

The background of the slide features two white robotic arms with yellow and black hazard stripes, positioned on the left and right sides. They are reaching towards each other, with their hands just inches apart, creating a sense of tension and collaboration. The background is a light blue and white industrial setting.

IES-City Framework: a consensus framework for fostering interoperability in the context of the Smart City applications

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IES-City initiative

IoT-Enabled Smart City Framework (IES-City)* is an international initiative launched by NIST and several partners (ENEA, ETSI, ANSI, USGBC, FIWARE, MSIT, TIA) aiming to:

- create a **reference framework** for the development of architectures for incremental and modular Smart Cities
- facilitate convergence and encourage harmonization among the many standards and consortia



* <https://pages.nist.gov/smartcitiesarchitecture/>

Summary

- **The context and the problem**
- The approach of IES-City initiative
- Conclusion

The current scenario

- **The Smart City is happening**

- Smart City technologies and solutions are being developed and deployed at a rapid pace, becoming part of the real life of cities and citizen

- **New opportunities are opening up**

- New services can be activated combining and exchanging data collected by several and heterogeneous systems and applications

- **New priorities**

- To conceive Smart City applications as a part of complex ecosystems, with subsystems and components able to interact each other, and to change over time
- To make the applications able to speak each other directly

Criticalities

3 primary **barriers** are preventing widespread deployment of effective, powerful smart city solutions:

- **Inadequate information and knowledge transfer**

- custom solutions unable to exchange information with each other, and therefore, neither replicable and reusable

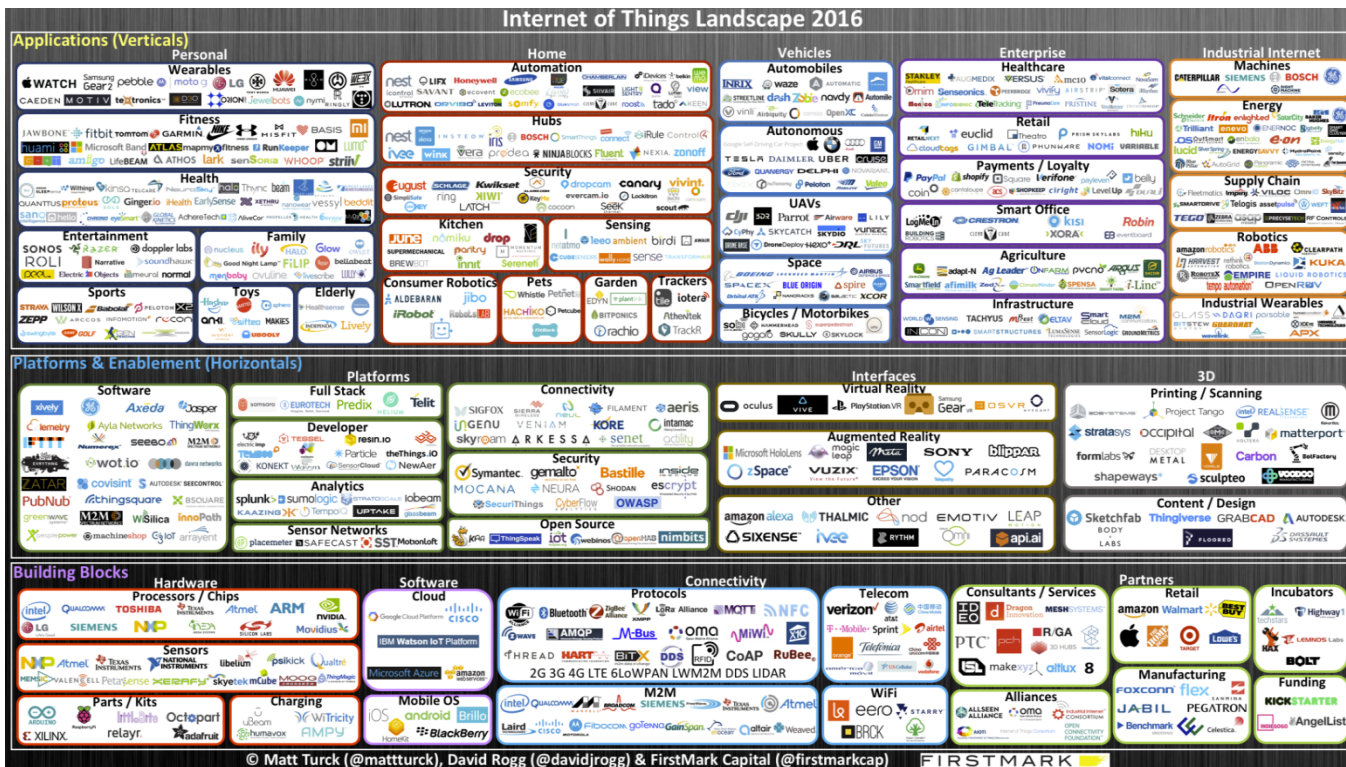
- **Wide range of standards**

- a number of architectural standardization efforts are underway worldwide but have not yet converged

- **Poor scalability**

- insufficient interoperability and scalability of underlying Internet of Things (IoT), and Cyber-Physical Systems (CPS) technologies that provide the foundation for many 18 smart cities applications

Divergent CPS/IoT Technology Landscape



Source: Turck, M (March 28, 2016), Blog, *Internet of Things: Are We There Yet? (The 2016 IoT 2224 Landscape)*, retrieved on 11/17/2017 from <http://mattturck.com/2016-iot-landscape/>

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The approach

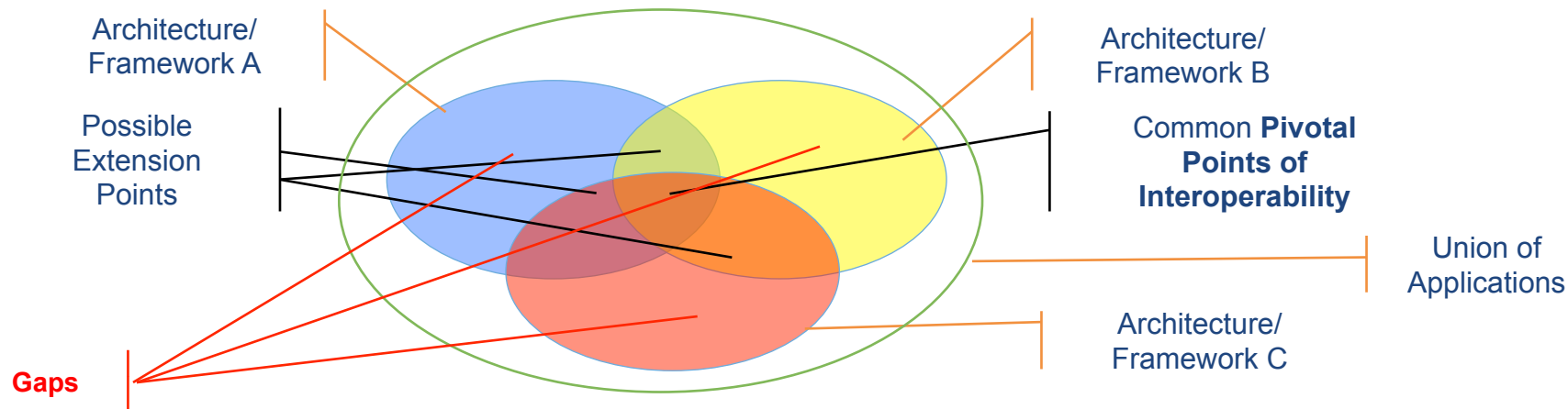
Starting point:

- Traditional approach to achieve interoperability, **adopting standards**, it is **not always possible**
 - *absence of adequate standards, divergence between several standard specifications, too much generic specifications*

IES-City focus (a new approach):

- Identifying a **set of principles for common interfaces (PPI, Pivotal Point of Interoperability)** to ensure interoperability also in case of absence of standards or misalignment of available standards

How to set the PPIs

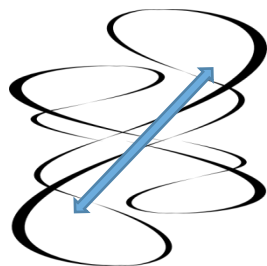


- 1) To collect a set of existing architectures/frameworks
- 2) To define a set of “Aspects” (ex: Functional, Business, Data,...)* being relevant in order to evaluate architectures/frameworks for Smart City
- 3) To analyse the selected architectures/frameworks respect the identified “Aspects” in order to detect common approaches
- 4) The intersections coming from step 3 are the PPIs

**based on the NIST Cyber-Physical Systems (CPS) Framework*

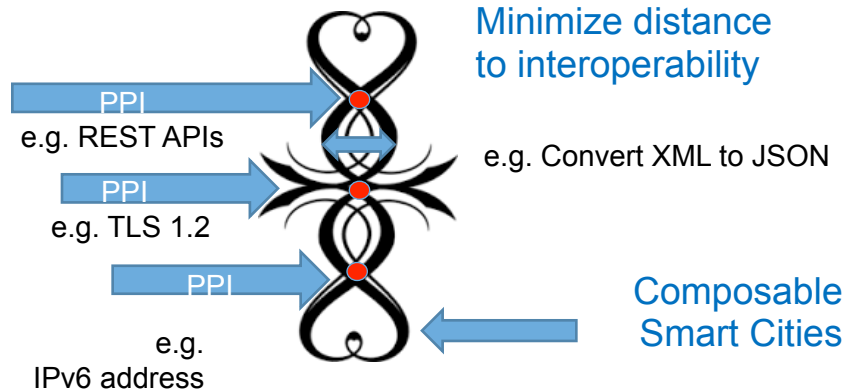
Open API as example of PPI

Independent technology
deployments



Potentially large
distance to
interoperability

With Pivotal Points of Interoperability




Results

A Framework Document

IES-City Framework Draft Release v20180208

A Consensus Framework for Smart City Architectures



- IES-City Framework
- (Internet-of-things Enabled Smart City Framework) Draft Release v20180208






3 This IES-City Framework is the product of an open, international public working group seeking to reduce the high cost of application integration through technical analyses of existing smart city applications and architectures. The Framework documents the findings of the authors and provides valuable tools that are based on the findings and that can lower barriers to an expanded smart city marketplace.

7 Currently, three primary barriers exist which inhibit widespread deployment of effective, powerful smart city solutions:

- Inadequate information and knowledge transfer: Most smart city deployments are based on custom systems which cannot exchange information with other cities, and therefore, are neither extensible nor cost-effective.
- Diverse standards: Current architectural standardization efforts have not yet converged. This creates uncertainty among stakeholders[5]. There is a lack of consensus on both a common language/taxonomy and smart city architectural principles [67]. The result is that the many groups with smart city interests are likely to generate standards and practices that are divergent, perhaps even contradictory, which would not optimally serve the global smart city community.
- Poor scalability: A third barrier is the insufficient interoperability and scalability of underlying Internet of Things (IoT), and Cyber-Physical Systems (CPS) technologies that provide the foundation for many smart cities applications [51].

21 Additional barriers include lack of resources, clear principles for prioritization, and limited access to the necessary technical expertise and experience.

22 To lower these barriers, NIST and its partners, below, convened this international public working group to compare and distill a consensus language, taxonomy, and framework of common architectural features to enable smart city solutions that meet the needs of modern communities.

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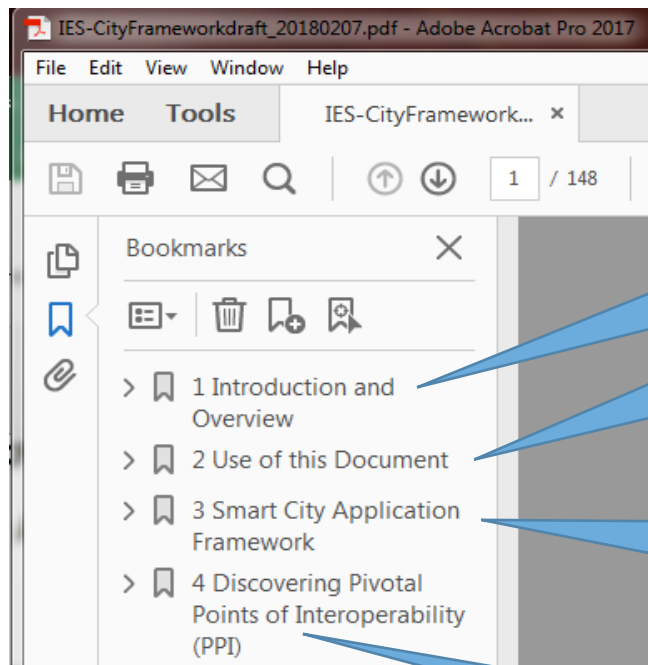
This is a public draft for review. A released version will appear via a link on the <https://pages.nist.gov/ies-citysearchitecture> when available.



Set of Artifacts

| Aspect/Concern | Is a Solution Provided? | |
|----------------------------|-------------------------|--------|
| | CI/RIA | FIWARE |
| physical activation | YES | YES |
| communication | YES | YES |
| Synthetic Interoperability | YES | YES |
| OSI Application | YES | YES |
| OSI Presentation | YES | YES |
| Network Interoperability | YES | YES |
| OSI Session | YES | YES |
| OSI Transport | YES | YES |
| OSI Network | YES | YES |
| Basic Connectivity | YES | YES |
| OSI Data Link | YES | YES |
| OSI Physical | YES | YES |

The Framework document



Summary

Elaboration of the Challenge

A look at two use cases – a day in the life; usage of IES-City

What the IES-City Framework provide

Use of this document

Guidance on the use of the framework for cities, policy makers and regulators, vendors/integrators, and standards development organizations

Smart City Application Framework

Study of the breadth of Smart City applications for: concerns, readiness, and benefits

Discovering Pivotal Points of Interoperability

Discussion of Pivotal Points of Interoperability (PPI), Zones of Concern (ZofC), and the NIST CPS Framework

Elements of the Application Framework Tool

| Dimension | Description |
|---|---|
| Breadth: List of applications and related metrics | It consists of both a framework (metrics + tool) for evaluating the breadth (elaborated on the basis of existing models) and the list of evaluated applications |
| Readiness: A framework for assessing City's Readiness | A List of Metrics + a tool to Assess the Readiness of Cities to Absorb Smart City Applications (elaborated on the basis of existing maturity models) |
| Benefits: A Framework to Measure Benefits | Metrics + tool for measuring benefits that can be derived from Assimilated Applications |

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Conclusions

- IES-City Framework provides a set of tools to aid stakeholders in lowering the barriers to integrating IoT and smart city features
- There is an Application Framework Tool that can speed initial studies on the potential for deploying technologies in cities and communities
- There is a technical methodology that simplifies comparing complex systems of technology currently deployed from different sources
- These tools can be ever-green adding more applications to the application framework tool and more analyses of technology suites for comparison

References

- **IES-City Framework**

- <https://pages.nist.gov/smartcitiesarchitecture/>

- **IES-City Framework Draft Document for Review**

- https://s3.amazonaws.com/nist-sgcps/smartcityframework/files/ies-city_framework/IES-CityFrameworkdraft_20180207.pdf

- **IES-City Framework Community**

- <https://pages.nist.gov/smartcitiesarchitecture/community/>

- **NIST Framework for Cyber-Physical Systems**

- <https://www.nist.gov/publications/framework-cyber-physical-systems-volume-1-overview>

Thanks for your attention!

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