

Smart Cities: your chance to do
relevant research

São Paulo Advanced School on Smart Cities

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What is "relevant" research?

Research with real impact

- Impact in the advance of Science
- Positive impact in Society
- Impact in laws and public policies



Decreto nº 55.662, de 30 de março de 2010

Cria o Parque Estadual de Itaberaba, o Parque Estadual de Itapetinga, a Floresta Estadual de Guarulhos, o Monumento Natural Estadual da Pedra Grande e dá providências correlatas

JOSÉ SERRA, GOVERNADOR DO ESTADO DE SÃO PAULO, no uso de suas atribuições legais,

Considerando as disposições do artigo 225 da Constituição Federal e do artigo 191 da Constituição Estadual, relativas à preservação, conservação, defesa, recuperação e melhoria do meio ambiente;

Considerando a competência comum da União, dos Estados, do Distrito Federal e dos Municípios em proteger e preservar o meio ambiente, nos termos do artigo 23, incisos VI e VII, da Constituição Federal;

Considerando as disposições da Lei federal nº 9.985, de 18 de julho de 2000, que instituiu o Sistema Nacional de Unidades de Conservação da Natureza - SNUC, em especial seu artigo 11 e § 4º que dispõem sobre os objetivos de criação da unidade de conservação da categoria parque estadual;

Considerando os resultados dos estudos do projeto denominado "Diretrizes para Conservação e Restauração da Biodiversidade do Estado de São Paulo", desenvolvido pelo Programa Biota - FAPESP, com a indicação de forte grau de importância para a criação de unidades de conservação de proteção integral, nas áreas constituídas, em maior parte, pelas Serras de Itaberaba e de Itapetinga;

Smart Cities: Definitions, Technologies and Opportunities



Todas fotos de Nelson Kon

Introduction



Introduction

- Majority of world population live in cities
- Current infrastructure and amount of resources do not cope with the demand satisfactorily
- The standard is a huge waste of resources in all the fields
For example, in:
 - Transportation: Taxis, Cars, Busses, Semaphores
 - Health
 - Education
- Most of the times, the cause is the lack of a global view and processes that optimize locally and not globally

- How to make our cities smarter?
 - Optimize use of resources and infrastructure
 - Apply Information and Communication Technologies (ICT)

- What for?
 - Improve the quality of life of citizens
 - Sustainability

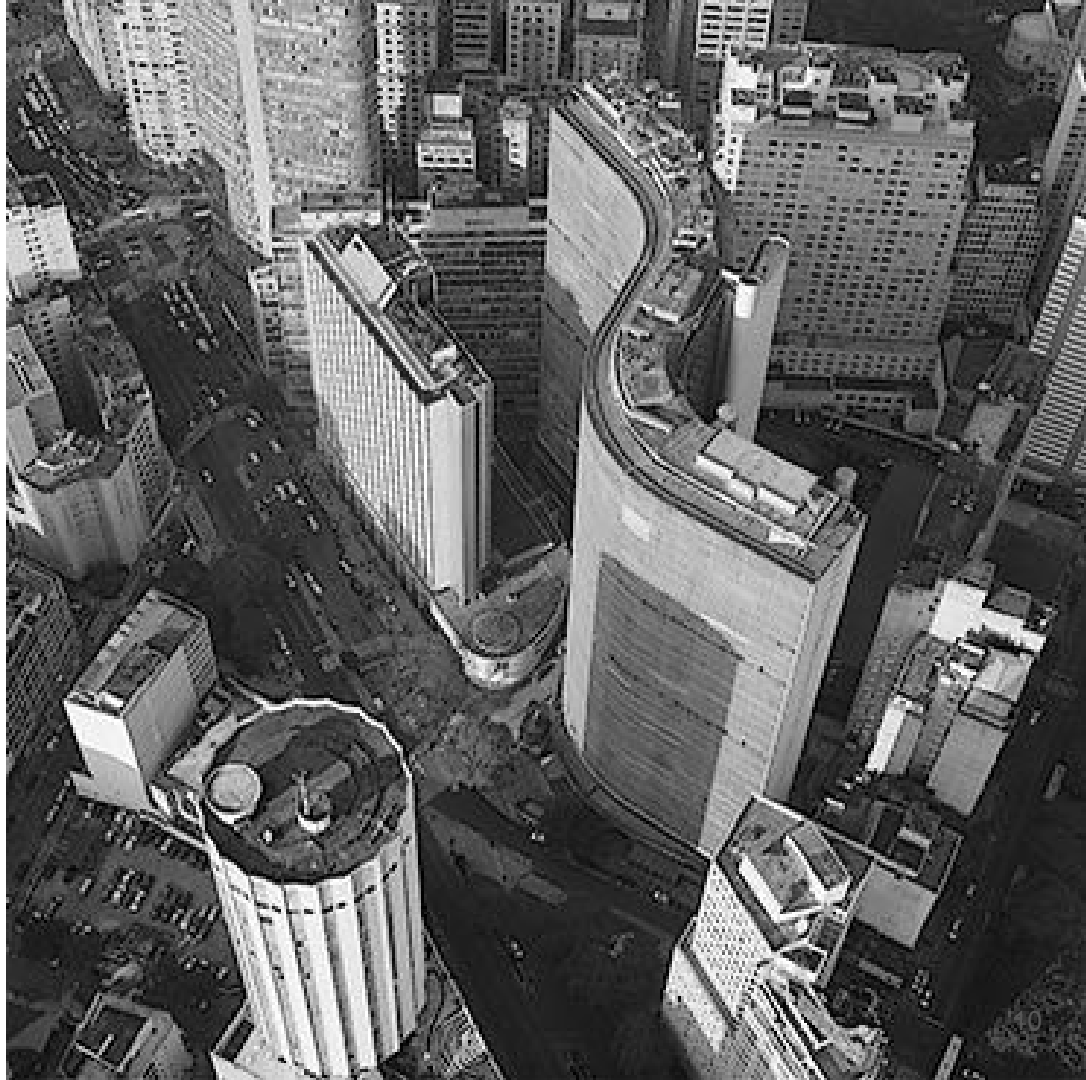
Does current research focus on the right things?

- Most of the research done in highly developed countries
 - In which 5% of the world population live
 - Focuses on the problems of these countries
- Can these solutions be mapped to the other 95% ?
- Should them?
- We must also focus on the other 95% !!!

What the cities of the future will bring us?

- Large amounts of collected data
- Development of applications and services for the city inhabitants
- Multiple application domains
 - Public and private transportation, Traffic, Health and Quality of Life, Education, Entertainment, Art, Games, Energy, Water distribution, Garbage collection, Commerce, Services, Housing, Employment, Tourism, etc.
- Software platform for integration of multiple domains

Definitions of Smart Cities



To Appear in ACM Computing Surveys

*Software platforms for smart cities:
Concepts, requirements, challenge,
and a
unified reference architecture*

Santana et al. 2017.



Definitions of Smart Cities

- Four major themes:
 - Improving quality of life of citizens with better services and optimized use of city resources
 - Integration among city services
 - Popular participation in city decision making and public policies
 - Use of Information Technology (IT)
- Some definitions mention economic advantages:
 - Incentives to the high-tech industry
 - Better environment for businesses

Definitions of Smart Cities

“A Smart City is a city well performing built on the ‘smart’ combination of endowments and activities of self-decisive, independent and aware citizens” (Giffinger et al. 2007)

“...when investments in human and social capital and traditional (transport) and modern (ICT) communication infrastructure fuel sustainable economic growth and a high quality of life, with a wise management of natural resources, through participatory governance” (Caragliu et al. 2011)

Definitions of Smart Cities

“A city connecting the physical infrastructure, the IT infrastructure, the social infrastructure, and the business infrastructure to leverage the collective intelligence of the city” (Harrison et al. 2010)

“A city that monitors and integrates conditions of all of its critical infrastructures, including roads, bridges, tunnels, rails, subways, airports, seaports, communications, water, power, even major buildings, can better optimize its resources, plan its preventive maintenance activities, and monitor security aspects while maximizing services to its citizens” (Hall et al. 2000)

Dimensions of Smart Cities

- Indicators to measure the "smartness" of a city
 - Smart Economy
 - Smart Citizens
 - Smart Governance
 - Smart Mobility
 - Smart Environment

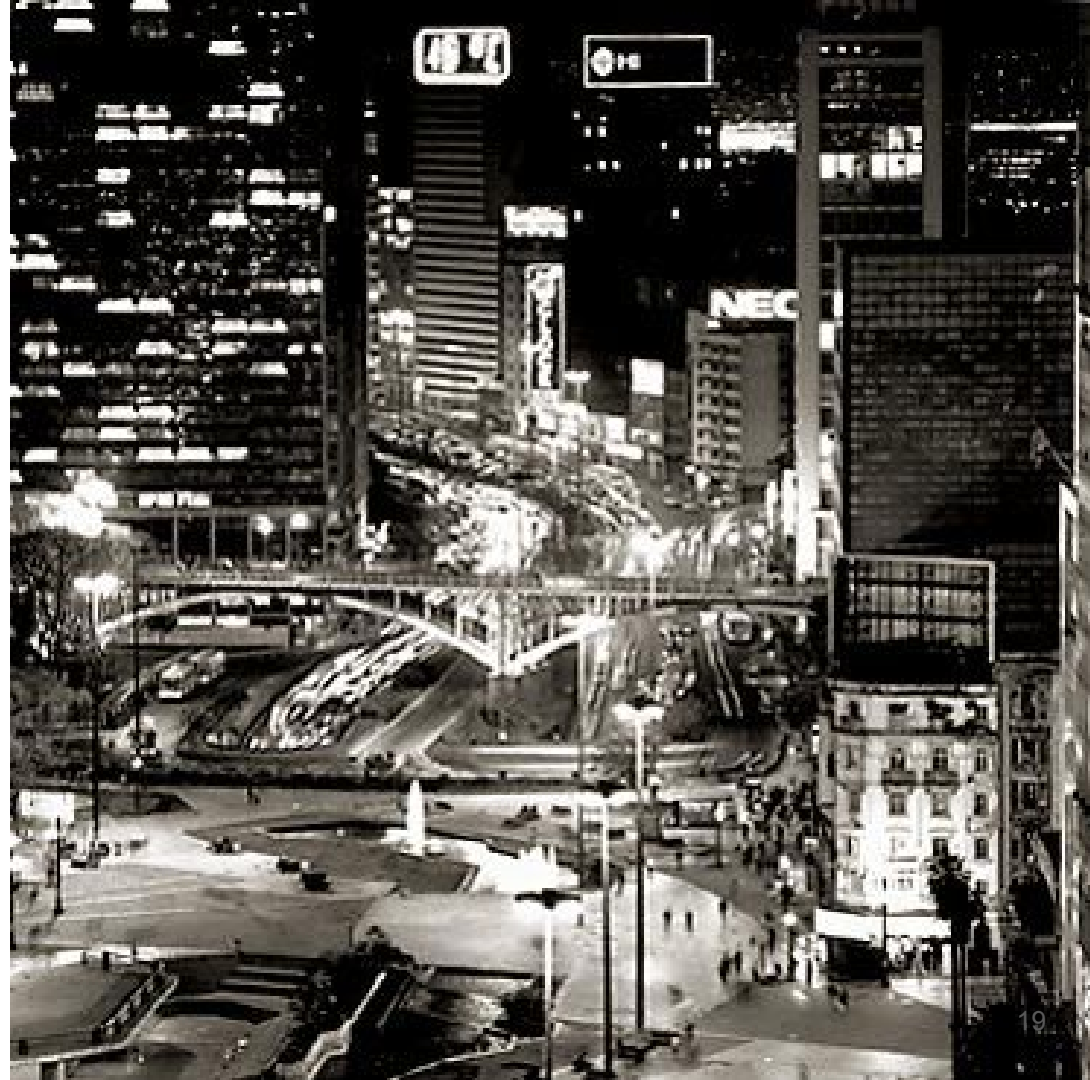
Technologies



Technologies

- Multiple technologies are used in the implementation of applications and platforms for smart cities
- Three of them are highly-mentioned:
 - Internet of Things
 - Participatory Sensing
 - Cloud Computing
 - Big Data

Smart City Initiatives



Smart City Initiatives

- Most initiatives in rich countries such as USA, Spain, and England
- Several initiatives in China
- Some isolated initiatives in Brazil, Mexico, India, and United Arab Emirates

Smart City Initiatives we studied



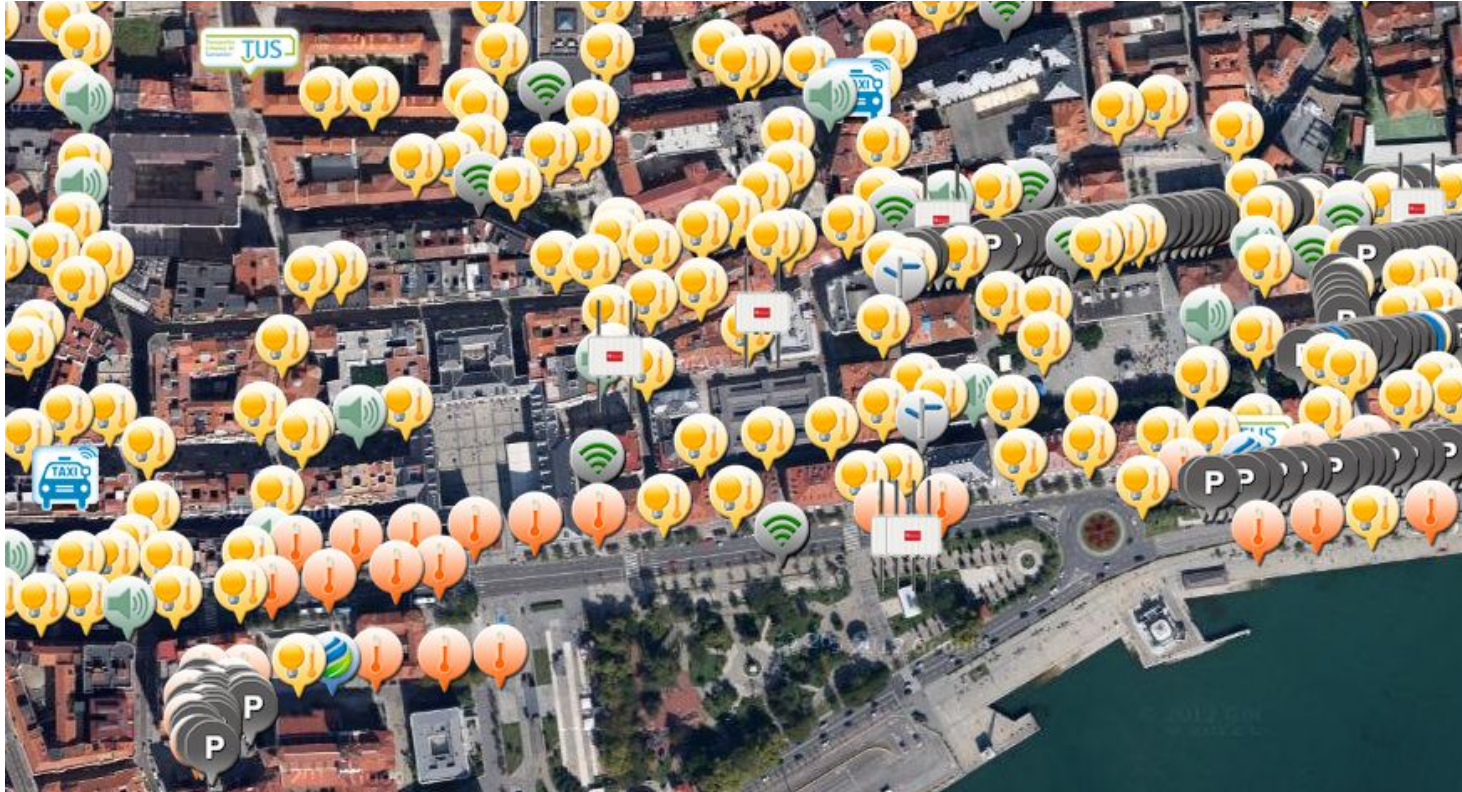
SmartSantander - Santander, Espanha

- Deployment of an infrastructure and software platform for Smart Cities
- Deployment of more than 20K sensors in the city collecting:
 - Temperature
 - Parking spots
 - Internet access points
 - Sound noise level
 - Garbage bins

SmartSantander - Santander, Espanha

- Also, collection of data from:
 - Buses
 - Taxis
 - Touristic points
 - Garbage collection trucks
 - Wi-Fi hotspots

SmartSantander - Santander, Espanha



<http://maps.smartsantander.eu/>

SmartSantander - Applications

Parking spots



Augmented Reality



Amsterdã, Holland



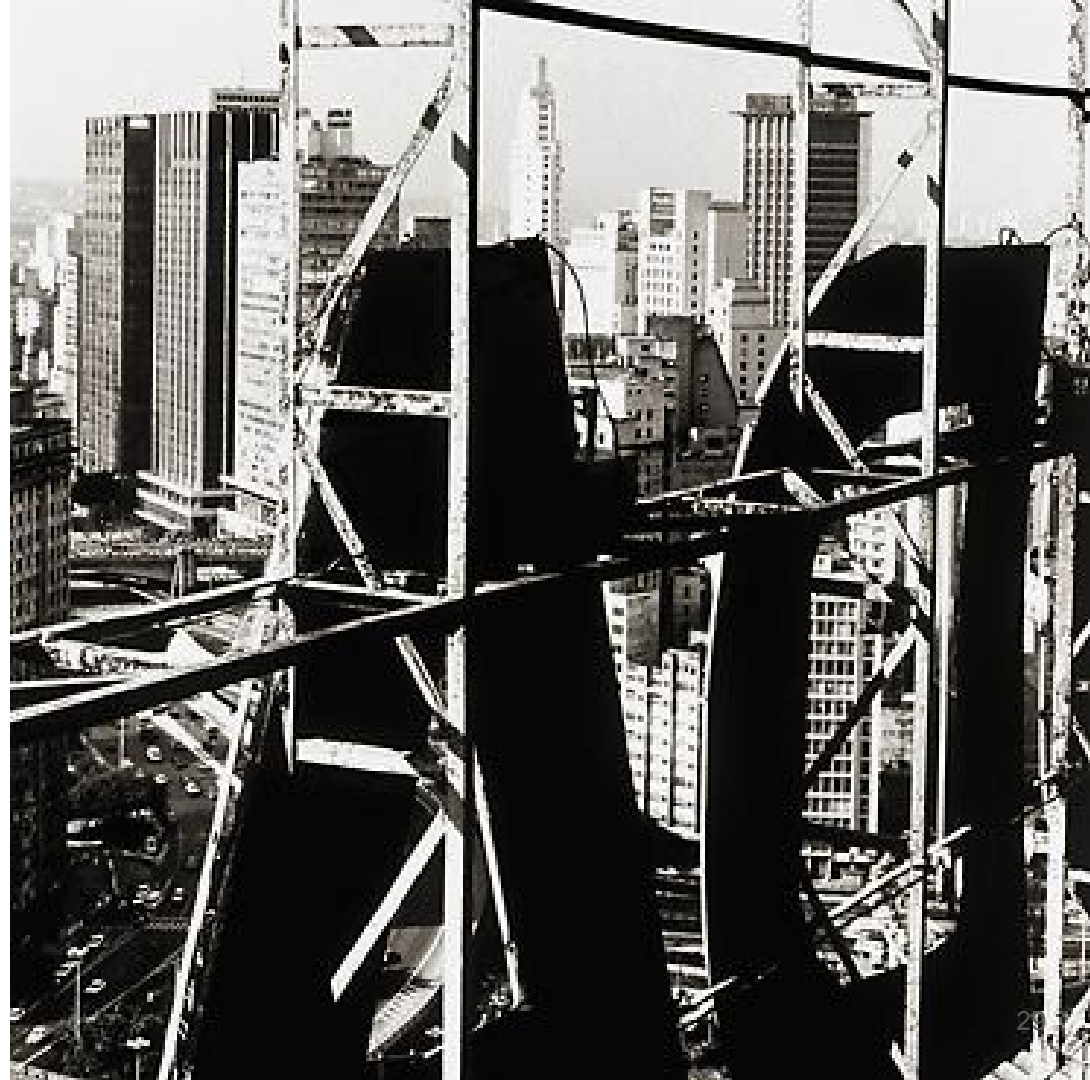
Chicago, United States

- WindyGrid Platform
 - Collects, stores, and processes city data
 - Unified visualization of city operation
 - Data from sensors, 911 calls, traffic, and public buildings
- Open Data Portal (<https://data.cityofchicago.org/>)
 - Thousands of data sets
 - Name, salary, and role of all city government personnel
 - Police event records
 - Map of abandoned vehicles
 - Population census data

- São Paulo

- Monitoring of busses in real time available via an open API
- Open Data Portal (<http://dados.prefeitura.sp.gov.br>)
- Georeferenced data (<http://geosampa.prefeitura.sp.gov.br>)
- Incentives to public transportation and bicycles

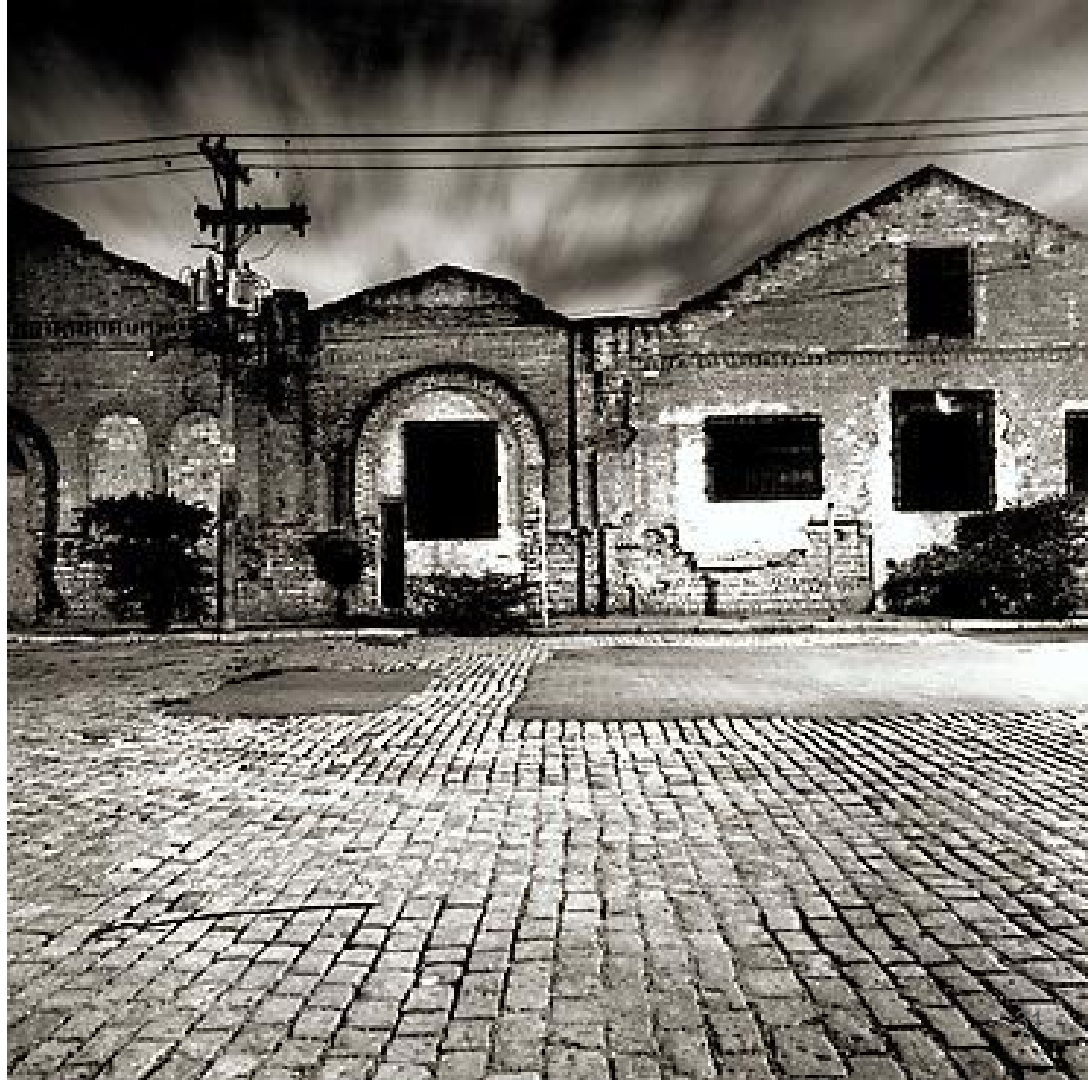
Platforms for Smart Cities



Platforms for Smart Cities

- The most rational way to develop Smart Cities is by using a Software Platform
- Facilitate the development, deployment, and integration of applications
- Multiple scientific and commercial projects

Functional and Non-functional Requirements



Functional and Non-functional Requirements

- From an analysis of 23 projects, we derived the most relevant:
- Functional requirements
- Non-Functional requirements

Functional requirements

- With the goal of facilitating the development of applications and controlling the city devices
 - Data Management
 - Sensor network management
 - Service management
 - Data processing
 - Data accessing
 - Environment for application execution
 - Software Engineering tools
 - Definitions of City Models

Non-Functional requirements

- Most of them related to large scale systems:
 - Interoperability
 - Scalability
 - Elasticity
 - Adaptability
 - Configurability
- Security and privacy of citizens
- Context-Awareness

Interoperability

- Different devices, systems, applications, and platforms
- All of them must operate in an integrated fashion
- Examples:
 - Sensors from multiple manufacturers
 - Systems implemented in different programming languages and operating systems
 - Platforms that share data and users
 - Legacy systems that must interact with novel applications in the city

Interoperability

- Solutions:
 - Standardized (APIs)
 - Open protocols (p.ex., REST)
 - Open Source-based infrastructure (possibly with proprietary components on top of it).
 - Semantic Web for integrating platform components;
 - Naming and discovery services based on ontologies

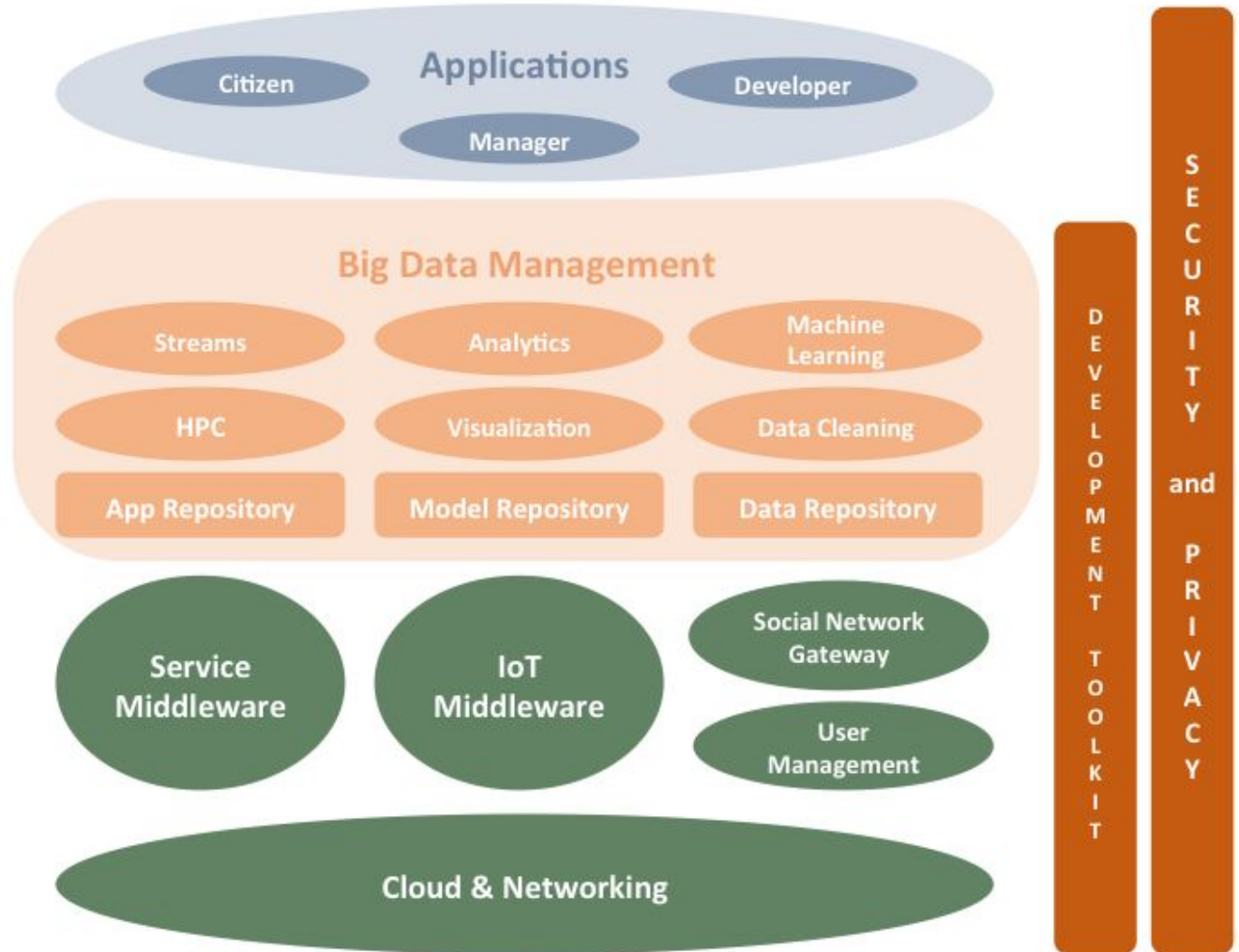
Reference Architecture

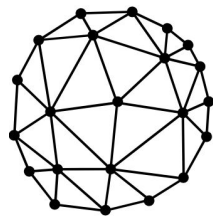


Reference Architecture

- From the requirements above, we can derive a Reference Architecture
- Major goal is to facilitate comprehension, implementation, and integration of services and applications for Smart Cities

Reference Architecture



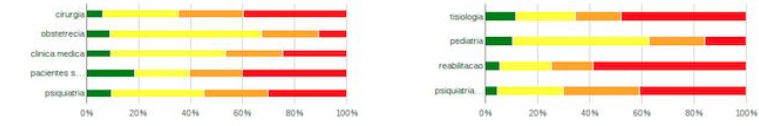
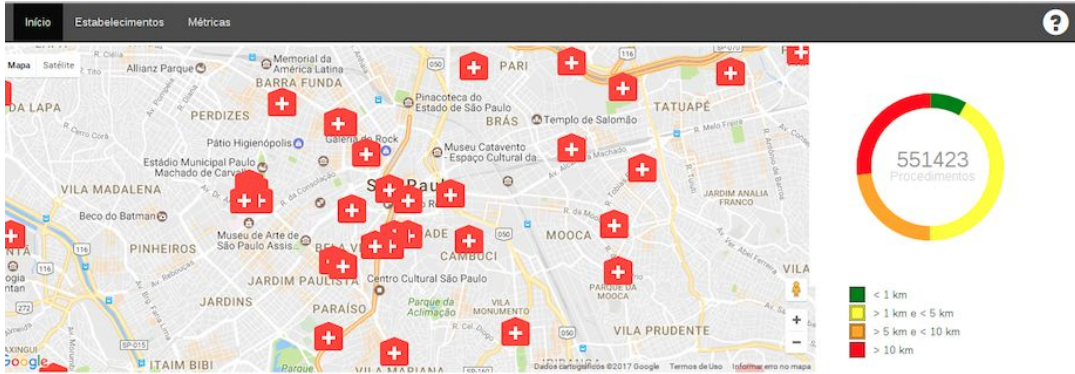


INCT

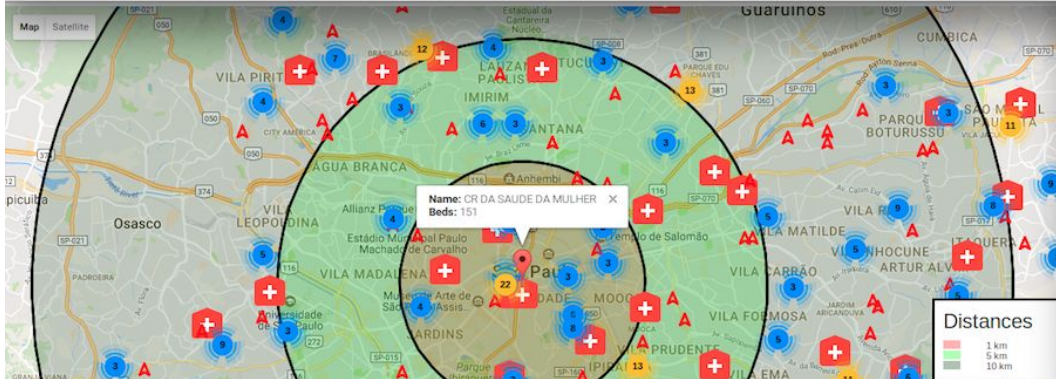
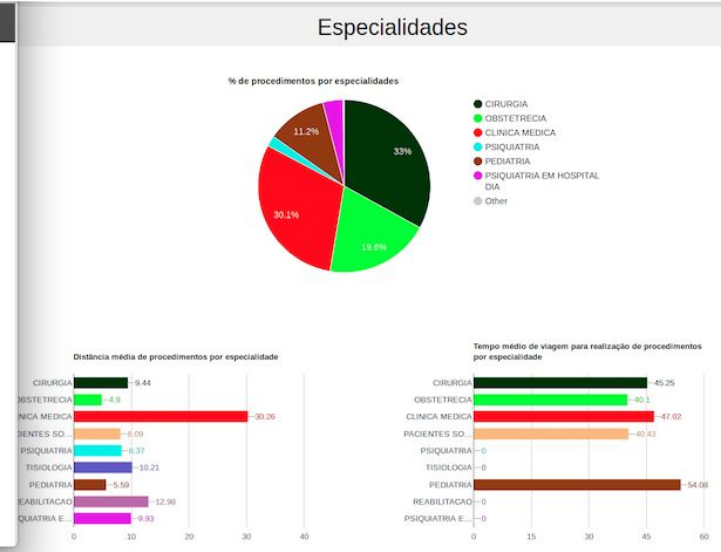
InterSCity

- Institute of the Future Internet for Smart Cities
- 48 researchers from 9 universities in Brazil
- In search of graduate students and post-docs
- **In search of International collaborations**

Health Dashboard



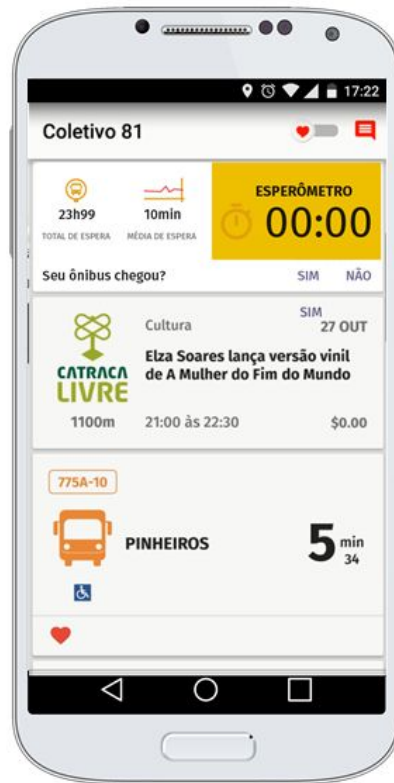
443173
Procedimentos poderiam ser realizados mais próximo a residência do paciente.



APP COLETIVO



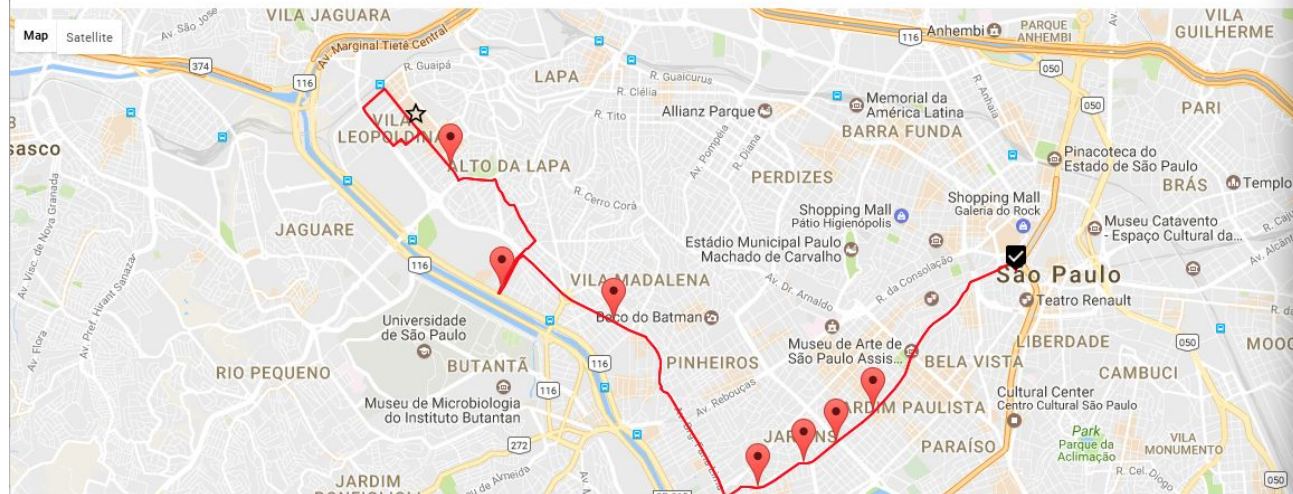
Painel totalizador



Bus Delay Dashboard

Número de carros: 7

Horário: 13:20:00



All Trips (2204)



1015-10
Terminal Jd. Britania



1016-10
Center Norte

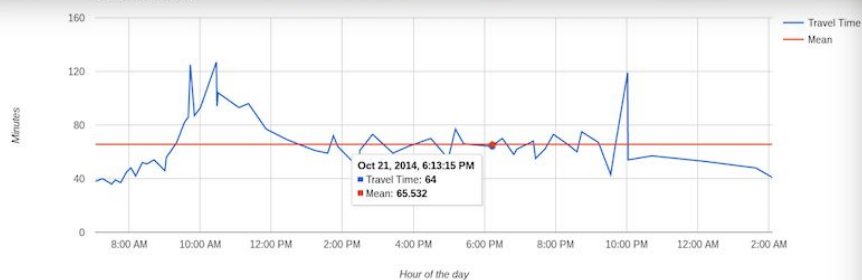


1016-10
Cemiterio Do Horto



1017-10
Vila Iorio

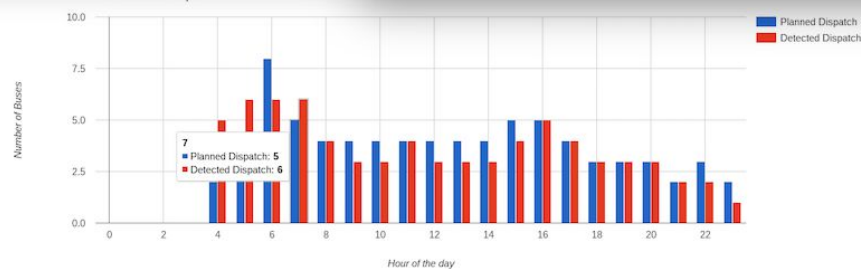
Travel Time in a line



Travel time in a line

The travel time graphic plots not only the travel time for buses of a chosen line but also a red line that represents the mean travel time of the day. Then, if the travel line is above the average, the trip takes longer than expected. If it is under, takes less than expected.

Planned X Real Dispatch



Planned versus Real dispatch

In the chart is possible to see the number of planned buses to dispatch versus the real dispatch done by the terminal. So, comparing both columns is possible to see if the contract is being fulfilled or not. Ideally both should be at the same level. If the blue column is higher than the red one, the terminal dispatched less buses than it should. If the red one is higher, the opposite happened.

Use of the InterSCity Platform in the classroom

Source code and support available for education

Example of student-developed applications

- Health
- Individual transportation / Public transportation
- Traffic Control

<https://gitlab.com/smart-city-software-platform/docs/blob/master/applications/applications.md>

How to make
your city
smarter?



In this context, how to make your city smarter?

1. Open Data
2. Incentives to the local innovation ecosystem
 - a. Startups
 - b. Collaboration City Government <-> Universities
3. Open Source Software and Open Hardware
4. Interoperability and standardization
5. Citizen participation
 - a. (from end-users up to city scientists)
 - b. Serious UX and Design Thinking methodology
6. Human resources education (city servants and professionals)
7. Infrastructure (last item because it's the less important)

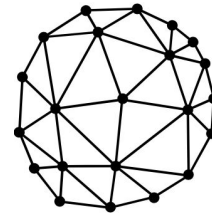
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Thank you!



INCT
InterSCity

<http://interscity.org>

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