Education About Standardization ILNAS/UL Master Programme

Master in Technopreneurship: mastering smart ICT, standardisation and digital trust for enabling next generation of ICT solutions

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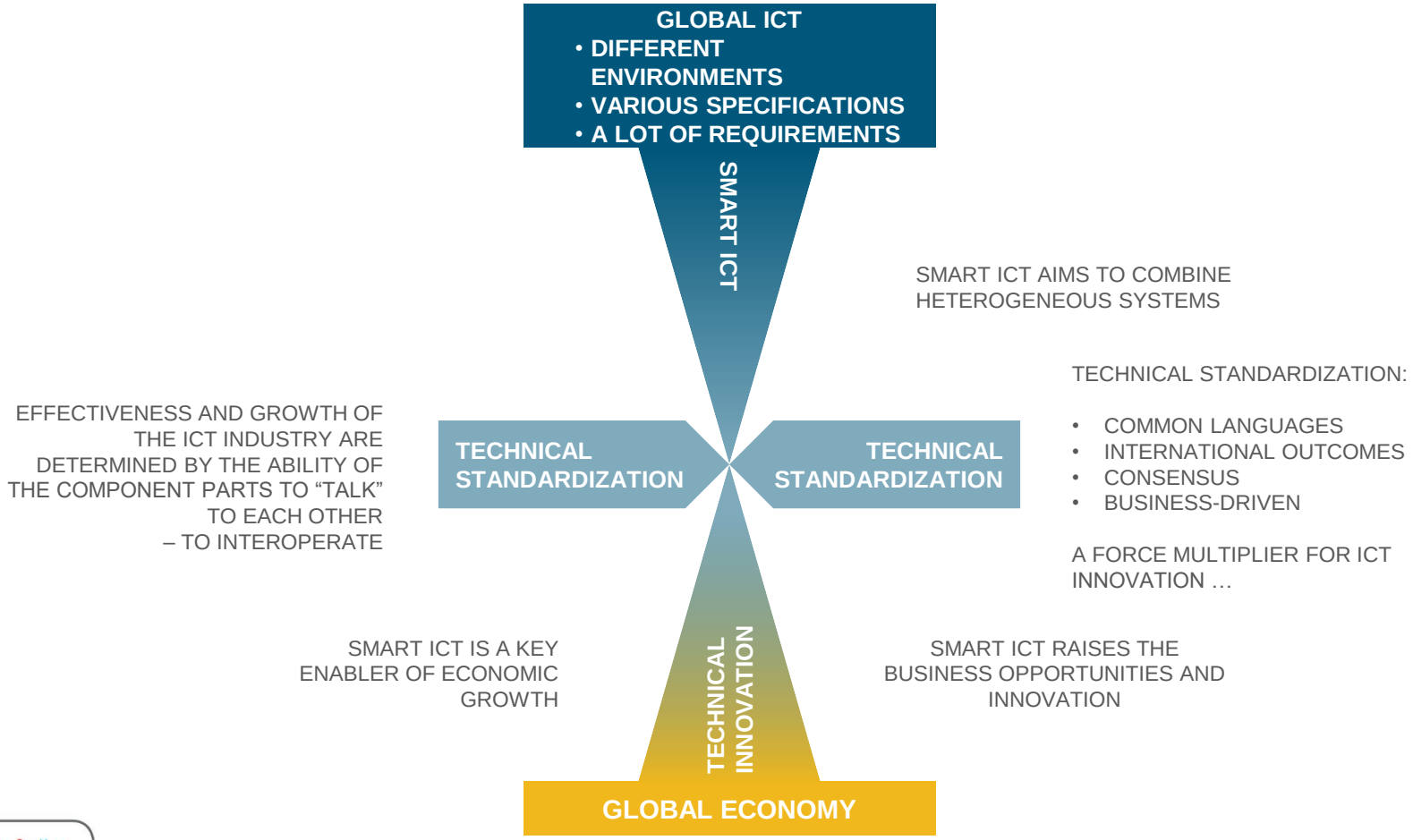
Chargé de Mission auprès du Recteur
University of Luxembourg

June 2019

Master in Technopreneurship: Mastering Smart ICT, Standardisation and Digital Trust for Enabling Next Generation of ICT Solutions

– READING GRID (University certificate “smart ICT for business innovation”)



Master in Technopreneurship: Mastering Smart ICT, Standardisation and Digital Trust for Enabling Next Generation of ICT Solutions

- FIRST CLASS 2015-16 (University certificate “smart ICT for business innovation”)

- **Organization:**
  - 2 semesters: 18 ECTS
  - Courses: September 2015 – June 2016

- **Figures**
  - 17 students registered
  - 12 students graduated
  - Innovative projects on Smart ICT topics
    - e-identification
    - Cryptocurrencies
    - Smart Cities
    - Big Data and e-Health
    - …

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– SECOND CLASS 2018-19 (University certificate “smart ICT for business innovation”)


digital luxembourg
innovative initiatives

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‹ news

2018 intake of students for the smart ict for business innovation university certificate

22 Mar. 2018

Certificate - Smart ICT for business innovation
Student Testimonials

A new intake of students for the Smart ICT for Business Innovation university certificate, developed by the University of Luxembourg and the ILNAS, began work this week at the Esch/Belval campus.

The students and professionals in the Information and Communication Technologies (ICTs) sector were there for the first lecture on the foundations of Smart ICT technologies, given by Dr Jean-Philippe Humbert, Deputy Director of the ILNAS. They were able to discover the overall context of the university certificate and the key

- **12 students registered**
  - 7 ICT professionals
  - 5 PhD students in Computer Science
- **Students coming from various economic sectors…**
  - Banking, Industry, Telecommunication, Energy, Legal, Consulting, IT
- **… with various profiles…**
  - IT manager, Project manager, Economist, Head of Information Security, Lawyer, PhD students, …
- **Students main areas of interest for projects**
  - High performance computing, Cloud Computing, Big Data, IoT/UaV, IT security, Artificial Intelligence, Distributed Ledger Technologies, …

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White paper "Digital trust for Smart ICT" September 2017 – the baseline

- **It surveys current advances in Digital Trust from three complementary points of view:**
  - A technical analysis
  - A business and economic prospective analysis
  - A technical standardization perspective
- **From the technical analysis**
  - It reviews the basic concepts of the technology and the existing work supporting the development of Digital Trust
  - It presents some technical challenges related to Digital Trust
- **From business and economic prospective**
  - It highlights the interest for Digital Trust
  - It stresses the need of Digital Trust for each Smart ICT concepts
- **From standards point of view technical standardization**
  - It considers both as an important tool to support Digital Trust for Smart ICT

https://portail-qualite.public.lu/content/dam/qualite/publications/confiance-numerique/white-paper-digital-trust-september-2017.pdf

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White papers on Smart ICT

- **White Paper "Data Protection and Privacy in Smart ICT" – October 2018**

- **White Paper "Blockchain and Distributed Ledgers - Technology, Economic Impact and Technical Standardization"**
  - Developed with the support of the Ministry of the Economy
  - Provides a comprehensive analysis of the developments in the areas of blockchain and distributed ledger technologies
  - Published on June 23, 2018 – Organization of an event at the Ministry of the Economy
  - 2 more events organized at ILNAS premises to answer market demand

- **White Paper "Internet of Things (IoT) - Technology, Economic View and Technical Standardization"**
  - Developed with the support of the Ministry of the Economy
  - Provides a broad view of the developments around IoT and related technologies
  - Published on July 06, 2018 during the ILNAS-ETSI Workshop

- **2019-2020: All the White Papers are going to be updated to serve as supporting material for the students of the Master Program**

https://portail-qualite.public.lu/dam-assets/publications/normalisation/2018/white-paper-blockchain-june-2018.pdf
https://portail-qualite.public.lu/dam-assets/publications/normalisation/2018/white-paper-iot-july-2018.pdf

Master in Technopreneurship: Mastering Smart ICT, Standardisation and Digital Trust for Enabling Next Generation of ICT Solutions

Strengthening ILNAS's relations with academic partners with the aim of structuring education about standardization and ad-hoc research in the Grand Duchy of Luxembourg

- **Origin:**
  - Pilot project conducted between September 2015 and September 2016: "Smart ICT for Business Innovation" university certificate in partnership with the University of Luxembourg
  - Current promotion: February 2018 to February 2019
- **Objective: University Master on Smart ICT, technical innovation, technical standardization and digital trust (horizon 2020)**
  - Will answer national priorities related to "Smart Secure ICT" topics, providing a smart way to link technology, standards and the business world, while creating an additional means of innovation at the national level

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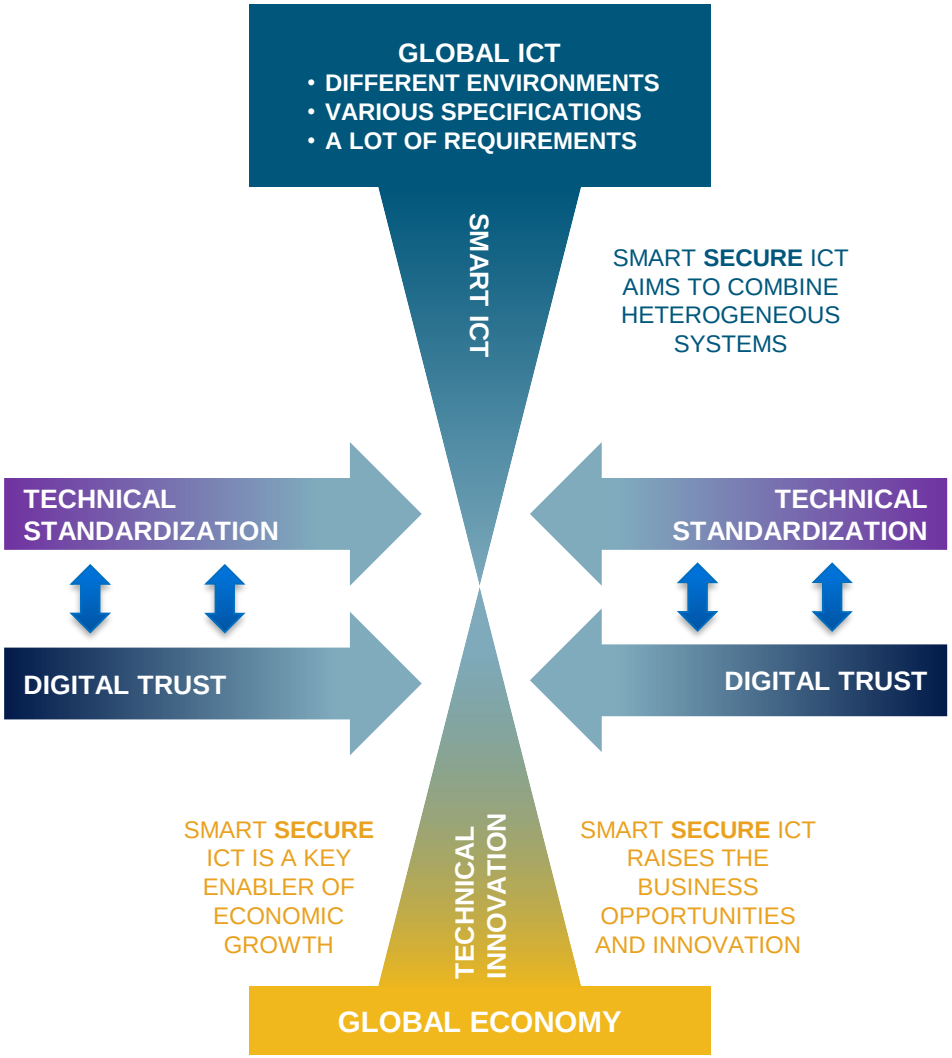
– (NEW) READING GRID



EFFECTIVENESS AND GROWTH OF THE ICT INDUSTRY ARE DETERMINED BY THE ABILITY OF THE COMPONENT PARTS TO **SECURELY** "TALK" TO EACH OTHER – TO INTEROPERATE

TECHNICAL STANDARDIZATION:

- COMMON LANGUAGES
- INTERNATIONAL OUTCOMES
- CONSENSUS
- BUSINESS-DRIVEN

A FORCE MULTIPLIER FOR ICT INNOVATION …

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New Digital Trust Layer

- **Smart ICT is fueling new business models, opportunities and innovation at large**
  - This domain becomes less tangible, more distributed, and more vulnerable to (cyber) threats and attacks
  - Digital Trust must be an essential part of Smart ICT

- **Digital Trust indicates a positive and verifiable belief about the perceived reliability of a digital information source, product or service, leading to an intention to use. It is not a technology, nor a process, it is an outcome exemplified by:**
  - Reliability
  - Accountability
  - Privacy
  - Transparency
  - Security
  - Quality
  - Integrity
  - …

- **Attainment of Digital Trust is driven by how Smart ICT technologies are both secured and used, and it helps to increase the broad adoption of innovative services, products, and the Smart ICT technologies**
  → SMART SECURE ICT
  - Digital Trust for Cloud Computing
  - Digital Trust for IoT
  - Digital Trust for Artificial Intelligence
  - Digital Trust for Big Data
  - …

Master in Technopreneurship: Mastering Smart ICT, Standardisation and Digital Trust for Enabling Next Generation of ICT Solutions

– PROGRAM DESCRIPTION

Blocks and Modules	ECTS
STANDARDISATION	
1. Smart Secure ICT and Innovation	1
2. Technical Standardisation	3
SMART ICT	
3. Smart ICT Technologies I	5
4. Smart ICT Technologies II	5
DIGITAL TRUST FOR SMART ICT	
5. Security for Smart ICT I	2
6. Security for Smart ICT II	3
7. Trust Architectures for Smart ICT	4
TECHNOPRENEURSHIP	
8. Management of Business and Technical Innovation	3
9. Digital Intelligence	2
10. Legal Aspects	2
MASTER THESIS	
12. Master Thesis	30
Total	60

Master in Technopreneurship: Mastering Smart ICT, Standardisation and Digital Trust for Enabling Next Generation of ICT Solutions" (60 ECTS)

Semester 1 (09 ETCS)	Semester 2 (10 ETCS)
Module 1 (1 ETCS) **"Smart Secure ICT and Innovation"** Introduction to the pillars of the master programme • Smart ICT • Technical Standardisation • Digital Trust • Technopreneurship	**Module 5 (2 ETCS)** **"Security for Smart ICT I"** Introduction to following security systems and related technical standardisation developments • Network Security • Database Security • Application Security • Security in Cloud (application, database, and network level)
Module 2 (3 ETCS) **"Technical standardisation"** Introduction to technical standardisation • ICT standardisation and related standards • Business innovation through technical standardisation • Standards analysis of the ICT sector in Luxembourg • Participating in a technical committee • MSP on ICT technical standardisation	**Module 4 (5 ETCS)** **"Smart ICT Technologies II"** In-depth technical overview of advances in Smart ICT technologies (Mobile Cloud Computing, 5G etc.) and related technical standardisation developments
Module 3 (5 ETCS) **"Smart ICT Technologies I"** In-depth technical overview of following Smart ICT technologies and related technical standardisation developments • Cloud Computing • Internet of Things (IoT) • Artificial Intelligence (AI) • Big Data Analytics)	**Module 6 (3 ETCS)** **"Security for Smart ICT II"** In-depth technical overview of following security systems and related technical standardisation developments • Security in sensor-based system (IoT, Industry 4.0, smart grid) at application, database, and network level. • Using artificial intelligence (AI) and machine learning (ML) to secure a sensor-based system (IoT, Industry 4.0, smart grid)

Semester 3 (11 ETCS)

Module 7 (4 ETCS)
"Trust Architectures for Smart ICT"

In-depth overview of trusted systems and related technical standardisation developments

- Distributed Web of Trust and trust architectures
- Distributed Ledger Technologies ("Blockchain")

Module 8 (3 ETCS)
"Management of Business and Technical Innovation"

- Concepts and frameworks in technical innovation
- Business plans for innovative Smart ICT concepts in companies
- Customization of development and innovation strategy

Module 9 (2 ETCS)
"Digital Intelligence"

- Technology trends and importance of Smart ICT watch
- Economic potential of Smart ICT
- Roles and value of Smart ICT in the organization
- Strategy and Governance standards for Smart ICT

Module 10 (2 ETCS)
"Legal Aspects"

In-depth overview of Iintellectual property rights (IPR)

- IP Consulting, Valuation, Transfer, and Dispute Resolution

Introduction to legal aspects

- Personal Data Protection (GDPR)
- Security of network and information systems (NIS Directive)
- Cybersecurity Act
- eIDAS Regulation
- Telecom Regulation
- Digital Ethics

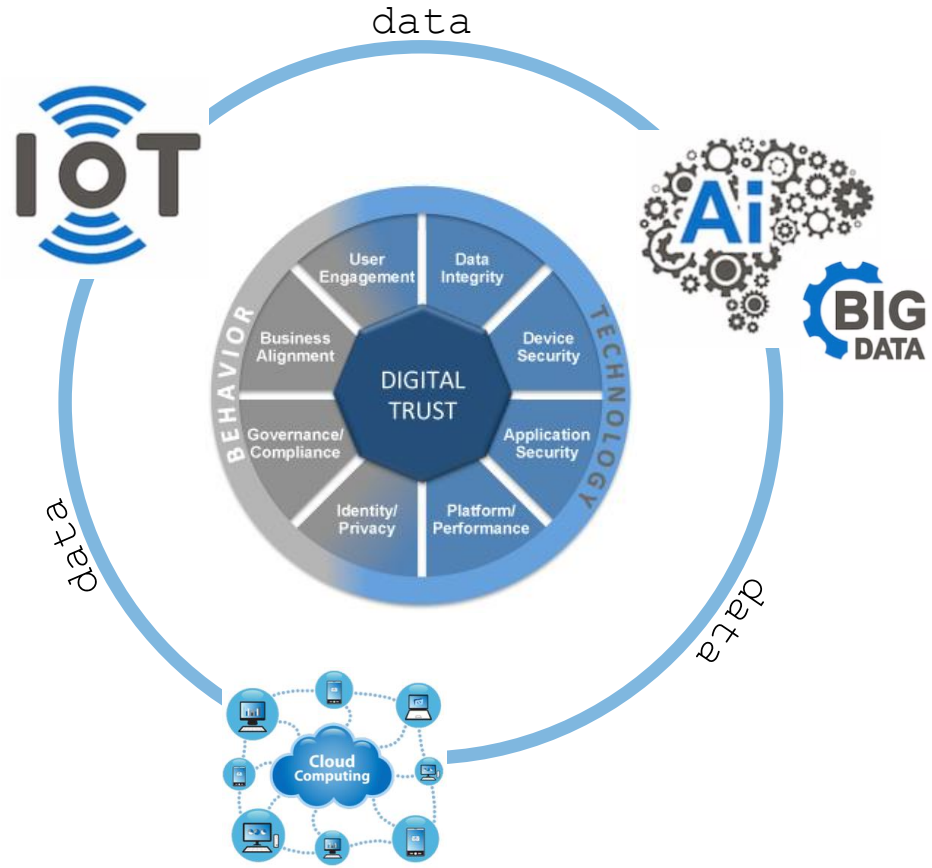
Semester 4 (30 ETCS)

Module 11
"Master Thesis"

SnT-ILNAS Research Programme on Smart ICT

- Programme
  - Technical Standardization on Smart ICT with Digital Trust (AI/Big Data, IoT, Cloud Computing)
- Duration
  - 4 years research project
  - Co-funded by SnT and ILNAS
  - Start date: 01/2017
- Members
  - 3 PhD students, 1 postdoc, 1 professor dedicated to the project
  - ILNAS, ANEC, PCOG and UL personnel also participates
- Objectives
  - Creating an innovative environment on digital trust for Smart ICT and the related standardization efforts
  - Development of a new master program (Life-Long Learning) in collaboration with industry

The Smart ICT Ecosystem



Smart ICT Key Components

1. **Core research pillars**
   - Internet-Of-Things,
   - AI/Big Data
   - Cloud Computing
2. **Connecting structural layer**
   - Data
3. **Transversal component**
   - Digital Trust and Security
   - Intersection between pillars

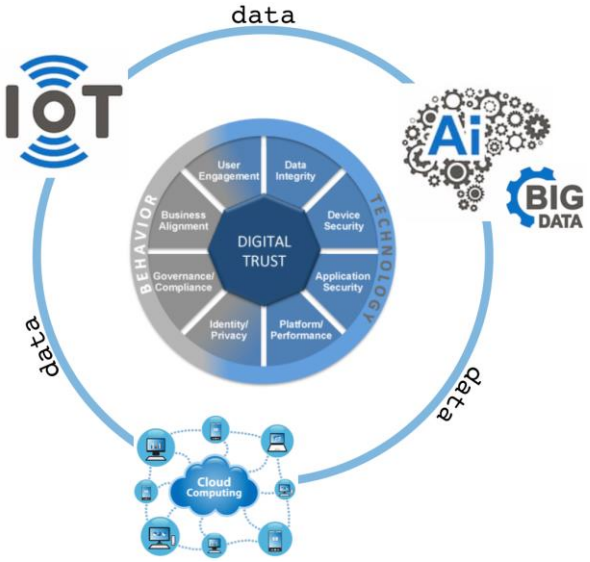
With special focus on

1. Core scientific research areas
2. Technical standardization needs

The Smart-ICT Team

Nader Samir
- PhD Candidate
- Since 1.10.2017
- Industrial experience in UAVs

Prof. Pascal Bouvry
- Principal Investigator
- Project coordination
- PhD supervision



Saharnaz Dilmaghani
- PhD Candidate
- Since 01.03.2018
- Standardization experience

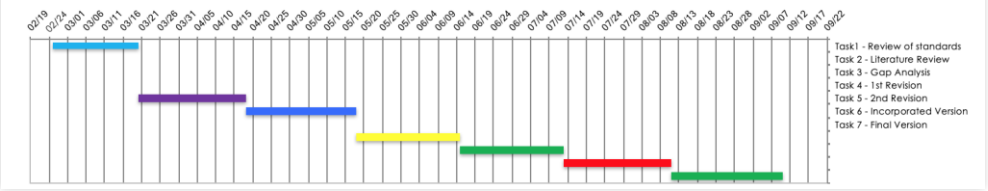
Matthias Brust
- Postdoc
- Project support

Chao Liu
- PhD Candidate
- Since 15.10.2017
- Cloud Computing

Technical Reports on Data Protection & Privacy
Gap Analysis between Research and Standardization

- **The objectives of the current work are**
  - Performing analysis to understand the gaps between research and standardization, and to draw a roadmap on reducing these gaps
- **Gap Analysis**
  - Focus on three separate but complementary products
  - Internet-Of-Things, AI/Big Data, Cloud Computing
- **Presentation**
  - World Standards Day 2019

Check	TASK NAME	Deliverable	STATUS	START DATE	END DATE	DURATION (days)	COMMENTS
☐	Task1 - Review of standards	Document	Not Started	02/25	03/20	23	
	Subtask 1.1 - SC 42/38/41		Not Started				
	Subtask 1.2 - SC 27		Not Started				
	Subtask 1.3 - Draft of Standards Development		Not Started				
☐	Task 2 - Literature Review	Document	Not Started	03/20	04/18	29	
☐	Task 3 - Gap Analysis	Document	Not Started	04/18	05/18	30	1st complete draft + followup progress meeting after 16/5
	Meeting with ILNAS - date to be defined						
☐	Task 4 - 1st Revision	gDoc	Not Started	05/18	06/15	28	Deliverable: updated gDoc incorporating comments
☐	Task 5 - 2nd Revision	gDoc	Not Started	06/15	07/13	28	Deliverable: updated gDoc incorporating comments
☐	Task 6 - Incorporated Version	gDoc	Not Started	07/13	08/11	29	Including minor updates
☐	Task 7 - Final Version	LaTeX	Not Started	08/11	09/10	30	
	Steering Board Meeting - date to be defined						



Contribution to Technical Standardization

- Evaluates the degree of privacy and the amount of protection addressed in a system
- Contribution to ISO/IEC JTC 1/SC 42 – **Artificial intelligence**
  - WG 3 – Trustworthiness
  - Trustworthiness technical report

Research Focus: Smart Secure ICT

- Nader Labib
  - Internet-Of-Things
  - Distributed UAV Traffic Management

- Saharnaz Dilmaghani
  - Artificial Intelligence and Big Data
  - Network-based Clustering Algorithms for AI and Big Data Analytics

- Chao Liu
  - Cloud Computing
  - Optimal Pricing in Cloud Computing

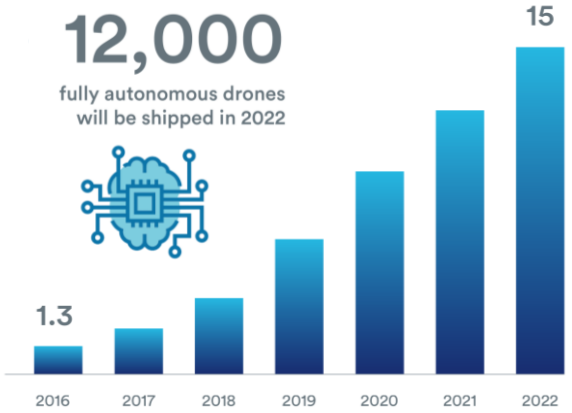
IoT: Global UAV Overview

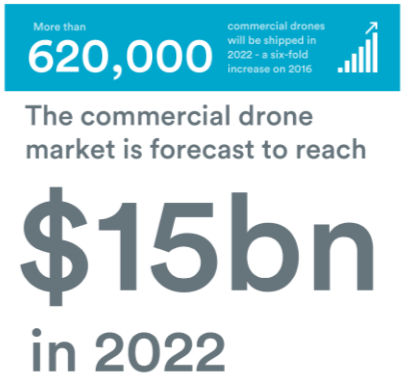
Introduction

- The number of Unmanned Aerial Vehicles (UAVs) is growing exponentially – 620,000 by 2022 [1]
- UAVs - devices connected in the ubiquitous network of Internet-of-Things (IoT).
- Growing array of potential applications.

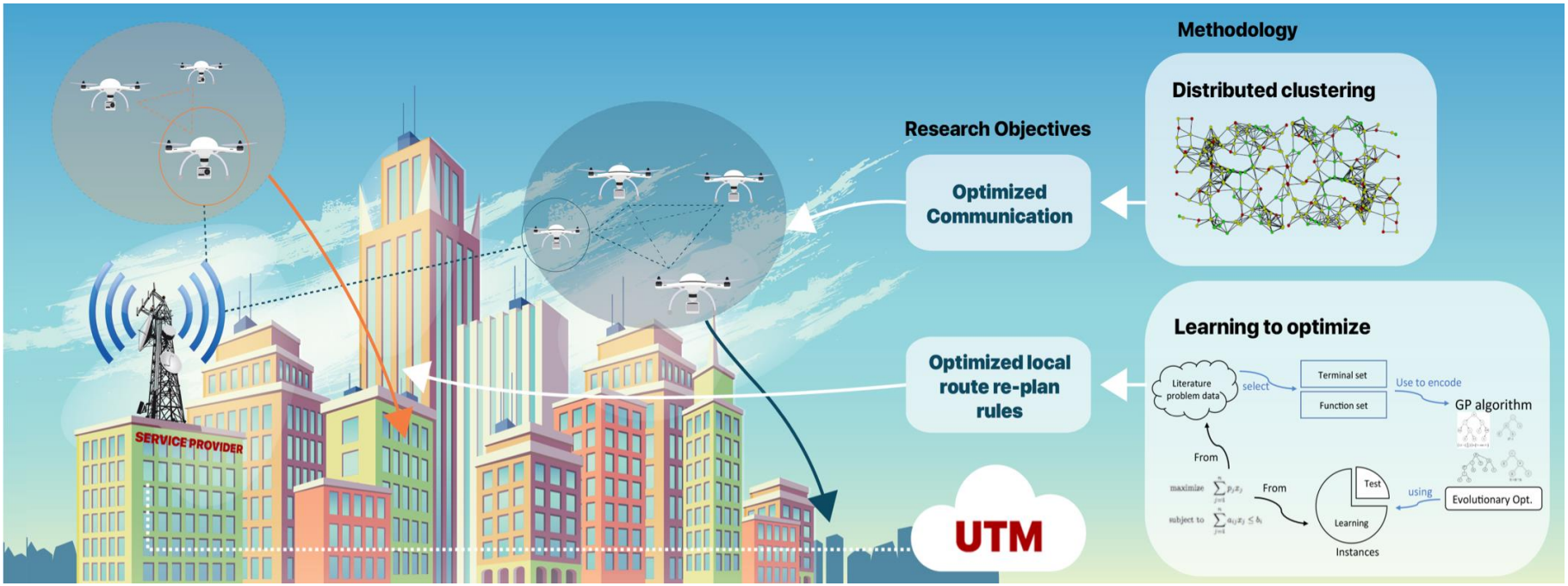
State of The Art

Governmental		Commercial
Nasa UTM	2016	OneSky
JUTM	2016	AirMap
Uspace	2017	Amazon
UOMS	2018	Google

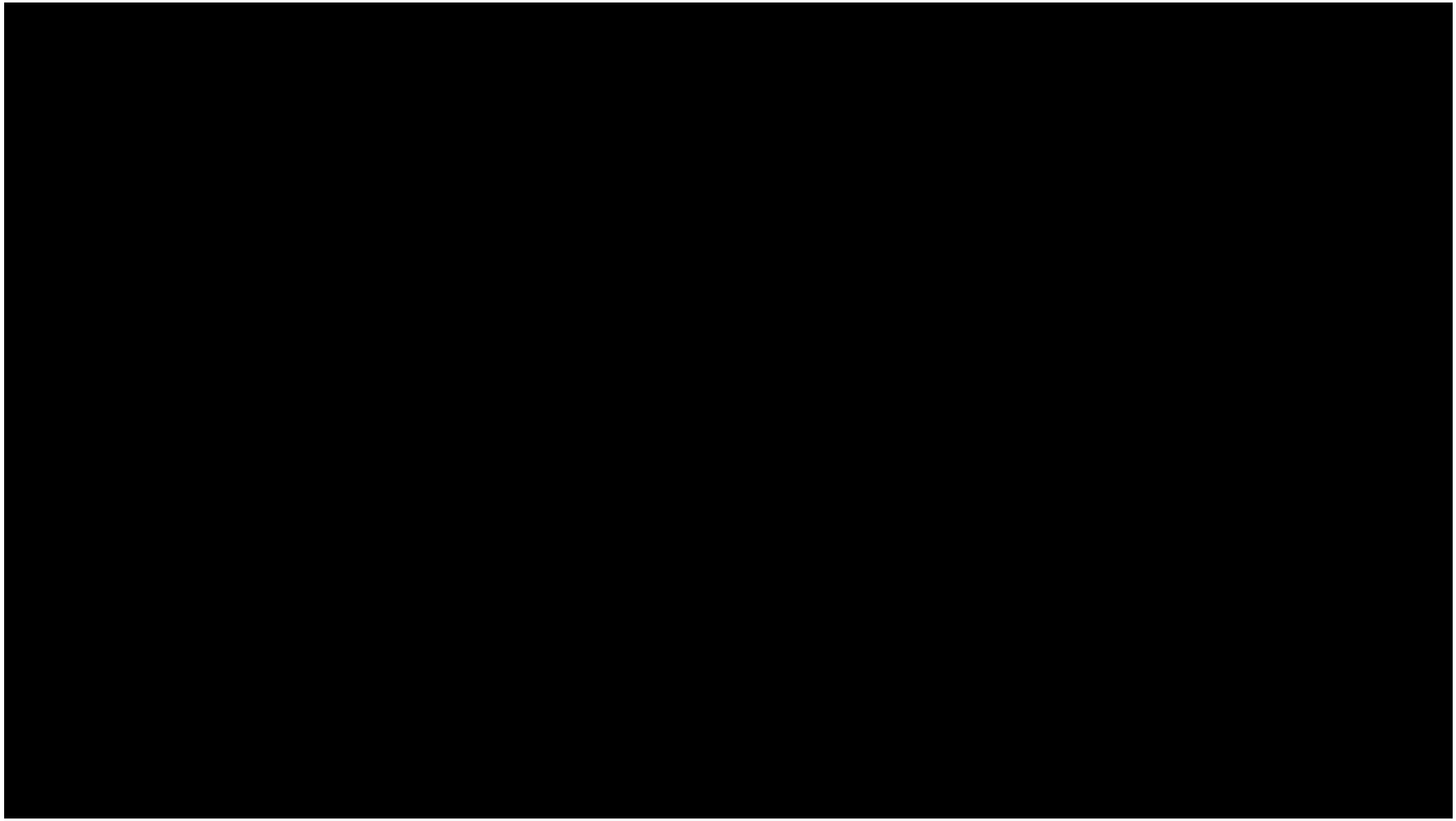




IoT: Distributed UTM



IoT: Distributed UTM



IoT: Optimization Problem Description

Objectives

- Minimize total average travel time
- Minimize total average energy

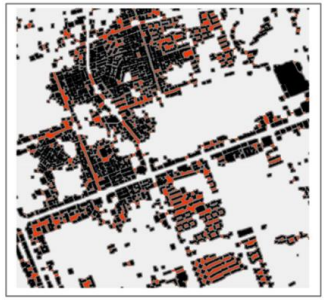
Constraints

- UAVs have a limited battery life.
- Airspace segments allow different lateral velocities

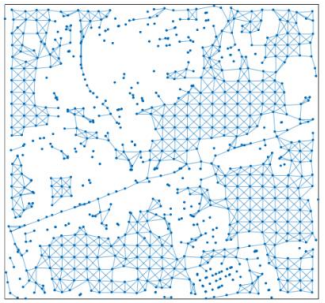
Assumptions

- UAVs are identical multirotor UAVs capable of ***hovering***.
- Initially, UAVs try to fly at their ***optimum lateral velocity***
- We neglect effects of weather on energy consumption and battery life.
- We neglect effects of acceleration and deceleration on power consumption.

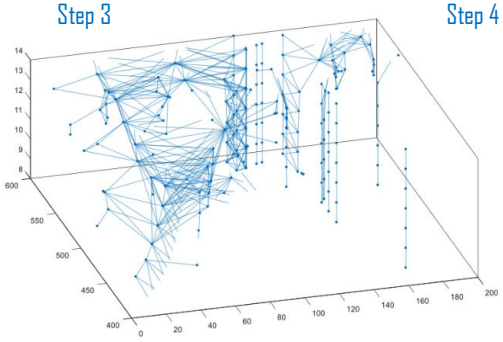
Step 1



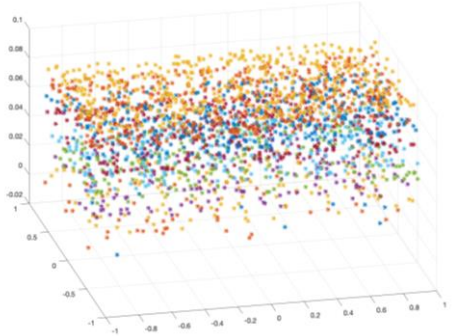
Step 2



Step 3



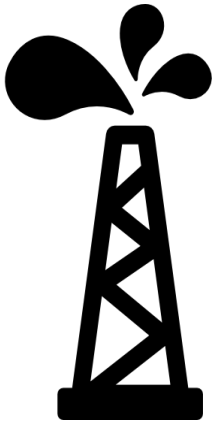
Step 4



AI: Network-based Clustering Algorithm for AI and Big Data Analysis

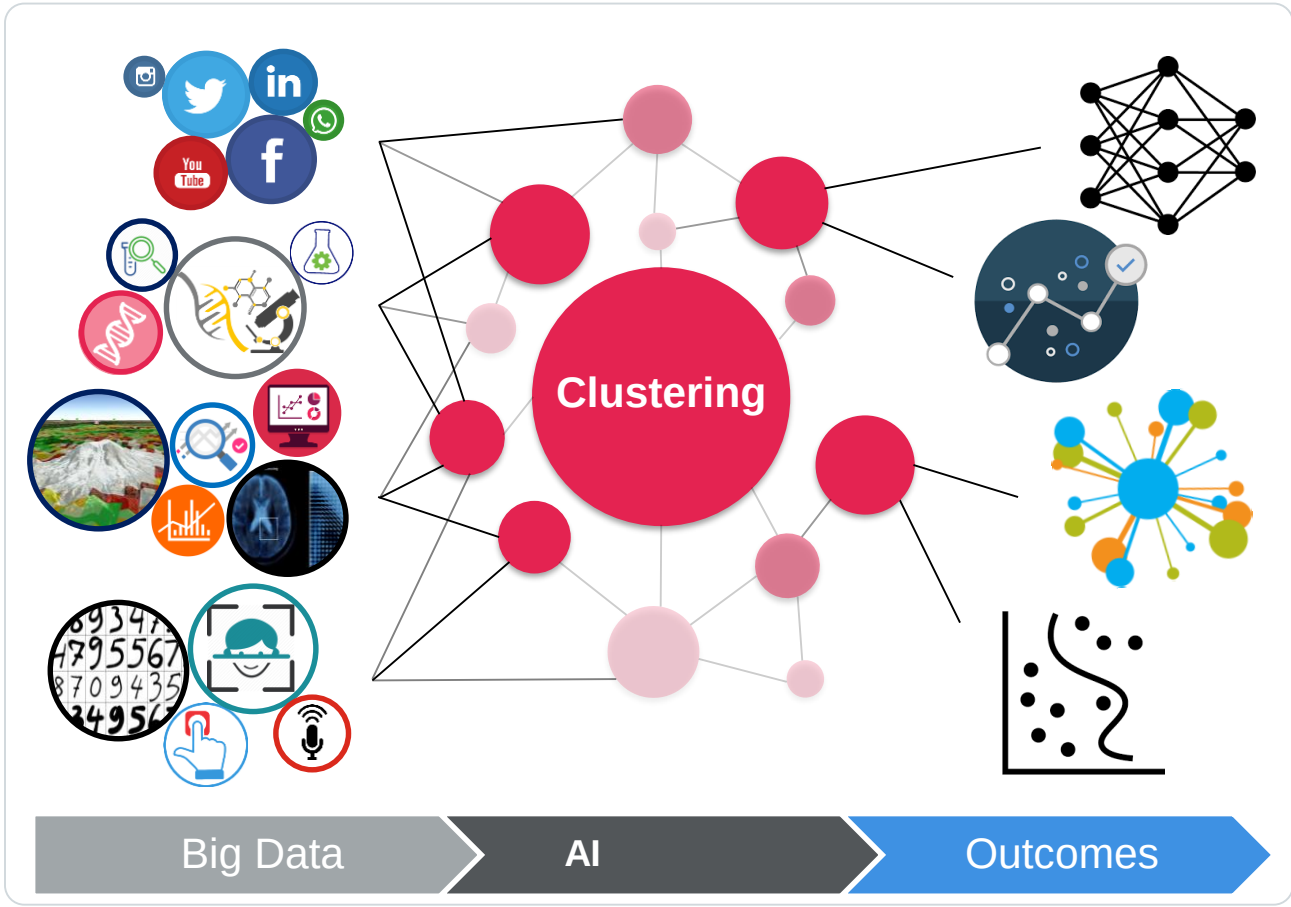
Data is Today's Oil!

44 zettabytes, from **4.4 zettabytes**



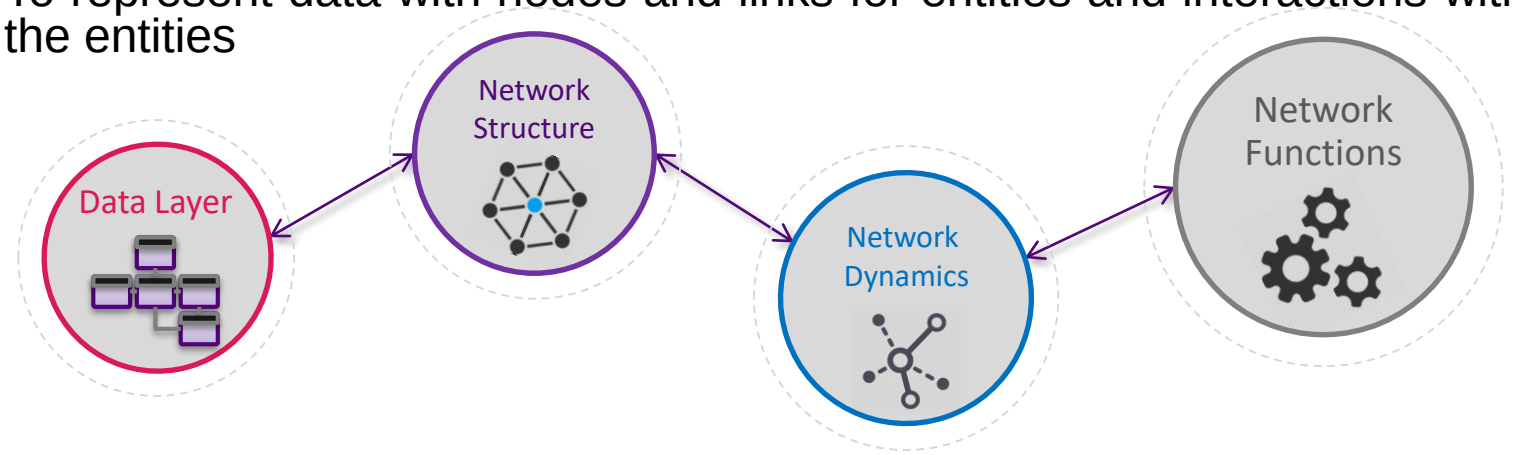
1.7 megabytes every second every human

656 million tweets per day



AI: Network-based Clustering Algorithm

- A network-based approach to benefit from network science to transform big data into network structures, which enables to dynamically cluster data.
- To represent data with nodes and links for entities and interactions within the entities

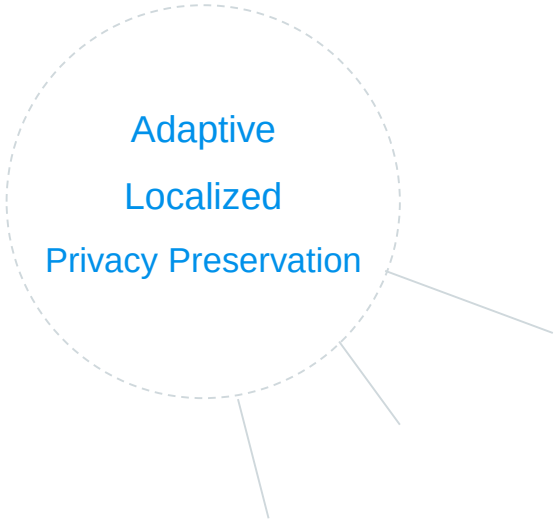


Data Layer	Network Structure	Network Dynamics	Network Functions
Translating relational data to network	Similarity functions	Changes over time	Community detection
Definition of nodes and edges	Network topologies	Epidemic models, Information flow	e.g., brain networks

AI: Proposed Approach

A novel network-based clustering algorithm

1. Adjust to data evolution and changes in probability distribution
2. Restrict the updating process solely to the relevant data by defined local policies
3. Reduce the unnecessary correlations to preserve the privacy

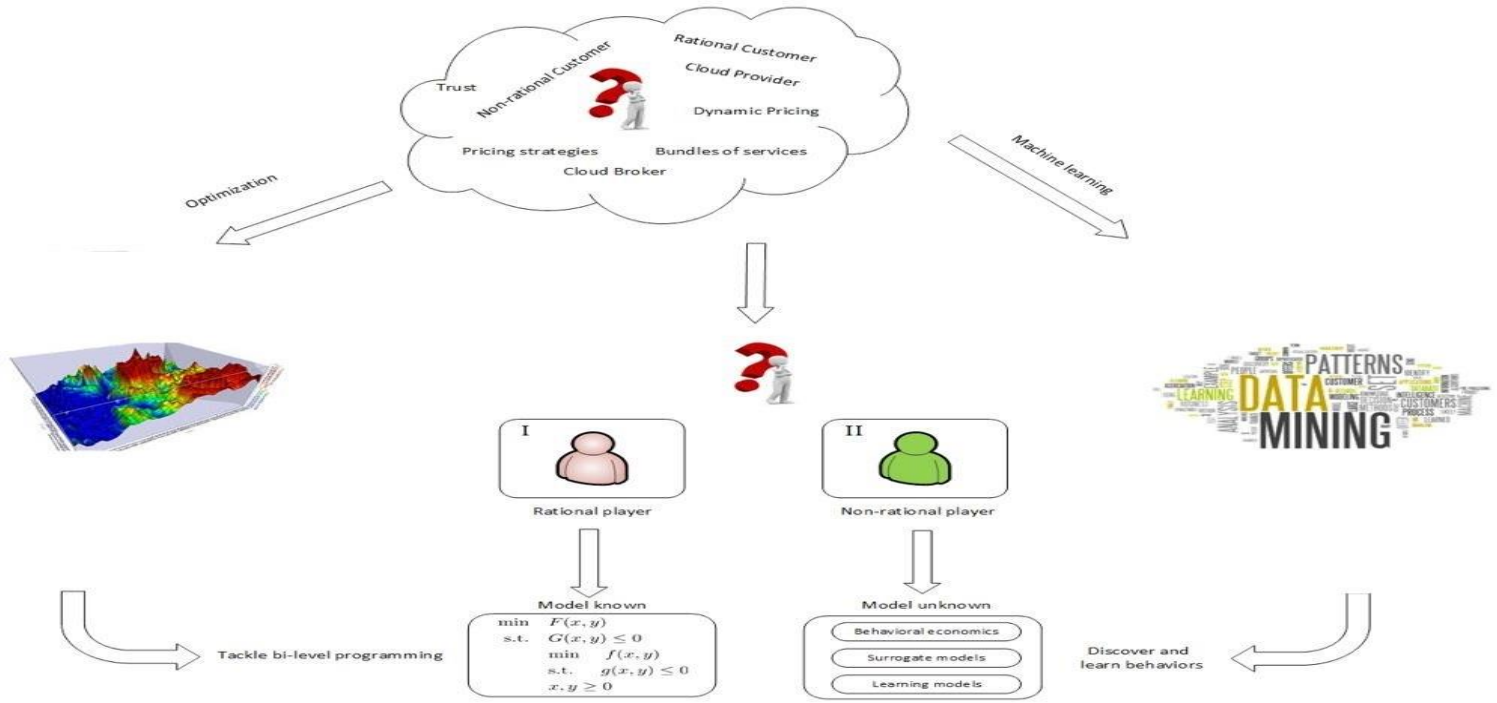


Cloud Computing: Research Overview

Pricing Strategies for Cloud Brokers at the Software-as-a-Service (Saas) Level

Objective

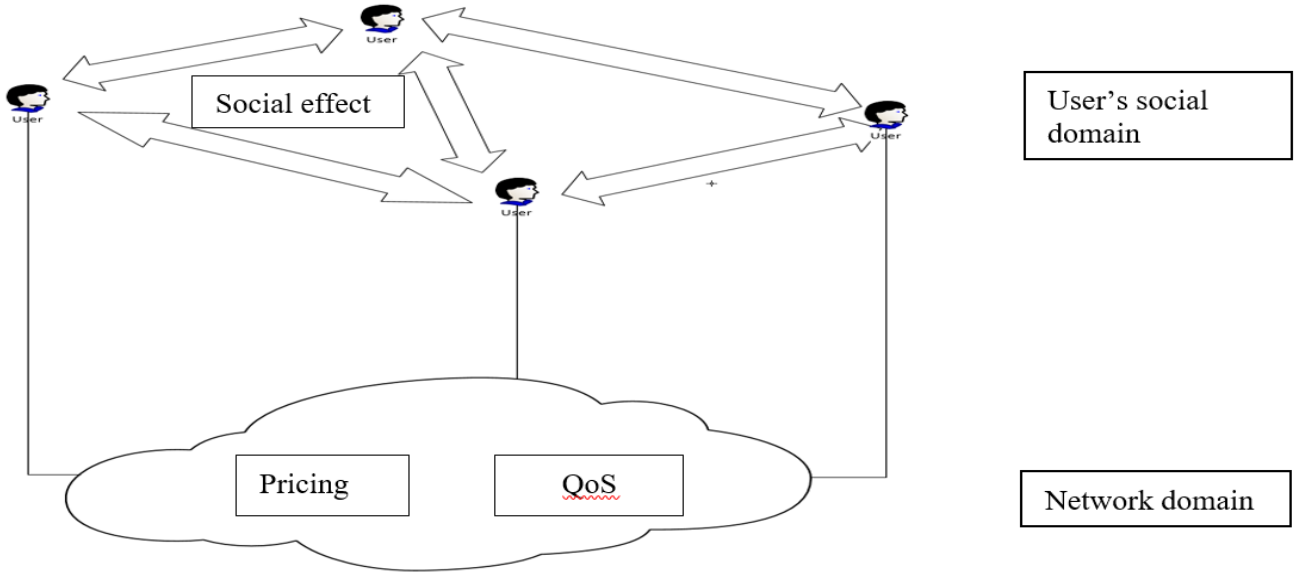
- Provide a coherent and global pricing model, including trust and reputation management model(s)



Cloud Computing: Optimal Pricing for Socially-aware Usage

- Propose a original model for the Customers' interactions to measure the positive impact on the future cloud requests.

- Jointly consider the price, the inter-users' social effect, and the limited capacity constraints.



Cloud Computing: Inter-users Interactions

One service provider, N users in this game.
For each user i $\in$ N,
$x_i \in [0, \infty)$ is the amount of data usage.
X $\triangleq$ (x_1, ... , x_N) denote the usage profile of all the users

The social utility represents the positive network effect of user's social domain, and user's social utility in this model is expressed by:

$$u_i(X_i, X_{-i}, P_i) = a_i X_i - b_i X_i^2 - c(\sum_{j\ N} X_j)^2 - P_i X_i + X_i \sum_{j \neq i} g_{ij} X_j$$

a_i & b_i,intrinsic coefficients, represent the utility of user i which derives by consuming data usage
c is determined by the capacity and resource constraints of the cloud network
g_{ij} represents the strength of user i's social tie with user j that shows the social effect of user j on user i, shows the positive network effect of user i's social utility

Cloud Computing: Bi-Level Optimization

Max $\sum_{i \in N} X_i P_i$

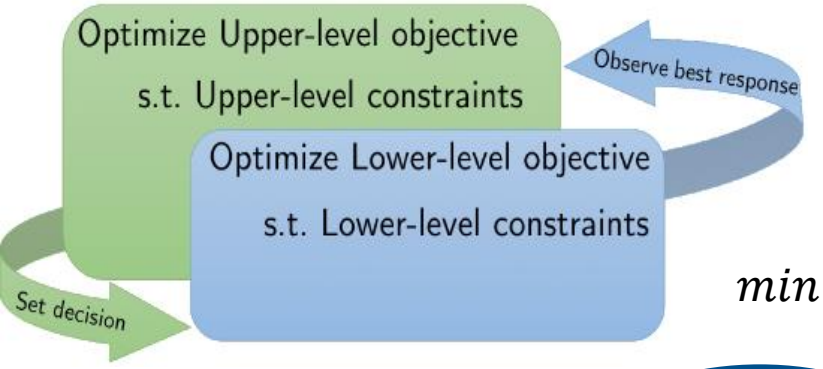
s.t. $P_i \geq 0,\ X_i \geq 0,$ etc.

Upper-level

$max\ [a_i X_i - b_i X_i^2 - c(\sum_{j \in N} X_j)^2 - P_i X_i + X_i \sum_{j \neq i} g_{ij} X_j]$

$a_i \geq 0,\ b_i \geq 0, etc.$

Lower level



Concave

$min\ [-a_i X_i + b_i X_i^2 + c(\sum_{j \in N} X_j)^2 + P_i X_i - X_i \sum_{j \neq i} g_{ij} X_j]$

Convex & Continous

Be replaced with KKT Conditions

Cloud Computing: Single-Level Reduction

The lower optimization problem can be replaced by Karush-Kuhn-Tucker (KKT) conditions.

Reduce the overall bi-level optimization problem to a single-level constrained optimization problem.

$$\min_{x_u \in X_U, x_l \in X_L, \lambda} \quad F(x_u, x_l)$$

subject to

$$G_k(x_u, x_l) \leq 0, k = 1, \ldots, K$$
$$\nabla_{x_l} L(x_u, x_l, \lambda) = 0$$
$$g_j(x_u, x_l) \leq 0, j = 1, \ldots, J$$
$$\lambda_j g_j(x_u, x_l) = 0, j = 1, \ldots, J$$
$$\lambda_j \geq 0, j = 1, \ldots, J$$

Lagrangian defined as : where

$$L(x_u, x_l, \lambda) = f(x_u, x_l) + \sum_{j=1}^{J} \lambda_j g_j(x_u, x_l).$$

Contact

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