ITU Workshop on "Future Trust and Knowledge Infrastructure", Phase 2
Geneva, Switzerland
1 July 2016

New Value Chains and Technical Issues for Future Trusted Information Infrastructure

Jun Kyun Choi

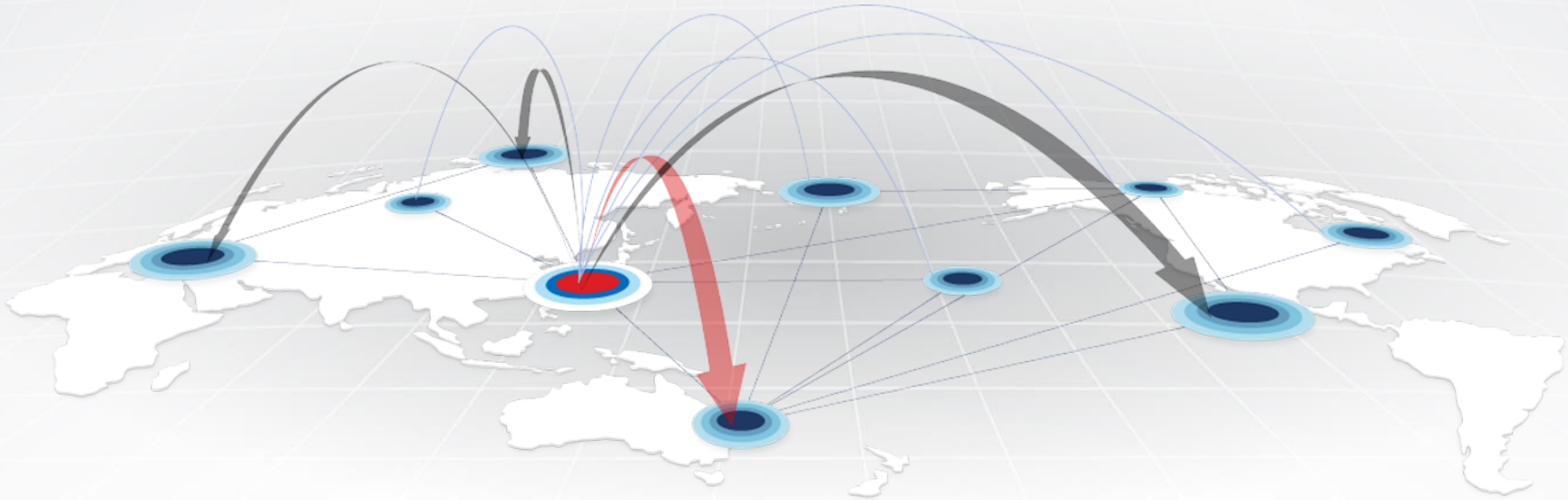
Professor, Korea Advanced Institute of Science and Technology (KAIST)
jkchoi59@kaist.ac.kr

1956 2016
CCITT / ITU-T

ITU

Contents

Value Chains of Trust



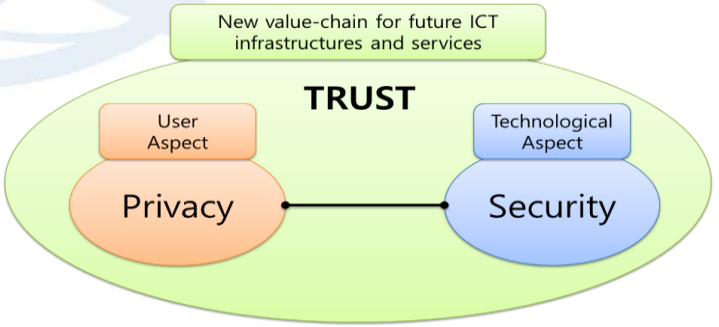
Meaning of Communication

Communication is 通 信

(deliver) (Trust)

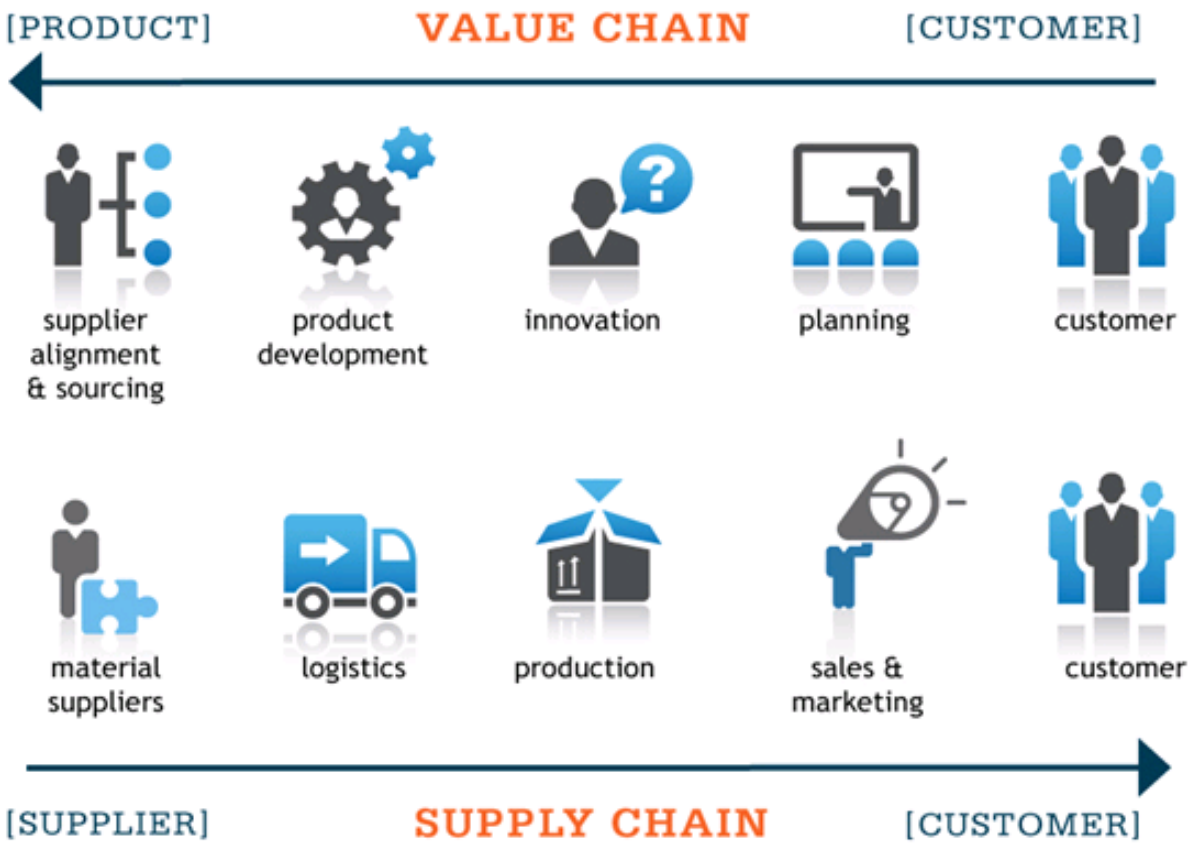
New Value of Trust

- **Physical Trust (more than QoS/QoE → QoT)**
  - **Availability**: operations of technology and system
  - **Controllability**: system, devices, platform, applications software
- **Cyber Trust (more than security)**
  - **Correctness** and safety on on-line data transactions
  - **Credibility** on Cyber-Physical-System (CPS) including IoT and Cloud
- **Social Trust (more than privacy)**
  - **Belief**, confidence, and **reputation** on social behaviors
  - Protect human errors and mistake



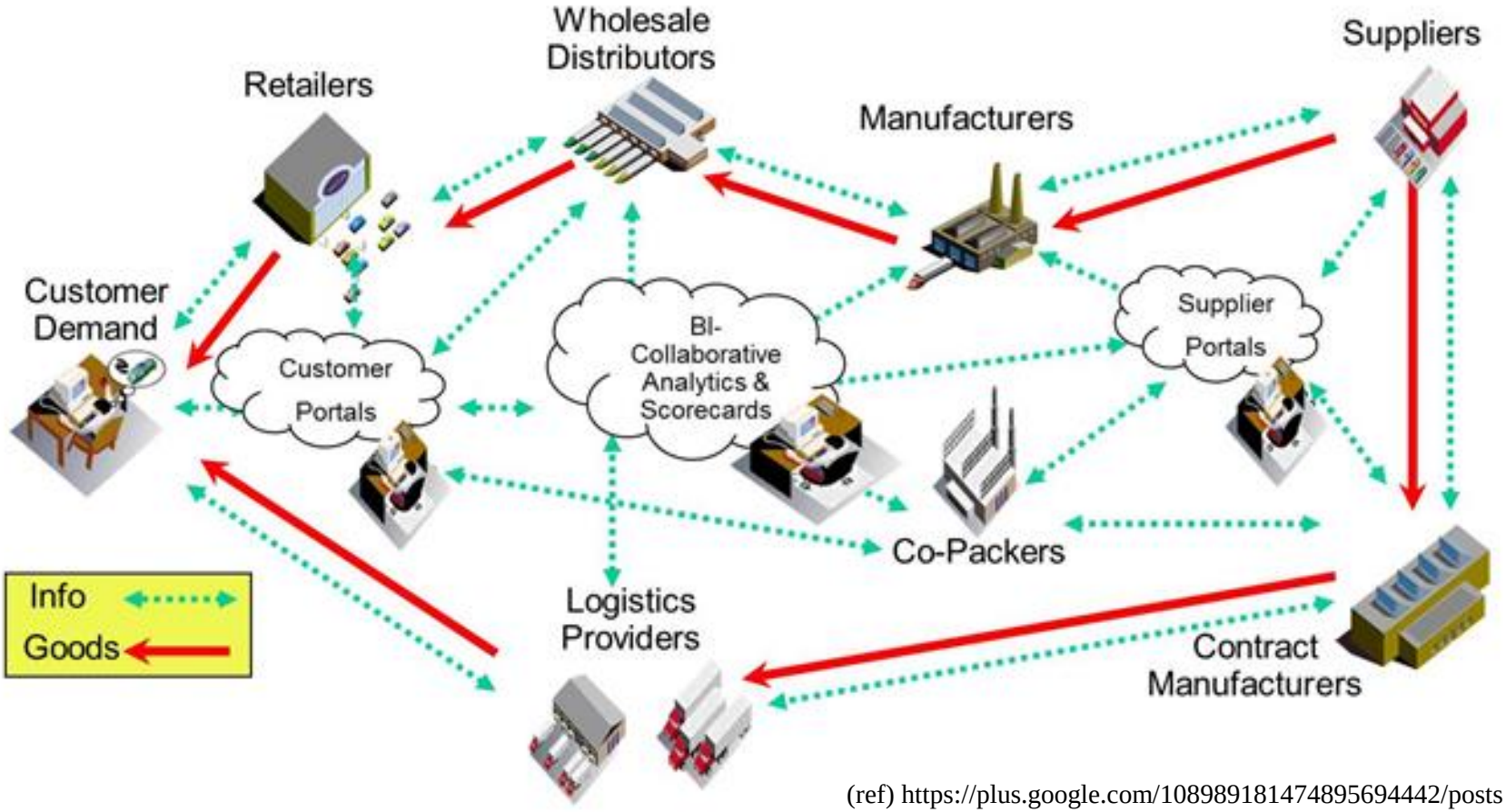
(Example)

Value Chain of Existing Markets - 1



(Example)

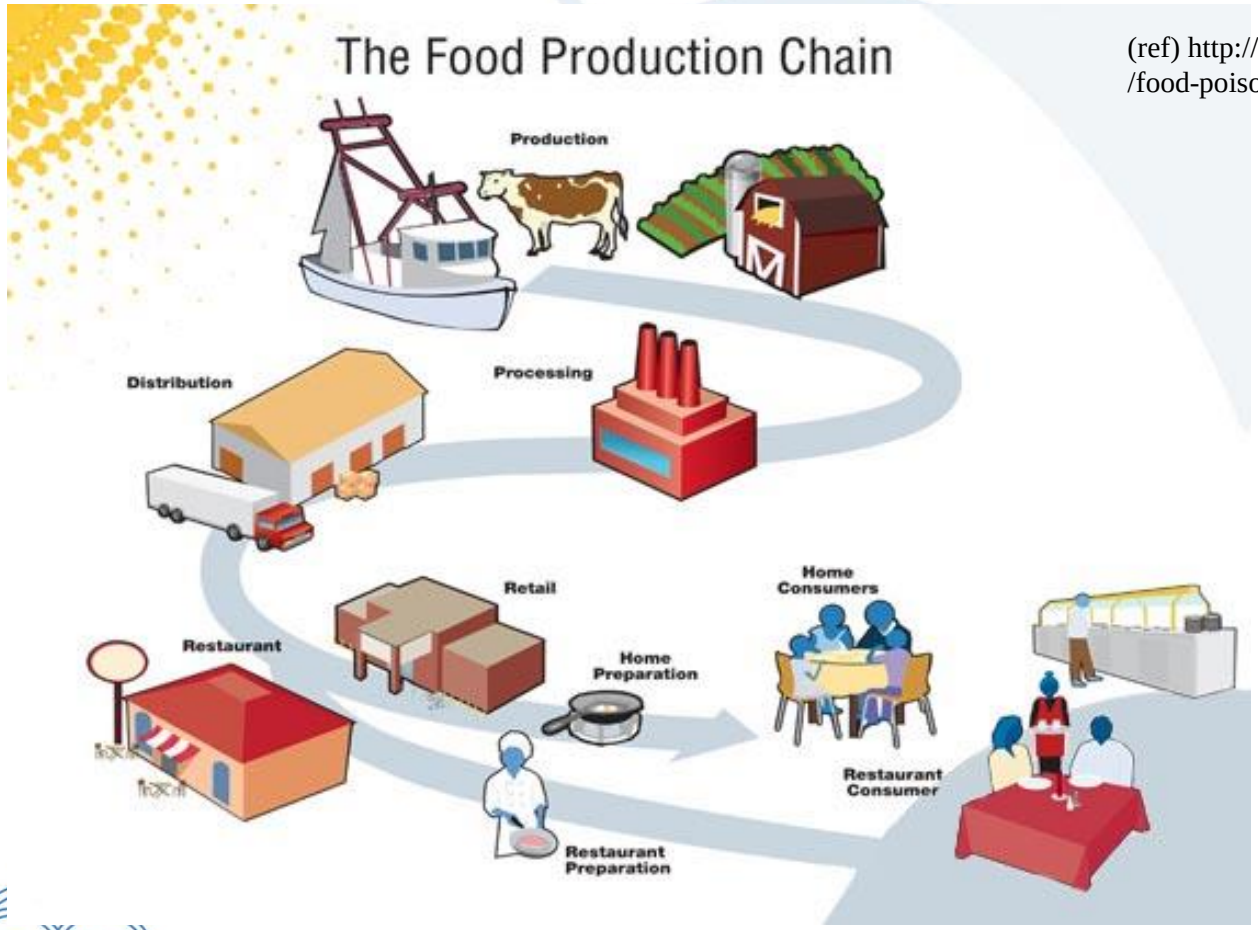
Value Chain of Existing Markets - 2



(ref) https://plus.google.com/108989181474895694442/posts

(Example)

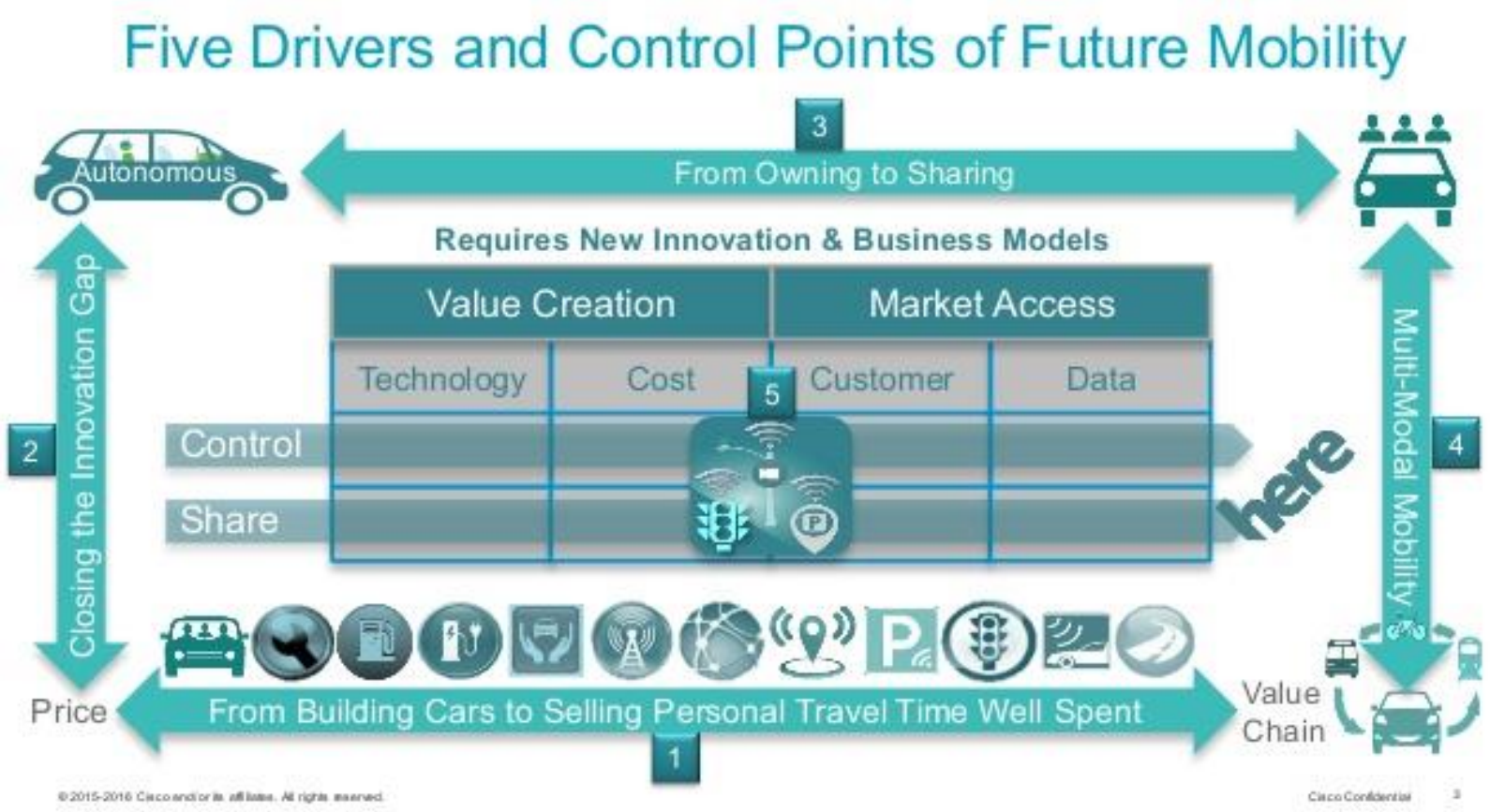
Value Chain of Existing Markets - 3



(ref) http://blog.friendseat.com /food-poisoning-whos-at-risk-infographic/

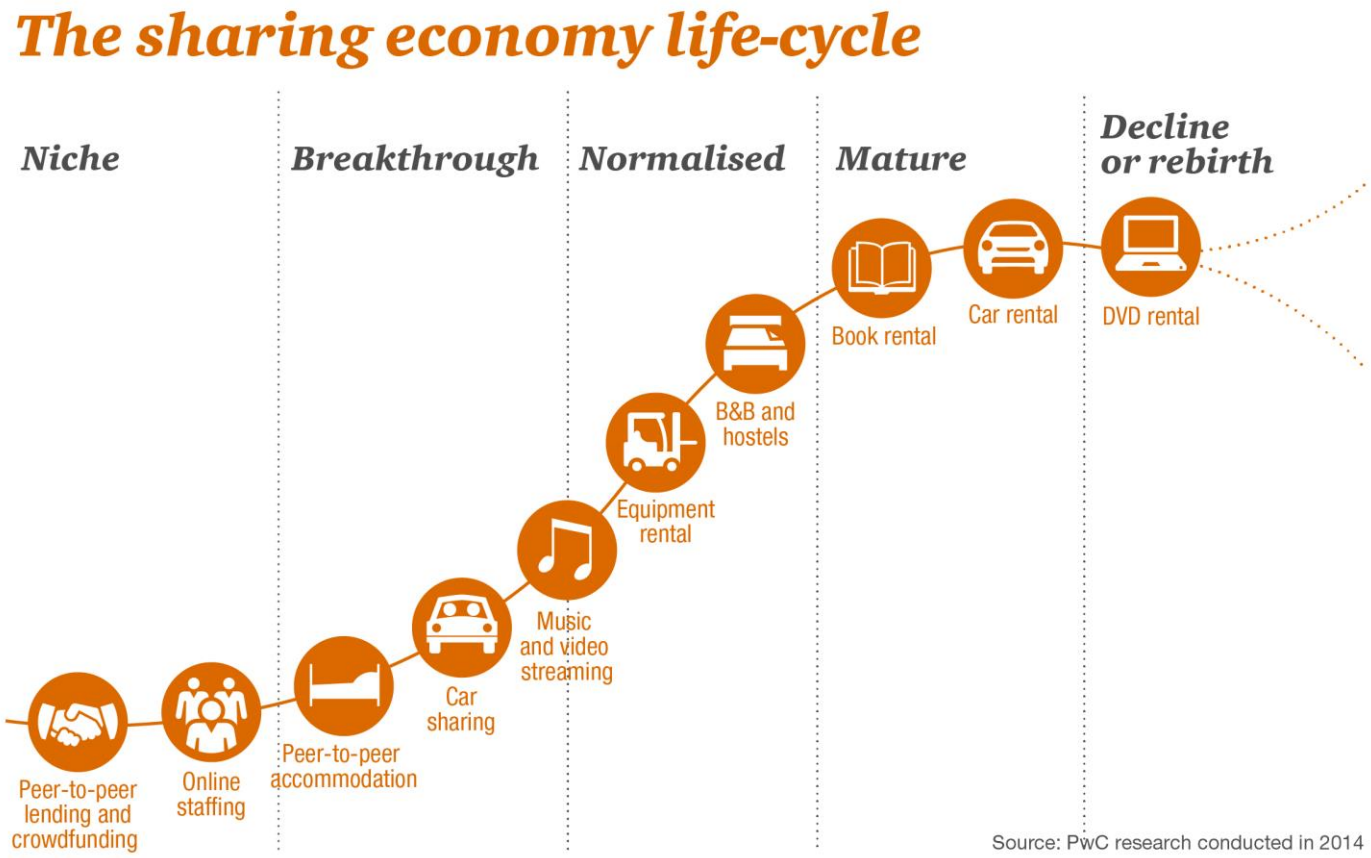
(Example)

Value Chain of Existing Markets - 4



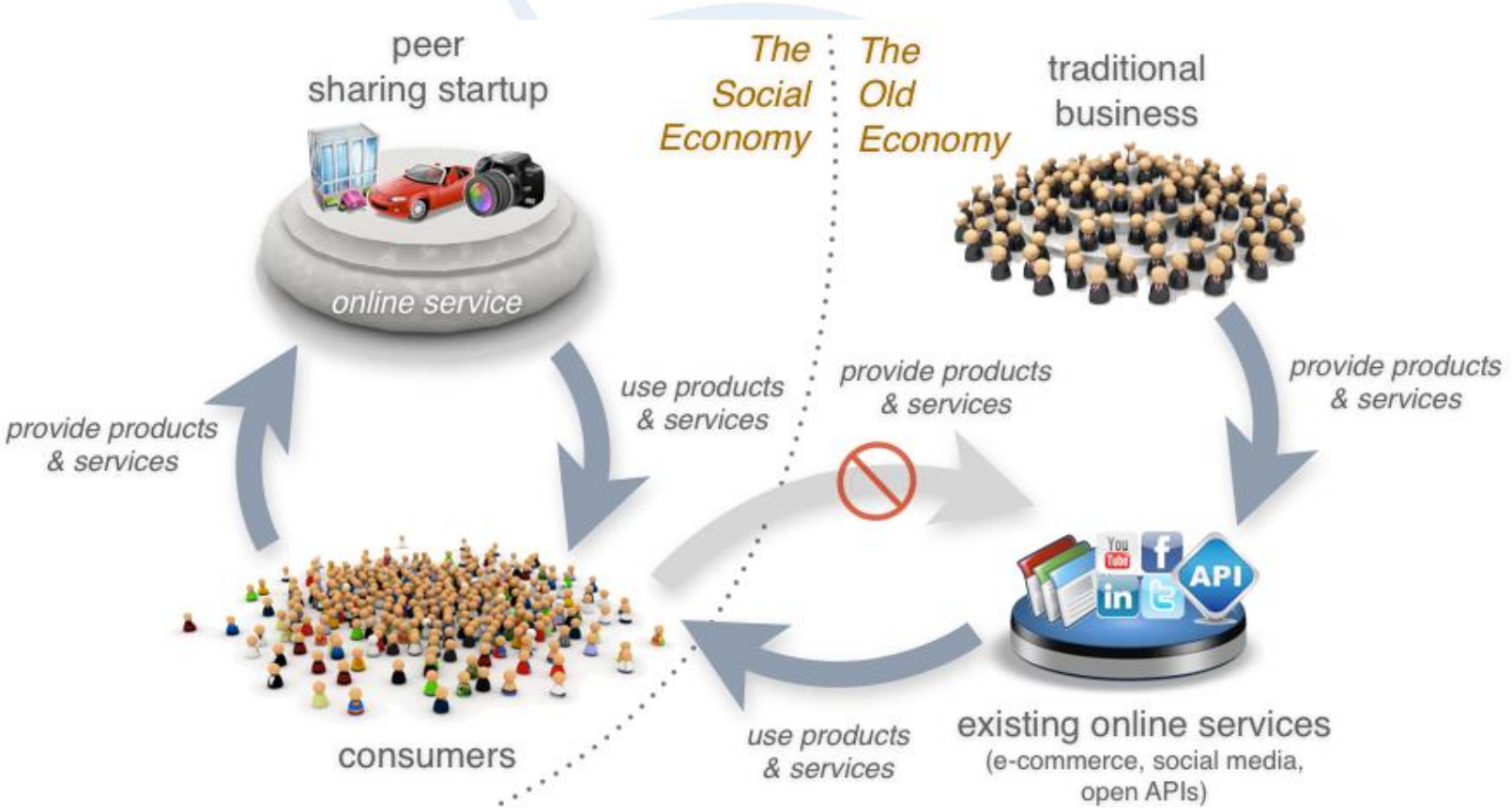
(ref) http://www.slideshare.net/AndreasMai/digitization-of-the-automotive-industry-connecting-the-new-mobility-value-chain

Evolution of Sharing Economy



http://www.pwc.co.uk/issues/megatrends/collisions/sharingeconomy/the-sharing-economy-sizing-the-revenue-opportunity.html

New Social Economy

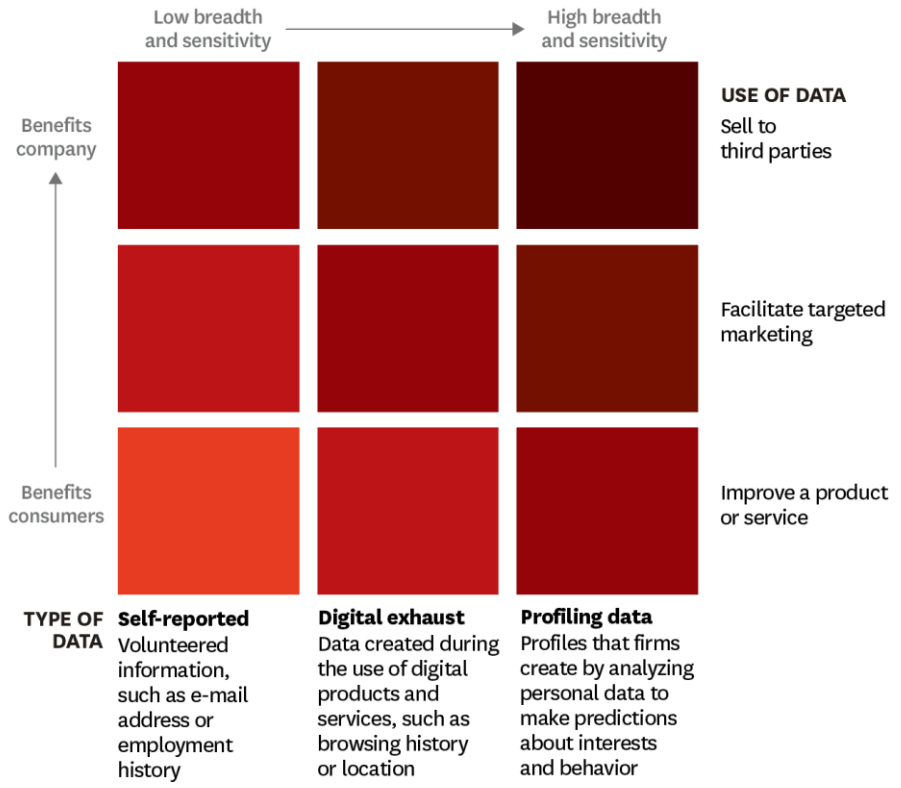


(ref) http://zdnet.com/blog/hinchcliffe

Social Graph for Supply Chain

http://www.supplychain247.com/article/why_supply_chains_should_be_more_socially_engaged

Value of Data Trust

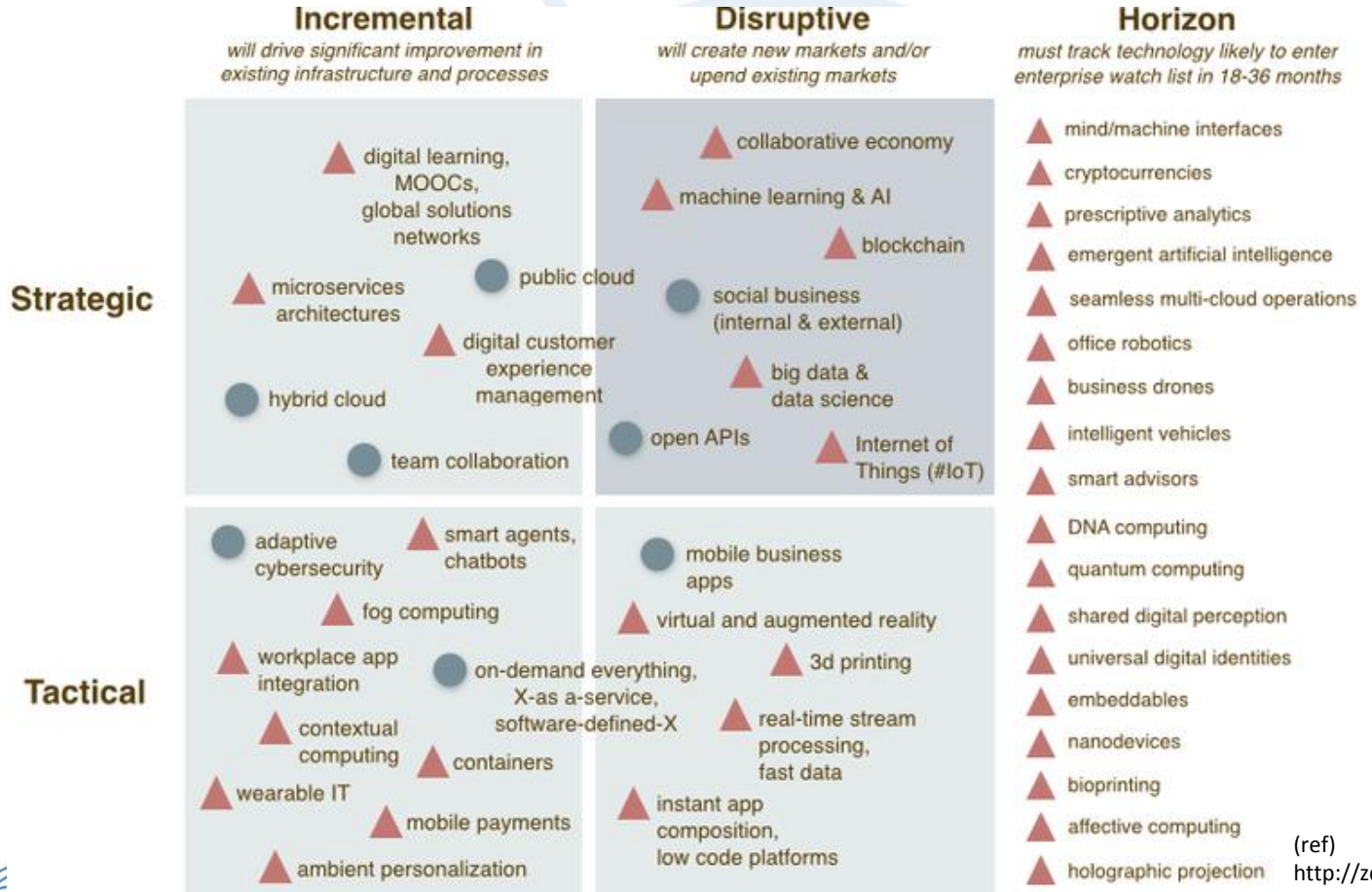


https://hbr.org/2015/05/customer-data-designing-for-transparency-and-trust

Open Innovation for New Value Chain

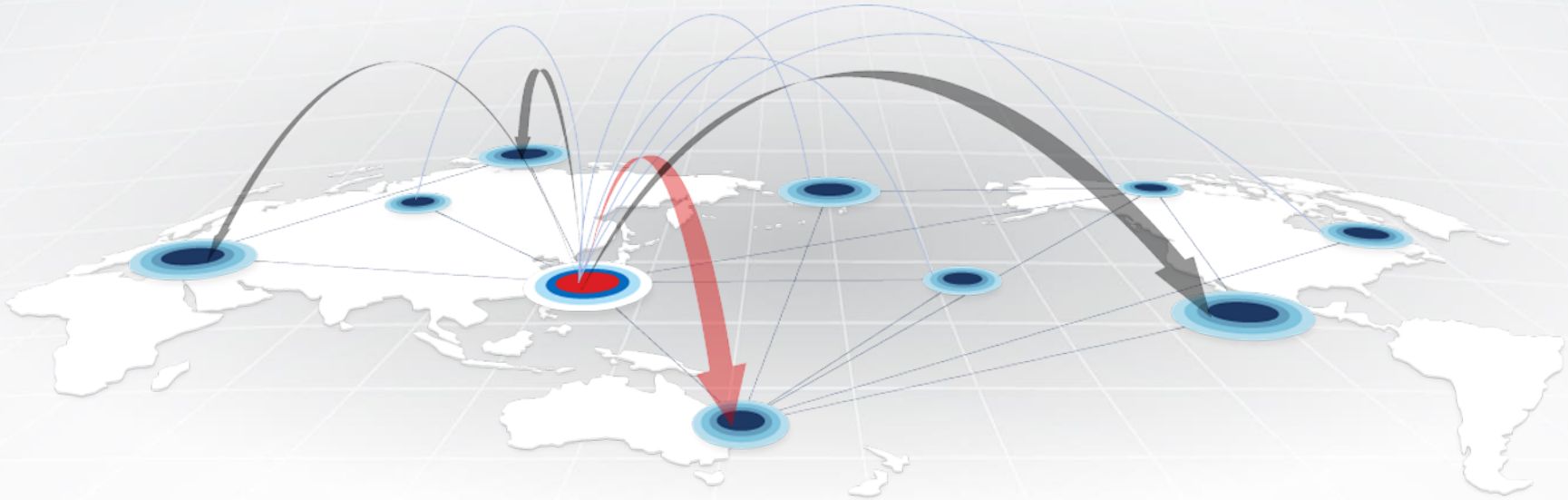
- **Open Networking and Open Innovation is key strategies**
  - **Open API**: open valuable data through APIs which is attractive, 3rd parties invested in, finally fair licensing and rewards
  - **Collective Intelligence**: accelerate external innovation as more deliberate and consistent way of an open call, or partnership for technology innovation
  - **Excellence**: specialize some new technologies or methods while ensuring standardization and governance among community
  - **Smart Agent**: agent with know-hows provides guideline, advice, and solutions
  - **Business Support**: viable technology to business in sustainable manner
  - **Incubator**: funding for new ideas and technology innovation
- **ICT infrastructure is essential for future knowledge society**
  - (**Product**) More sophisticate products and complicate solutions
  - (**Technology/Platform)** Viable technology and service platform
  - (**Human**) Collaborative learning of human capability among peoples

Technologies for Future Value Chain



(ref)
http://zdnet.com/blog/hinchcliffe

Technical Issues for Trust Provisioning



Key Technical Issues on Trust Provisioning

- **Technical Issues for Trust Information Infrastructure**
  - Network architecture for trust provisioning
  - Delivery protocol for trust provisioning
  - Algorithm and solutions for trust provisioning
- **Trust Provisioning on ICT Services and Applications**
  - Trust provisioning on IoT applications
  - Trust provisioning of cloud applications
  - Trust provisioning on convergence applications (e.g., health, energy, etc.)
  - Trust provisioning for human life and business
- **Market and Deployment Issues relating to Trust**
  - Trade-offs on cost per benefit among trust, privacy and security
  - Step-wise deployment of trust markets

Key Technical Issues

Network Architecture for Trust Provisioning

- **How to build Trust Domain**
  - **Who**: human, server, device with relevant id (name, key, IP address) ?
    - **Scalability**: how many peoples, server, and devices
    - **Granularity**: detailed behaviors and information flows
  - **When**: at instance or at later time to verify trust
    - **Frequency** : how many times per hours
    - **Levels**: physical layer, cyber layer and/or social layer
    - **Instance**: a time to send, access, receive, handover, register, on/off
  - **Coverage**: closed/multiple geographical area or open virtual domain
    - **Extension**: Secured tunnels to remote location or among multiple domain
  - **Action or Execution:** at the interface like firewall or DPI system
    - Access permission, block, warning, monitoring, and/or notification, etc.

Key Technical Issues

Communication Protocol for Trust Provisioning

- **Trusted Information Infrastructure for Data Trust**
  - **Key Requirements for Data Trust**
    - No extension of existing data delivery protocols
    - No change of existing security protocols
  - **Strategies on Protocol for Data Trust**
    - Separate or out-of-band management protocols to monitor, inspect, collect, and/or analyze level of trust
    - Action: access control, notify, and change data flows
- **Application Procedures for Cyber or Social Trust**
  - **Key Requirements for Cyber and Social Trust**
    - No change of existing applications (e.g., email, SNS, web browsing, database, etc.)
    - Add-on functions may be optionally or selectively
  - **Strategies on Protocol for Cyber and Social Trust**
    - Insertion of specific checking code on applications procedures
    - Separate or out-of-band management protocols for trust certification

Key Technical Issues

Algorithm and Solutions for Trust Provisioning

- **Key requirements for algorithm and solutions**
  - Competitiveness or harmony with security solutions
  - Good adaptability among multiple stakeholders
  - Good flexibility for future add-on features
- **Key direction for trust provisioning**
  - Consider mobile in nature (i.e., smartphone, smart pad)
    - Regardless of geographical or physical locations
  - Simple is beauty! → future safe
  - Focus on simple trust zone if possible
    - via id, address, name, membership or bio information, etc.
    - with trust server, trust gateway, trust thing, and trust object, etc.

Key Technical Issues

Trust Provisioning on IoT Applications

- **Device Trust**
  - **Sensor reliability/availability**: failure, battery low, malfunction, etc.
  - **Data assessment**: correct values on temperature, time, and location
- **IoT Data Trust**
  - **OAM&P**: ownership of control and management according to value chain
  - **Data protocol**: query, get, put, post, and delete, etc.
- **Context-aware IoT Trust**
  - **Operation**: context-aware information from a lot of sensors (e.g., fire, alarm, emergency, illegal, violation, etc.)
  - **Application**: share values and benefits from data analytics
    - at right time, right location, and right actions, etc.

Key Technical Issues

Trust Provisioning of Cloud Applications

- **Trust on cloud platform**
  - Trustworthy data delivery and access with SaaS/PaaS concepts
  - On-demand data protection and privacy
- **Operation and Management Trust**
  - **Responsibility** : who, when, what, where, and why
    - Ownership for access, process, and management of cloud data
  - **Trust management** : access and handling procedures
    - Trust management of cloud platform with policy and governance
    - Proper and valid data with robustness and redundancy
- **Application Trust**
  - Trust index according to value chains of cloud eco-system
  - Trust provisioning on cloud applications (without additional certification)

Key Technical Issues

Trust Provisioning on Convergence Applications

- **Trust on heterogeneous physical systems (energy, transport, health, etc.)**
  - **Performance and Availability**: more strict QoS on delay, throughput, and failure
  - **Control and Management**: safe and acceptable operations of resources
  - **Protocol**: error tolerant and very low latency as well as data security
- **Trust provisioning with experiences and know-hows**
  - Trust accumulation of human behaviors
    - Operational experience and know-hows with accumulated history
  - Rule and procedure for trust refinement and adjustment
    - Trust learning mechanism by utilizing neural network concepts
- **Trust applications among multiple stakeholders**
  - Trust index and trust assessment (based on history, reputation, etc.)
  - Trust negotiation, trust value chain, and trust relationship

Key Technical Issues

Trust Provisioning for Human Life and Business

- **Rethink about human right and justice**
  - Future cyber society is artificial society based on ICT infrastructure
    - Review regulations and laws of existing society
    - Sometimes, the existing regulation may be not relevant
  - Consensus for future knowledge society are needed
- **New Regulation for Future Trust Eco-Society**
  - Trust governance
    - Global governance are needed (logging, tracking, certifying, etc.)
    - New distributed trust authority like blockchain may be considered
  - Trust for human life and social community
    - Some privacy data may create new eco-system with acceptable governance

Key Technical Issues

Trade-offs among Trust, Privacy and Security

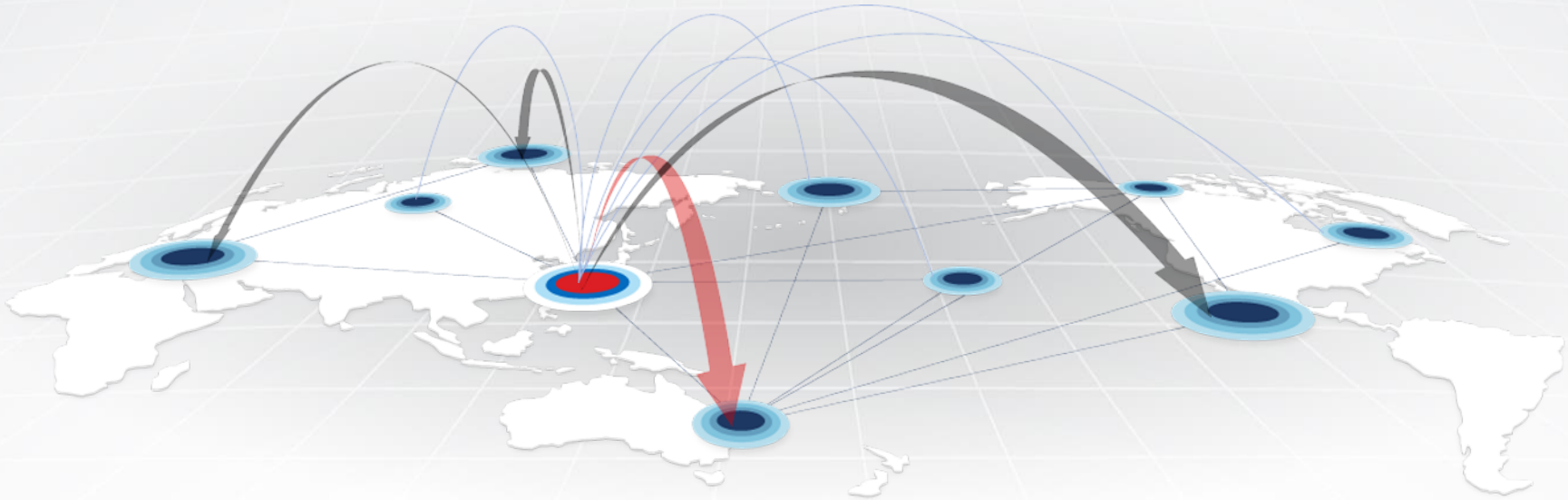
- **Values of Security → not enough to protect value chain among multiple stakeholders**
  - Impossible to handle or intervene all the data and human transactions → who pay for?
  - Minimum level of security may be regulated by governance, but
    - The minimum level is depending on applications → Who define the level of secure data ?
    - Good protection of cyber terror or crimes → detail surveillance may remind "George Orwell 1984"
- **Values of Privacy → Dual or multiple personality (e.g., Dr Jekyll and Mr Hyde)**
  - Who and why protect privacy ? → by owner or governance
  - If owners (or me) allow private data to open,
    - Nobody may be claimed in nature → But, who know unexpected problem ?
    - Governance gives regulation by consensus (like young people under 19)
    - News and on-line journalism may be intentionally linked to invoke user preferences
- **Values of Trust → Trust Index based on consensus or credit accumulation**
  - Difficult to handle all the trust metrics with security and privacy together
    - How to handle more than million cases ? → Simple trust index like stock market index is more relevant
  - Create new trust economy by Trust Index
    - Establish trust value chain and trust relationship (e.g., Carbon Emission Trading, etc.)

Key Technical Issues

Step-wise Deployment of Trust Eco-system

- **1st Stage: create individual and separate Trust Islands**
  - Collaborative trust economy combined with IoT and Cloud Solutions
  - Fintech solution equipped with IoT Trust
- **2nd Stage: Linked to Value Chain among Trust Islands**
  - Trust platform for multiple stakeholders (energy, transport, health, safety, etc.)
    - Convergence applications with Trust → Energy+ICT, Health+IT, Transport+ICT, etc.
    - Collaborate energy market among consumer, provider, and retailer, etc.
    - Trust economy on transport/logistics market among bus, truck, railway, ship, etc.
- **3rd Stage: Deploy global trust governance based on Trust Index**
  - Global cyber trading with trust (e.g., e-commerce, Fintech, banking, etc.)
    - Establish global trust agency, trust authority, trust gateway, etc.
  - Realize trust governance at global domain

ITU-T
Standardization Strategies of Trust



Toward Knowledge Society

- **Rule and principles for future knowledge society**
  - **Magna Carta** (Great Charter of Freedom): Year 1215
  - **Democracy, Republic** (Governance): Roman, Europe (year 1800 ~)
  - ??? (Collective Intelligence, Collaborative): Year 2000 ~
- **Knowledge society means**
  - Knowledge is invisible public good available to every individual
  - Foster universality, liberty, and equality as a concept of openness
  - Changes of education, science, culture, and communication
- **Empowerment of ICT technology and standardization**
  - Identification of data, object, system, device, event, and human, etc.
  - Format and structure of data, Information, and knowledge
  - Platforms or solutions to access, deliver, process, share and accumulate

Why ICT infrastructure need Trust ? - 1

- **Knowledge Society is Risk Society ?**
  - Do not open Pandora's Box
    - By making ICT resources accessible to all the people with promises but with Unknown Dangers
    - If spread of knowledge is accelerated, self-regulating capability of the society is also boosted.
    - New character of the risks threaten us to cope with complexity of interaction and mechanism of ICT infrastructure
      - Find out the effective means of dealing with these complexity
  - But, instability and insecurity are consequences of scientific progress and technological innovation
    - Feel free the individuals from the fears and uncertainty to enable us to control risk

Why ICT infrastructure need Trust ? - 2

- **How to prevent Risks**
  - Risks are not equal and some are unacceptable
    - Risks taken intentionally or incurred passively
  - New technological revolution is a great advantage for researchers to a vast amount of resources
    - But, impossible to identify risk beforehand
- **Risk Identification**
  - A matter of good governance
    - Undifferentiated flow of data is no value if we are unable to use it
    - Public and private authorities with technical and scientific abilities are needed

Why ICT infrastructure need Trust ? - 3

- **Risks on ICT Technologies**
  - The access of a large number of knowledge resources cause irreparable damage and create unpredictable dangers.
  - The IoT/M2M systems have always proved unpredictable and fallible although it is not proof against breakdowns
  - To protect misuse of knowledge falling into the hands of terrorist, scientists and engineers have a duty to protect the public-safety from hazards
  - The growth of knowledge societies might need the most effective means to reduce risks and to share the benefits of ICT revolution

Standardization Strategies of Trust

- **Consensus on Trust Information Infrastructure**
  - New value chains on trust provisioning
  - Harmony with data platform and new knowledge eco-systems
- **Architectural Framework and Trust Service Models**
  - Evolution scenario of the ICT infrastructure for future trust eco-society
  - A lot of trust model and technical solutions with future flexibility
- **Detailed Technical Solutions for Trust Provisioning**
  - Value-added services and new eco-society for trust provisioning
    - Trust on sharing and collaborative Economy
  - Trust value chain among multiple stakeholders
    - Starting from IoT Trust and Cloud Trust to converged applications like energy, health, etc.
  - Focus on data-centric or user-centric trust applications
    - Current infrastructure and platform should be re-configured or realigned

Future Plan for Trust Provisioning at ITU-T

- **Key Issues for next study period of ITU-T (2017 – 2020)**
  - Collaborate among SG's to set up the related standard plans
  - International joint activities between De Jure standards and De Facto Standards including academia and forums
  - Technical standards create new value chain for future knowledge society
    - How to evolve the existing ICT infrastructure? otherwise, totally new infrastructure !!
- **Trust Index**
  - Like ICT Development Index or OECD index
  - Establish global trust governance to encourage new value chain for future knowledge society


Thank you!