criteria



- ▶ **Volume** – is 1.5 billion big?
- ▶ **Velocity** – the Bitcoin blockchain grows in real time, but not very fast
- ▶ **Variety** – not really; all blocks are the same
- ▶ **Variability** – not really; the interpretation of a block remains constant
- ▶ **Veracity** – not really; this is one thing Blockchains are good at!
- ▶ **Visualization** – yes! a challenge to be addressed
- ▶ **Value** – Civil security and law enforcement



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This changes when we begin to
consider multi-ledger analysis!





TITANIUM Results

Early Results



- Law Enforcement Requirements (BKA)
- Legal Requirements – Distributed Ledgers (KIT)
- Cross-ledger Analytics – Ethereum (UIBK)
- Cybercrime Forensics – Ransomware (AIT)

Law Enforcement Requirements



Roles

- Stakeholder Manager
- Full-Partner Stakeholders
- Associated Stakeholders

Methodology

- Stakeholder Workshop (September 2017)
- Stakeholder Survey (September-October 2017)
- Consolidation and Analysis (November 2017)
- Review (December 2017)
- Results: Deliverable D3.2 (2017-12-31) – **EU RESTRICTED**

Law Enforcement Requirements

Stakeholder User Group



- The Stakeholder User Group consists of representatives from all stakeholder partners, including funded project stakeholders and non-funded associated stakeholders.

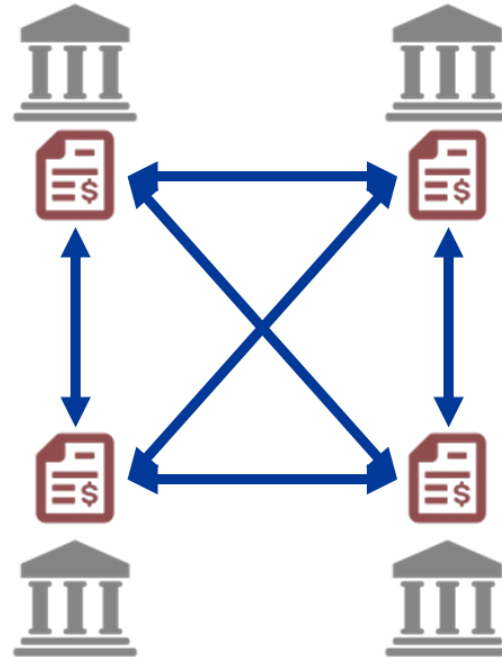
Associated Partners	
Law Enforcement Organisations	Country
Bayerische Landeskriminalamt	DE
Cyprus Police - Cybercrime Unit	CY
Criminal Police Directorate	HR
Romanian Police	RO
Europol	EU
Metropolitan Police Service	UK
National High Tech Crime Unit	NL
National Crime Agency	UK
Police Academy in Szczytno	PL
Polícia Judiciária	PT
Swedish Cybercrime Center	SE
Swiss Federal Office of Police	CH
Other Organisations	Country
European Central Bank	EU

Full Partners	
Law Enforcement Organisations	Country
Bundeskriminalamt	DE
The International Criminal Police Organization	FR
National Bureau of Investigation	FI
Bundesministerium für Inneres	AT
Ministerio del Interior	ES

Legal Requirements – Distributed Ledgers



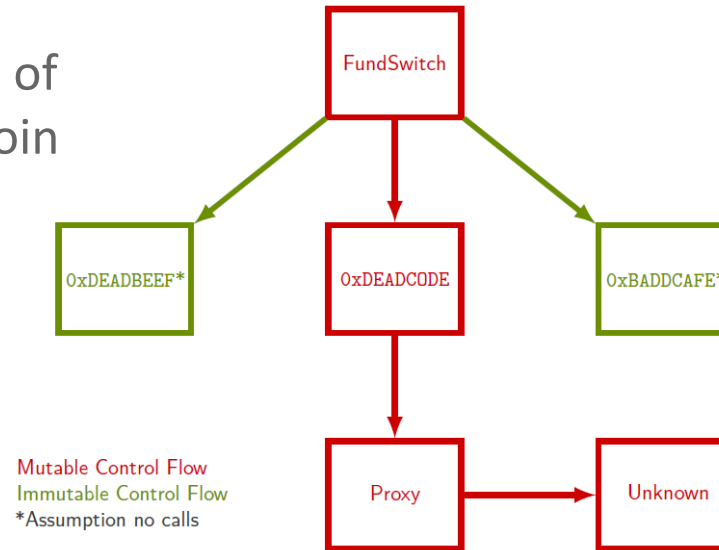
- ▶ Paulina Jo Pesch (KIT) in collaboration with Christian Sillaber (UIBK)
- ▶ Application of the EU GDPR transparency requirements to Distributed Ledger (DL) systems
 - Relevant characteristics of DL systems
 - Applicability of GDPR to DL systems
 - DL systems participants as (joint) Data Controllers
 - Outlook and possible approaches to improving transparency



Cross-ledger Analytics – Ethereum



- ▶ Michael Fröwis and Rainer Böhme (UIBK)
- ▶ Expanding the forensic analysis of public Blockchains beyond Bitcoin
- ▶ Control flow immutability in Ethereum Smart Contracts
- ▶ Conclusions
 - ▷ Ethereum enables trust-less contracts in principle but...
 - ▷ 2 out of 5 contracts actually have mutable control flow



Cybercrime Forensics – Ransomware



- ▶ Bernhard Haslhofer (AIT) in collaboration with Masarah Cynthia Paquet Clouston and Dupont Benoit (University of Montreal)
- ▶ Reproducible method for identifying, quantifying, and comparing payments of ransomware families.
- ▶ A combination of
 - ▷ Desktop research to identify seed addresses
 - ▷ Forensic analysis of the ransomware transactions using the open source GraphSense toolset



Other Results



- ▶ Numerous Ethics Requirements Deliverables (Confidential)
- ▶ D7.1 Dissemination Plan (Public)
- ▶ D8.1 Project Handbook (Public)
- ▶ D8.2 Data Management Plan (Public)

Future Work

- Legal, Societal, and Ethical Impact
- Field Labs: Evaluation Goals and Methodology
- Intelligent Crawling
- Cross-ledger Analysis
- Privacy Impact Assessment





Thank you for your attention!

Dr. Ross King

AIT Austrian Institute of Technology GmbH

ross.king@ait.ac.at

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CREDITS

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