5G India 2019
3rd INTERNATIONAL CONFERENCE
26TH & 27TH JUNE 2019 ⋄ THE LEELA, MUMBAI
Digital Transformation with 5G

Systems Approach Imperatives in 5G ALS Standardization

USI ICT RA & 5G ALS Synergy

(Unified Smart Infrastructure ICT Reference Architecture)

&

(5G Application Layer Standards)

narang n. kishor
mentor & principal design architect
narnix technolabs pvt. ltd.

narnix

Cities >>> Smart Cities >>> Sustainable & Secure Cities

narnix

designing with secure n sustainable dna

The Smart Transformation

The society, the business, the infrastructure, the services and all other aspects of the civilization on the planet Earth are going through a paradigm shift in the wake of technological advancements, especially in the field of ICT

All the ecosystems, be it Smart Cities, Smart Grid, Smart Buildings or Smart Factories now find themselves making three classes of transformations:

- improvement of infrastructure – to make it resilient & sustainable…
- addition of the digital layer- which is the essence of the *smart paradigm*; and
- business process transformation - necessary to capitalize on the investments in smart technology.

The genesis of Smart City

In a Smart City-

- **'Sustainability is the Destination'**
- **'Resilience is the Characteristic'**
- **'Smart is the Accelerator'**

Standards are the Chromosomes of Smart Infrastructure

narnix

designing with secure n sustainable dna

Features of a Smart City

- Citizen participation
- Identity and culture
- Economy and employment
- Health
- Education
- Mixed use
- Compactness
- Open spaces
- Housing and Inclusiveness
- Transportation & Mobility
- Walkable
- IT connctivity

ICT and IoT

Opportunities

in all these

areas!

- Intelligent government services
- Energy supply
- Energy source
- Water supply
- Waste water management
- Water quality
- Air quality
- Energy efficiency
- Underground electric wiring
- Sanitatlon
- Waste management
- Safety

24 Features identified by MoHUA

GoI

narnix

designing with secure n sustainable dna

The Imperatives:

The technological trends in *"Smart Homes"*, *"Smart Buildings"*, *"Smart Cities"* & *"Smart Grid"* are being considered and pursued in isolation from each other by the respective stake holders. In fact, they form a very tightly interwoven & homogenous confluence of similar technologies being applied in different domains for a common cause of making our planet earth "smart, green n secure".

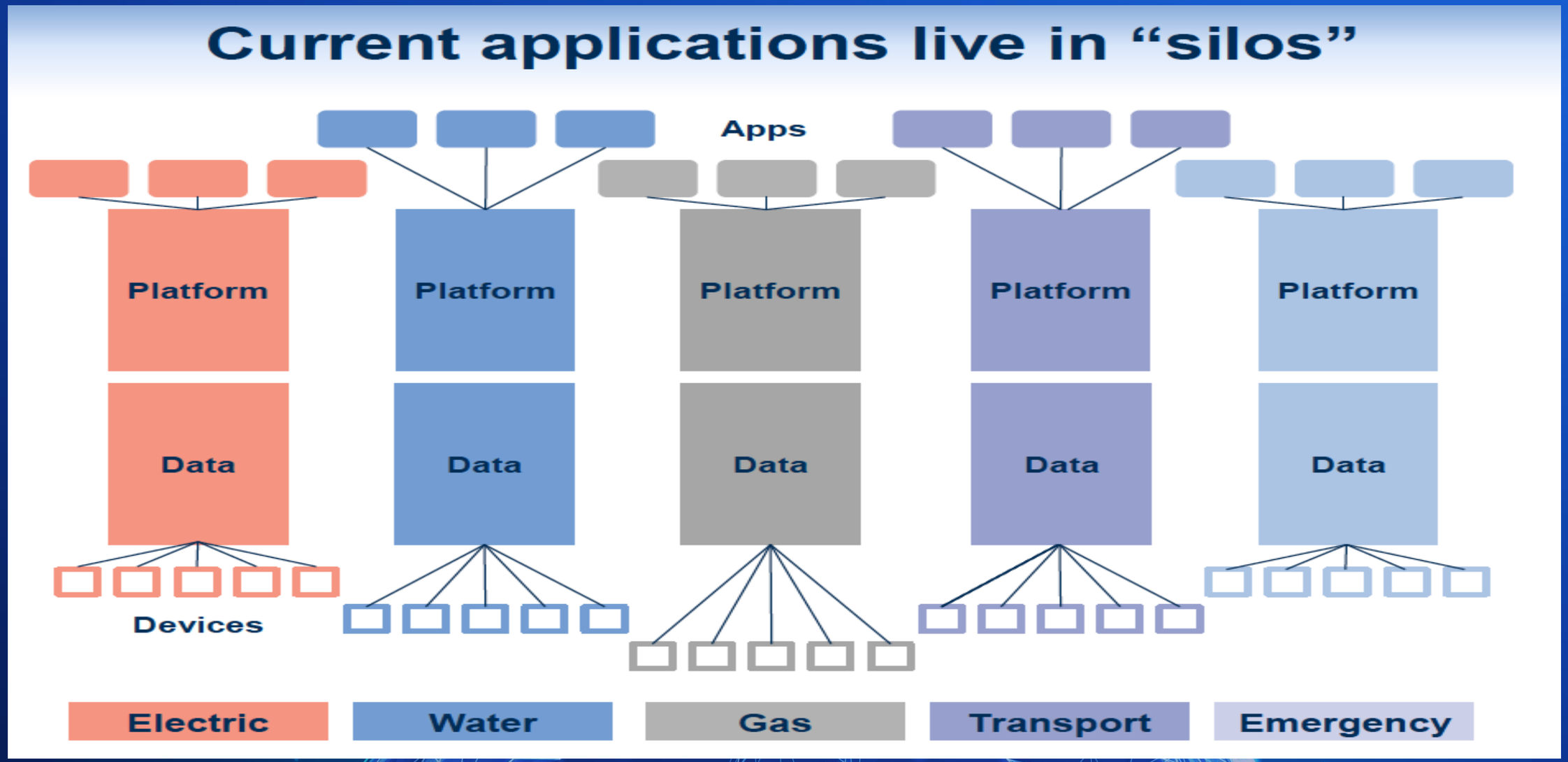
Smart Cities & Smart Infrastructure

A sample Indian business case for next 5-10 years:

- 250 million Smart Electricity Meters are going to be procured & deployed under the NSGM (National Smart Grid Mission).
- All these **Smart Meters** are going to use **250 million Communication Modules** and minimum **0.5 million Gateways/DCUs** (Data Concentrator Units).
- **Smart Streetlights** are going to use more than **100 million Communication Modules** and at least **half a million of DCUs/Gateways**…
- **Smart Buildings** are going to deploy more than **50 million smart Sensors** and at **least 100K – 200K DCUs/gateways…**
- **Automobile**s shall be using at least **100-200 million** communication nodes for Vehicle O & M, V to V, V to I & other telematics applications…
- Similarly, various applications of the Smart Infrastructure paradigm like Smart Water, Smart Gas, Smart Traffic, Smart Environment, Smart sewage Disposal etc. are going to use a few billions of Smart Sensors with Communication Modules

To summarize, India ALONE, is going to need a minimum of 5 - 10 billion Communication modules to be integrated into the Smart Sensors and Controllers and 10– 50 million Gateways that shall be needed to operate and maintain the *Nation Wide Critical Infrastructure* that needs to be deployed to enable and empower the citizens to lead a sustainable, safe and secure life …

Current Applications live in silos



CACOPHONY or SYMPHONY ? ? ?

The Enraged Musician, William Hogarth, 1741

narnix

designing with secure n sustainable dna

"The beauty of standards is that there are so many to choose from!" Andrew S. Tanenbaum, 1990

- *"Standards & even SDOs are not at the forefront of city planners', utilities' or users' minds"*
- There are misconceptions on what standards are for, and, the case for use of standards has not been made.
- Liberalization and Markets have a lot of great virtues, but they cannot create their own conditions of existences: they **must be designed**!

narnix

One of the most challenging Imperatives
for
"Standard Development Organizations"

Harmonization of Standards

in

Smart Homes, Smart Buildings, Smart Manufacturing, Smart Grid & Smart Cities

for

smart, sustainable & secure communities

designing with secure n sustainable dna

narnix

Two Underlying philosophies

Standards are the chromosomes of Smart Infrastructure

&

If “Data is the Oil of the 21st Century”

Neelie Kroes, EU Commissioner responsible for the Digital Agenda

(without pollution side effects)

Then **“Big Data” is the Crude Oil**

Narang N. Kishor, NARNIX TECHNOLABS

As it needs lot of processing before it becomes usable

narnix

designing with secure n sustainable dna

A (man-made) Systems is…

narnix

…is more than a collective entity.

The System is the product of the interactions of its parts, rather than the sum of its parts

Systems have properties that none of its parts have (emergent properties)

The performance of a system depends on how the parts fit not how they act taken separately

System Standards –
Applying Systems Engineering

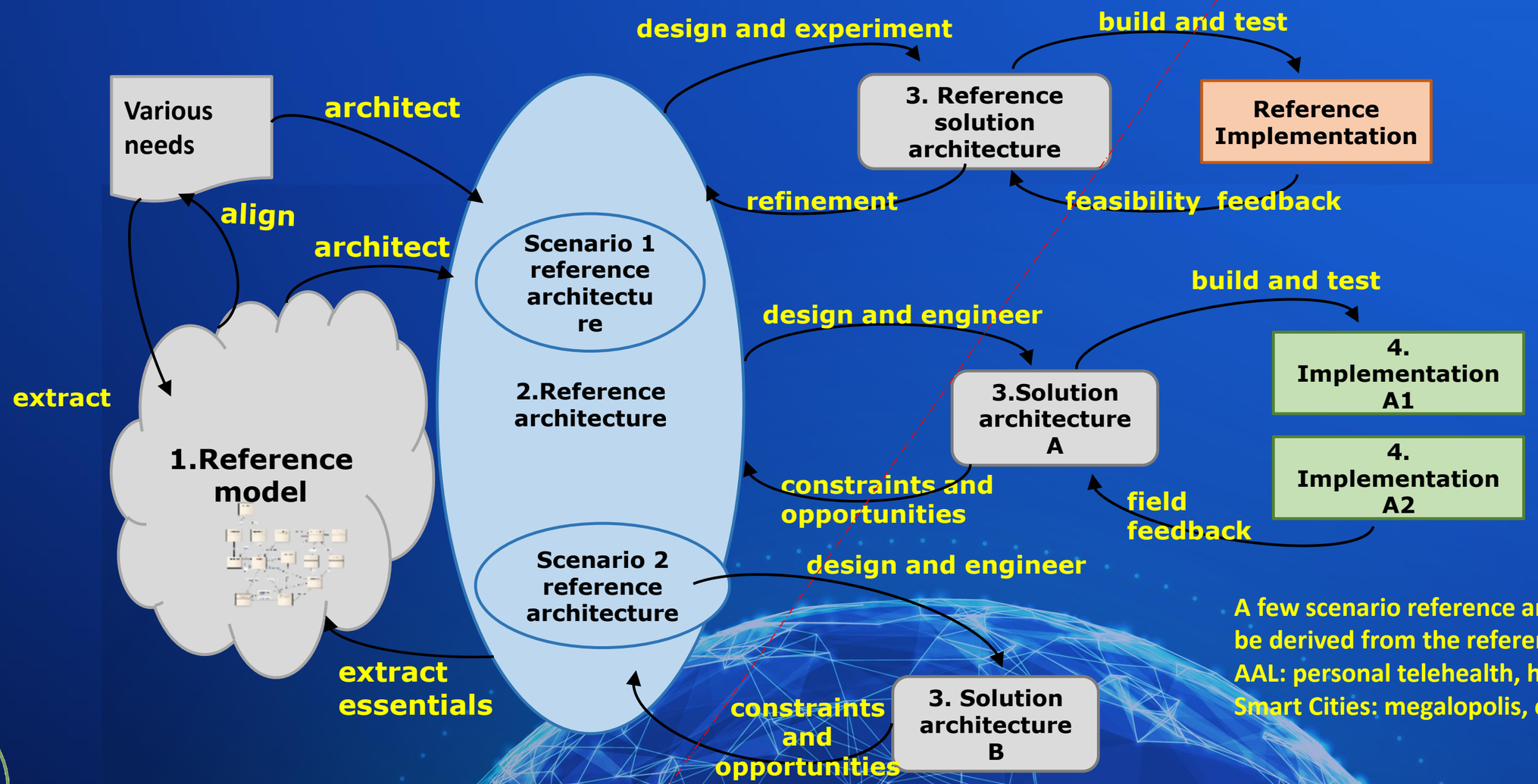
- Pre-standardization Process
- Collect use cases
- Mapping them to a Model/s
- Deriving the Interfaces and with that need for new standards
- Work plan & list of standards that can be used in this area…

narnix

Four levels of abstraction in the Systems Approach

1. **Reference Model**
   - abstract framework for understanding concepts and relationships between them in a particular problem space (or subject field)
2. **Reference Architecture**
   - template for solution architectures which realizes a predefined set of requirements
     - Note: A reference architecture uses its subject field reference model (as the next higher level of abstraction) and provides a common (architectural) vision, a modularization and the logic behind the architectural decisions taken
3. **Solution Architecture**
   - architecture of the system-of-interest
     - Note: A solution architecture (also known as a blueprint) can be a tailored version of a particular reference architecture (which is the next higher level of abstraction)
4. **Implementation**
   - realisation of a system-of-interest

Levels of architecting



A few scenario reference architectures may be derived from the reference architecture
AAL: personal telehealth, home
Smart Cities: megalopolis, city, village, island

narnix

Problem space **Solution space**

Purpose of reference architecture

- **Explain to any stakeholder** how future implementations (which are based on the reference architecture) can address his/her concerns and change his/her personal, professional and social life for the better
  - explicitly link needs (or high-level requirements) with the principles of reference architecture
- **Provide a common methodology** for architecting cyber-physical systems in the particular system domain
  - different people in similar situations find similar solutions or propose innovations
- Help stakeholders, programmes and projects to **collaborate and coordinate their efforts**
  - common agreements (i.e. standards) on various system elements (e.g. services, interfaces, data, etc.), common vision, etc.

narnix

LITD 28 - Work Groups - Domains

S. No.	Work Group Name	Convenor
1.	LITD28/WG1 – Smart Cities	N. Kishor Narang
2.	LITD28/WG2 – Active Assisted Living	Prof. Supten Sarbadhikari
3.	LITD28/WG3 – Smart Manufacturing	Shailendra Miglani

LITD 28 - Study Groups

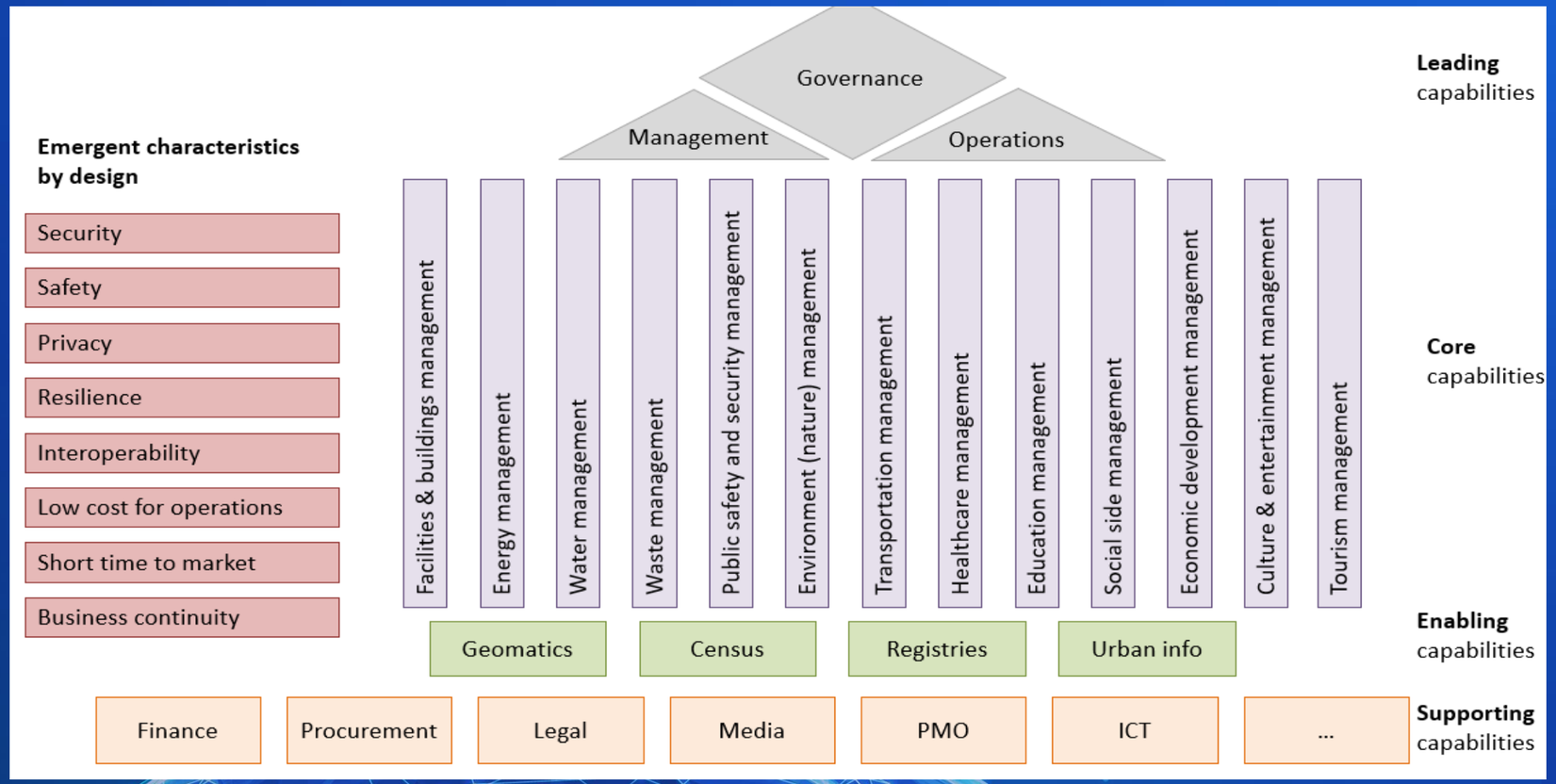
S. No.	Study Group Name	Convenor
1.	**LITD 28/SG 1 - Use Cases for ICT & Electrotechnology in Smart Cities**	Anveshi Gutta
2.	**LITD 28/SG 2 - Implementations Challenges**	Anveshi Gutta
3.	**LITD 28/SG 3 - Standardization Inventory & Mapping**	Ravindra Desai & K. Manikandan
4	**LITD 28/SG4 -RF Spectrum allocation & de-licensing implications**	Kunal Shah & Amarjeet Kumar
5	**LITD 28/SG5 - 5G imperatives for Smart Infrastructure**	Ashwani Kumar & Rajeev Shorey
6	**LITD 28/SG6 - Unified Common Citizens' Payment Systems Framework**	Alok Sethi
7	**LITD/SG7 – e-Governance for Urban India**	Krishnakumar Thyagarajan
8	**LITD/SG8 - Digital Experience & Infrastructure**	Ankur Pathak

LITD 28– Panels(To develop Standards)

S. N0.	Panel Name	Convenor
1.	**LITD 28/P1 -** Last Mile Communication Protocols	Amarjeet Kumar
2.	**LITD 28/P2 –** Common Service Layer	Aurindam Bhattacharya
3.	**LITD 28/P3 –** IT Architecture for Smart Infrastructure	Rajinder Baniyal
4.	**LITD 28/P4 -** Unified Data Semantics & Data Models for Smart Infrastructure	Uttam Kotdiya & C. Subramanian
5.	**LITD 28/P5** – Unified & Secure Gateway for Smart Infrastructure	K. J. Singh
6.	**LITD 28/P6** – ICT Architecture for Unified, Secure & Resilient Smart Infrastructure	N. Kishor Narang
7.	**LITD 28/P7 –** Data Layer Architecture for Smart Infrastructure	C. Subramanian
8	LITD 28/P8 – e-Governance Platform Architecture	Krishnakumar Thyagarajan

Common digital platform and digital solutions

- **Step-by-step absorbing by the digital platform Smart Cities capabilities**
  - Supporting
  - Enabling
  - Leading
  - Core

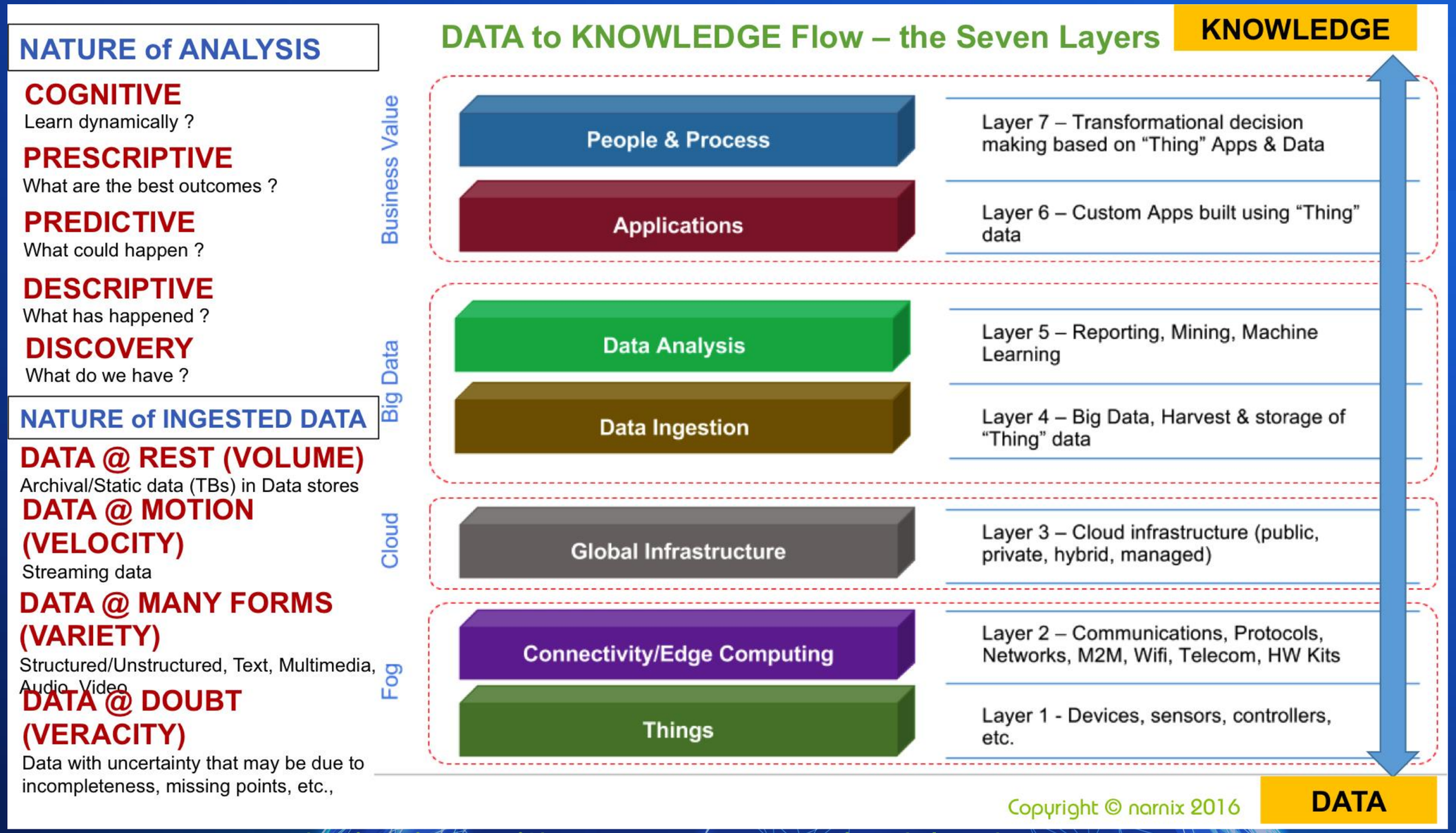


Initial implementations can be a digital solution which is later transferred into the digital platform

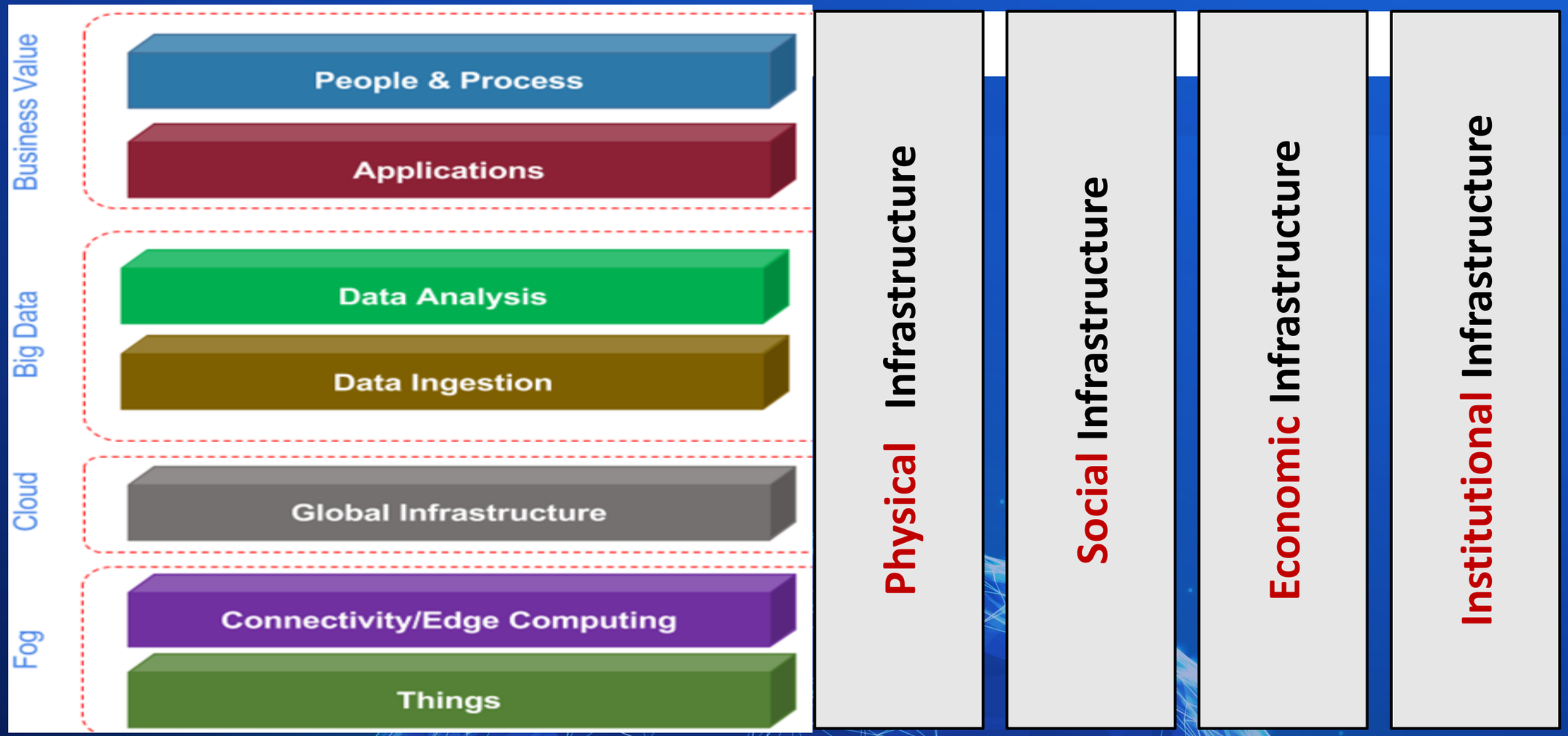
narnix

designing with secure n sustainable dna

7 Layers of Information Flow



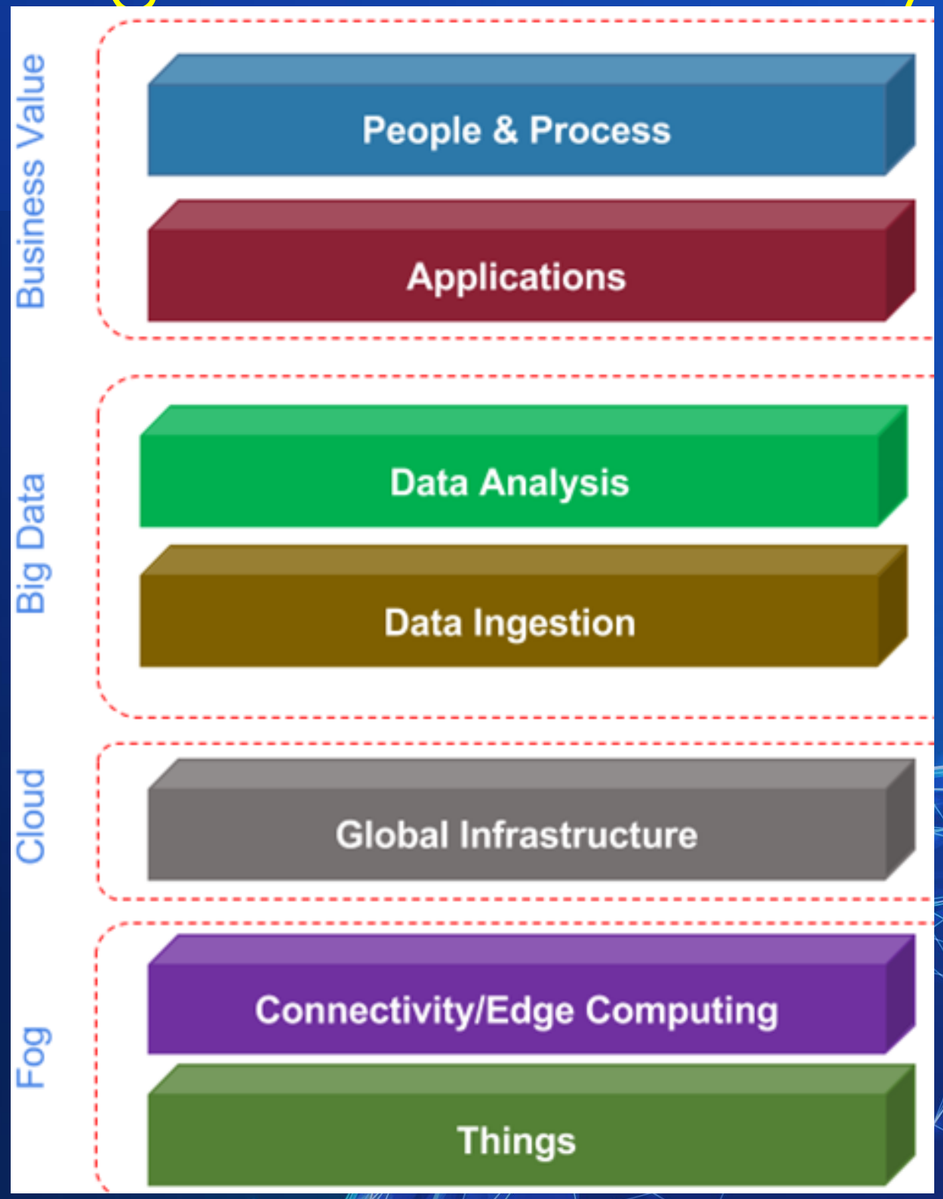
Mapping the Smart Infrastructure Philosophy to High-level Functionality



narnix

designing with secure n sustainable dna

Mapping the Smart Infrastructure Philosophy to High-level Functionality



Physical Infrastructure

Social Infrastructure

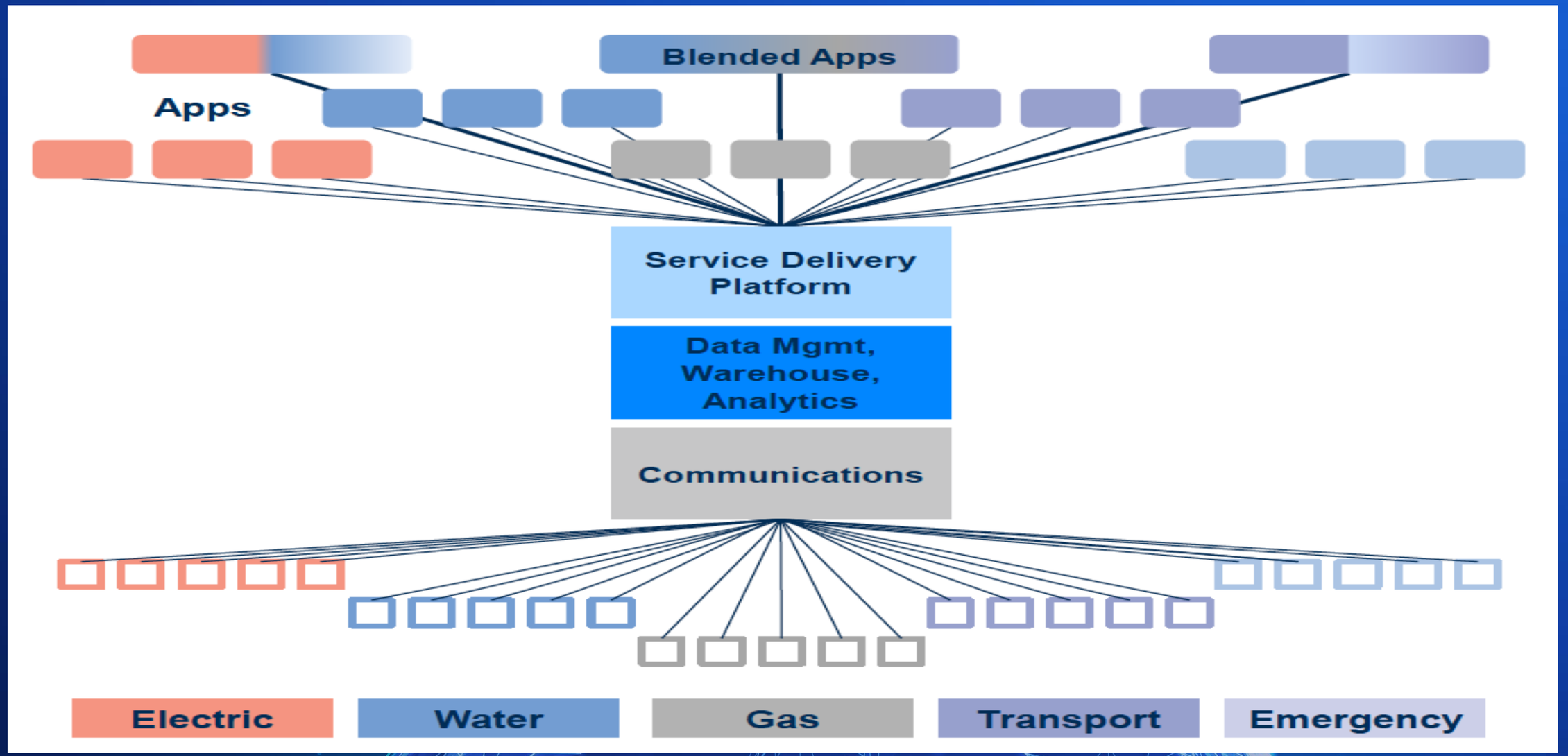
Economic Infrastructure

Institutional Infrastructure

The application needs **change** (as part of the users' requirement) to derive value from different infrastructure pillars, **but** the ICT and IoT **backbone remains (or should remain) the SAME !!!**

narnix

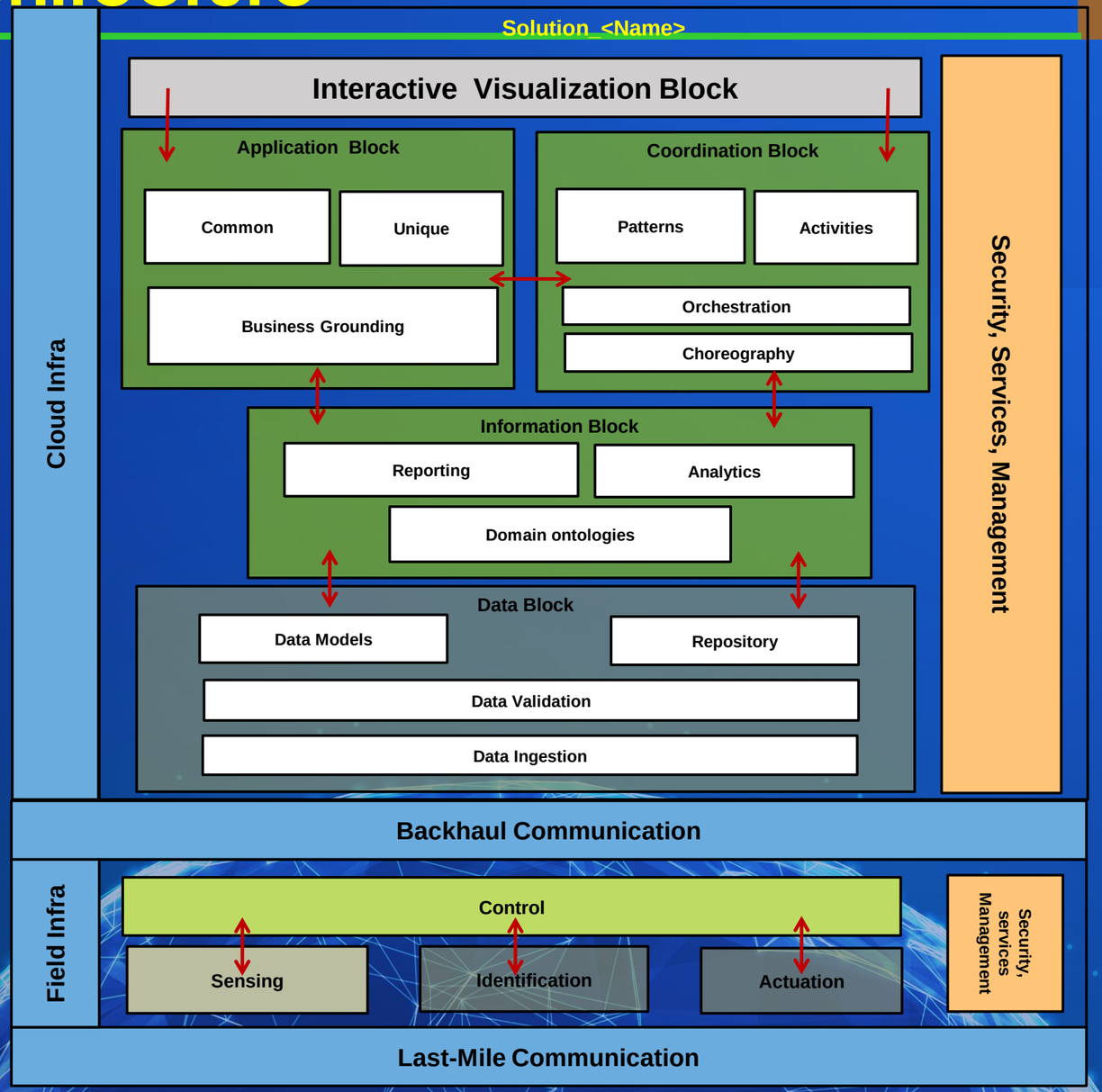
The way forward: Unified architecture



narnix

designing with secure n sustainable dna

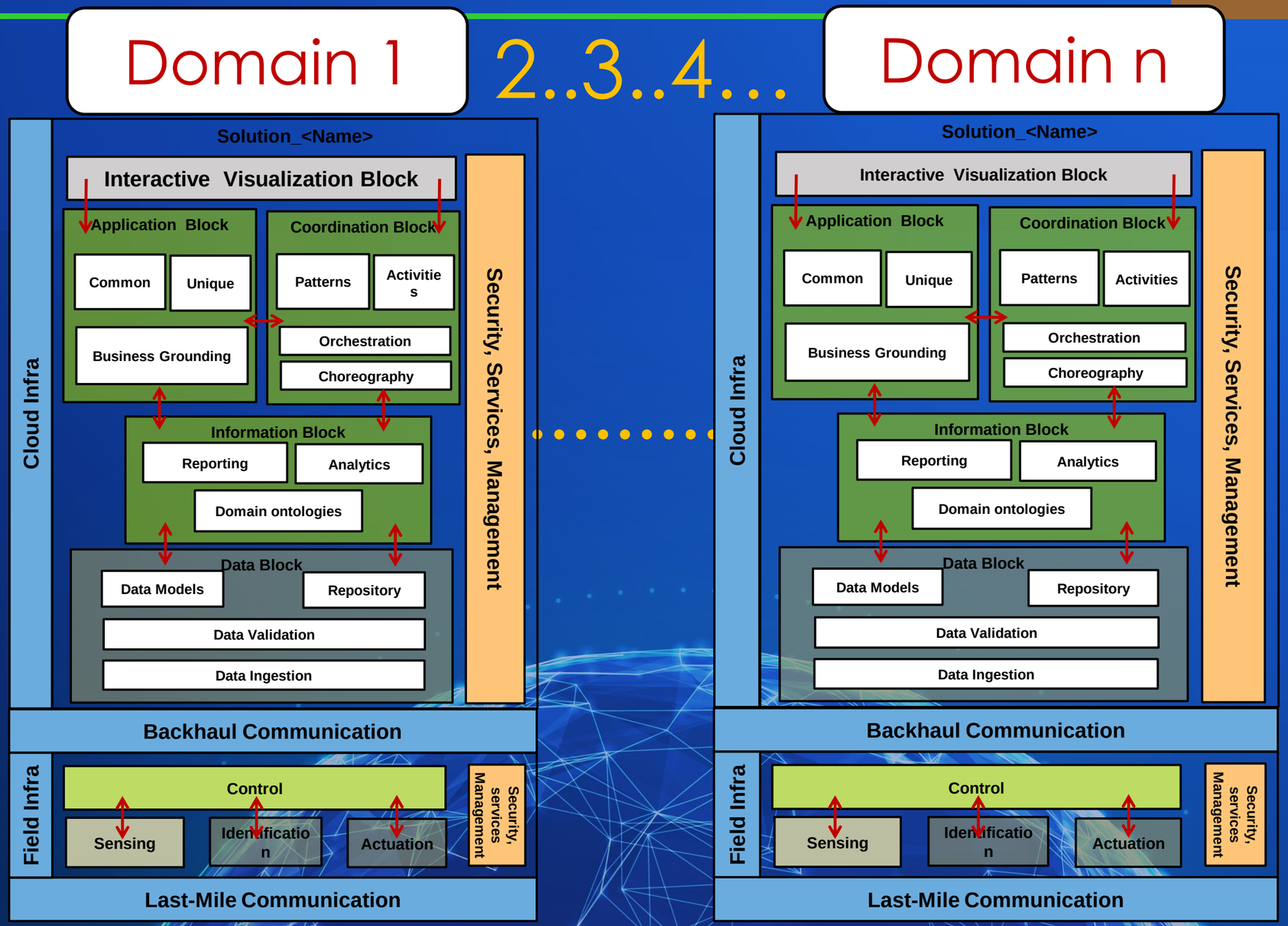
Smart Utility ICT Architecture



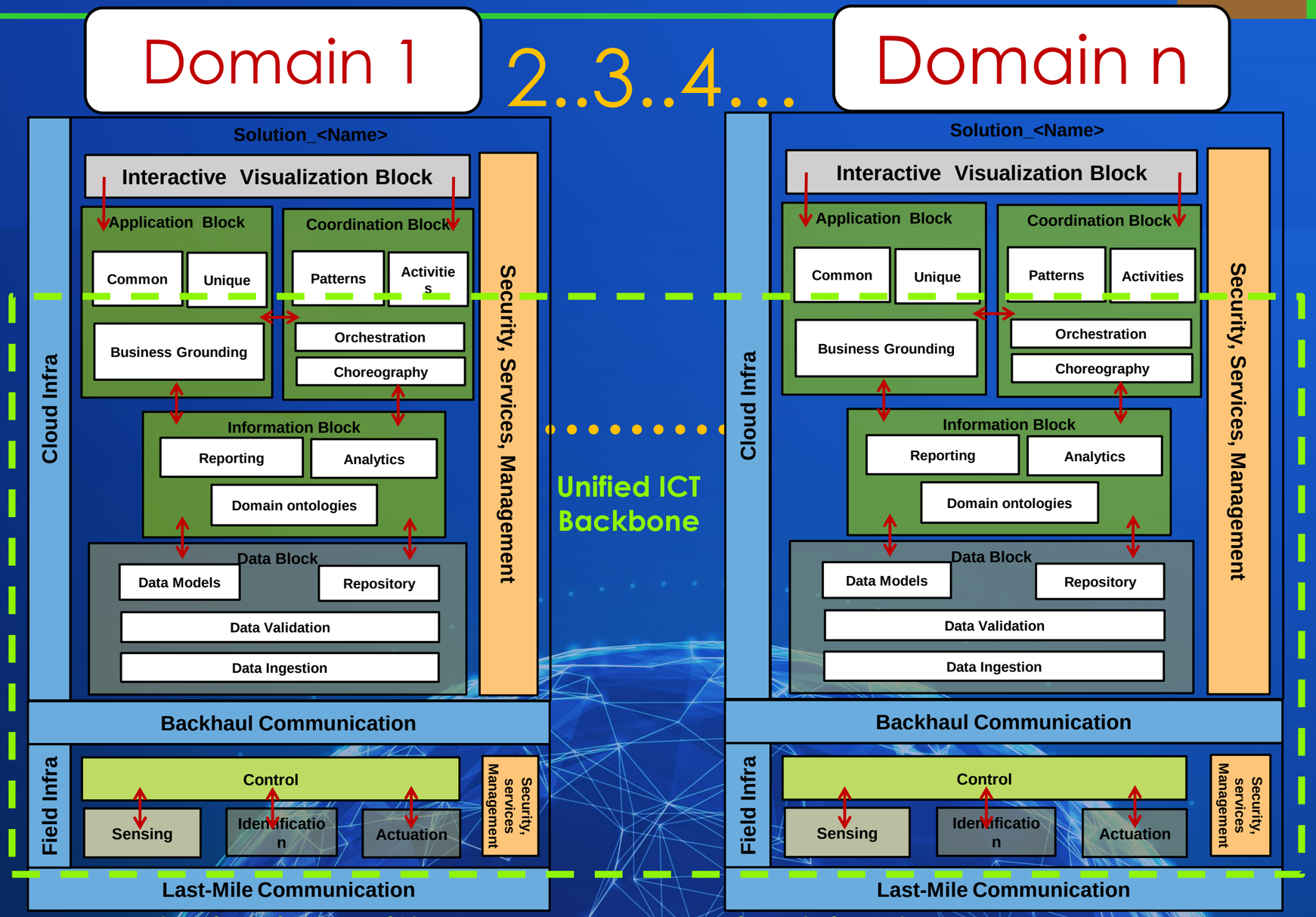
narnix

designing with secure n sustainable dna

Smart Utilities ICT Architecture

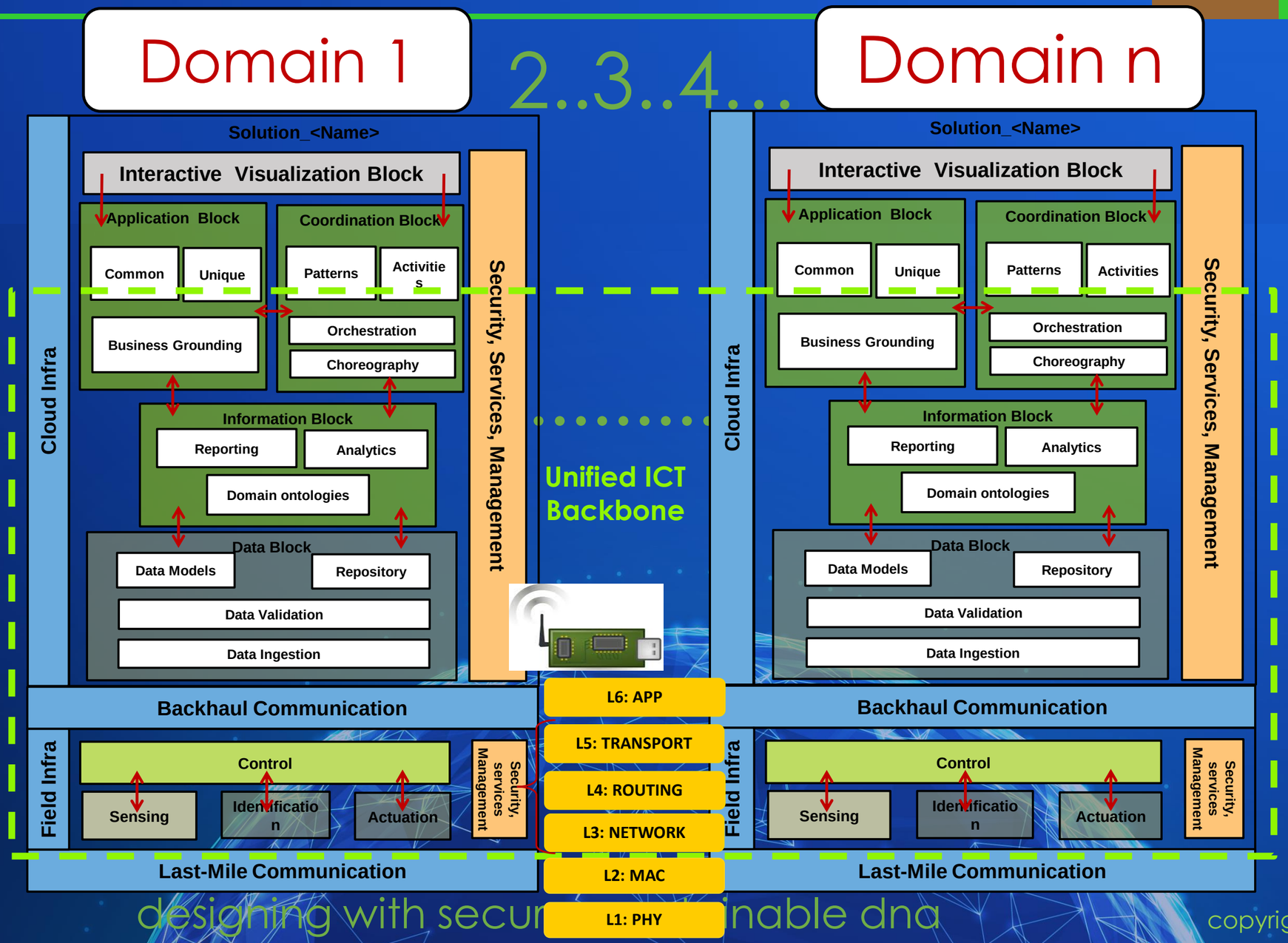


Smart Utilities ICT Architecture



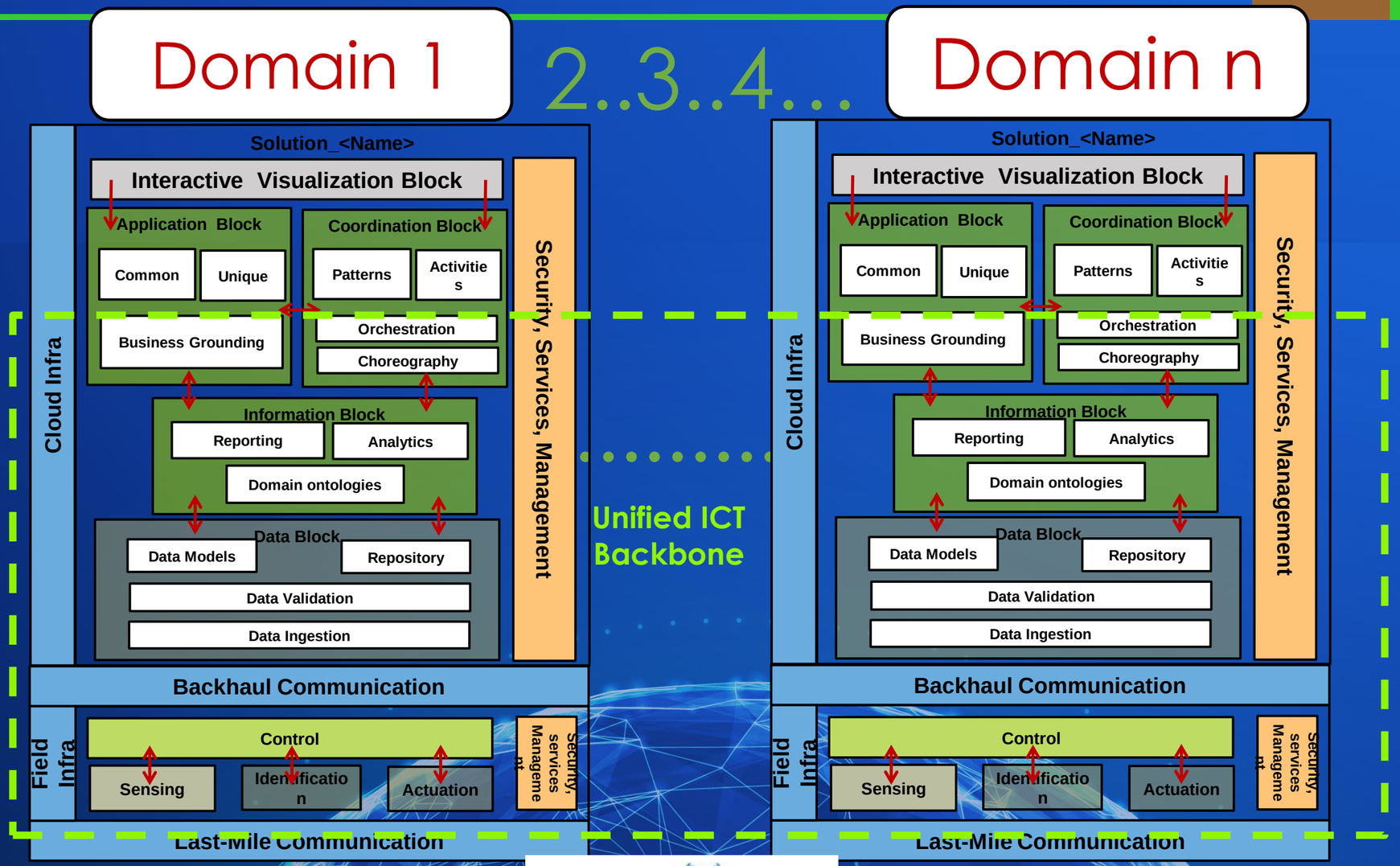
designing with secure n sustainable dna

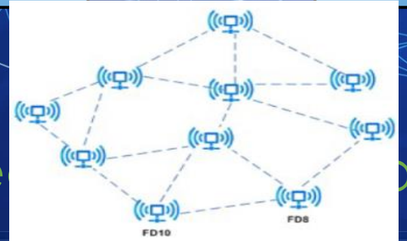
Smart Utilities ICT Architecture



designing with secur inable dna

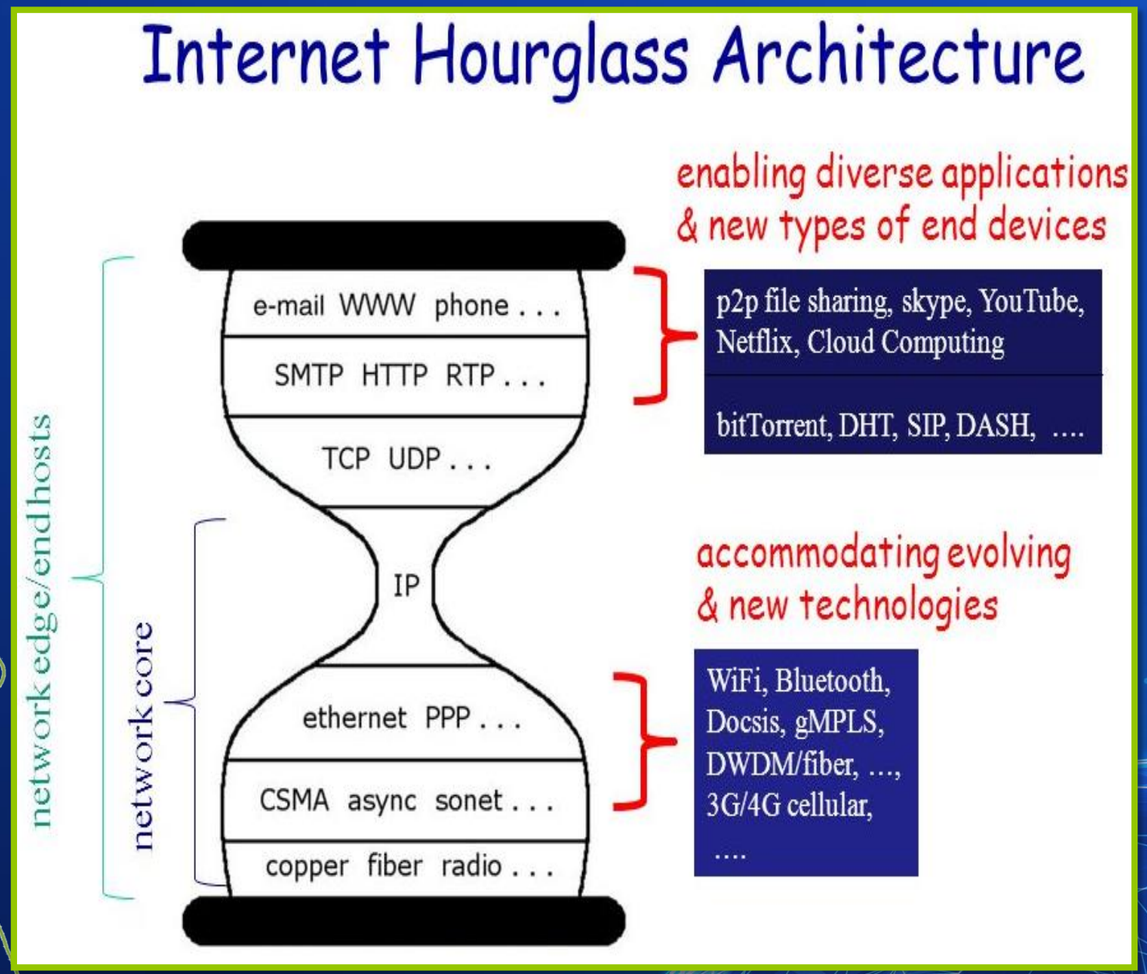
Smart Utilities ICT Architecture

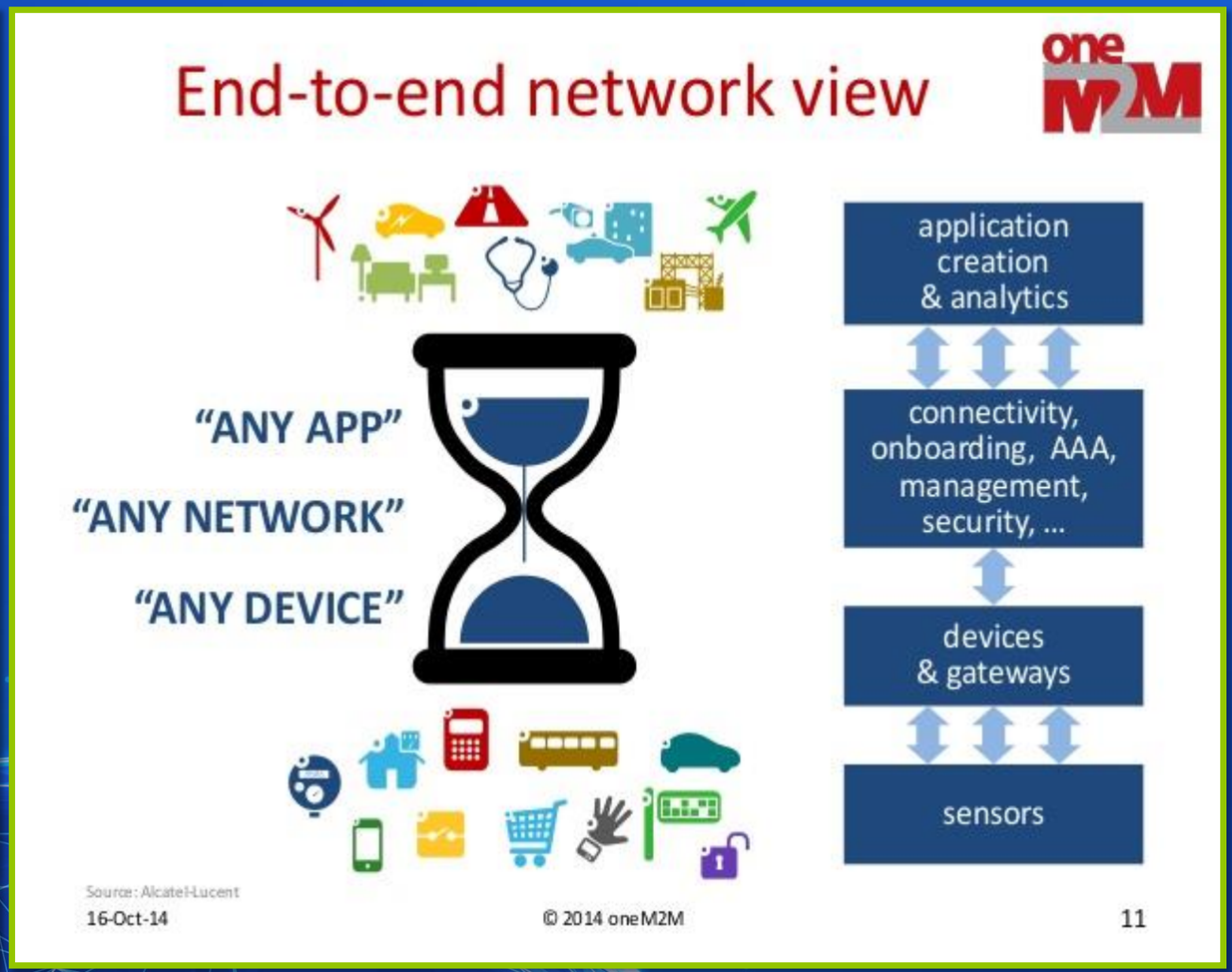




designing with se able dna

Unified ICT Architecture Abstraction:

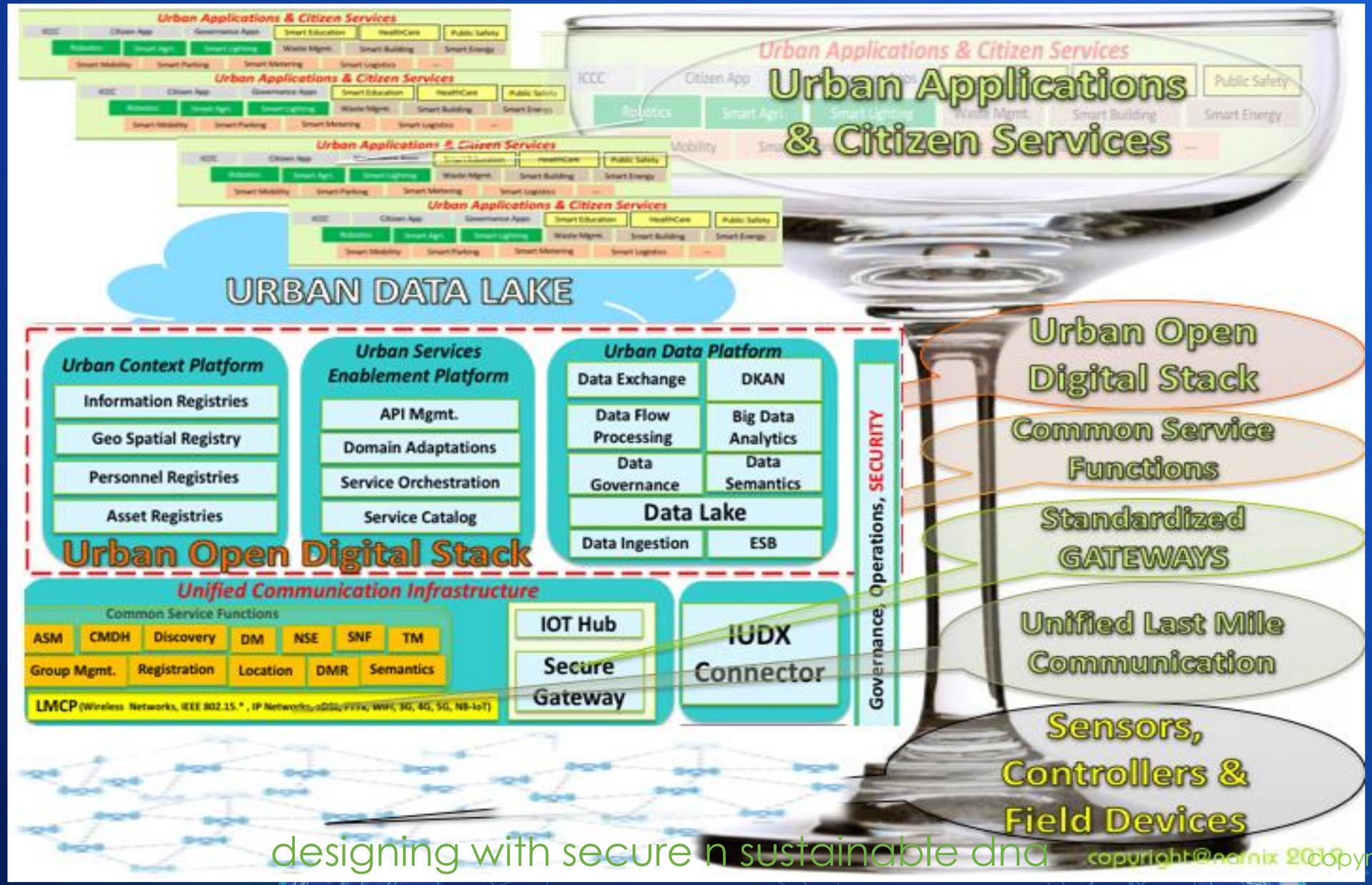




Moving from Hour Glass Architecture to…

designing with secure n sustainable dna

Classic Saucer Champagne Glass Architecture Model:

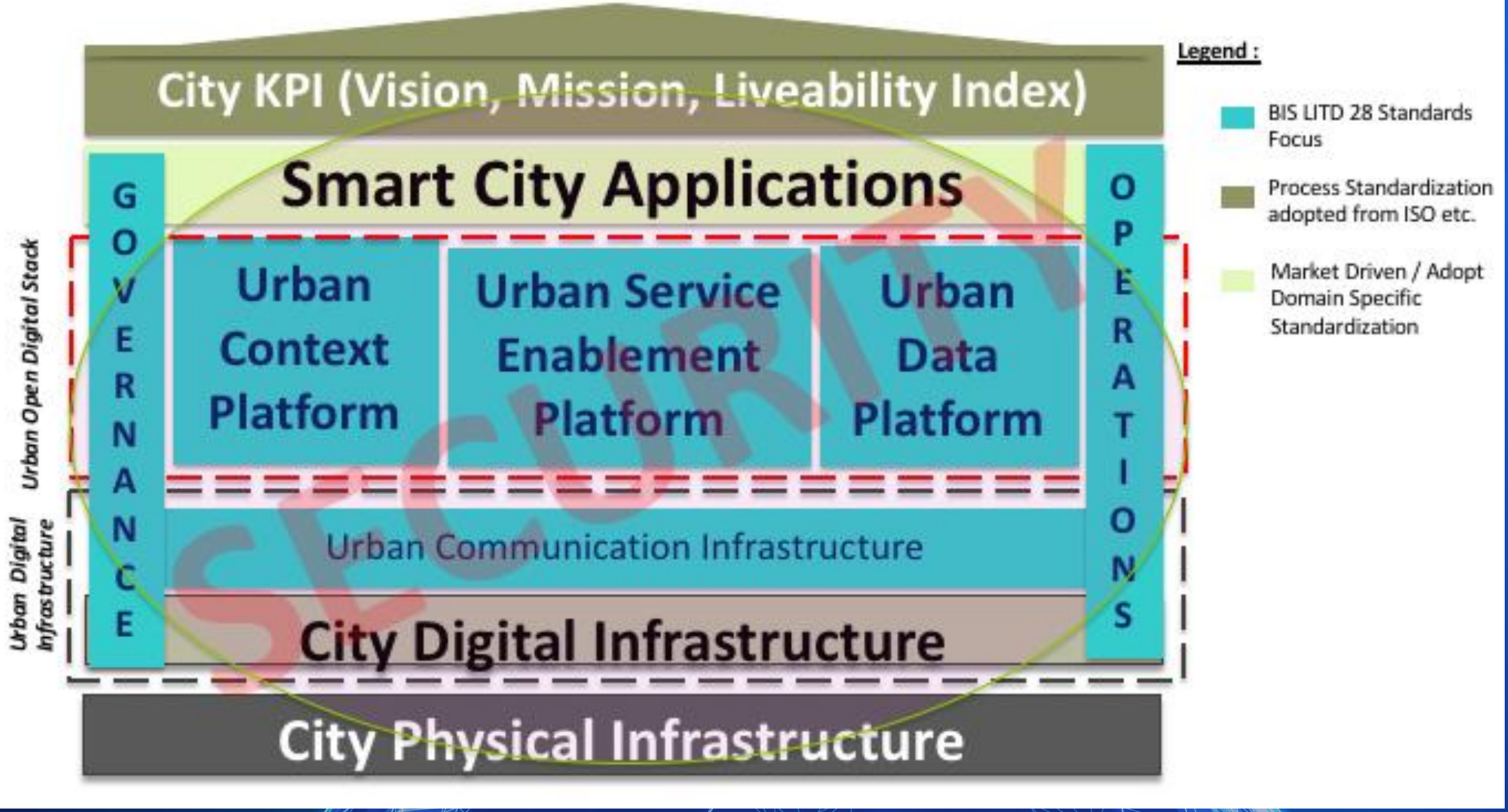


designing with secure n sustainable dna

...Classic Saucer Champagne Glass Architecture:

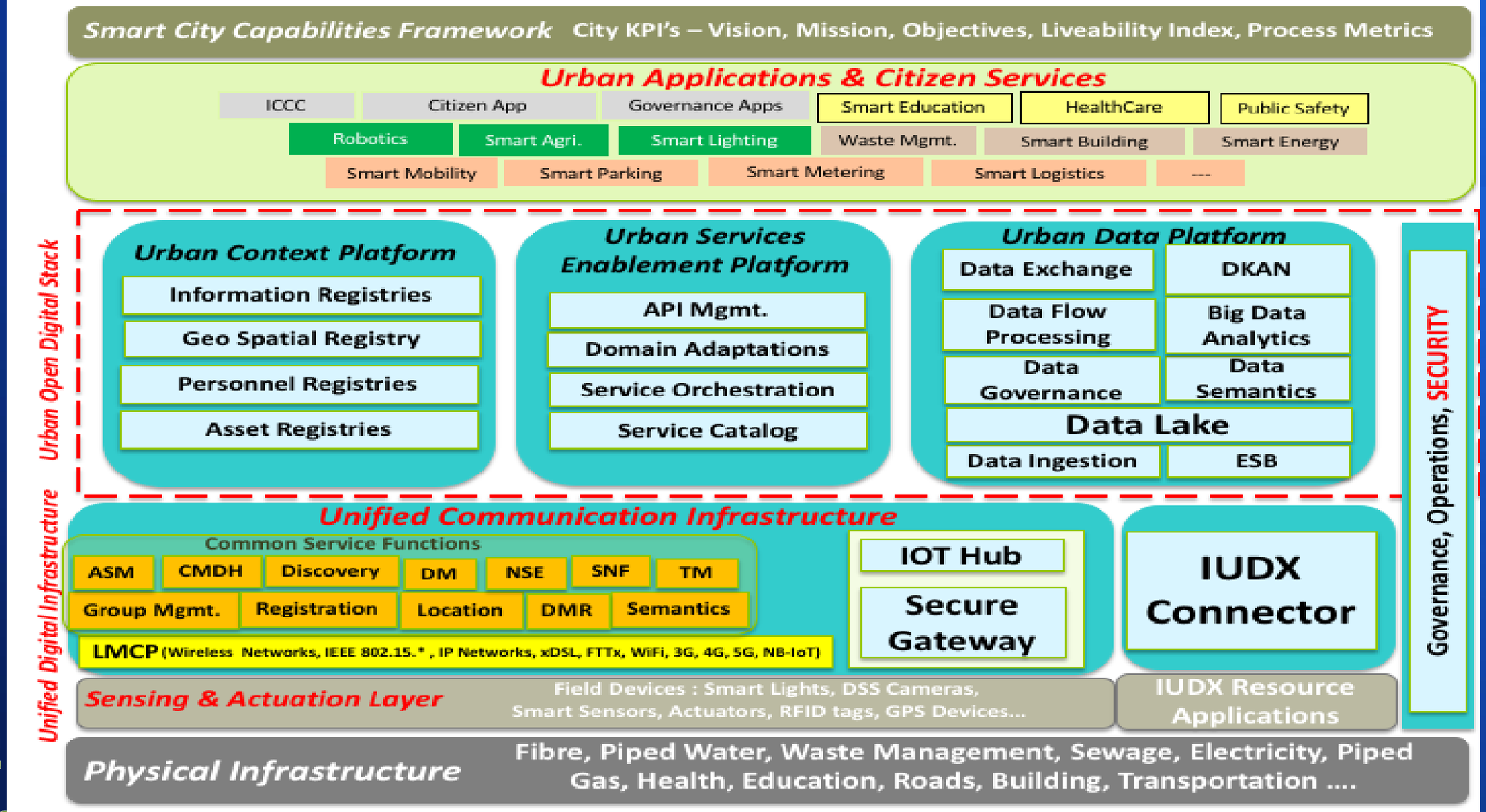
The evolved Comprehensively Unified ICT Architecture can be modelled as a **"Classic Saucer Champagne Glass"** with a **wide Flat Bottom Base** depicting the multitude of Field Devices & sensors etc. The **Saucer Shaped Bowl** on the Top depicting being filled with an ever-increasing spectrum of City Applications and Citizens' Services. The **Long Stem** depicts all the **Common Layers** viz.: the Unified Last Mile Communication, Common Standardized Gateways (application or Vertical Agnostic), Common Service layer representing the Common Service Functions in the **Gateways**, as well as, in the **Cloud**... and the Smart City Middleware & City Data Reservoir in the Cloud.

It is the **"Long Stem"** of the **"Champagne Glass Model"** instead of the Short & Narrow Neck in the "Hourglass Model" that brings the comprehensive harmonization, standardization & interoperability in the Architecture leading to optimization in operational efficiency & Life Cycle Cost of the ICT Infrastructure in any Smart City.



narnix

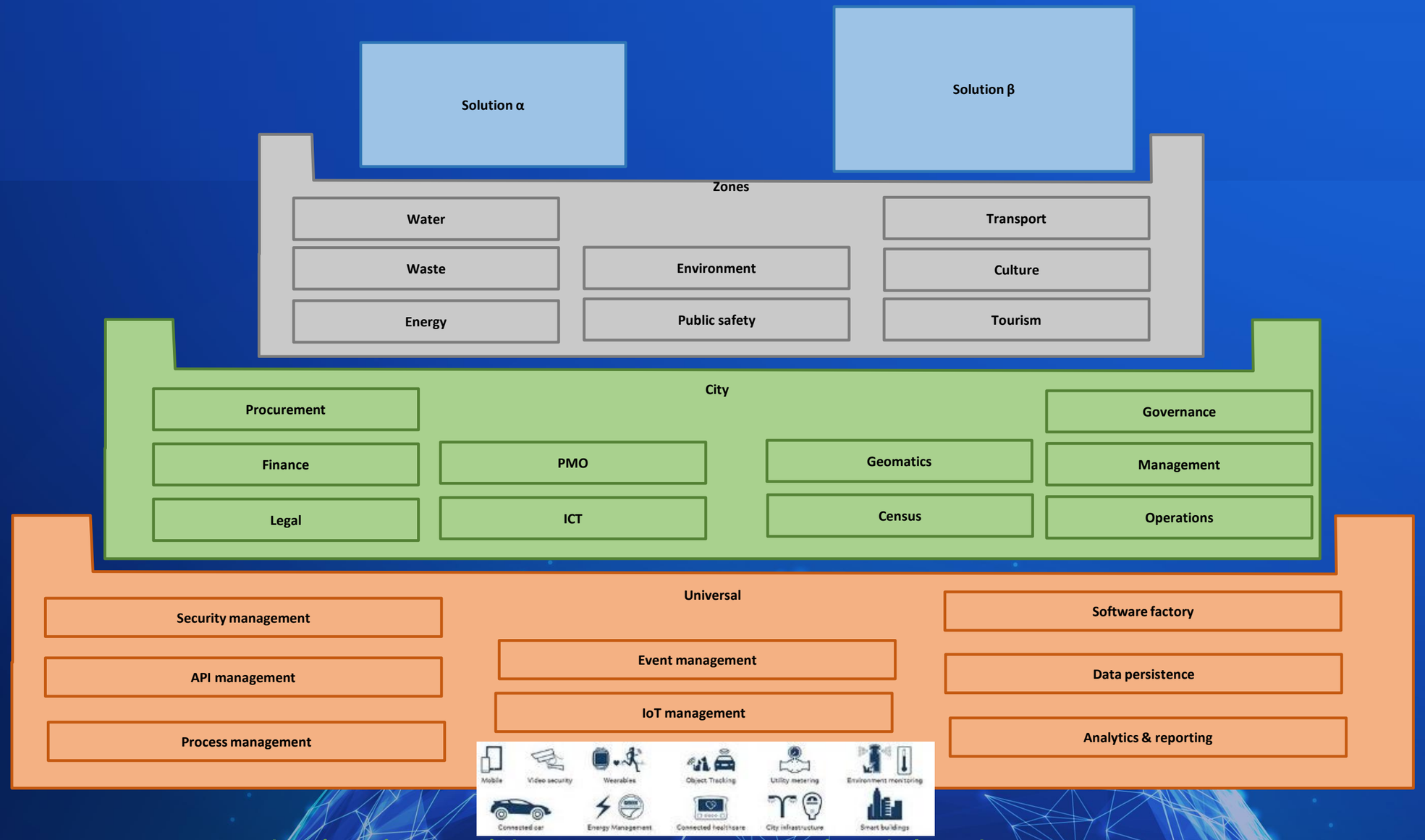
designing with secure n sustainable dna



narnix

designing with secure n sustainable dna

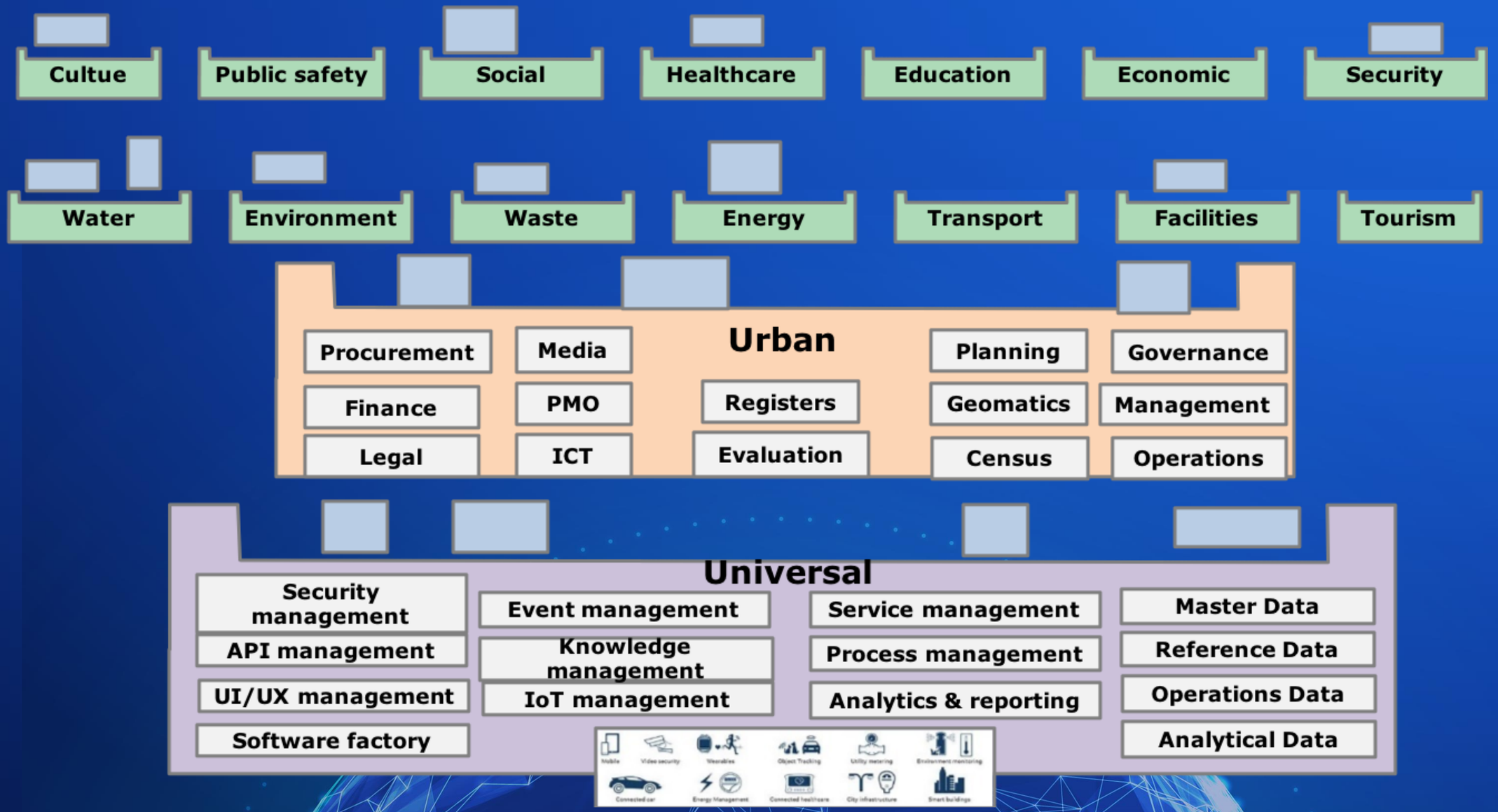
Common digital platform and digital solutions



narnix

designing with secure n sustainable dna

Platforms Approach…



narnix

designing with secure n sustainable dna

Some more focus Areas…

LITD 28 shall also undertake studies on the following subjects:

- E-governance portals delivering services online (like single windows for building plans etc.)
- Transportation systems that integrate multiple modes of transport and enable integration through common smart fare cards etc.
- Various SCADA systems being integrated into command centers at city level
- Various energy systems and their integration
- Electric Vehicle Charging Infrastructure Integration
- How to manage decentralized systems that require wireless as well as hard-wire access to data servers
- How to manage standards in systems that employ GIS maps as well as other digital data sources
- Interoperability and automation of alerts and commands between the GIS systems and command and control centers
- Role of Blockchain, Artificial Intelligence and Machine Learning in the Smart Infrastructure ICT Framework
- Stakeholder mapping of all the data expected to be generated from smart city
- ….

narnix

designing with secure n sustainable dna

LITD 28 Deliverables Imperatives:

- Comprehensive **Security Architecture**
- Comprehensive **Big Data Architecture**
- **5G Inclusive ICT Reference Architecture**

for Unified & Secure Smart Infrastructure

narnix

designing with secure n sustainable dna

Study Group 5 on 5G Imperatives for Smart Cities

LITD – 28 - Smart infrastructure Sectional Committee , Bureau of Indian Standards

narnix

designing with secure n sustainable dna

Terms of Reference

Create actionable reference deliverable capturing -

- An overview on 5G standardization work in 3GPP and track areas related to smart city use cases
- **Identify early 5G use cases for smart cities and technical requirements –**
  - Real-time surveillance, Assisted-driving, Connected public-transport, V2X Safety, Critical Communication – Emergency communications with precise location/public safety/disaster, Connected stadiums and VR, Remote health consultations/3D CT scans
- **Recommend a homogeneous framework/architecture using the legacy/current technologies as well as 5G architecture**
  - Review the current ICT architectures and technologies being deployed in smart cities deployments
  - Review the ICT architecture, technologies & standards being developed for smart cities in LITD 28
  - Identify infrastructural requirements and solutions for 5G services in smart cities and sharing framework – EV charging points, smart poles, outdoor sites, backhaul, indoor coverage, powering
- **Develop a smooth migration path from current technologies to comprehensive & homogeneous 5G architecture**

The Study Report: summary of the content…

Comprehensive view to key building blocks (enablers and capabilities) available from 5G technology for smart infrastructure, and deployment considerations, laying the foundation for detailed exanimation of specific aspects as way forward

narnix

designing with secure n sustainable dna

A few Next steps…

- Identify 5G Friendly, 5G Intensive & 5G Extensive Applications & Use Cases within the Smart Infrastructure paradigm and even outside…
- Identify the feasibility of developing Application Layer Standards around them…
- Develop a phased implementation & deployment plan for them…
- Develop the most optimized **"5G inclusive ICT Reference Architecture for Smart Infrastructure"**…
- Develop a smooth migration & adoption strategy from Contemporary ICT Architectures to the 5G Inclusive Architectures…

A few Next steps…

- Study SBA/ Open API's at 3GPP versus common service layer platform for use cases – examine API's
- How to leverage network slicing/ SBA 5G to implement diverse critical use cases and e2e QoS mapping from transport layer to application layer
- Role of virtualization/ SDN/ MEC for dynamic use cases implementation and deployment flexibility

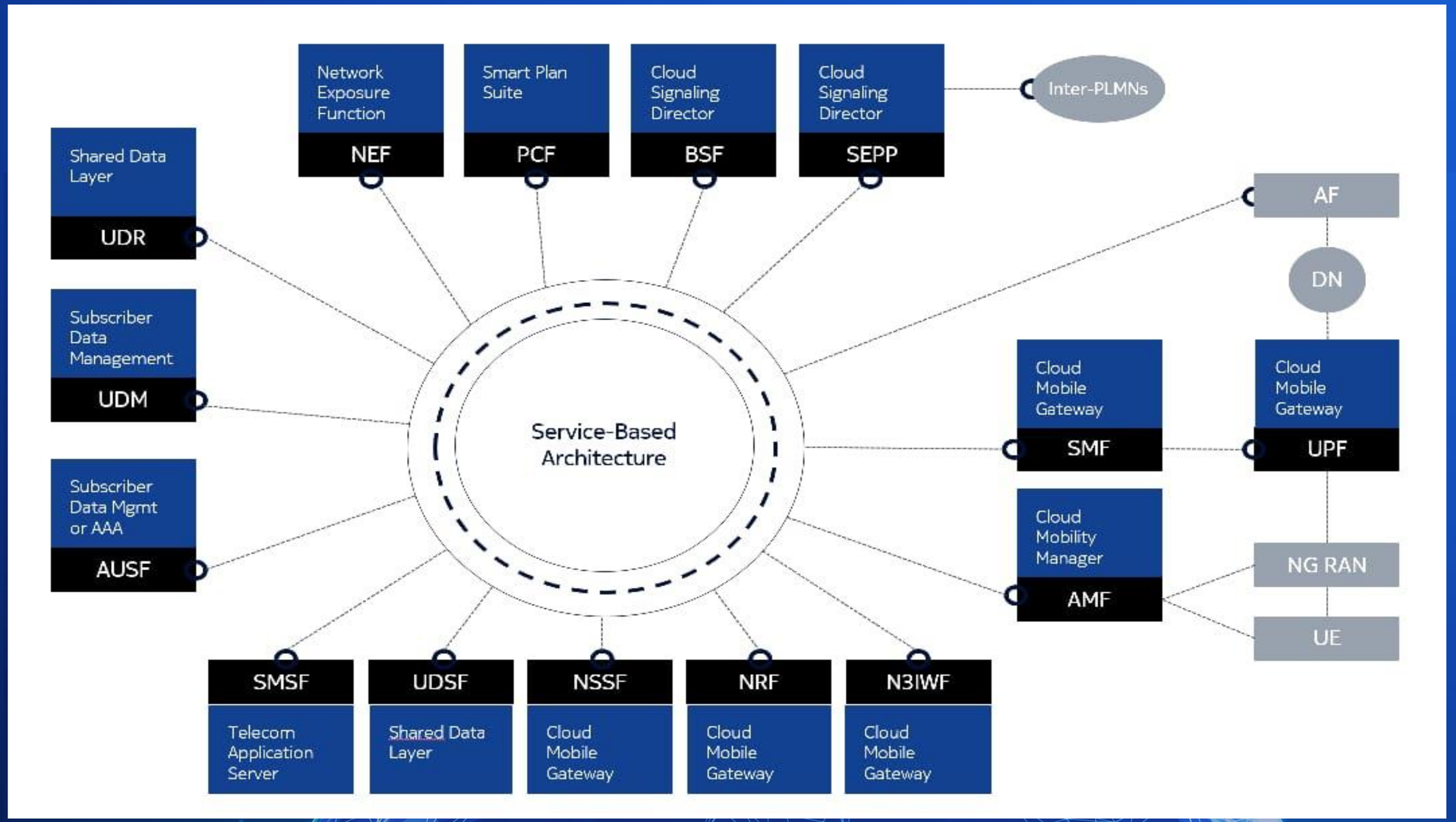
narnix

designing with secure n sustainable dna

Recommendations on Development of Application Layer Standards

- **5G Applications will deliver great value to the country**
- While there is vast global eco-system in the applications layer standards, new SDOs are being formed around 5G applications
- **Short Term**
  - Piggy back work in Standards Project Teams, Use Case labs and Awareness Promotion to support Applications Layer development
- **Longer Term**
  - Set up a Committee to recommend 10 year plan to bring India into full participation in SDO process (same committee as Standards)

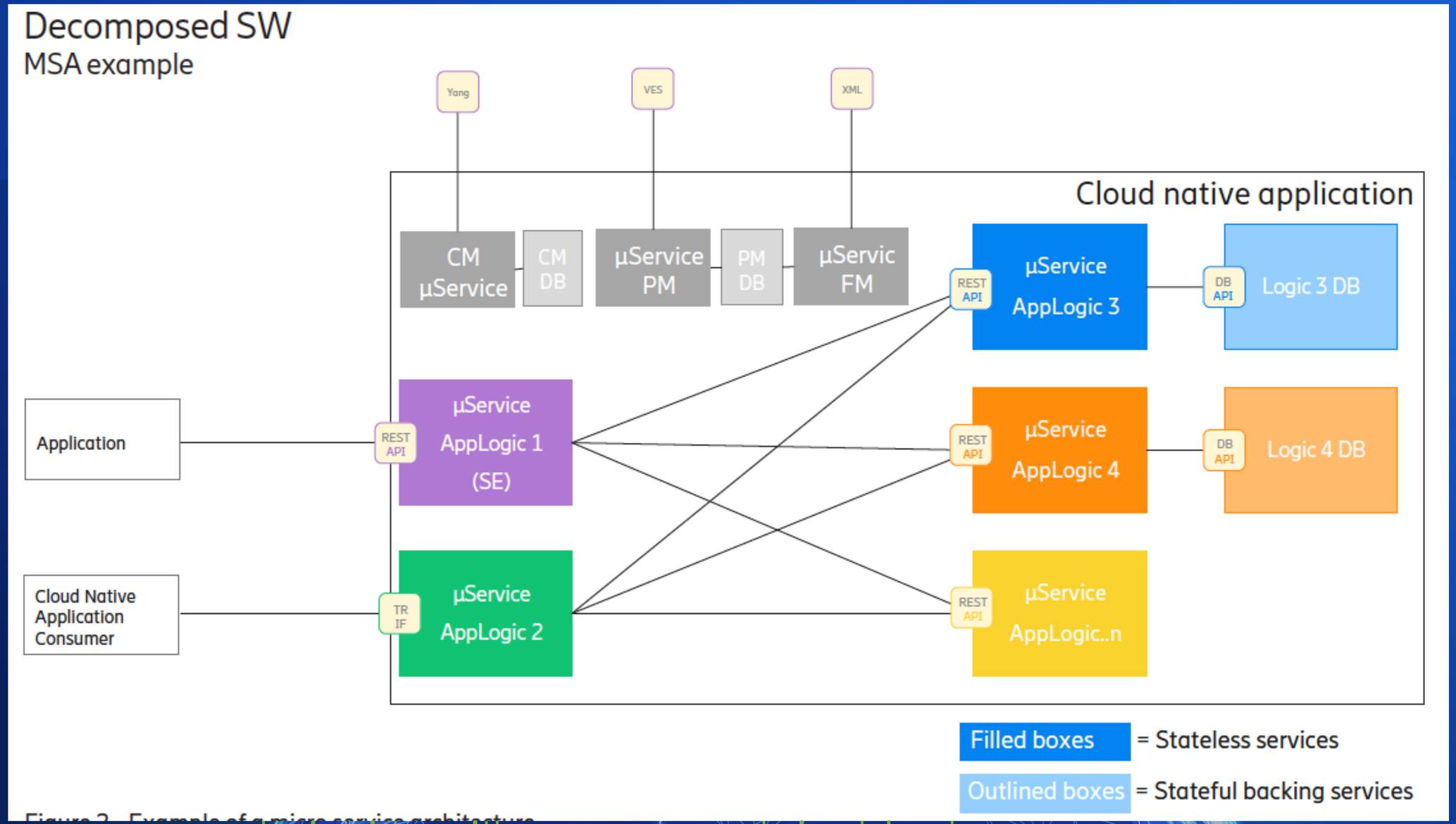
5G Service Based Architecture



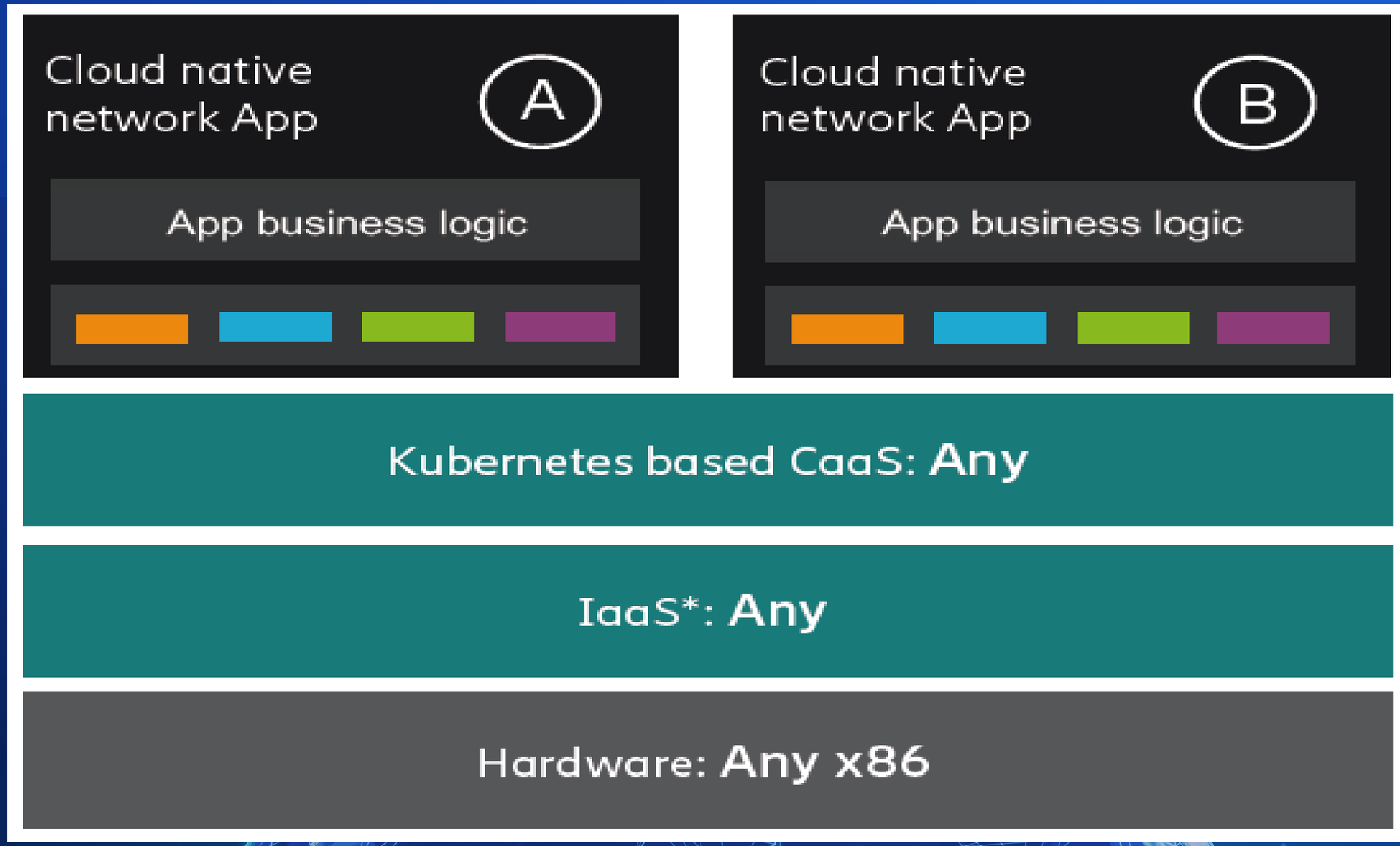
narnix

designing with secure n sustainable dna

Example of a micro service architecture



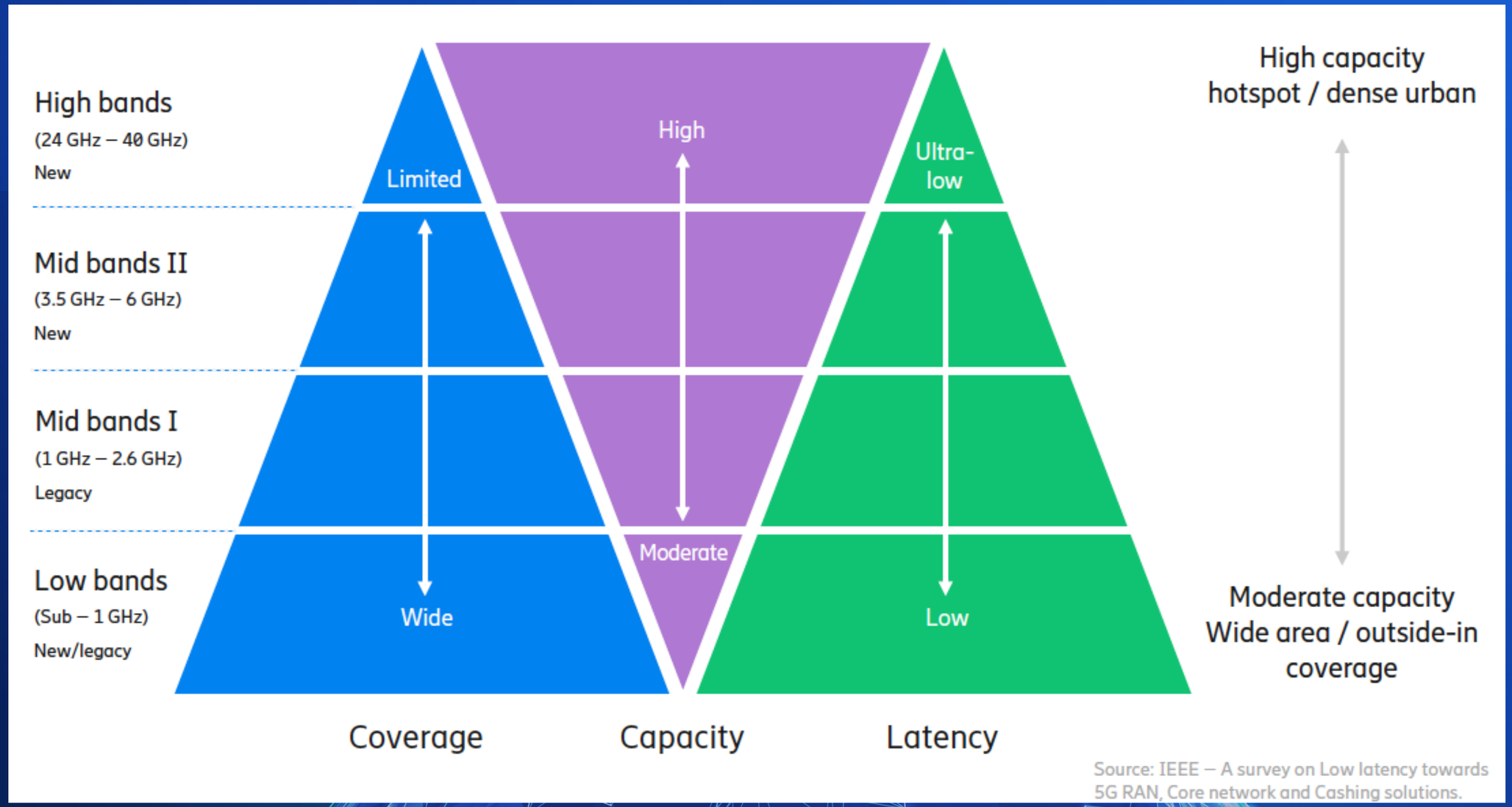
Cloud native application stacks



narnix

designing with secure n sustainable dna

5G spectrum strategy



5G Networks Characteristics

- The ability to handle multiple, tailored use cases is what makes 5G more disruptive than previous generations of cellular technology.

- As 5G will need to coexist and interwork with 4G for many years to come, we're likely to see the vast majority of these deployments as non stand-alone (NSA) initially, as a way of reducing time to market and ensuring good coverage and mobility.

Network Architecture

- Current network architecture needs to evolve to meet the needs of the wide variety of use cases enabled by 5G technology.
- As part of this, the transport network must evolve and scale efficiently to meet widely varying, but strict, requirements for performance, capacity, latency, and security.
- It must also support the various needs of parallel network architectures and technologies, and seamlessly support the coordination between many more cell sites, including those that will coexist with 4G technology for many years to come.

Design Principles

- Agnosticism
- A Micro-service Architecture
- Application Resiliency
- State Optimized Design
- Orchestration and Automation
  - Internal automation and orchestration
  - Network level orchestration and automation

narnix

designing with secure n sustainable dna

5G Paradigm – Key Attributes…

- Distributed Architecture
- Network Slicing
- CUPS
- Cloud RAN
- Virtual Network Functions (on Cloud native)
- Cloud Native Digital Services
- Microservices Architecture
- Continuously Evolving Software
- DevOps

narnix

designing with secure n sustainable dna

Today, one of the main concerns about virtualizing the network functions is backward compatibility. It is critical to make sure the virtual network functions (VNFs) can interoperate with the physical network functions and the older infrastructure.

But even more important is how best to develop, test, deploy, and manage APPLICATIONS to take advantage of the new capabilities provided by 5G Paradigm with all its key attributes...

Some Questions…

- Under ALS, what are we going to Standardize?
  - The Application Platforms? For different use cases?
  - Interfaces of the AL with other 5G Network Layers ?
  - And/or….
  - Whatever, we choose to Standardize, how granular we want to (or should) go?

narnix

A few inputs for the immediate NEXT STEPS…

Follow the Systems Approach

- Study & Analyze the selected Use Cases to understand their respective Characteristics
- Study & Analyze the 5G Network Architecture(s) and enumerate their characteristics, as well…
- Develop a Matrix to map the Application(use cases) characteristics with the 5G Network Architecture Characteristics that shall enable & empower the Applications' characteristics.

- This Mapping shall help us understand & develop the customized “5G Architecture Views” that shall meet any single or set of Applications & /or use cases.

- This shall also help us understand the kind of VNFs, Network Slices, Microservices, Containers, Data Repositories that shall be needed to serve the respective applications…

Only after this stage,

we could actually identify as to what aspects can or should be standardized…

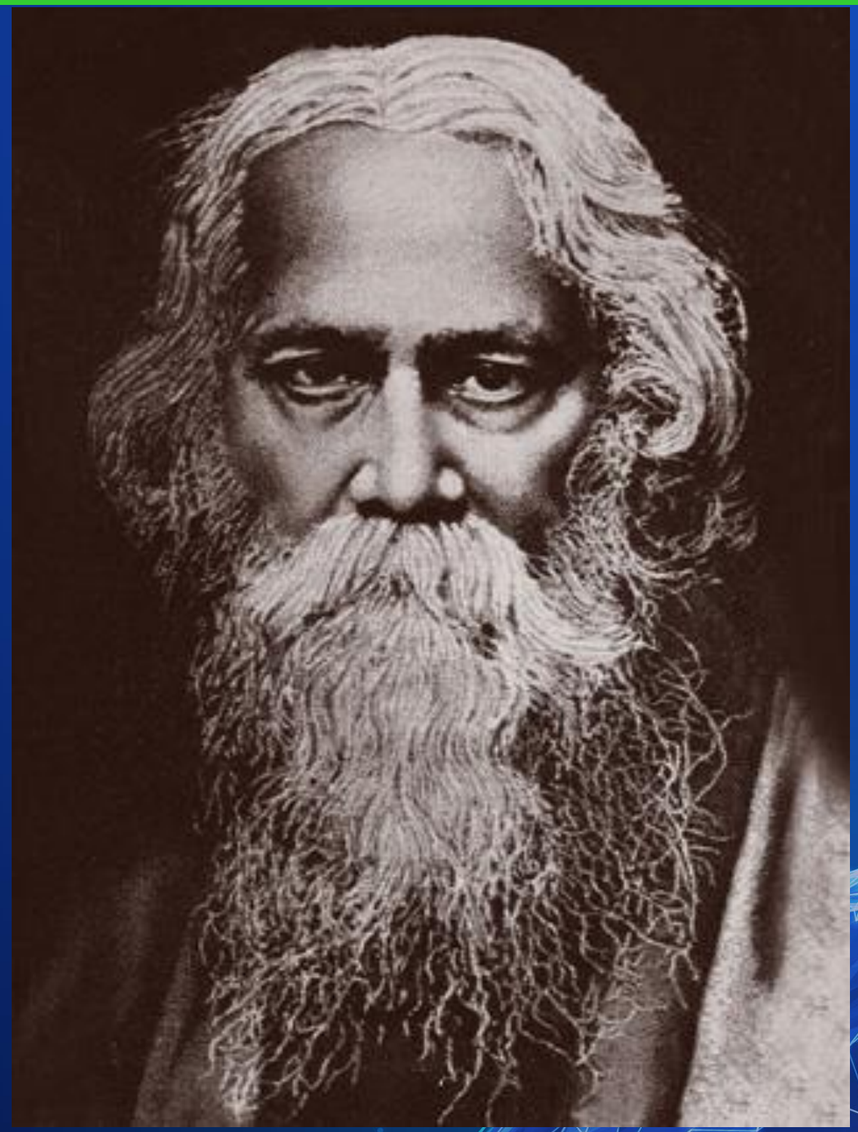
narnix

designing with secure n sustainable dna

narnix

designing with secure n sustainable dna

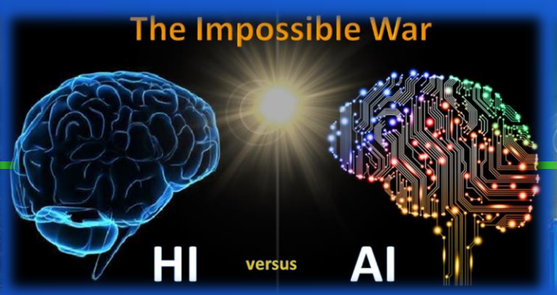
Resilience….

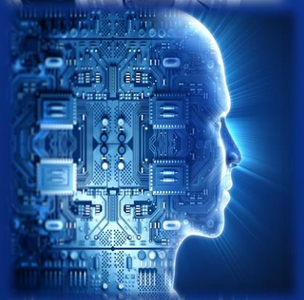


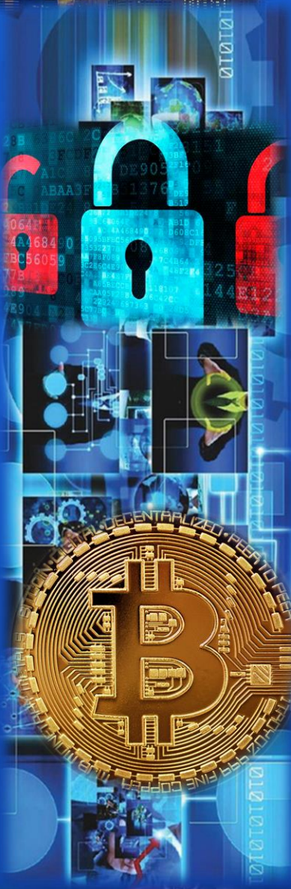
Let us not pray to be sheltered from dangers but to be fearless when facing them

narnix






design is our religion
&
we are fanatically religious

narnix

narang n. kishor
+91 9810163990
kishor@narnix.com




Brief Profile - narang n. kishor

narang n. kishor
Mentor &
Principal Design Architect
narnix technolabs pvt. ltd.

Technology Philanthropist,

Innovation & Standardization Evangelist…

Technology Consultant, Mentor & Design Architect in Electrical, Electronics & ICT…

- Over 40 years of professional experience in education, research, design and consulting .
- Over 30 years of hardcore Research and Design Development Experience in Solutions, Systems, Products, Hardware, Software & Firmware (Embedded Software) in fields of Industrial, Power, IT, Telecom, Medical, Energy and Environment.
- Over 10 years of Consultancy Experience to different segments of business & industry.
- Over 200 Research & Design Mentees in the Electronics & ICT & STI Ecosystems.
- Leading & contributing in multiple National & Global Standardization Initiatives at BIS, Niti Ayog, TSDSI, IEC, ISO, ITU, IEEE etc.…

narnix

designing with secure n sustainable dna

Brief Profile - narang n. kishor

Leading Standardization activities @BIS - the Indian National SDO in - Smart Cities, Smart Manufacturing, Smart Energy & Active Assisted Living as the Chairman of **Smart Infrastructure Sectional Committee LITD 28 in BIS.**

Contribution in Global SDOs:

- **Vice Chair – Strategy & Convener – Reference Architecture Work Group in IEC SyC Smart Cities.**
- **Project Leader – IEC TS 63188 ED1** – Smart Cities Reference Architecture Methodology
- **Project Leader – IEC 63205 ED1** – Smart Cities Reference Architecture
- Co-Editor – ISO 30145 on Smart City ICT Reference Framework
- Co-Editor – ISO 30146 on Smart City ICT Indicators

Representing Indian National Body BIS & contributing with Indian perspective in

- IEC – SyC Smart Energy, SyC Active Assisted Living & SyC Smart Cities. IEC - SEG4, SEG6, SEG7, SEG8 & SEG9
- ISO - TC 268 on Sustainable Development in Communities.
- ISO/IEC JTC1/SC 41 – Internet of Things & related Technologies, JTC1/SC 42 - Big Data & Artificial Intelligence; and JTC1/WG11 – Smart Cities.
- ITU-T SG20 - Internet of Things (IoT) and its applications including smart cities and communities (SC&C).
- IEEE Smart Cities & Internet of Things Steering Committees.
- ....

narnix

designing with secure n sustainable dna