Smart City Roadmaps
Barcelona City Case Study

An initiative by Xona
Partners in collaboration
with

BARKENO
ADVISORS

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Case Study: Barcelona Smart City

Smart City as an Industry Driver

Developing a smart city requires an ecosystem that

- Links the elements of the innovation ecosystem

- Promotes alliances and PPPs among entrepreneurs, industry and city government

- Researches technologies to improve cities in collaboration with industry and academia

- Develops new business models for the sustainability of urban solutions

- Tests, prototypes and deploys urban solutions

- Assess and develop best practices and standards to scale and replicate solutions

- Export the solutions to generate global opportunities

Barcelona as an Example

## Barcelona has developed 22 programs to answer its necessities

1. Telecommunications networks
2. Urban platform
3. Smart data
4. Smart lighting
5. Energy self-sufficiency
6. Smart water
7. Smart mobility
8. Re-naturalisation
9. Urban transformation
10. Smart urban mobility
11. Urban resilience
12. Citizenship
13. Open government
14. Barcelona in your pocket
15. Smart waste collection
16. Smart regulation
17. Smart innovation
18. Health and social services
19. Education
20. Smart tourist destination
21. Infrastructures and logistics
22. Leisure and culture

Alignments of programs with the needs of a city is critical

The Approach

Barcelona created the Barcelona Institute of Technology to align objectives and generate knowledge related to urban innovation, and to promote alliances and interaction between the city, industry, research centers, academia and civil society to capitalize on Barcelona's knowhow and apply it for the benefit of the citizens

City of Barcelona
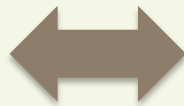
The Ecosystem

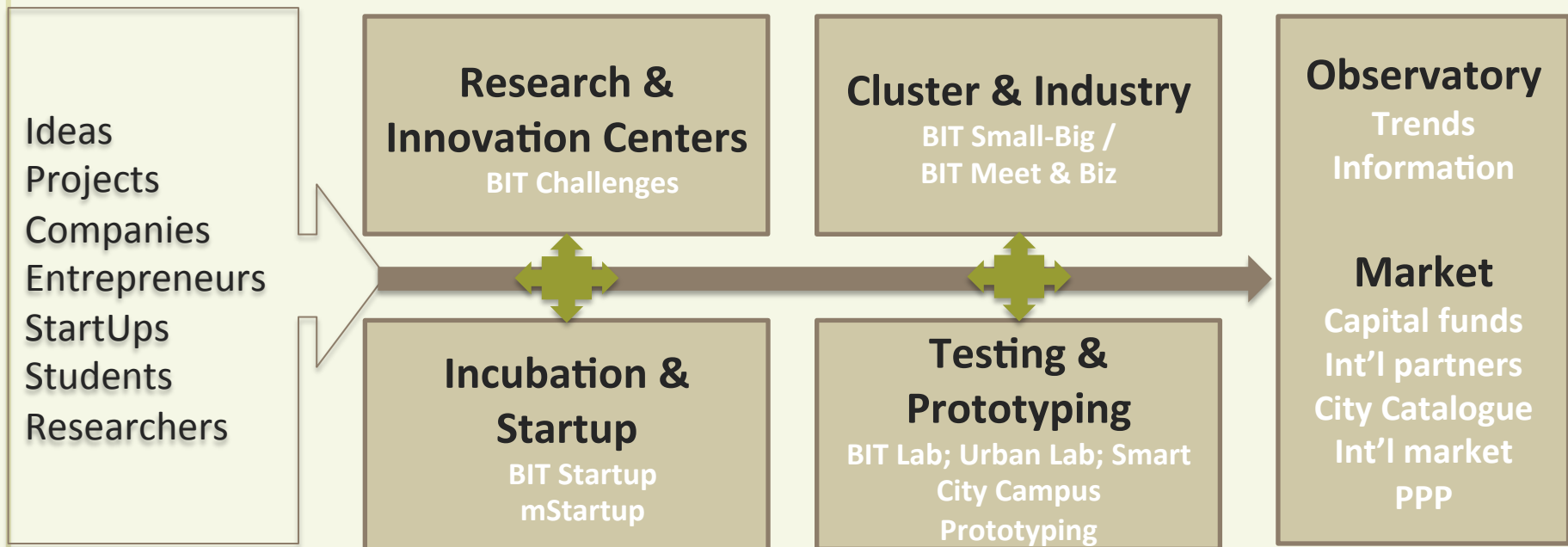| Innovation ecosystem	Capitalization and model transfer	Training and research in urban innovation
• Urban lab • Centres of research and excellence • Clustering and local business ecosystem (SMEs, entrepreneurs) • Technology incubator • Startups	• Services & solutions catalogue • Transfer, international promotion and collaboration	• Lines of research (scientific committee) • Training and education

Smart city campus • A place where the city develops its strategies

Innovation Ecosystem

Create synergies and promote joint collaborative participation in urban innovation projects

Ideas
Projects
Companies
Entrepreneurs
StartUps
Students
Researchers

Research & Innovation Centers
BIT Challenges

Cluster & Industry
BIT Small-Big /
BIT Meet & Biz

Observatory
Trends
Information

Incubation & Startup
BIT Startup
mStartup

Testing & Prototyping
BIT Lab; Urban Lab; Smart City Campus Prototyping

Market
Capital funds
Int'l partners
City Catalogue
Int'l market
PPP

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The Urban Lab

Objective: Facilitate use of public space as urban laboratory for companies, start-ups and entrepreneurs to test their products and services

- ✓ Test in real environment
- ✓ Foster urban impact of solutions
- ✓ Find needs of the city and benefit citizens
- ✓ Foster open innovation
- ✓ Reduce time to market of solutions

| What it is...	What it is not...
› It is a test space for those products that have a direct involvement in the operation of the city or the services provided by the City Council.	› Is NOT a test space for products or services on the market or already being marketed.
› It is a test space to accommodate projects that provide benefits to citizens and to resolve unresolved needs.	› Is NOT a test space for innovative projects that have no direct benefit but on the management of the City Council or the public.
› It is a test space to accommodate projects that are aligned with the objectives, priorities and lines of action of the City Council.	› It is NOT a way to finance innovative projects.
	› Implies no commitment by the City Council to implement long-term solution tested in the Barcelona Urban Lab.

The Urban Lab: Advantages

› Testing innovative services in live environment
› Agility in joint tasks of City Council -company pilot
› Availability of municipal buildings and public roads
› Quick results / points of product improvement

› Shortens product time to market
› Provides brand visibility at City Council level
› Availability Quality Seal Urban LAB in the communication strategy of the company
› Synergies with other municipal projects
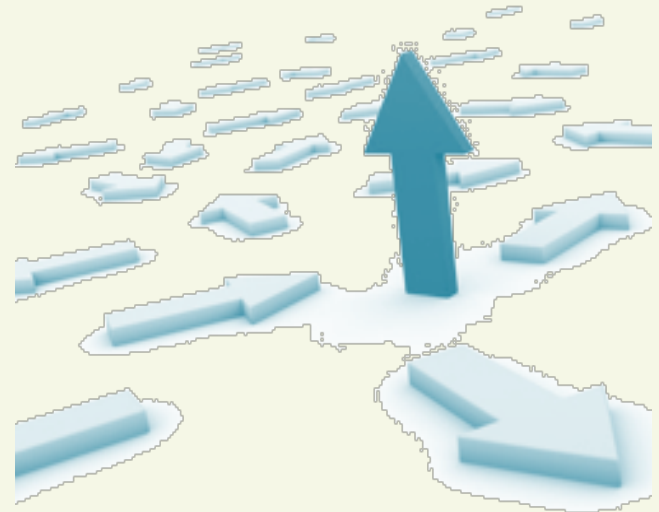
SMART CITY USE CASES DESIGN AND IMPLEMENTATION

Technology Development Services

Technical Office Services of Urban LAB are primarily framed in three differential axles:

1 Advice on the suitability of the project to within the City objectives

If required, guiding the technical / functional goals of the project required by the city following municipal strategy

2 Search internal customers in the city of Barcelona

In response to the expected results of the project, these departments of the City be more likely to be exhibited interest. **Barkeno ensures a response from it in about 1 month**
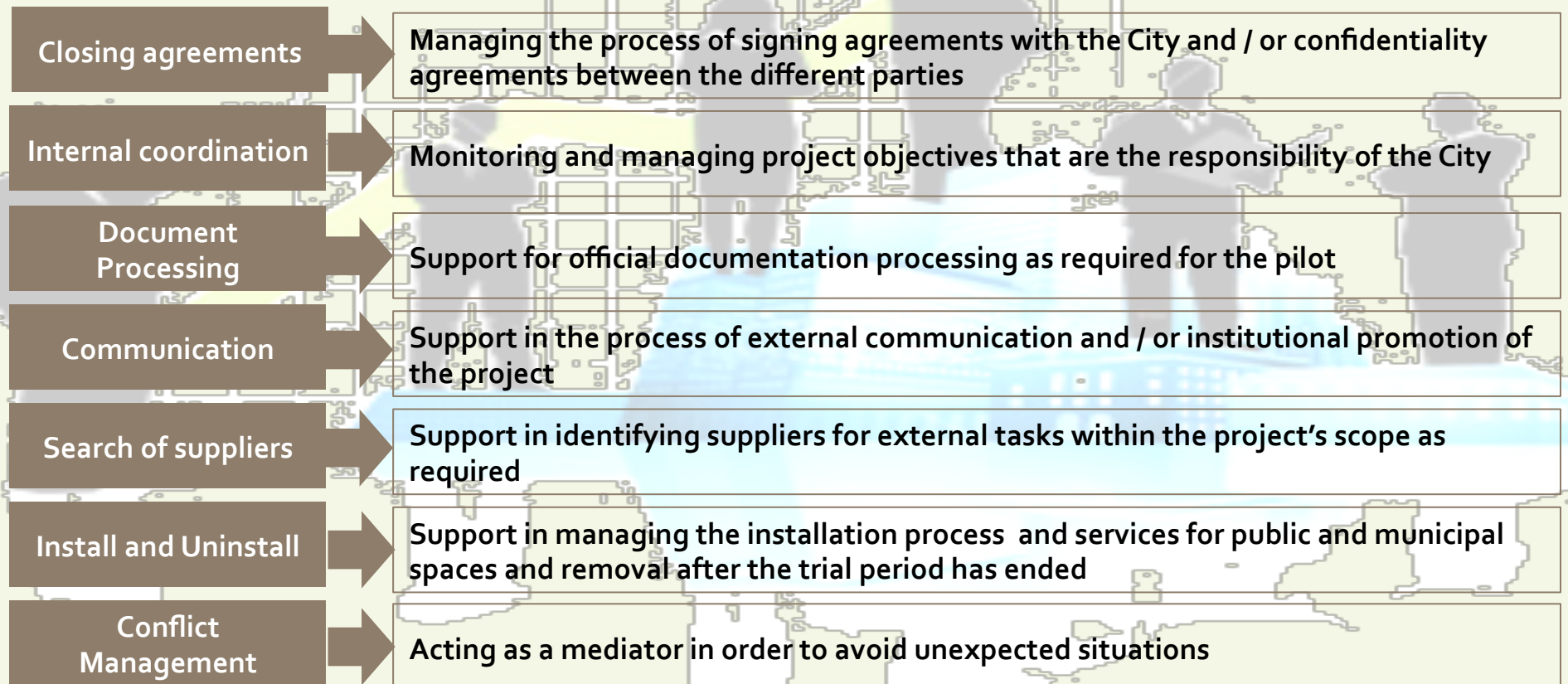
3 Monitoring and ongoing management

Both the internal aspect of the project (City Hall), and external (external service providers)
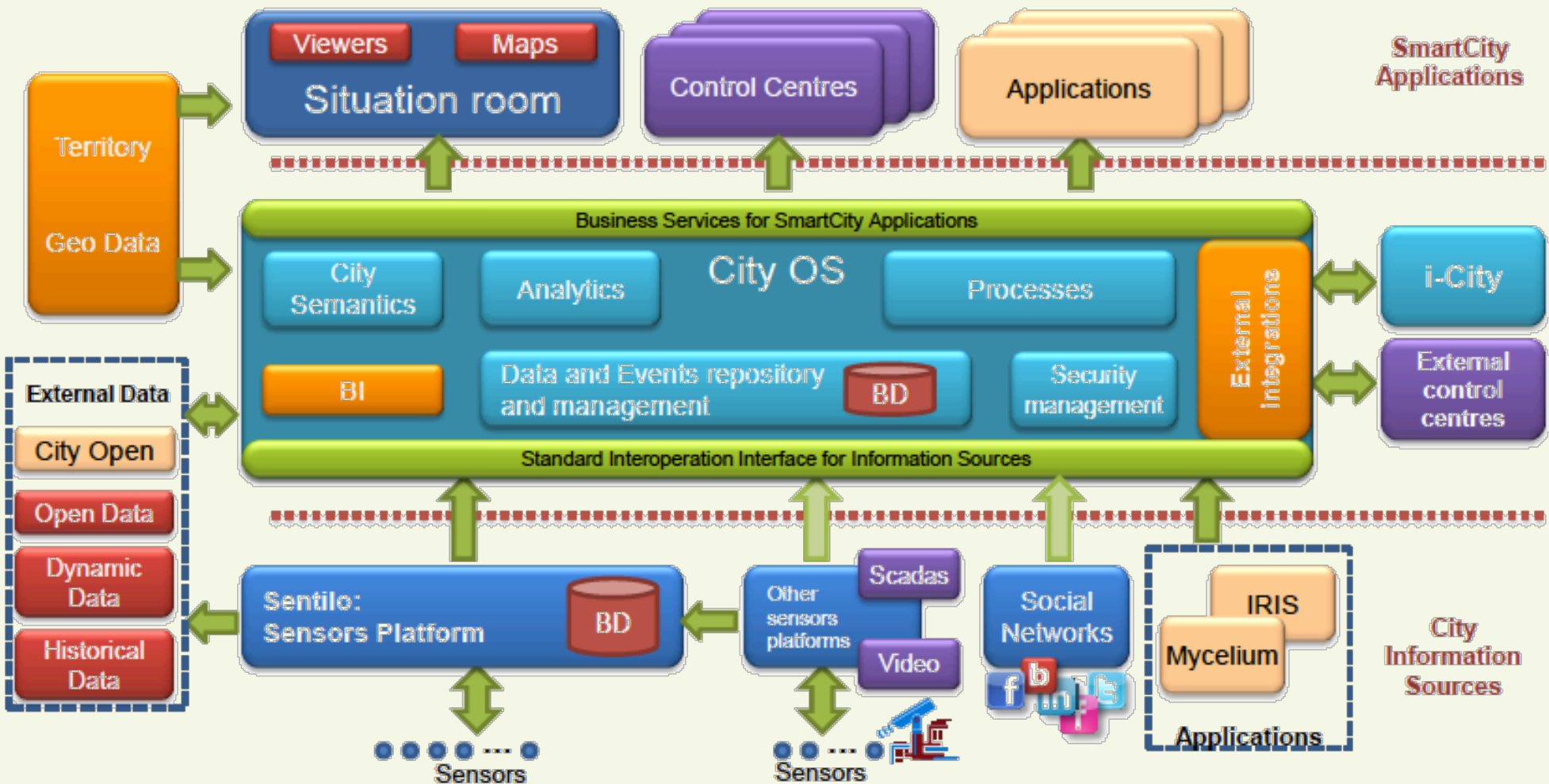
Technology Development Services

Monitoring and ongoing management

Special emphasis on monitoring and ongoing management of the project; the main activities are:

Closing agreements	Managing the process of signing agreements with the City and / or confidentiality agreements between the different parties
Internal coordination	Monitoring and managing project objectives that are the responsibility of the City
Document Processing	Support for official documentation processing as required for the pilot
Communication	Support in the process of external communication and / or institutional promotion of the project
Search of suppliers	Support in identifying suppliers for external tasks within the project's scope as required
Install and Uninstall	Support in managing the installation process and services for public and municipal spaces and removal after the trial period has ended
Conflict Management	Acting as a mediator in order to avoid unexpected situations

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Specification, Design and Engineering of Smart City OS

City OS Architecture: Concepts

Application Within Smart City OS: Cloud SLA Management

Sample Smart City Deployment

Provisioning and management of Smart City Cloud & Data Center Applications

Foster Eco-System of Plug-in Eco-system within the Smart City
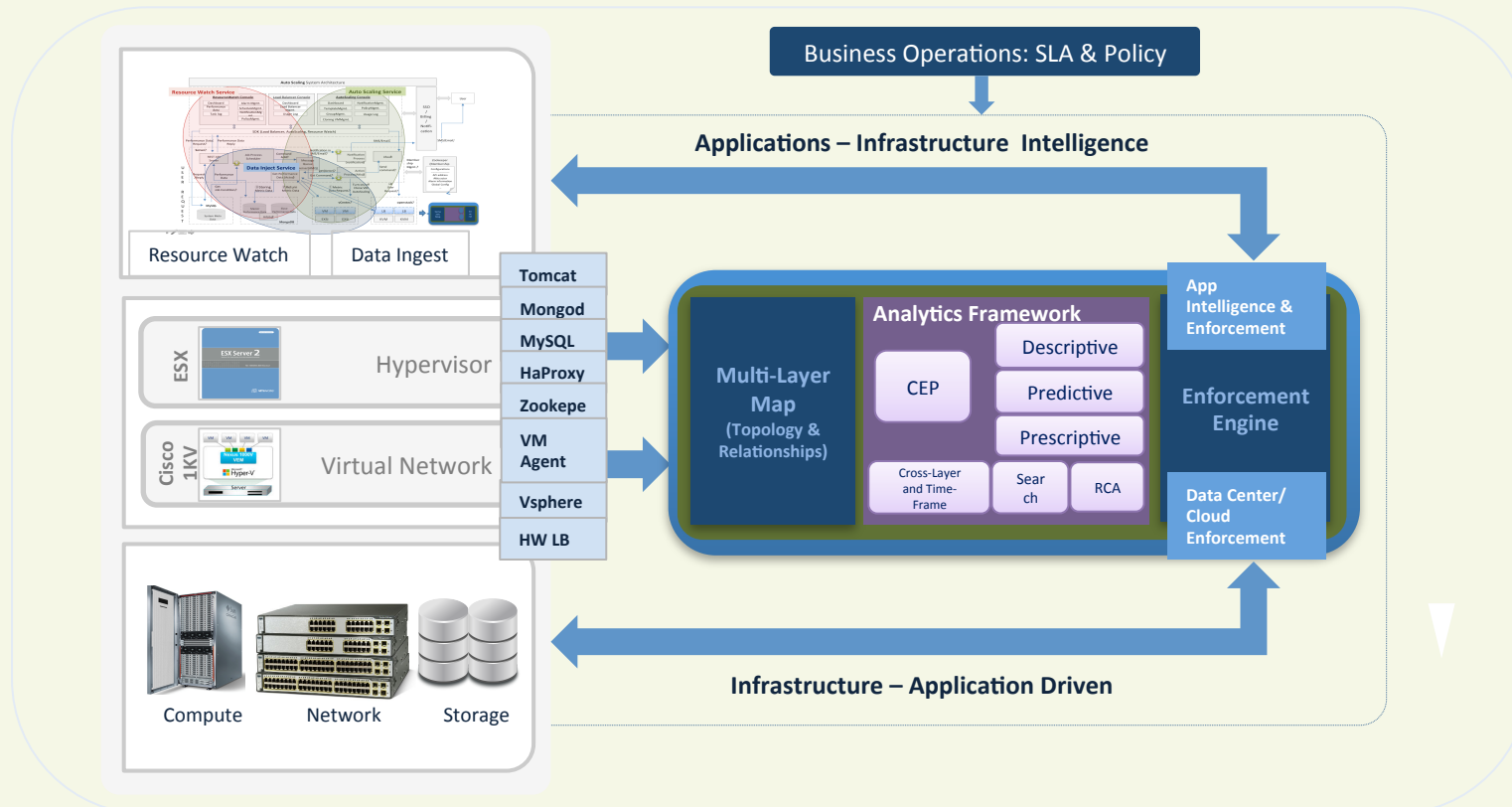
Bridge between Smart City and IaaS/PaaS/SaaS

City of Barcelona Use Case

Barcelona Eco-System

Barcelona Cloud Providers & Application users

Local Analytics & Monitoring Plug-in Eco-System

Business Operations: SLA & Policy

Applications – Infrastructure Intelligence

Resource Watch | Data Ingest

Tomcat
Mongod
MySQL
HaProxy
Zookepe
VM Agent
Vsphere
HW LB

ESX — Hypervisor

Cisco 1KV — Virtual Network

Compute | Network | Storage

Multi-Layer Map (Topology & Relationships)

Analytics Framework

CEP

Descriptive
Predictive
Prescriptive

Cross-Layer and Time-Frame | Search | RCA

App Intelligence & Enforcement

Enforcement Engine

Data Center/ Cloud Enforcement

Infrastructure – Application Driven

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EVALUATION & DEPLOYMENT OF INTERNET OF THINGS SOLUTIONS IN SMART CITIES (EXAMPLES)

IoT: The Ecosystem 'Stack'

Services
- Application of IoT in different market verticals such as connected car, intelligent home, mobile health, smart grids, etc.

Platforms
- Internet-centric or telco-centric platforms to enable IoT services

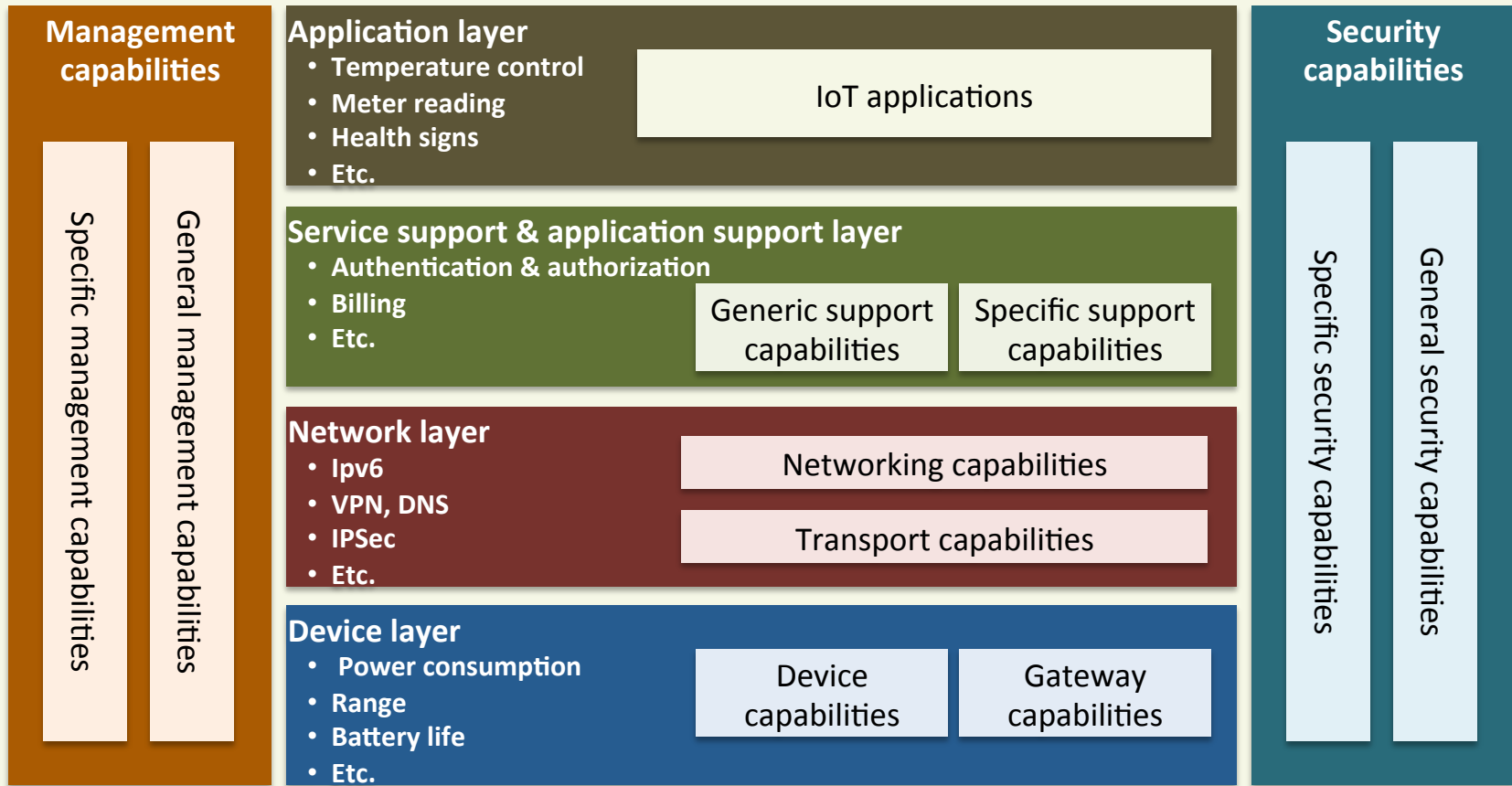**Applications**
- Use cases of IoT

Connectivity
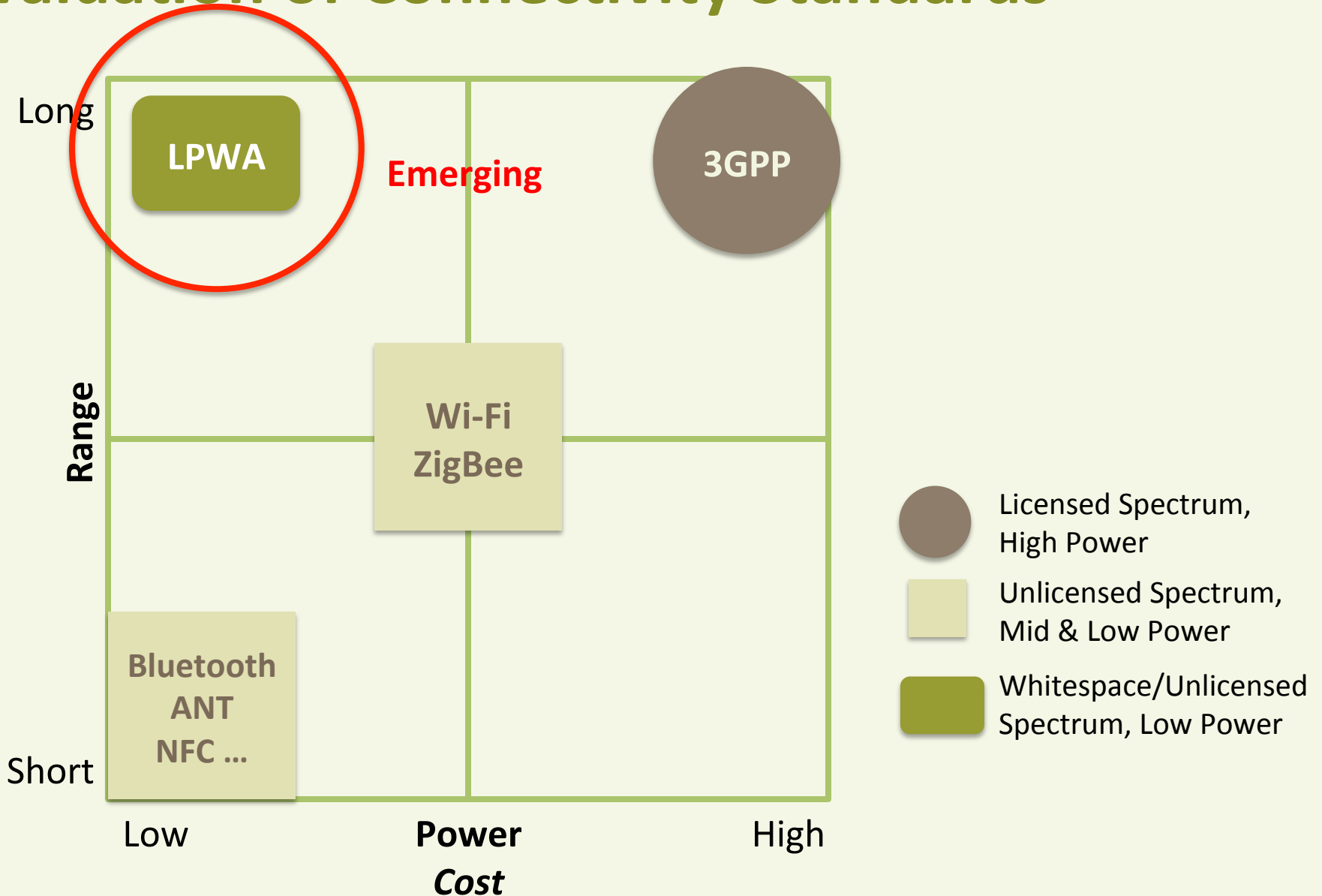- Wireless and wireline communication technologies connecting devices to the network

Devices
- Devices includes connected sensors, identifiers/ processors and gateways

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IoT in a Smart City Context

Management capabilities

Specific management capabilities

General management capabilities

Application layer
- Temperature control
- Meter reading
- Health signs
- Etc.

IoT applications

Service support & application support layer
- Authentication & authorization
- Billing
- Etc.

Generic support capabilities

Specific support capabilities

Network layer
- Ipv6
- VPN, DNS
- IPSec
- Etc.

Networking capabilities

Transport capabilities

Device layer
- Power consumption
- Range
- Battery life
- Etc.

Device capabilities

Gateway capabilities

Security capabilities

Specific security capabilities

General security capabilities

IoT is a complex multidisciplinary combination of different aspects of communication, security, management and data functions

Based on ITU-T Y.2060, 2012

Evaluation of Connectivity Standards

Range (vertical axis: Short to Long)
Power / Cost (horizontal axis: Low to High)

- **LPWA**
- **Emerging**
- **3GPP**
- **Wi-Fi ZigBee**
- **Bluetooth ANT NFC …**

Legend:
- Licensed Spectrum, High Power
- Unlicensed Spectrum, Mid & Low Power
- Whitespace/Unlicensed Spectrum, Low Power

Low Power Wide Area protocols emerging are in addition to existing standards

Evaluation of Security Models

1	Network Access	Security in Radio Access
2	Network Domain	Network security for signaling & user data
3	User Domain	Security for mobile
4	Application Domain	User & Apps security
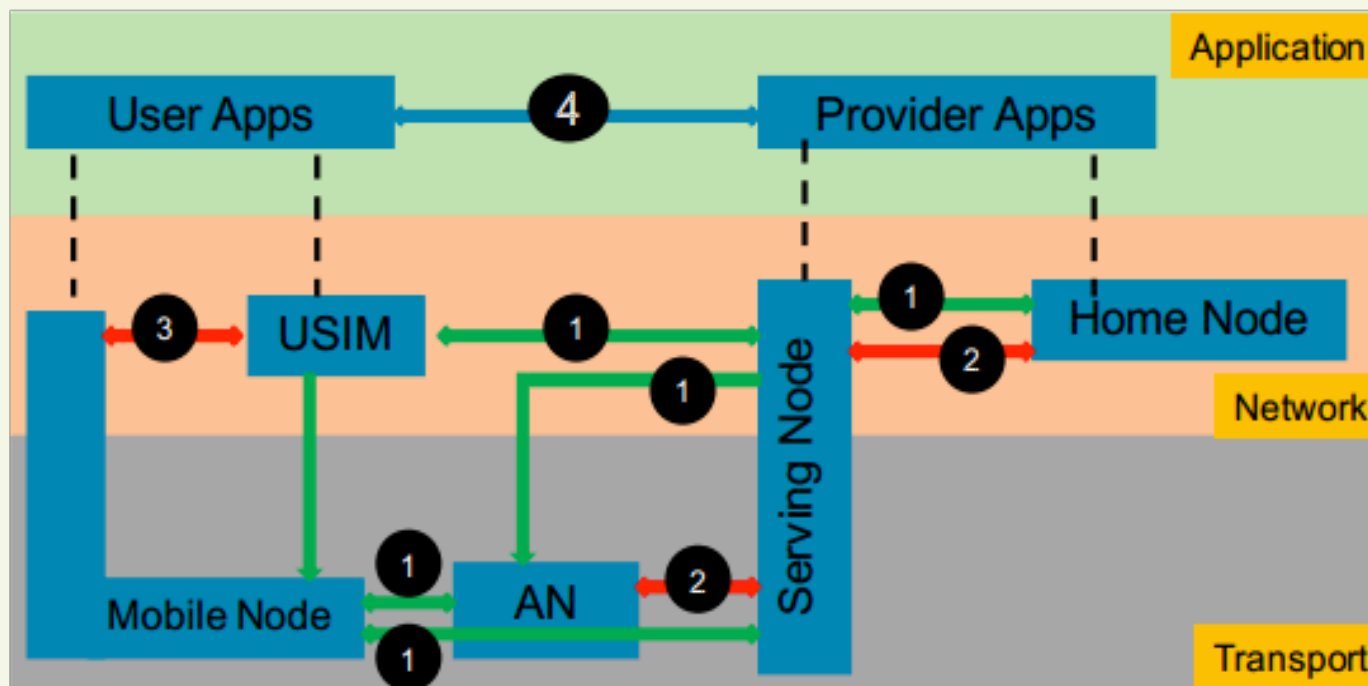
Security in the IoT context has emerged as a key area of focus

Specification of IoT Multi-layer platforms
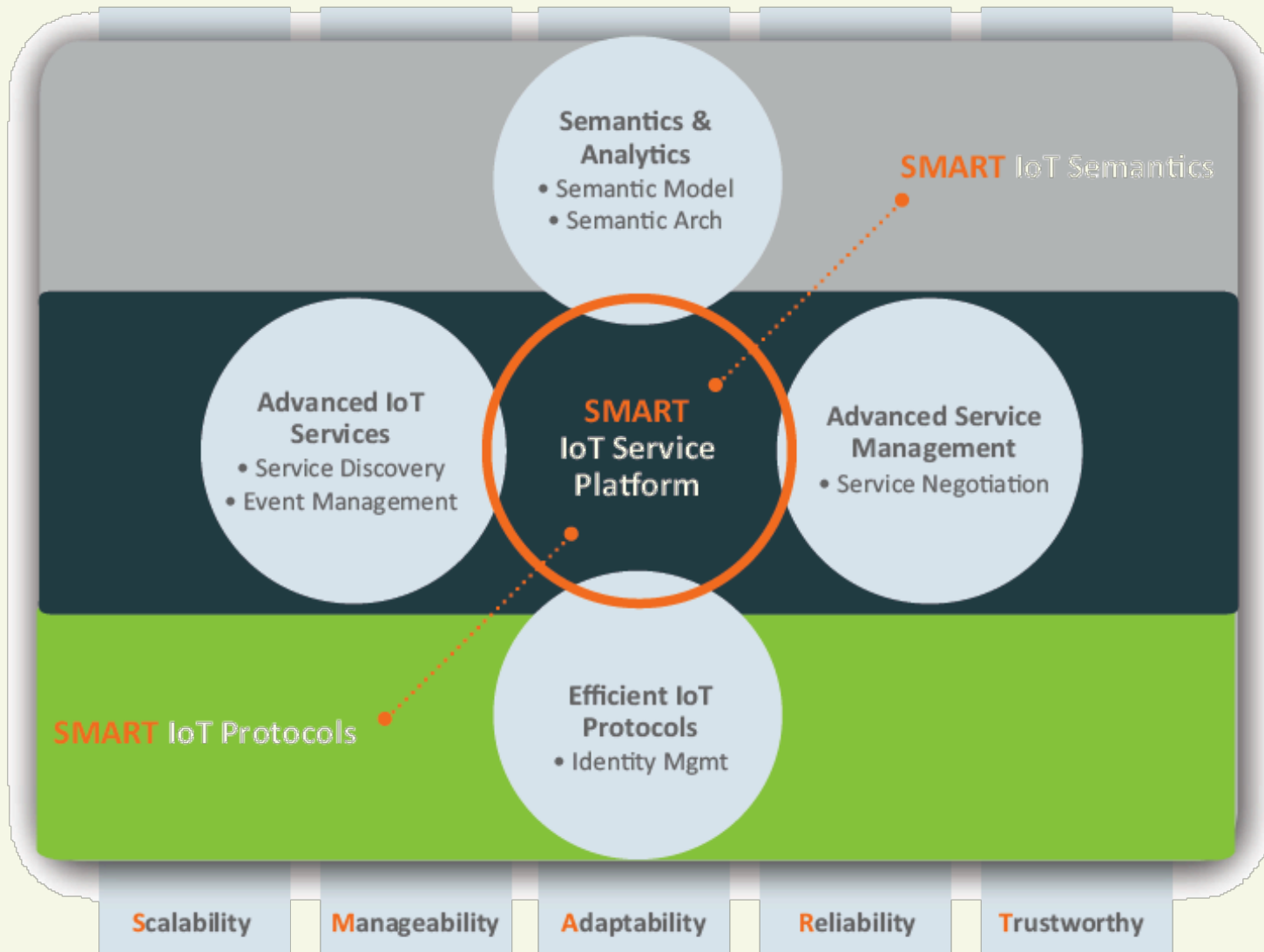
Porting of IoT Applications to Cloud Environments

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