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Trust in IoT and Its Applications

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  - Trust in IoT
- Understanding of Trust
  - Trust features
- Key Design Principles and Challenges
- Various Technical Issues
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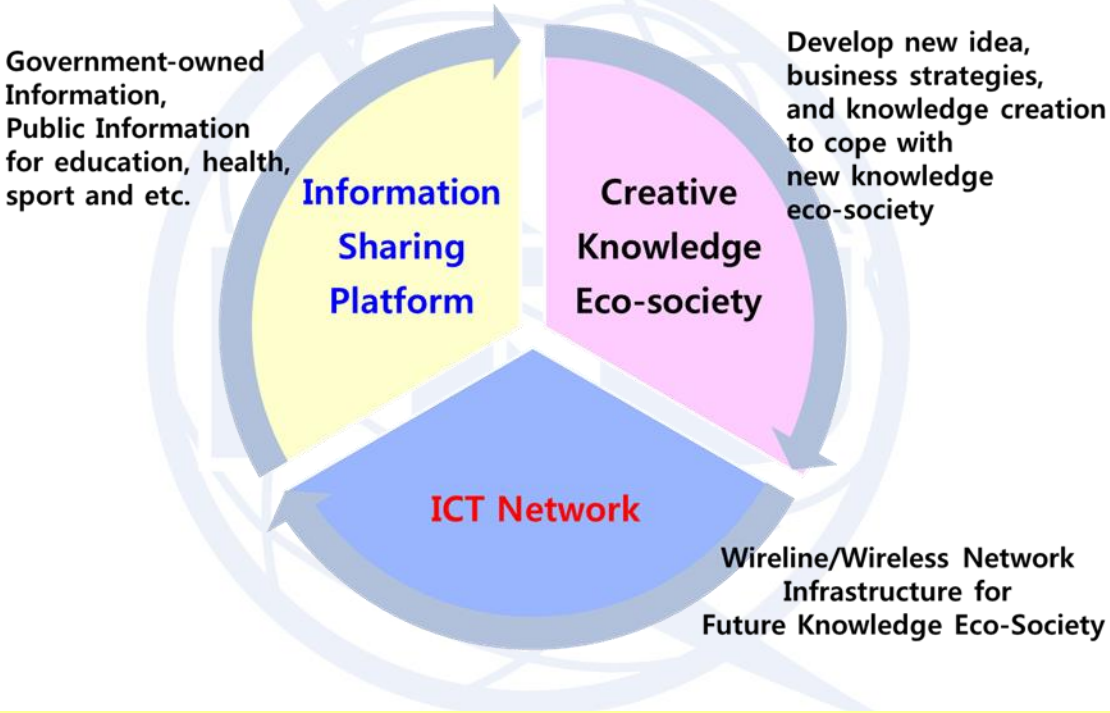
Trust and Knowledge

- **Future trust and knowledge infrastructure**



ICT is a Basis of Knowledge Society

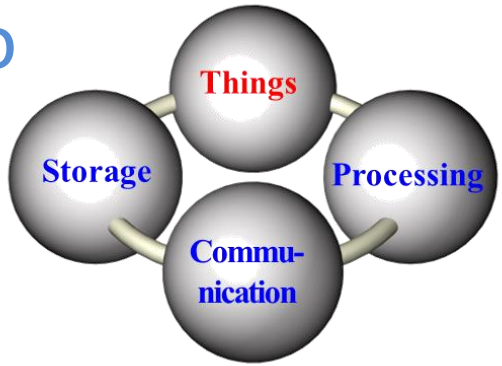
Potential Risks

Y.3052 – "Overview of trust provisioning in ICT infrastructures and services" Feb. 2017

Increasing Intelligence in IoT

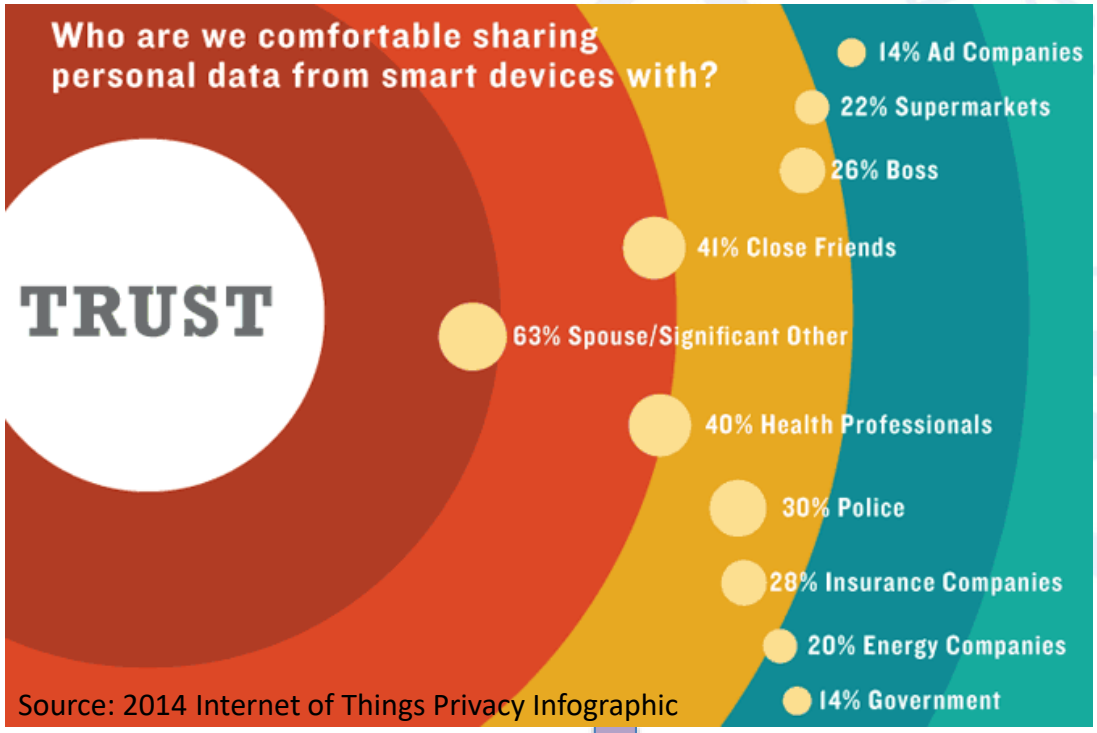
Control and Trust

- Behave intelligently and rationally to
  - **Sense** real-world behaviour
  - **Perceive** the world using information models
  - **Adapt** to different environments and changes
  - **Learn** and **build** knowledge
  - **Act** to control their environments



Barrier to growth of IoT market

Data and Trust



Source: 2014 Internet of Things Privacy Infographic

Volume – Data at Rest

Variety – Data in Many Forms

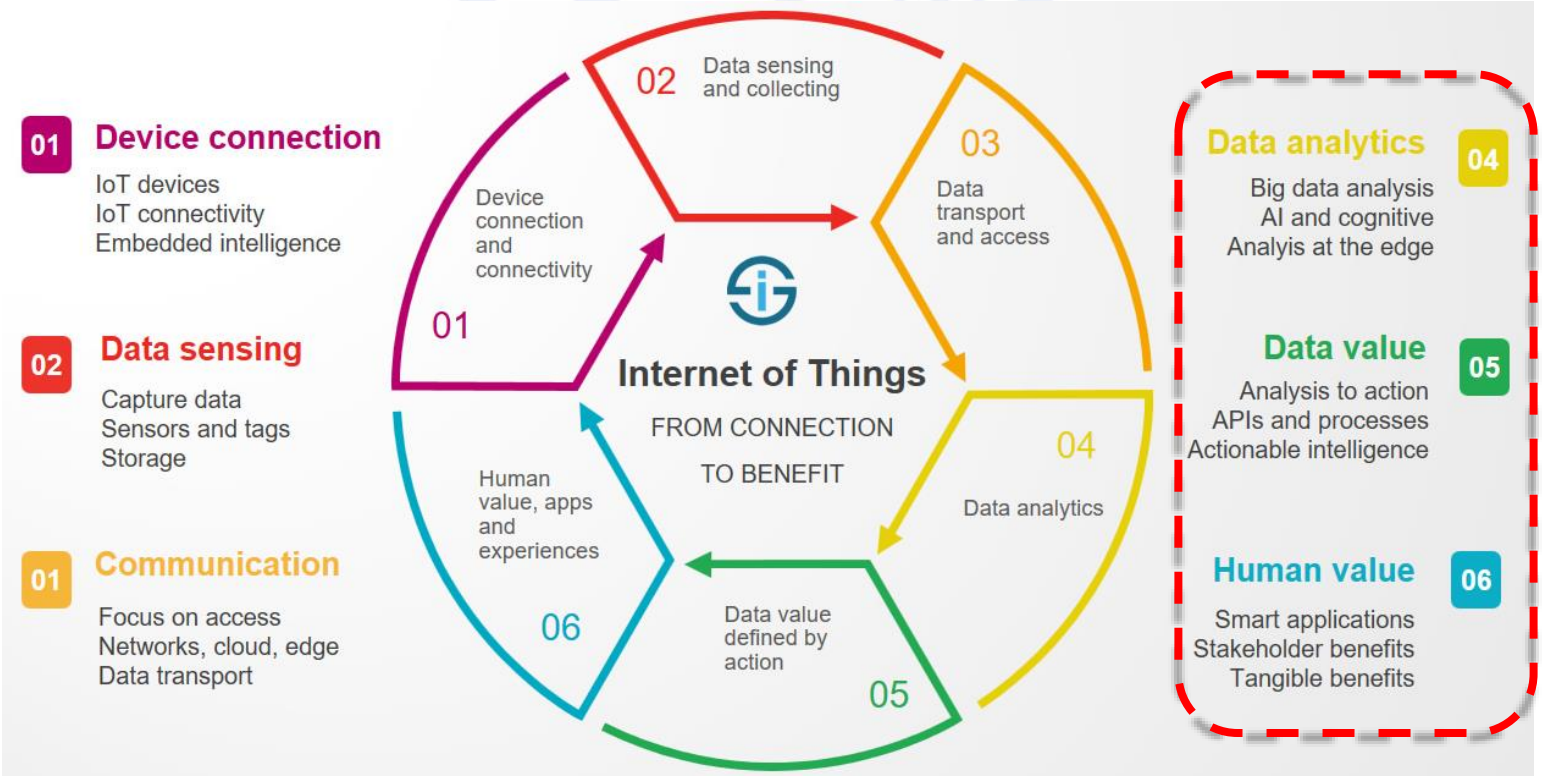
Velocity – Data in Motion

Variability – Data in Change

Veracity – Data in Doubt

Towards Internet of Value

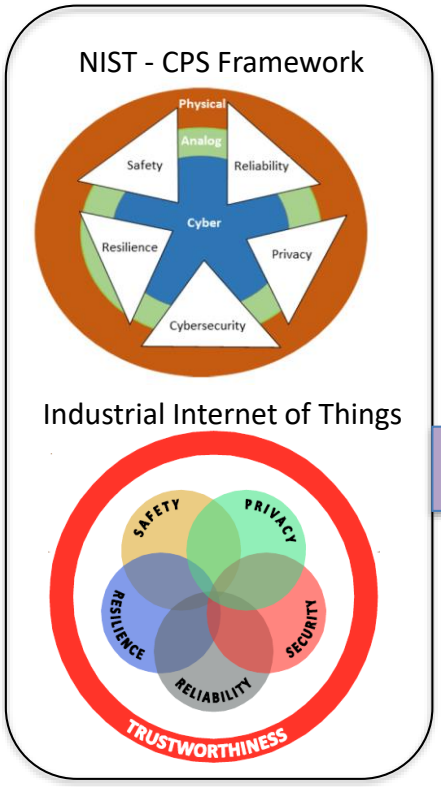
Data is Value – How to measure Value?

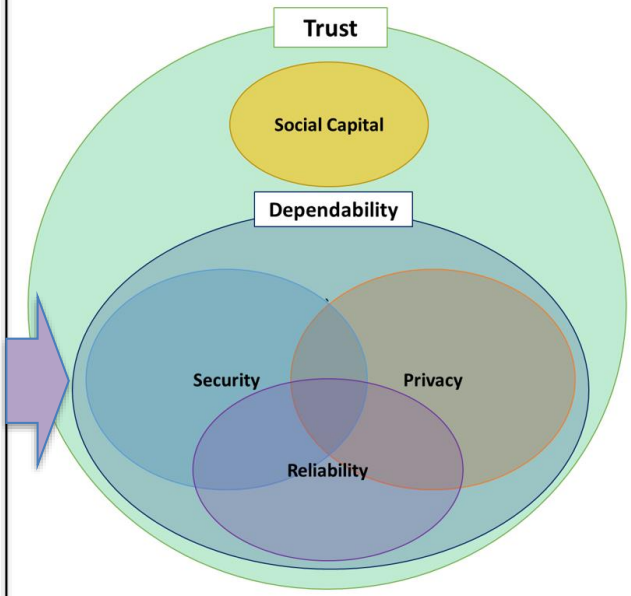


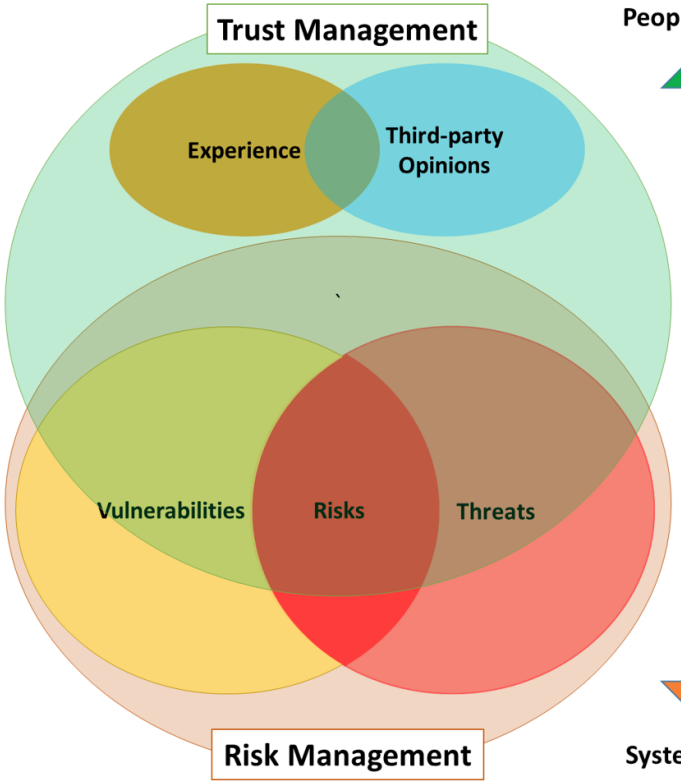
Source: i-SCOOP, https://www.i-scoop.eu/internet-of-things-guide/internet-of-things/

Security, Privacy and Trust

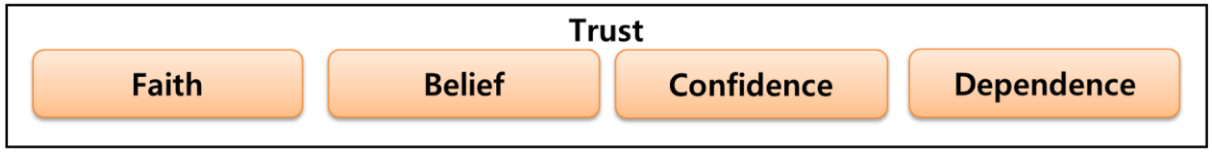
IoPTS – Internet of People, Things & Services







Understanding of Trust



Trust of a party **A** to a party **B** for a given task **S** is the measurable belief of **A** in that **B** accomplishes S dependably for a specified period **P** within a particular trust context T (in relation to the task **S**)

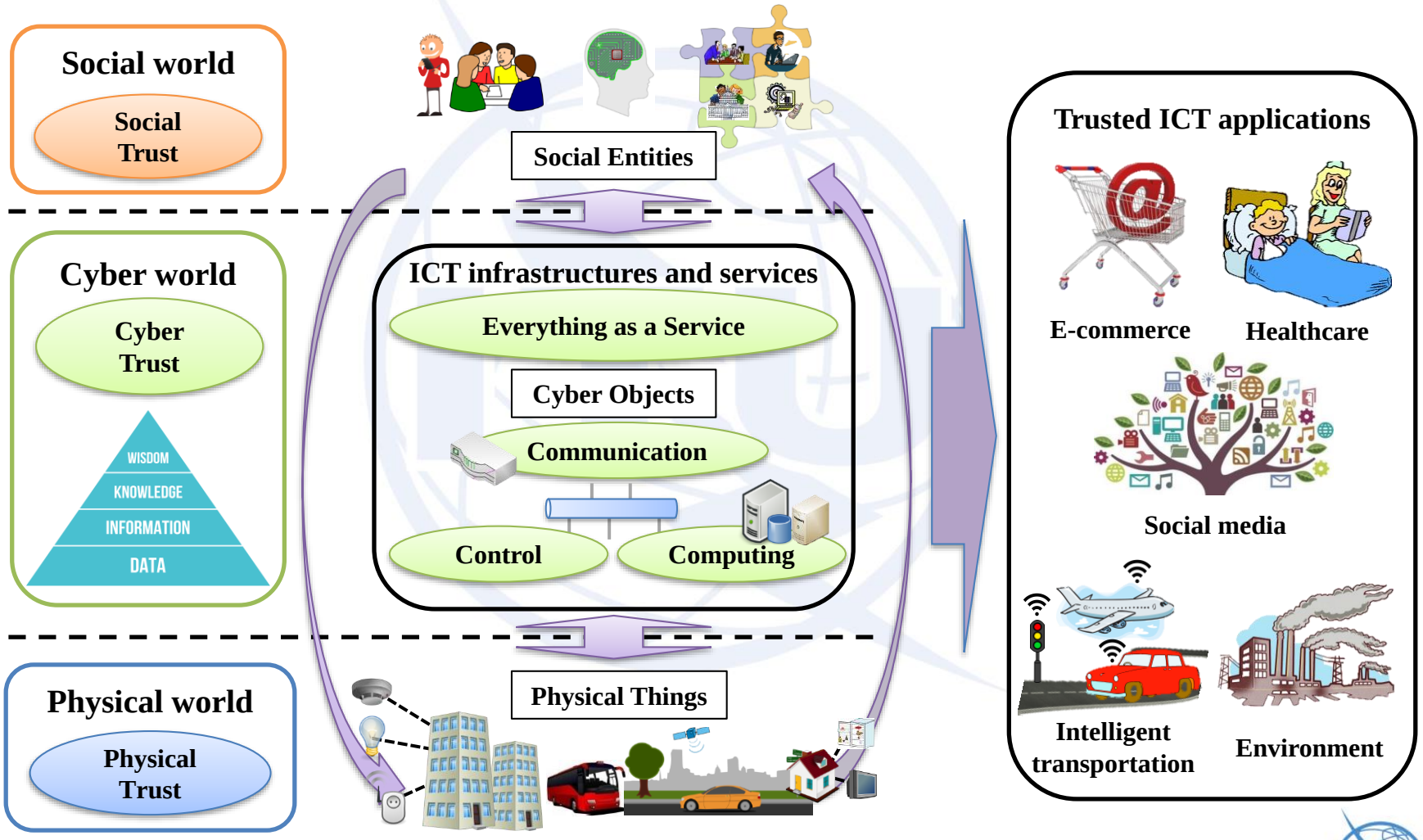
Trust is **relative** to a specific task (a service). Different trust relationships appear in different business contexts

The measurement may be **absolute** (e.g. probability) or **relative** (e.g. Level of Trust)

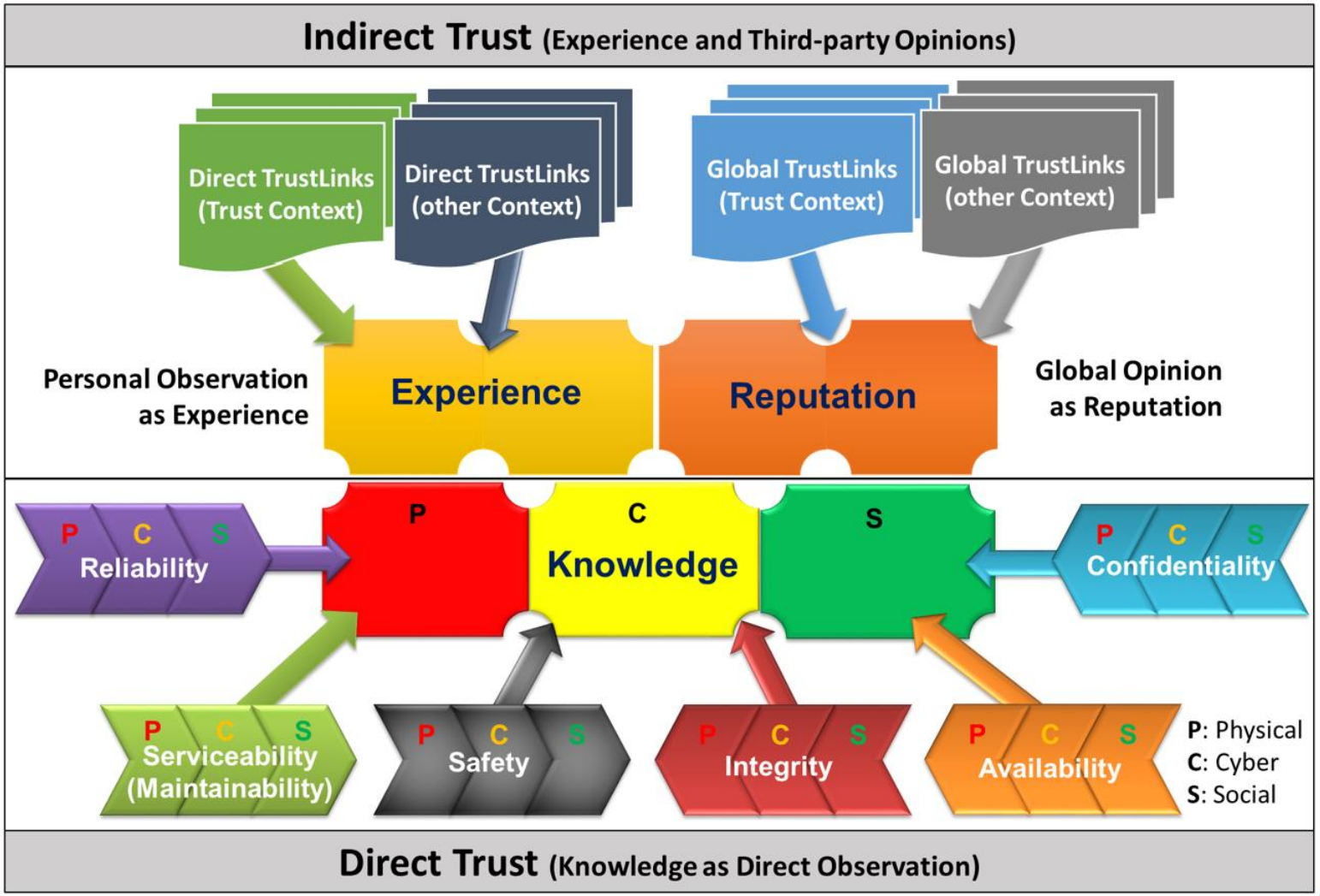
This period may be in the **past** (history), the **duration of the service** (from now and until end of service), **future** (a scheduled or forecasted critical time slot), or always

Dependability is deliberately understood broadly to include
availability, reliability, safety, confidentiality, integrity and serviceability

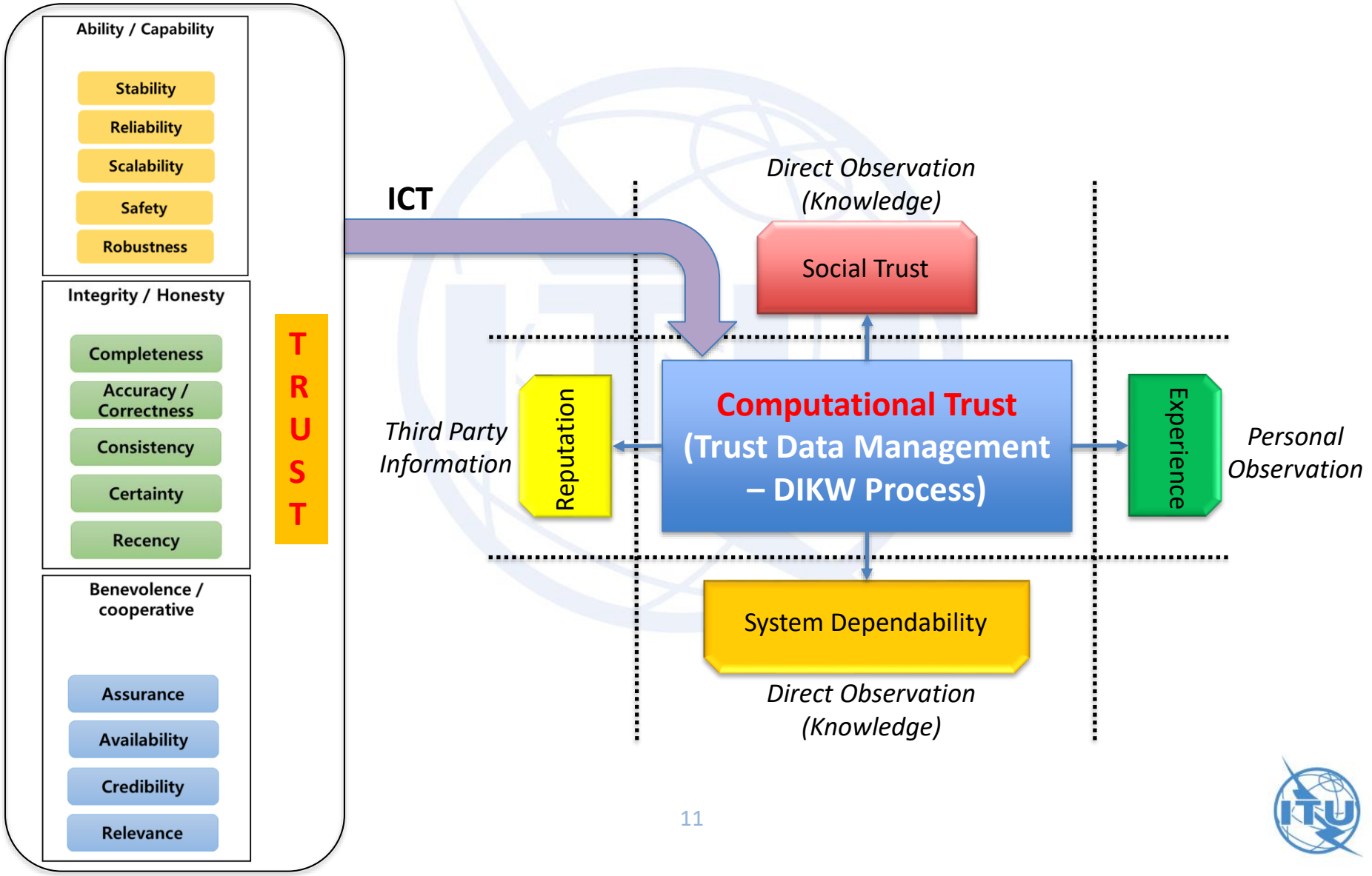
Social Cyber Physical Trust



Direct Trust vs. Indirect Trust



Computational Trust



Key Design Principles

Consider Trust as a Key Component for IoT

- Interactions and relationships among Social/Cyber/Physical worlds
- Ensuring IoT data quality
- Trustable intelligent services based on data convergence and mining
- Trustworthy environment for correct operations
- Enhanced security and privacy

Challenges for Trust in general

1. Understanding of trust
2. Trust relationships
3. Trust management
4. Measure & calculate
5. Decision making
6. Autonomy
7. Constraint environment
8. T-SCPI architecture
9. New business models
10. Standardization

NOTE - T-SCPI: Trustworthy Social-Cyber-Physical Infrastructure

Gyu Myoung Lee, “Challenges for Trustworthy Social-Cyber-Physical Infrastructure,” ITU Workshop on “Future Trust and Knowledge Infrastructure”, Phase 1, Apr. 2015.

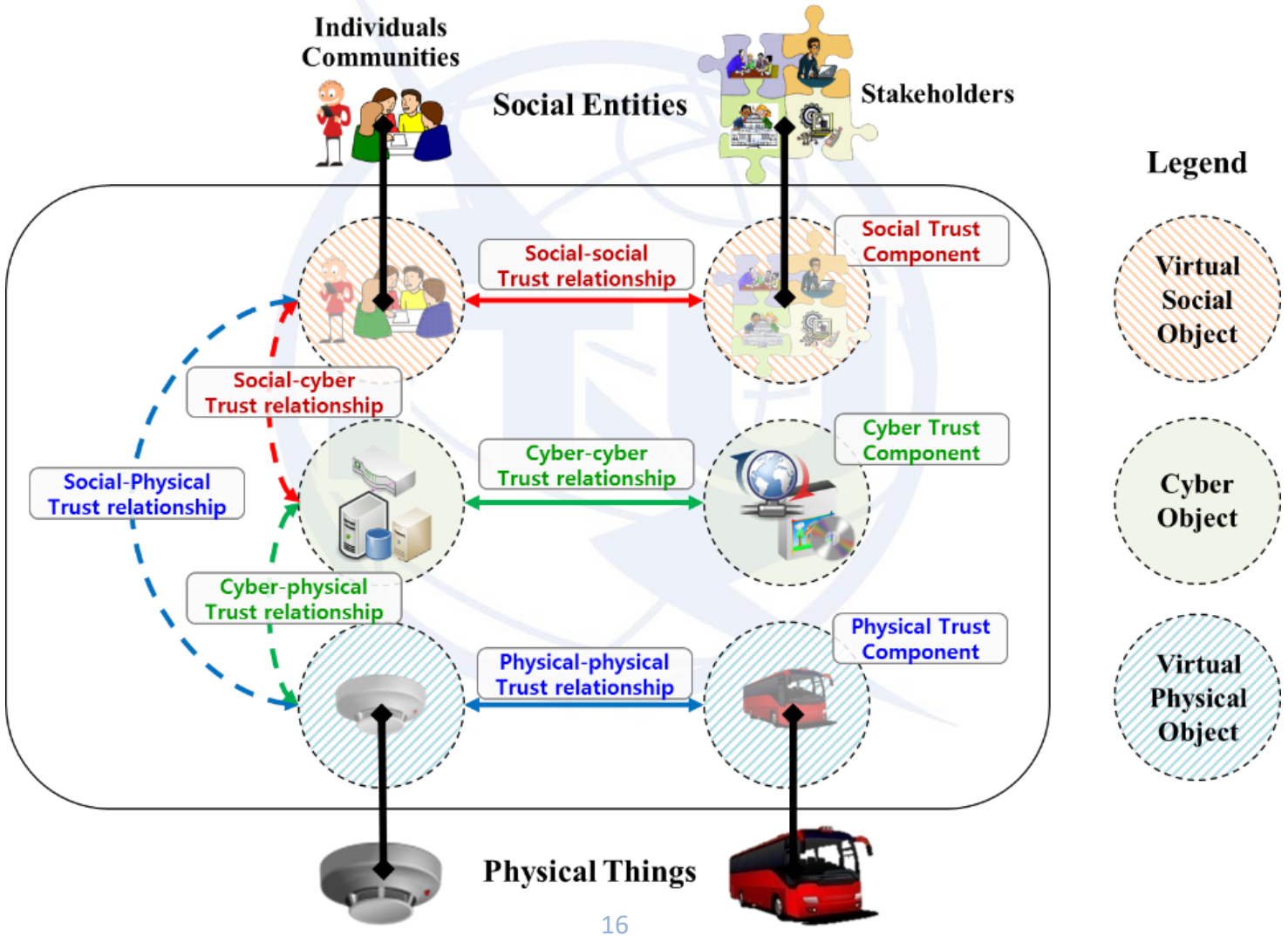
Challenges for Trust in IoT

- Highly interconnected IoT infrastructure
  - A new kind of **complex system**
- Assuring continuous trustworthiness
  - Trust is **situation-specific** and trust **changes over time**
- Data transparency
  - **Promote transparency** about what data is collected and how it will be processed and handled
- Trust, security and privacy become tightly coupled
  - **A unified approach** towards trust, security and privacy co-analysis, design, implementation and verification
- The integration of the physical, cyber, and social worlds
  - **Social-cyber-physical trust** relationships

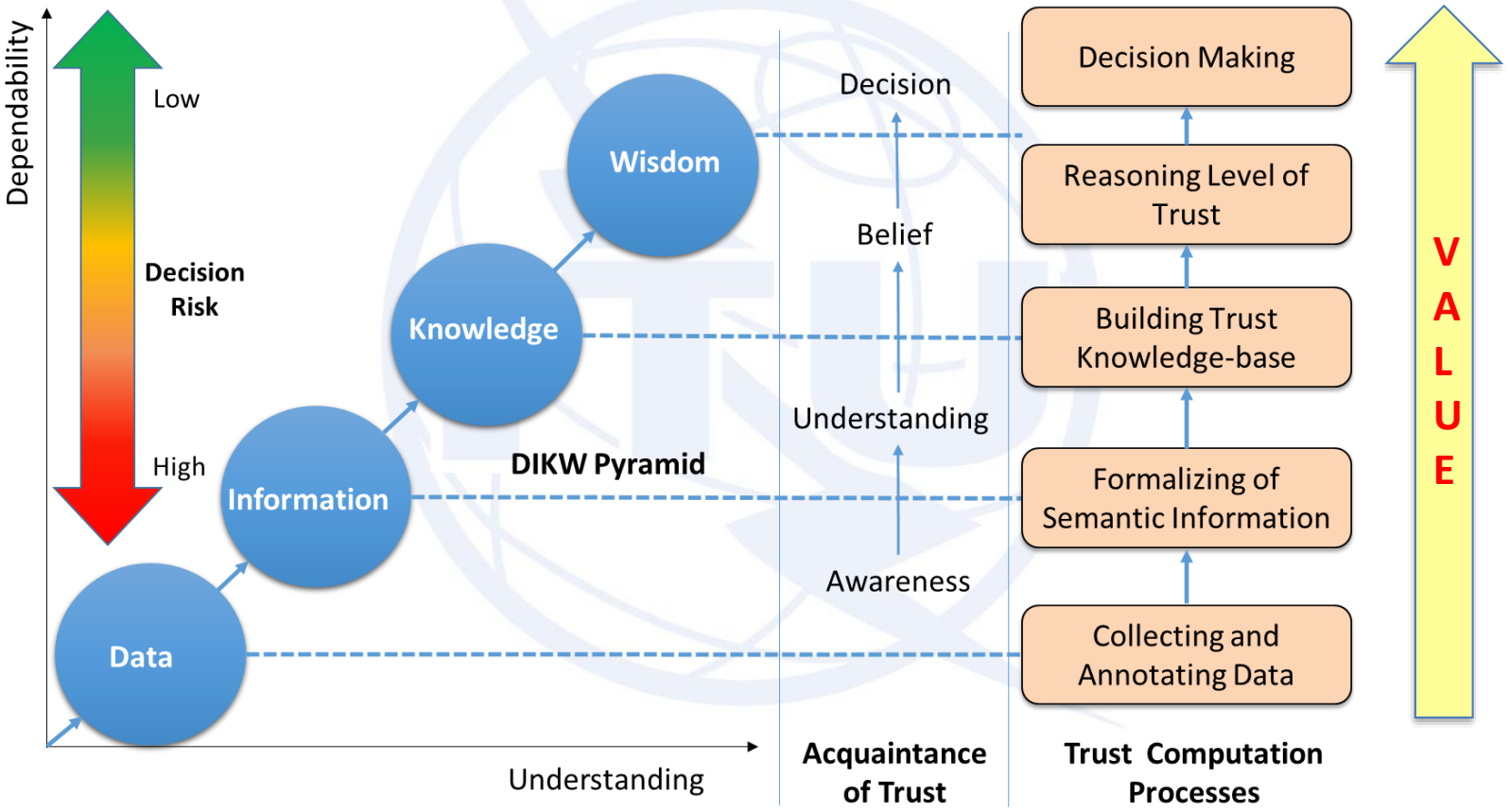
Technical Issues

- Identification of entities
- Trustworthy data collection and aggregation
- Trustworthy data process and analysis
- Trust modelling and measuring
- Trust computation and trust evaluation/validation
- Dissemination of trust information
- Trust establishment and provisioning
- Trustworthy system lifecycle management

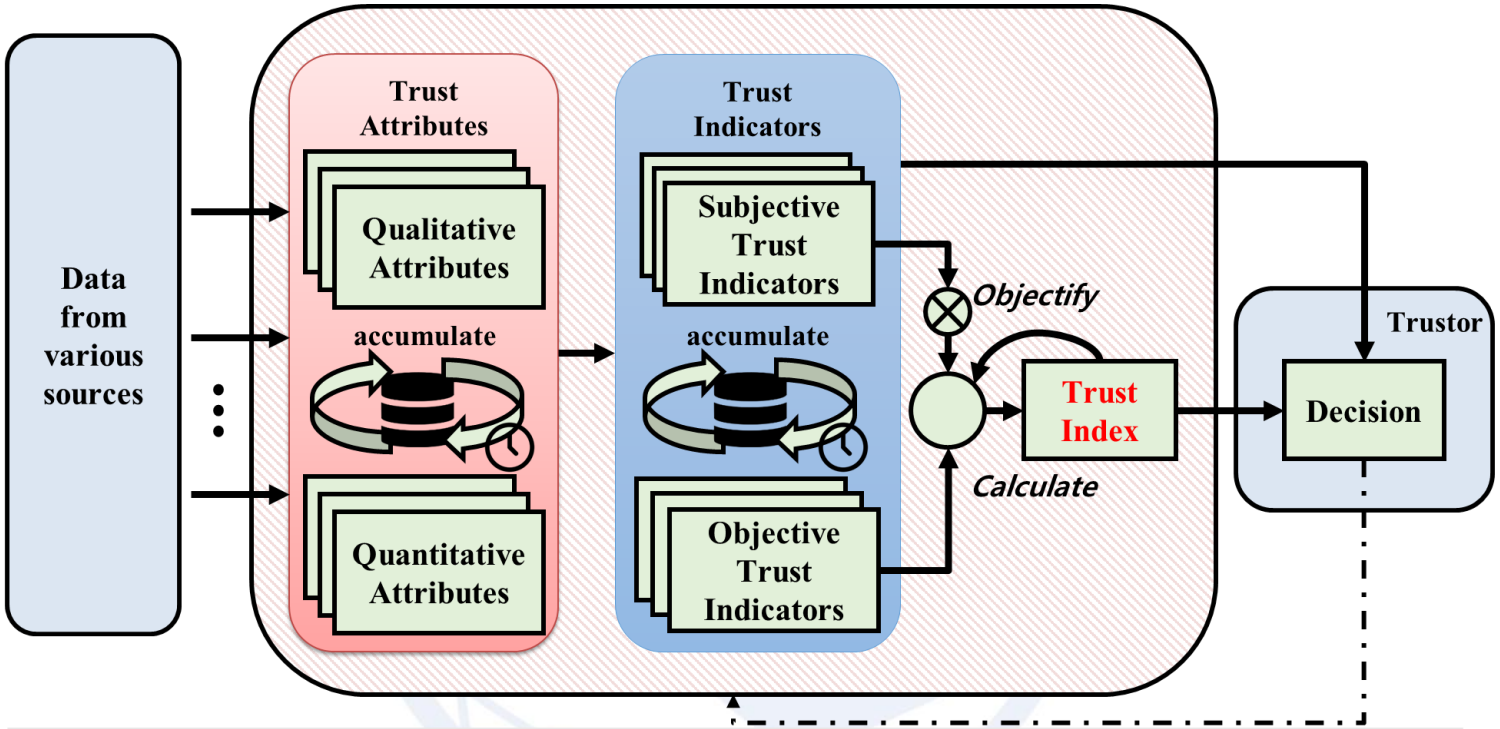
Trust Relationship Model

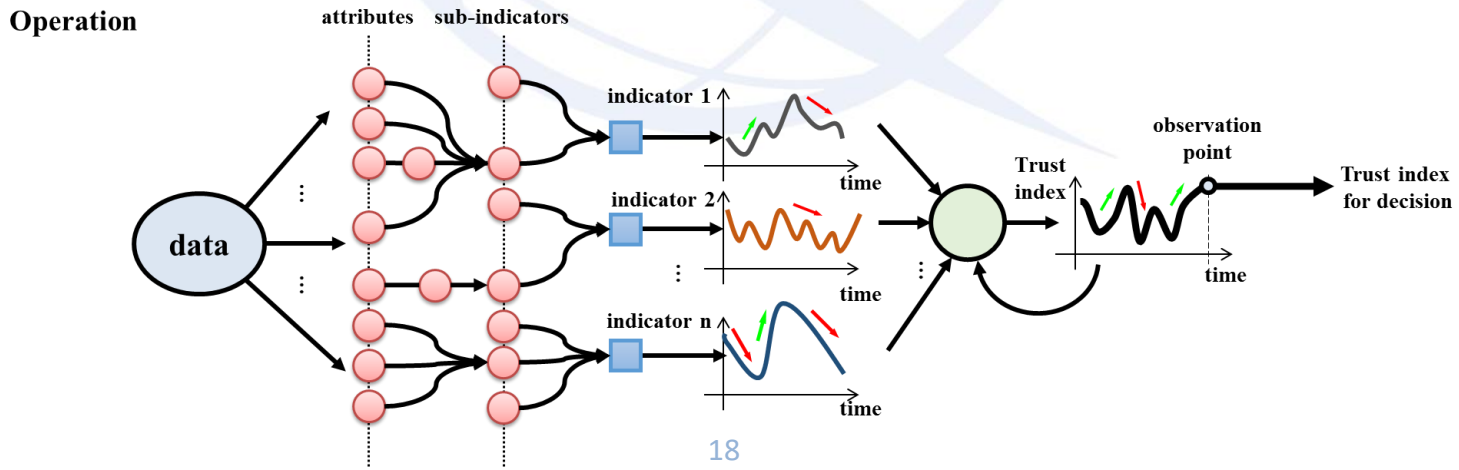


Trust Computation Procedure



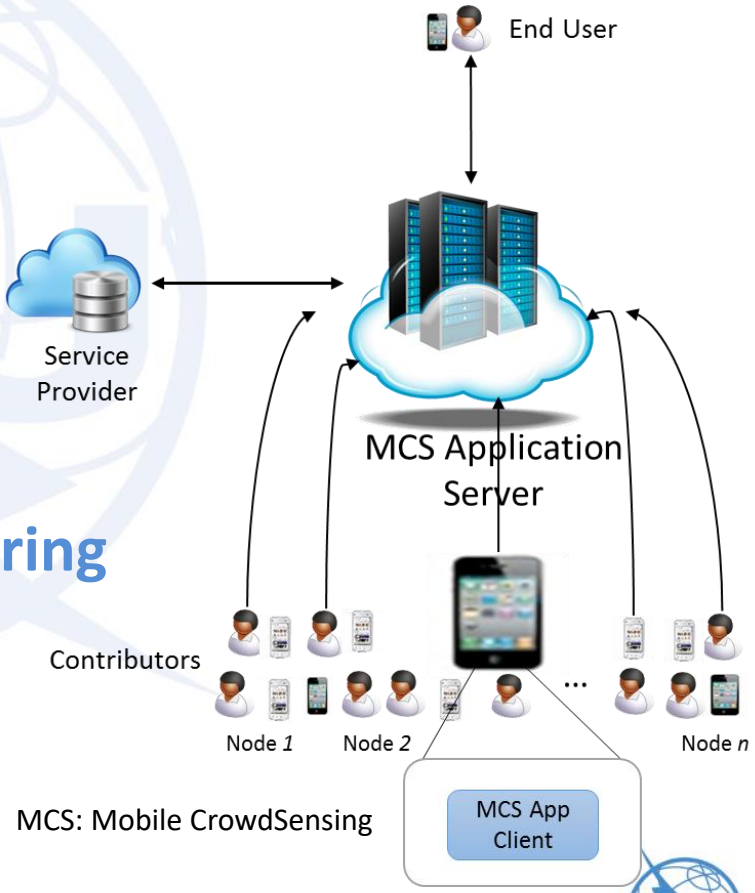
Trust Index


Data from various sources
Trust Attributes
Qualitative Attributes
accumulate
Quantitative Attributes
Trust Indicators
Subjective Trust Indicators
accumulate
Objective Trust Indicators
Objectify
Calculate
Trust Index
Trustor
Decision


Operation
attributes
sub-indicators
data
indicator 1
indicator 2
indicator n
time
time
time
Trust index
observation point
Trust index for decision
time

Trustworthy Smart City Crowdsensing

Smart Citizen – collective monitoring of the city

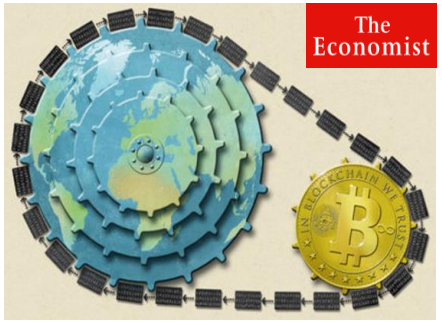


- **Smart transportation, smart metering and public safety**
  - Benefits to public, business and government
  - **Ensuring Trustworthiness**

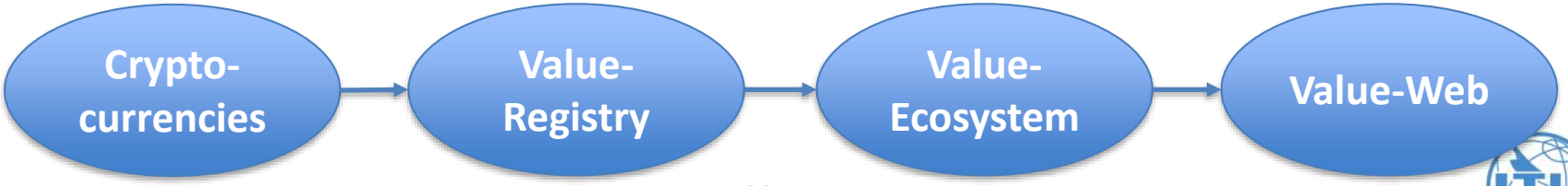
MCS: Mobile CrowdSensing

A New Paradigm – Blockchain

"It is a machine for creating trust."
(Source: The Economist)



- The currency in the IoT is **data**.
- Revolutionizes how transactions are recorded
  - a **decentralized digital ledger** that records transactions
  - **building trust**, **reducing costs** and **accelerating transactions**



Conclusion

"**Trust** is the **oxygen** which will breathe life into the IoT. Industry needs to show **data** is safe and that it is properly treated." (source: www.techuk.org.)

Trust is an essential element for value added business models in the IoT.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