Smart Cities Framework

2019 Summer Session for Young Professionals

IEEE Future Networks Education

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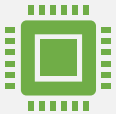
Topics

Smart City Challenges and Enablers

Governance Structure

Strategic Ecosystem Alignments



Smart City Performance

Smart City Challenges and Enablers

Smart City Challenges

Funding: Single source of funding may not be sufficient. Cities may need a combination federal, state, municipal, community, and investor funding sources

Trust, Privacy, and Security: Trust is essential for smart city development. Cities will need to promote an open data model that balances security and privacy. May include localized ethical and societal policy framework.

Different priorities and levels of technological innovation: Cities may focus on different priorities within a varied technological landscape. Roadmap will need to accommodate

Sustainability: Urban population growth is increasing and increases the pressure on a city's infrastructure.

Natural resources are exploited and wasted in cities, e.g. 50% of water resources are wasted due to leaky infrastructures,

Residential and commercial buildings consume 1/3 of the global energy produced

Cultural Sensitivity: Cities already have an intrinsic culture and value system. Smart city development and operations should blend seamlessly within each city's unique characteristic.

Technology Standards: Standards are currently in development. Ecosystems may have application specific standards that may be proprietary.

Contextual Data Models: Contextual data and associated data models may be needed for optimized solutions and the reduction of industry silos

Smart City Funding Portfolio

Smart City Challenges and Competitions	Interest - promote urban integration, mobility, economic development, and technological capabilities Sources – national governments, private entities for select smart city components
Public—Private Partnerships (PPPs)	Interest - mutual economic benefits from public infrastructure, community facilities and related services initiatives Funding sources - government and private sector entities via shared investment capital, risks, oversight, and responsibilities
Loans and Municipal Bonds	Interest - funding projects with other sources of funding or to adjust the level of funding to enable smart projects to align with the project schedule. Funding sources - investment banks, insurance firms, and governments
Community Based Sources	Interest - individual communities within an urban area. It may fund a part of a larger Smart City project but not necessarily the entire project. Funding sources - grass roots organizations, large businesses invested in a community, local businesses looking for area rejuvenation, and targeted project economic stimulus
Local Level Funding	Interest - driving population, local economy, tourism, and attracting new businesses to the immediate area. Funding sources - public development agencies, local economic development corporations, state/county/municipality , or other locally invested entities such as utilities.
Private Funding	Interests - specific project areas such as economic development, tourism, improved urban mobility in congested areas, and sustainability Funding sources - private funders.
User Charges and Pay for Performance	Interest – Pay per use for a particular smart city experience or user surcharges in the form of taxes and billable services Funding sources – Users on pay per use basis or surcharges

Smart City Technology Enablers

Connectivity and the digital divide

Connectivity should be viewed as the fifth utility and it is needed to bridge the digital divide.

Access to mobile communications increase the potential for local economic development and access to services, e.g. easy access to transportation from residences to workplaces.

Multi-tiered security for network, device, data and users

Support mission critical, shared, dedicated or non-critical applications.

Some users may not wish or do not have the means to participate in applications or services that request user identities.

Needs based positioning technologies

New standards and technologies that may serve a specific segment across all ecosystems, e.g.

- McX (voice data, video),
- Personal mobility (multiple form factors),
- Unmanned Aerial Vehicles (UAVs),
- Vehicle-to-Everything (V2X),
- Energy Efficiency (IEEE 192x)

Air access rights

Cities may pursue monetization of air access for taller structures and UAVs

Digital Twins

Create a digital version of processes, products, services, people, places, things to analyze and monitor systems for operations, maintenance, and future improvements.

Contextual data models

Ecosystem specific data models to enhance the data economy or the monetization of data.

It includes core network data accounting, data model frameworks including ecosystem specific data, and compatible & consistent semantics (interpretation of data)

Artificial Intelligence (AI)

Assisted use (repeatable tasks),

Augmented use (new use cases that may include business model changes)

Autonomous (requires a high degree of trust)

Smart City Governance

Dynamic City Environments

Dynamic City Environment

- Ecosystems are interconnected and are mutually dependent on each other's inputs and outputs.
- Ecosystem managers that are involved in organizing activities and delivering services to satisfy city dweller needs (e.g., transportation, education, and health services)
- Coordinating and facilitating the functioning of economic activities of companies operating within the city area (e.g., tax benefits, permits and regulation, dedicated infrastructures, and financing).

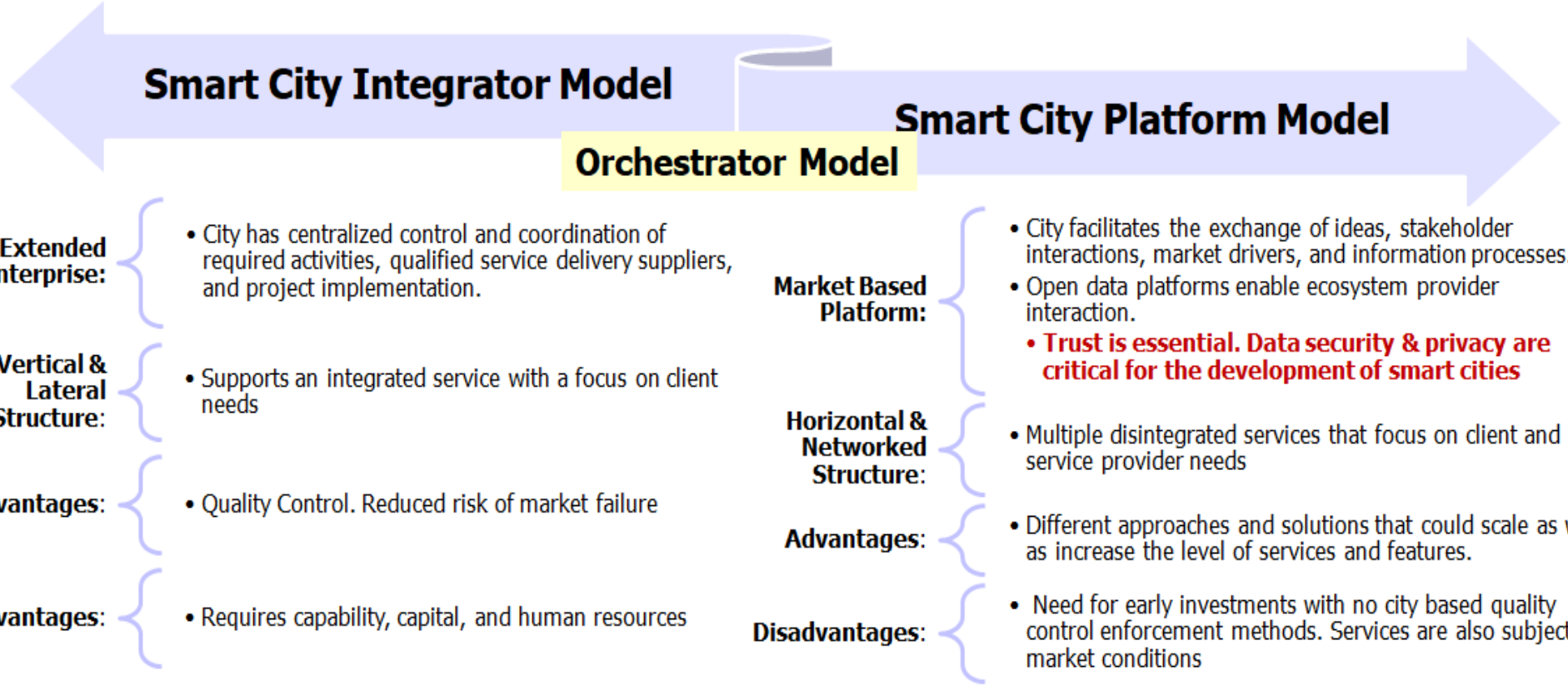
Multiple challenges requiring trade-offs

- Ability of a city with a high quality of life score to attract talent
- Ability to attract companies
- Ability to attract a strong base of employers that generate job opportunities through business friendly policies
- Ability to improve the quality of life of citizens.

Dynamic City Structures

- Static equilibrium - Current *static* mental and textbook logics focus on the optimal design of the organizational structure and, thus, emphasize static equilibrium,
- Dynamic structures - City orchestration is precisely about managing the evolution dynamics of city ecosystems.

Smart City Governance and Finance – Needs and Challenges



Orchestrator Model: dynamically adjust between Integrator or Platform to evolve
Ecosystem of Ecosystems Structure: Multiple complex connected ecosystems with multiple stakeholders and technologies.

Source - Governing the City: Unleashing Value from the Business Ecosystem, Ivanka Visnjic, Andy Neely, Carmelo Cennamo, and Nikola Visnjic, California Management Review, 2016, Vol. 59

Trust, Privacy, and Data Security are essential

Cities may use the Orchestrator Model to adjust for financial resources, stakeholder needs, and quality control

Funding pipeline from national & local governments, PPP, entrepreneurs, and communities may help with the implementation of the project portfolio

Integrator and Platform market suitability

Integrator approach

- Market failure context - incentives of the individual entities skew the market
- Significant externalities, e.g. not enough entities to participate in a market based solution
- Project control – control specifics of product / service, e.g. functions, quality, or time of the delivery.

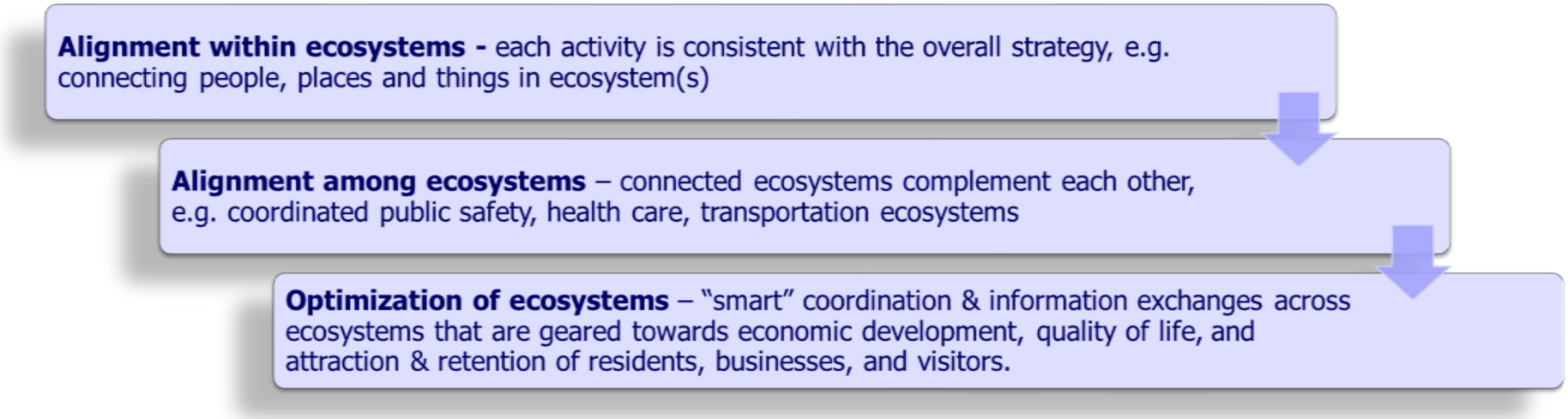
Platform Market Approach

- Market demand is clearly identifiable
- Market incentives are strong
- Variety of outcomes is allowed and even encouraged.

Connectivity and Ecosystem Alignments

Smart Cities: Ecosystem of Ecosystems

Structured Approach (Top Down)



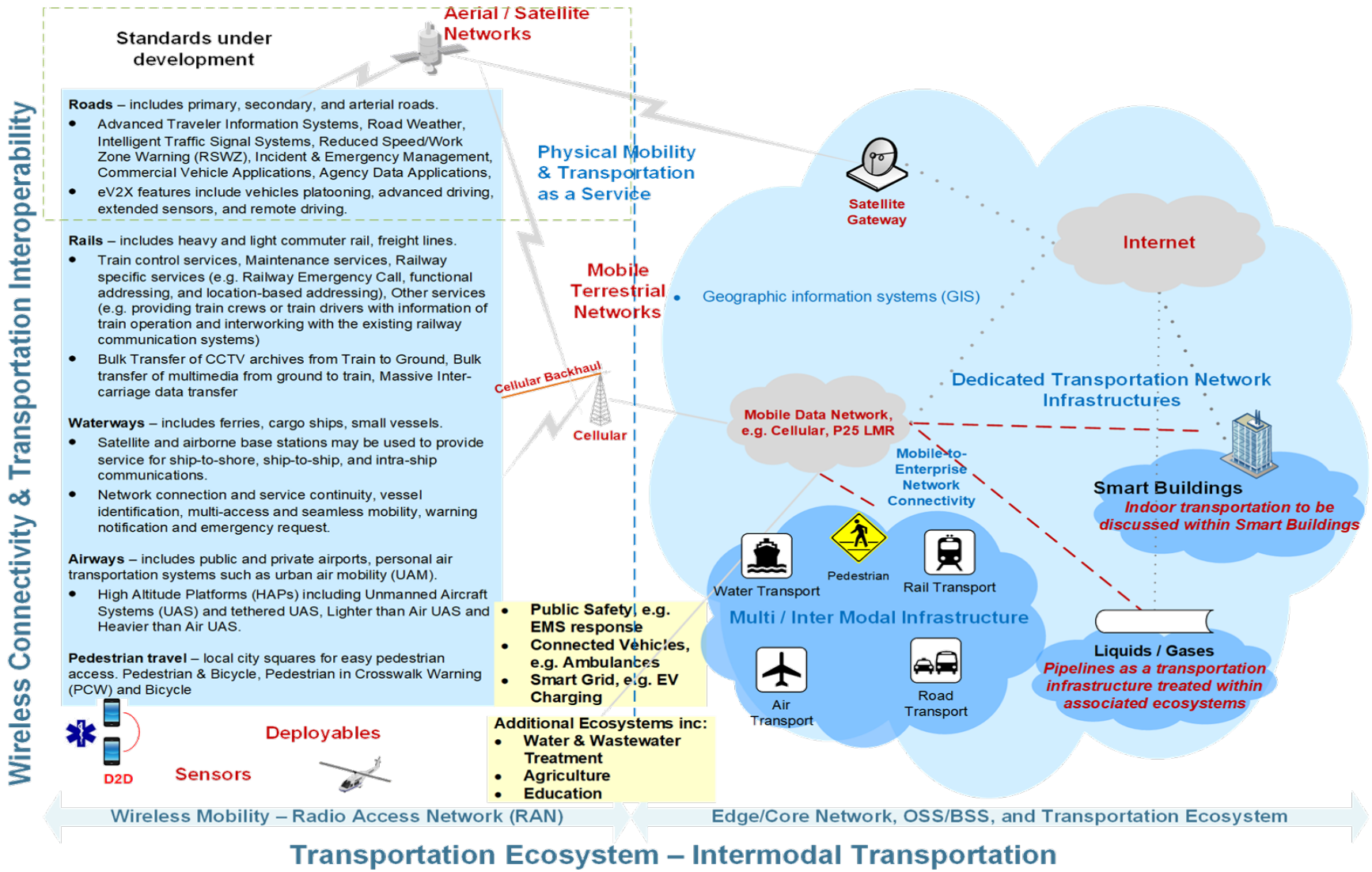
Unstructured or Organic Approach (Bottom Up)

Data Analytics and other observations will stimulate infrastructure (re)assessment

"In economics it often appears that a lot of this unmanaged and unguided individual activity leads to aggregate results that are not too bad, indeed about as good as could be expected if somebody took command and figured out what ought to be done and had a way to get everybody to do what he was supposed to do."

Micro Motives and Macro Behavior, Thomas C Schelling

Transportation Ecosystem Intra Ecosystem Alignment Example



What capabilities are needed to support the physical transportation infrastructure modes?

- *Roads*
- *Rails*
- *Maritime*
- *Air*
- *Pedestrian / Micro Mobility*

What are the main drivers?

- *Physical Infrastructure*
- *Public, private travel access points*
- *Intramodal and Intermodal transfer points*

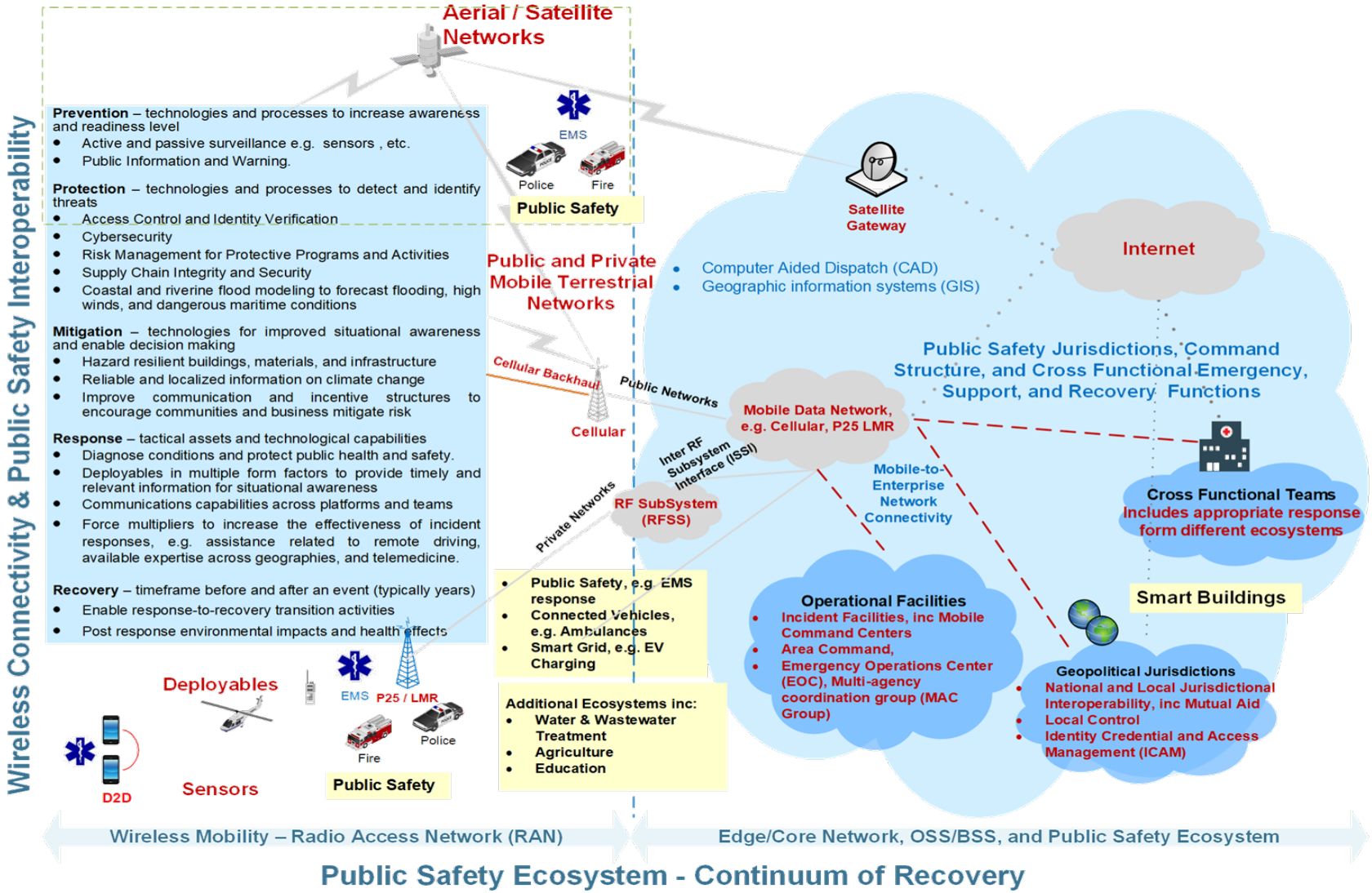
How do we translate the needs into technical requirements?

- *eMBB*
- *mMTC*
- *URLLC*
- *Network Operation Enhancements*

What is the roadmap vision?

- *Access*
- *Service Delivery*
- *Network Operations & Customer Support*
- *Network extensions*

Public Safety Ecosystem - Inter Ecosystem Alignment Example



What capabilities are needed to support the different continuum of recovery phases?

- *Prevention*
- *Protection*
- *Mitigation*
- *Response*
- *Recovery*

What are the main drivers?

- Geopolitical
- Tactical command structure
- Number of first responders
- Duration
- Inter ecosystem alignment (Cross Functional Emergency Support and Recovery Functions)

How do we translate the needs into technical requirements?

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What is the roadmap vision?

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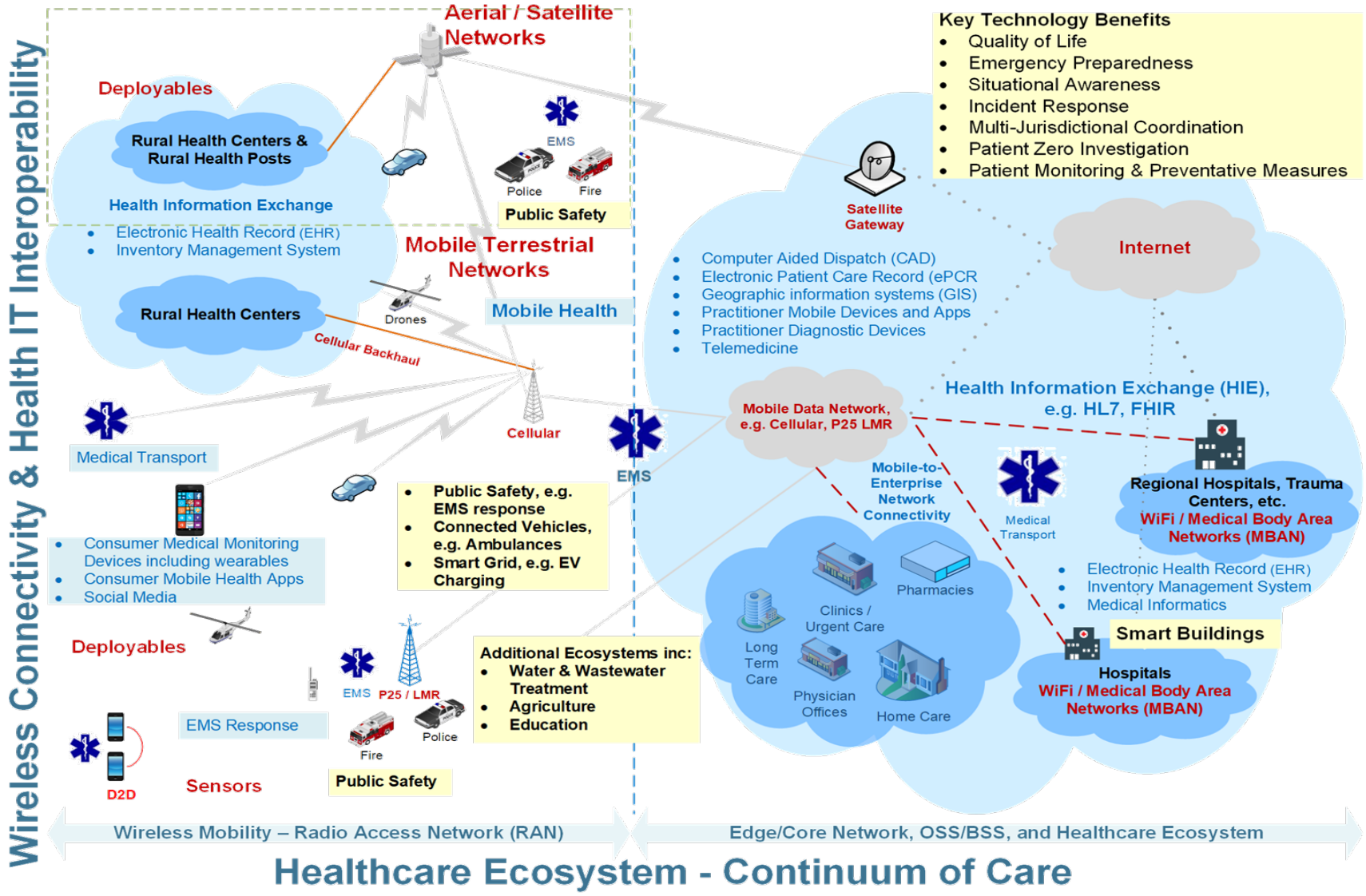
Healthcare Ecosystem – Smart City Optimization Example



How does a city optimize the interconnected ecosystems?

- Healthcare
- Public Safety, e.g EMS
- Transportation, e.g. connected ambulances
- Electricity, e.g. smart grid for EV charging
- Agriculture, e.g. diseases,
- Smart Buildings, e.g. hospital design

What are the main drivers?

- Contextual data models
- Privacy & Security
- Communications capabilities

How do we translate the needs into technical requirements?

- eMBB
- mMTC
- URLLC
- Network Operation Enhancements

What is the roadmap vision?

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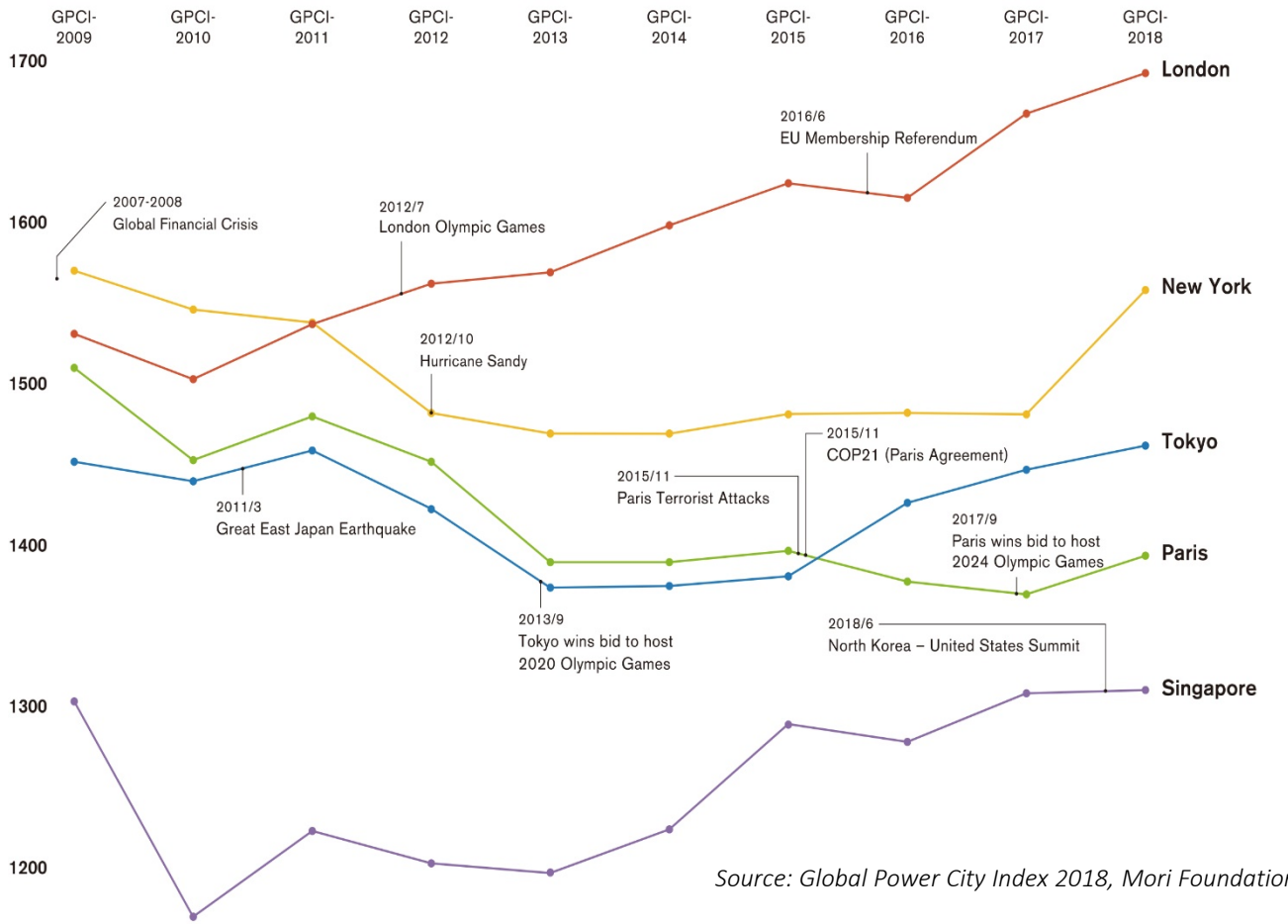
Smart City Performance Analysis

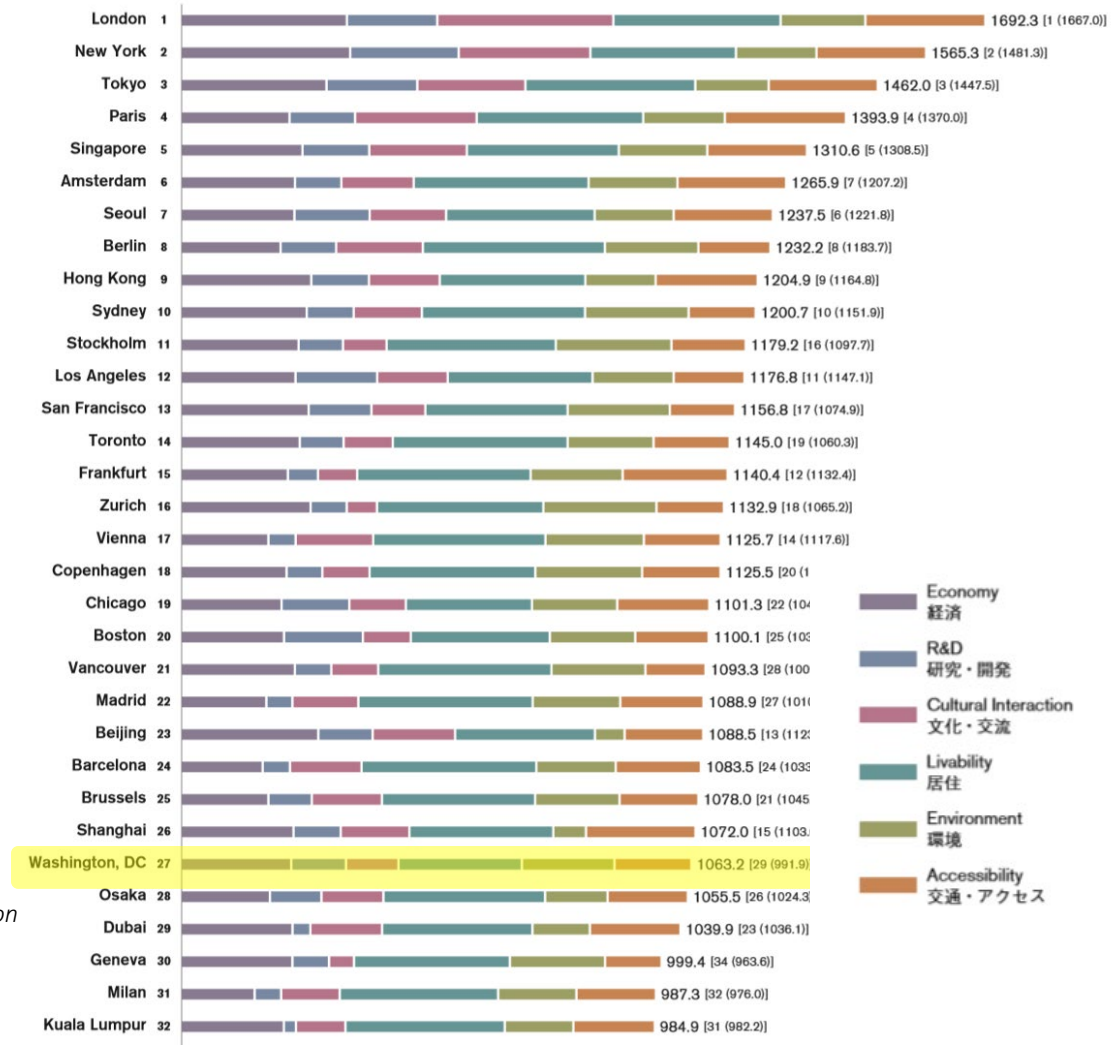
Mori Foundation – GPCI 2018 Cities

Source: Global Power City Index 2018, Mori Foundation

City Performance Based on GPCI



Source: Global Power City Index 2018, Mori Foundation



MAMCA (Multi-Actor, Multi-Criteria Analysis)

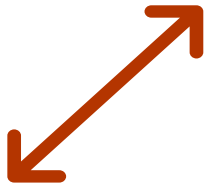
- Cities may MAMCA for the analysis of alternatives and choices from the perspective of different groups of stakeholders and judgement criteria.
- This may help shape strategic and policy initiatives

Functions - Economy, R&D, Cultural Interaction, Liveability, Environment and Accessibility.
Stakeholders - Managers, Researchers, artists, visitors and residents.

Policy Lessons

Cities may use benchmarking results to enact policies for strategic global performance focus

Non GPCI decisive factors



Other non GPCI policy functions and indicators

- Cities are self-organizing and may experience issues related to social cohesion, ethnic conflicts, ageing, international migration, natural disasters, human health conditions, and urban governance systems
- **These factors are decisive for the future outlook of a city but they are difficult to include in a numerical indicator system,.**

Cities should explore other policy functions and indicators **beyond the GPCI**, e.g.

- local housing markets
- labor markets
- educational system quality.
- Urban technology - access to and use of advanced technologies, such as biotechnology, nanotechnology, information technology etc.
- Technological capital – enact human and policy efforts to attract multinational business firms that may use modern technology and conduct education and research activities.
- Long-range dedicated urban development policy to choose which criteria to work on and by doing so how to increase their attractiveness.
- Reduce negative effects such as ethnic segregation, crime, pollution, etc

Source: A multi-actor multi-criteria analysis of the performance of global cities, Karima Kourtit, Cathy Macharis, Peter Nijkamp, Applied Geography, Volume 49, May 2014

Summary

Smart City Enablers

- Includes Funding, Trust, Privacy, Prioritized Roadmap Implementations, Multi-Tiered Security, Technology Standards, and Contextual Data Models

Governance Structure

- Cities need a dynamic governance structure
- Orchestrator model offers flexibility with a smart city ecosystem of ecosystems approach.

Strategic Ecosystem Alignments

- Smart Cities implementations should be aligned within and and across ecosystems to meet the objectives of the city
- Roadmaps should consider access, service delivery, operations & customer support, and network extensions

Smart City Performance

- Cities cooperate and compete on an international scale
- Analytics may be used to help shape strategy and policy.

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