2018 PROJECT

Cyber-Attack Detection and Information Security for Industry 4.0

PROGRESS REPORT

July – November 2018

Nguyen Linh-Trung
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VNU University of Engineering and Technology (VNU-UET)
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ASEAN IVO Forum
Jakarta, Indonesia
27-28 Nov, 2018

Cyber-Attack Detection and Information Security for Industry 4.0

Context - Industry 4.0

- a main driver for the development of smart cities
- a vision of smart factories built with intelligent cyber-physical systems
- breakthrough achievements in many sectors (healthcare, food, and agriculture, …)
- when connected to the cyber world, **cybersecurity risks** become a key concern due to open systems with IP addresses

Objectives

To provide tools to **enhance cybersecurity** in Industry 4.0 by applying several recently-developed smart technologies: **deep learning**, **blockchain technology** and **physical-layer security**

Members

1. Nguyen Linh-Trung (Vietnam)
2. Nguyen Viet Ha (Vietnam)

VNU ĐẠI HỌC QUỐC GIA HÀ NỘI Vietnam National University, Hanoi

3. Dusit Niyato (Singapore)

NANYANG TECHNOLOGICAL UNIVERSITY SINGAPORE

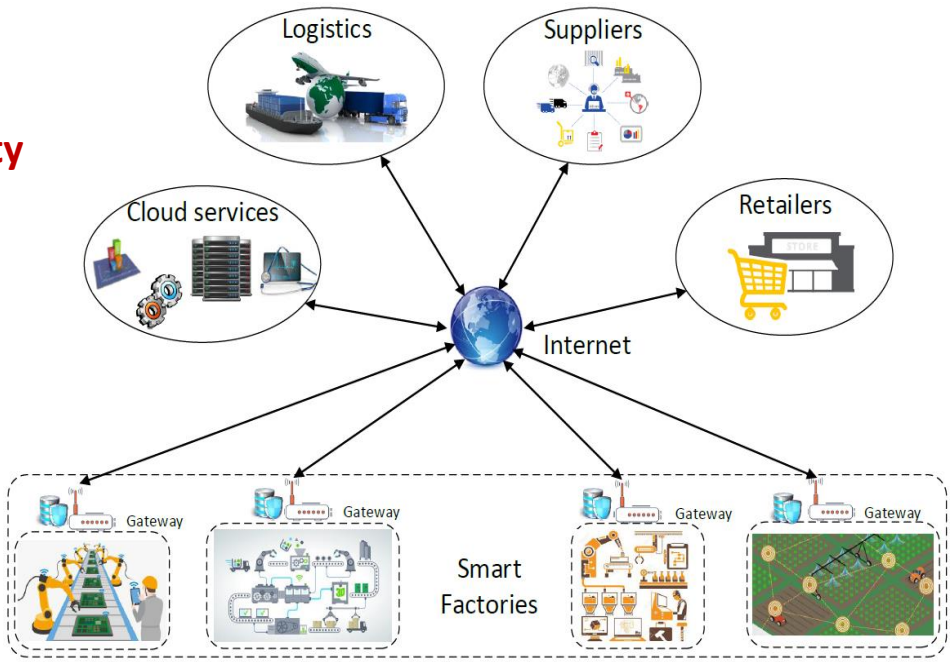
4. Eryk Dutkiewicz (Australia)
5. Diep Nguyen (Australia)
6. Hoang Dinh (Australia)

UTS UNIVERSITY OF TECHNOLOGY, SYDNEY

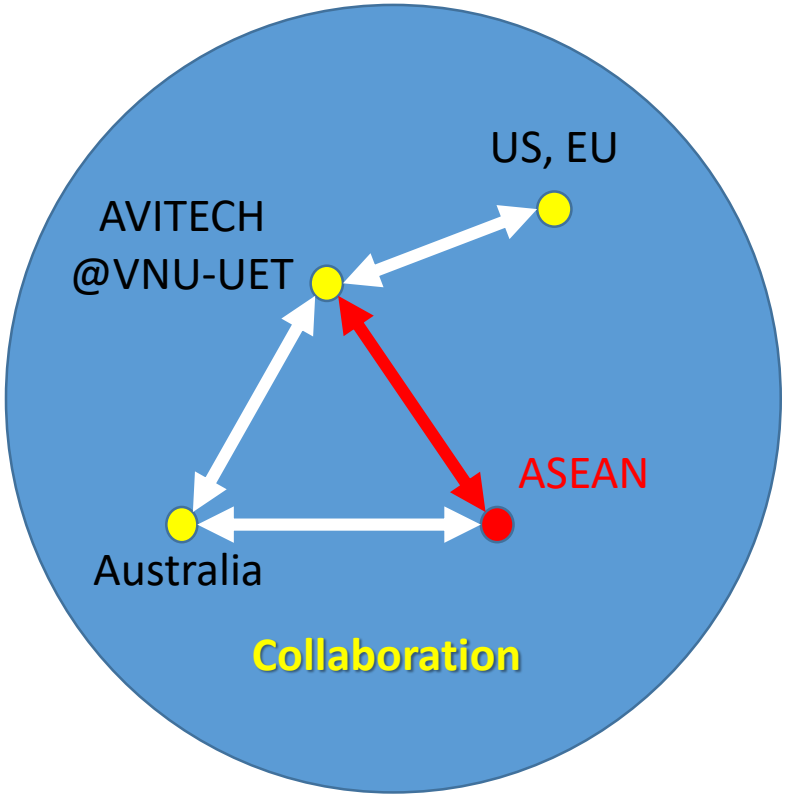
Budget NICT: 110k, UTS-VNU JTIRC: 37k

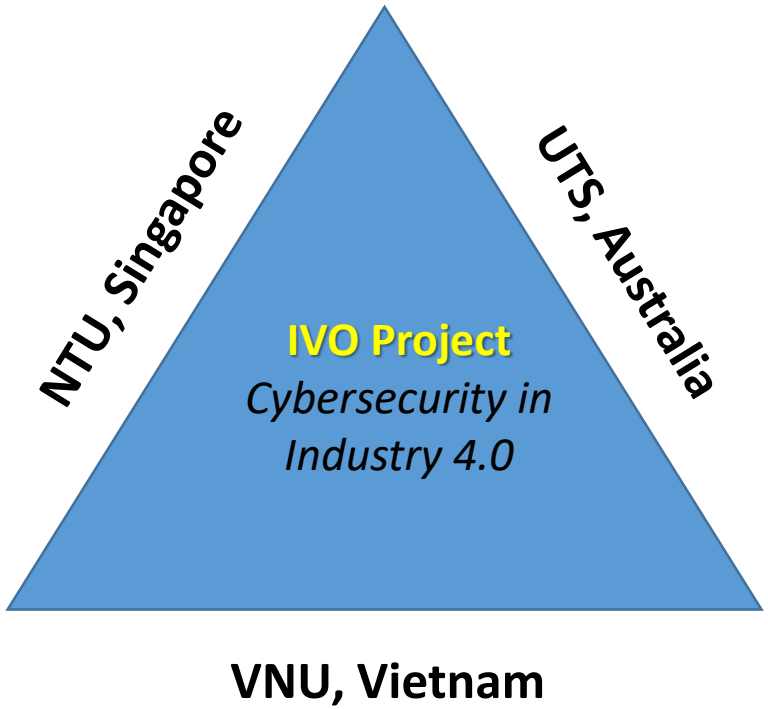
Duration 7/2018 – 6/2021

Information and communication systems in Industry 4.0



Consortium


US, EU
AVITECH
@VNU-UET
ASEAN
Australia
Collaboration


NTU, Singapore
UTS, Australia
IVO Project
Cybersecurity in
Industry 4.0
VNU, Vietnam

Targets

1. A method to detect cyber-security threats in Industry 4.0 through using advanced deep learning algorithms
2. A framework to protect data from cyber-attacks using blockchain technology
3. Solutions to enhance security at the physical interface of information transmission using physical-layer security technology
4. A sustainable research collaboration network in the ASEAN region, in Australia and worldwide, for developing human resource in Vietnam that is able to develop effective cyber-security solutions

Tasks

Background:

1. Analyze and identify potential cyber-security risks in Industry 4.0
2. Develop an innovative risk assessment model to quantify the risks in Industry 4.0
3. Implement an online web reference service listing and ranking the risks in Industry 4.0

Solutions:

4. Develop and implement an innovative method to detect and isolate cyber-security attacks using deep learning
5. Develop an unprecedented data securing method using blockchain technology
6. Develop receiver-based friendly jamming and collaborative beamforming methods to safeguard sensors/actuators
7. Implement and evaluate performance of the proposed blockchain application on a real testbed

Dissemination:

8. Annual Workshops and Exhibitions on Cyber-Security

Year-1 Milestones

Project progress

- Student recruitment (ongoing):
  - PhD candidates: Tran Viet Khoa, Bui Minh Tuan, to enroll in Mar 2019
- Management:
  - Project Kick-off meeting – Dec 14, 2018 @VNU, Hanoi, Vietnam
  - Workshop on cyber-security – Mar 19-20, 2019 @ Ha Long, Vietnam
- Technical developments:

  Associated with prior studies:

  1. W Wang, DT Hoang, Z Xiong, D Niyato, P Wang, P Hu, Y Wen,

     A survey of consensus mechanisms and mining management in blockchain networks, *IEEE Communications Surveys & Tutorials* [submitted]
  2. TTT Quynh, TV Khoa, LV Nguyen, N Linh-Trung

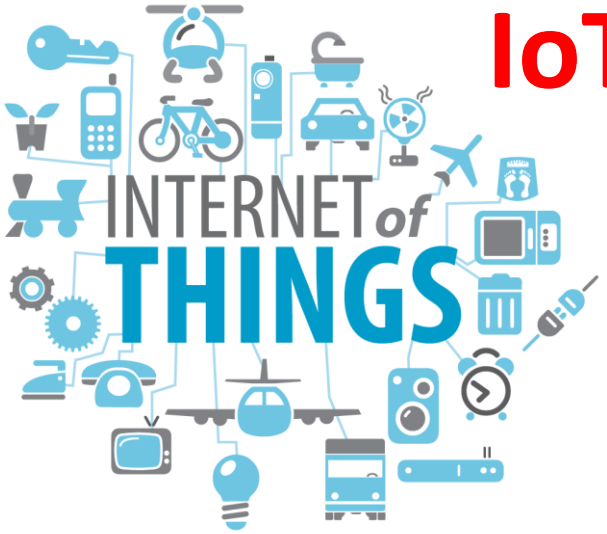
     Network Coding with Multimedia Transmission: A Software-Defined-Radio based Implementation, *SigTelCom Conf*, March 2019 [submitted]

  Started within IVO timeline (8/2018 –):

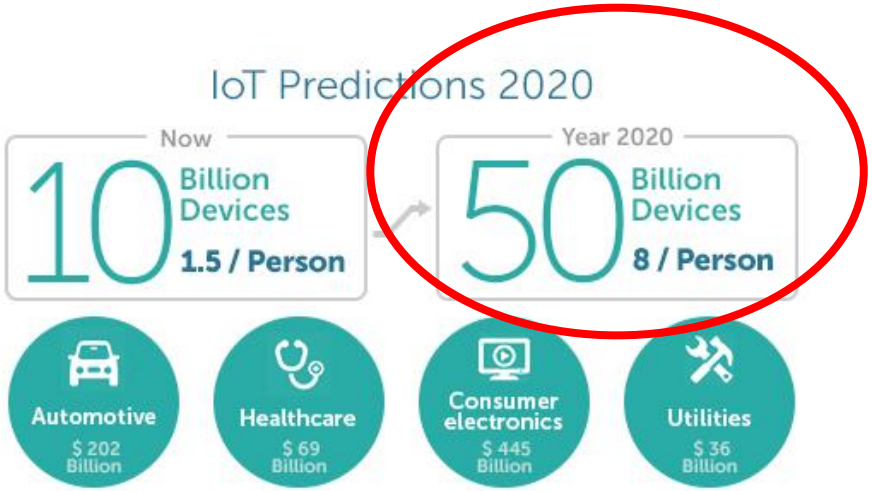
  3. TV Khoa, DT Hoang, N Linh-Trung, D Niyato, D Nguyen

     Energy-efficiency consensus mechanisms for future blockchain networks, *VNU-UET Technical report*, 12/2018.

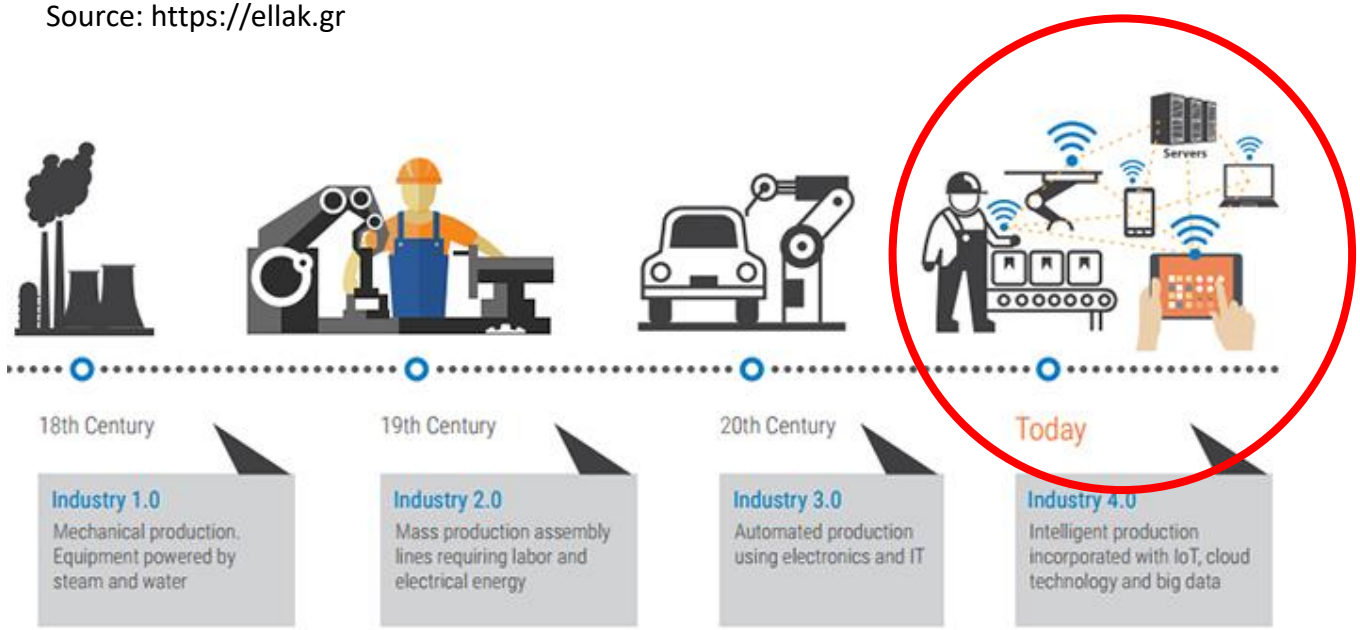
IoT



Source: https://ellak.gr



Source: http://www.gigavation.com



Source: http://coe-iot.com

- **Industry 4.0**: smart factories built with **intelligent cyber-physical systems**
- Intelligent production with **IoT**, **cloud technology**, **big data**

Vietnam – Towards Industry 4.0

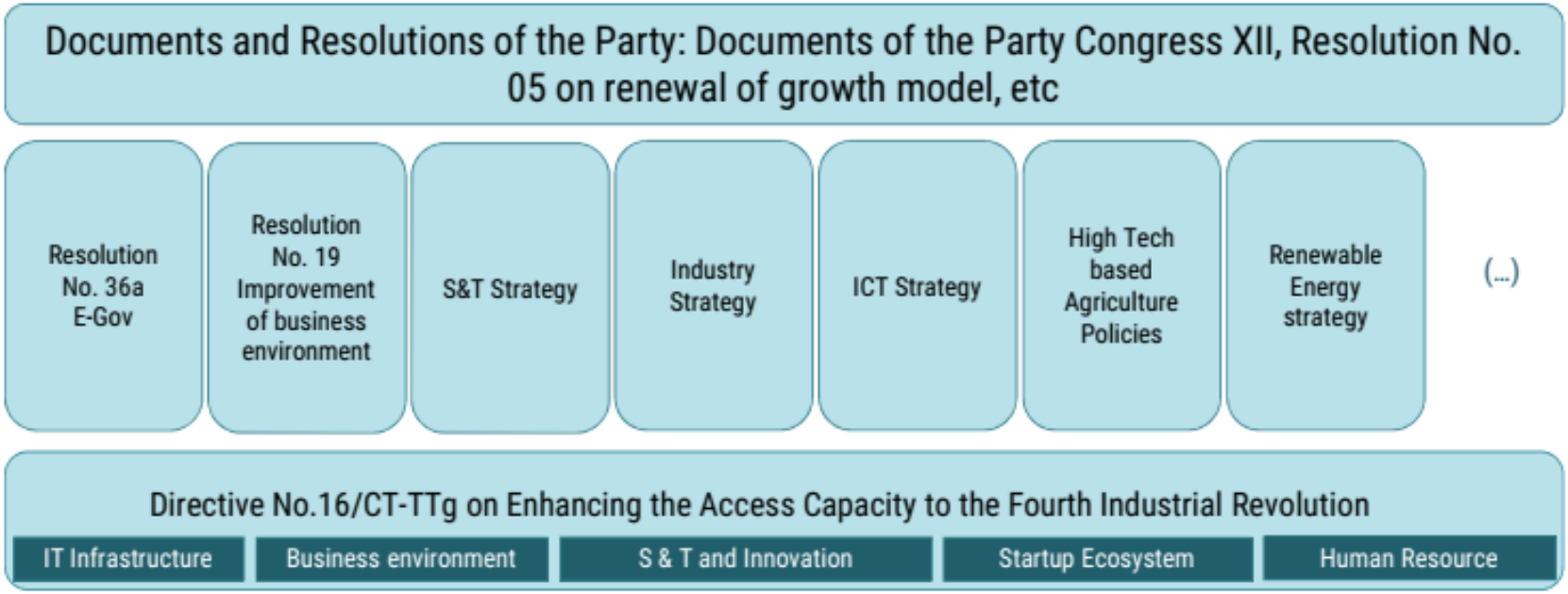
Source: A.T. Kearney, press research

Vietnam – Towards Industry 4.0

Evaluation of readiness for Industrial 4.0

Source: MoST

Vietnam – Towards Industry 4.0



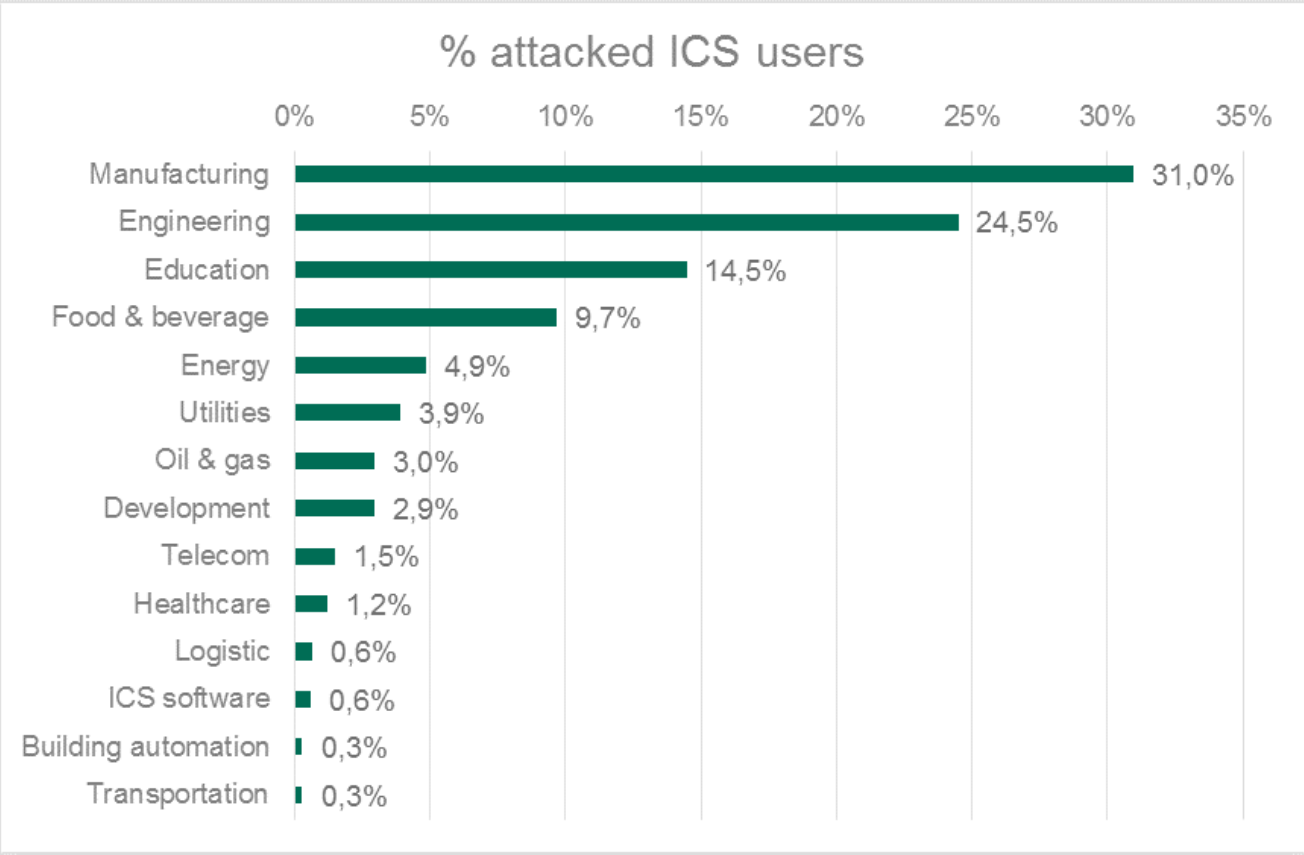
- Politburo Resolution on I.R. 4.0
- Government Resolution on Implementing Politburo Resolution on I.R. 4.0
- Report on foresighted scenario of 4.0 on digital economy development
- Vietnam 2035 Innovation Report
- 4.0 S&T program
- iTrithucViet
- National 4.0 strategy

Source: MoST

Vietnam – Cybersecurity

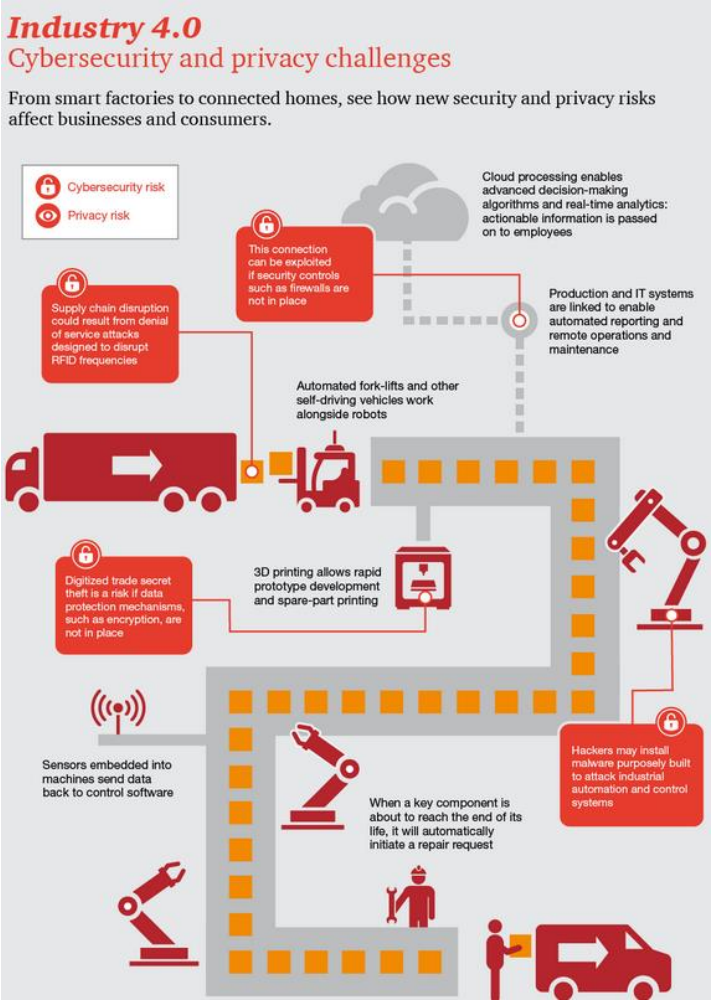
Top country with attacked industrial computers (71%)

Law on Cyber-security (1/1/2019)



Source: Kaspersky

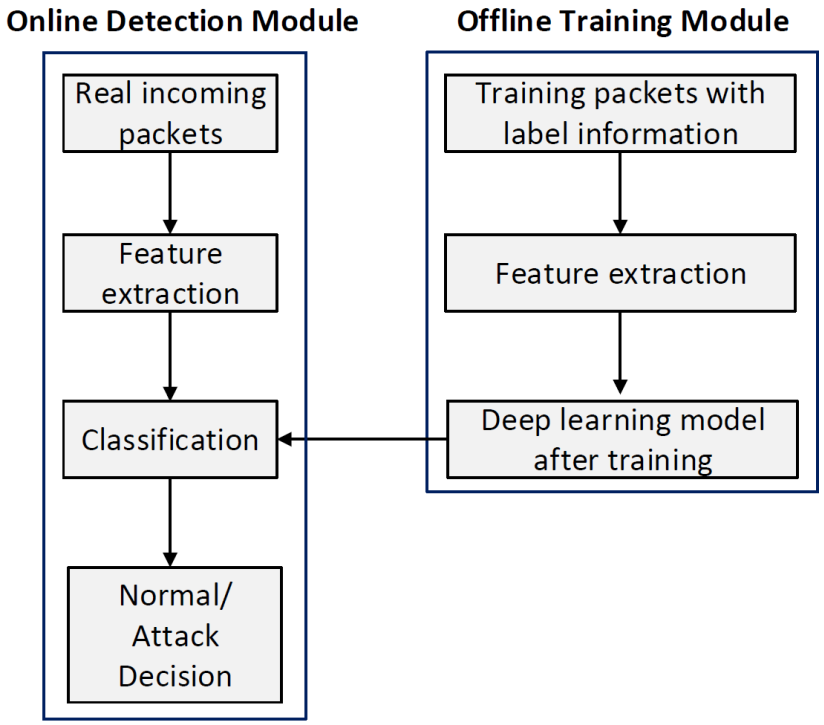
Cybersecurity Issues & Challenges



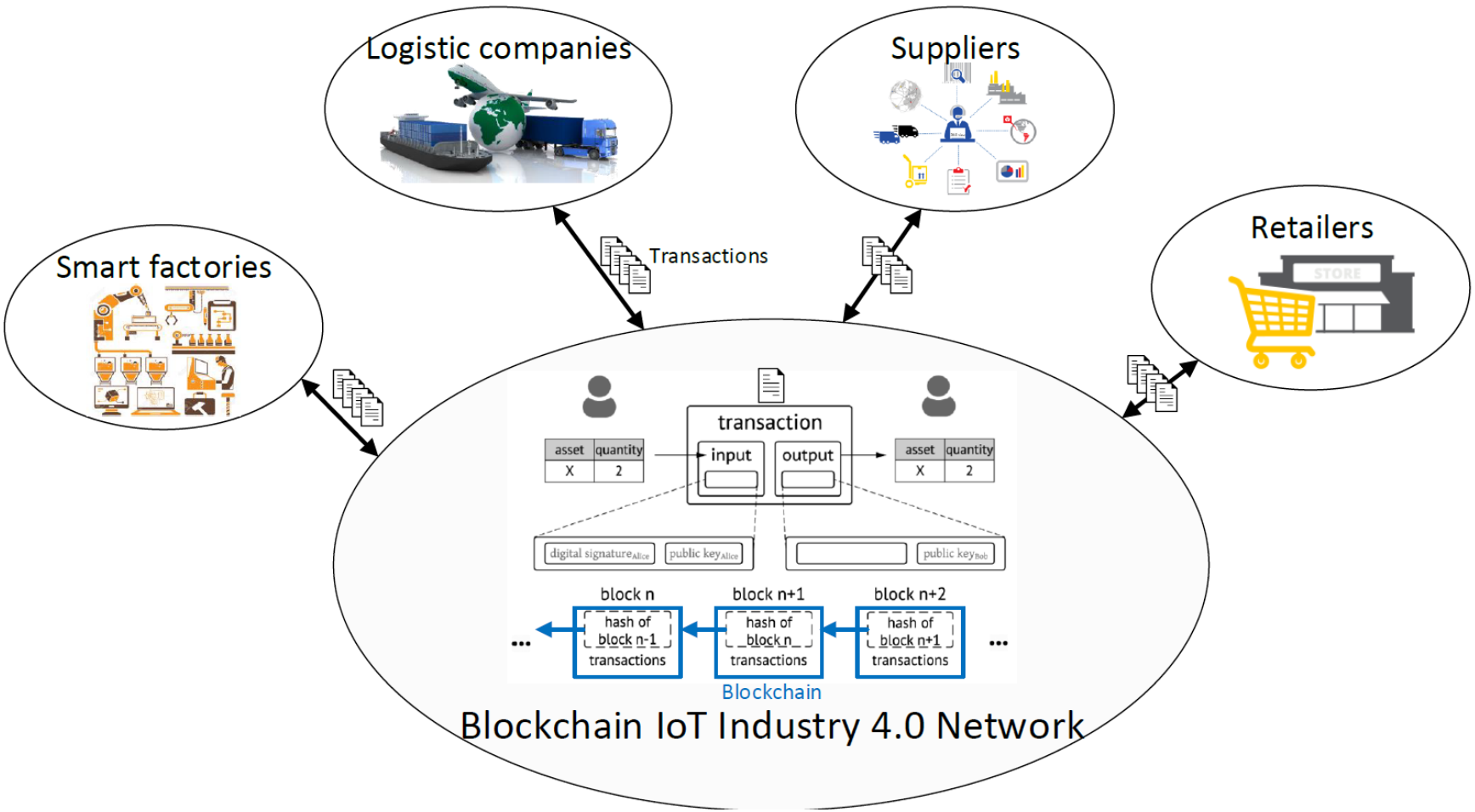
- When I4 is connected to cyber world, cybersecurity risks become key concern due to **open systems with IP addresses** creating more avenues for cyberattacks
- **Manufacturing**: among **the top 3 industries targeted** by spear phishing attacks, suffering 20% of all attacks
- **Complexity** of managing production and supplier networks grows enormously
- Due to **increased connectivity** of smart machinery to the Internet, cyber threats increase and broaden
- A huge amount of data will be generated, causing difficulties in **big data security**
- I4 includes many decentralized manufacturing systems with **real-time decisions**, and thus detecting and preventing cyber attacks need be performed promptly and in parallel

Deep learning to detect attacks

- Challenges:
  - Multiple types of attacks
  - Imbalanced traffic classification
  - …



Blockchain to prevent attacks



Solutions to enhance physical-layer security

- Technologies/Tools:
  - Physical-layer network coding
  - Compressed sensing
  - Friendly-jamming
  - …
- Challenges:
  - Low-complexity
  - Low-energy
  - High-scalability

Case study

NTU platform:

The smart contract data collection & attack on blockchain

https://www.youtube.com/watch?v=1rC48XCu3UY

Thank you!