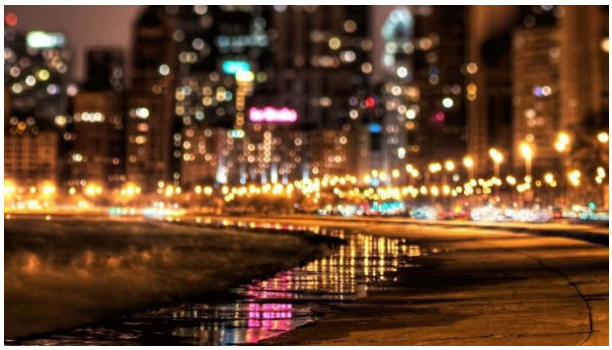
Facultad de Ciencias Exactas
UNIVERSIDAD NACIONAL DEL CENTRO DE LA PROVINCIA DE BUENOS AIRES

TRABAJO TEÓRICO PRÁCTICO: SMART CITIES.

TUPAR, TUDAI Y TUARI

➢ Actividades de pre- lectura.

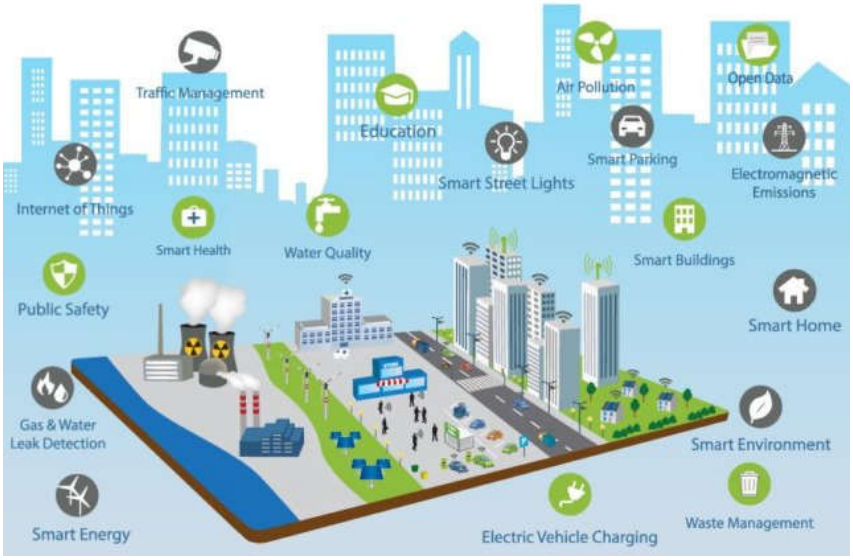
1. **OBSERVE** las siguientes imágenes. **CONSIGNE** a qué problemas urbanos se refieren y cómo éstos afectan la vida de los ciudadanos**.**

2- RESPONDA las siguientes preguntas:

a. *¿Cuáles son los problemas que afectan a las ciudades en crecimiento?*
b. *¿Existen algunos de estos problemas en Tandil o tu ciudad de origen?*
c. *¿Cuáles son o han sido las propuestas para resolverlos?*
d. *¿Consideras que los resultados son satisfactorios?*
e. *¿Cómo podría la tecnología contribuir en tales casos?*
f. *¿Cuáles son las limitantes para desarrollar soluciones de alta tecnología?*

3- **OBSERVE** la imagen e **IDENTIFIQUE** las características de la ciudad inteligente[1].



4- **SELECCIONE** una de las características de la actividad anterior y **EXPLIQUE** cómo le gustaría verla aplicada en su ciudad.

➢ Actividades de lectura.

5- A continuación trabajaremos con secciones de un texto académico. **LEA** el título y **REDACTE dos ideas** que espera encontrar en el texto.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Internet of Things for Smart Cities

Andrea Zanella, *Senior Member, IEEE*, Nicola Bui, Angelo Castellani,
Lorenzo Vangelista, *Senior Member, IEEE*, and Michele Zorzi, *Fellow, IEEE*

[1]Si el concepto es nuevo para vos te invitamos a ver éste video con información complementaria sobre ciudades inteligentes: https://www.youtube.com/watch?v=lKpoi8lf_tI.

g.

- ….....
- .....

6- REALICE un barrido de lectura y **VERIFIQUE** si sus predicciones aparecen en el texto.

7- IDENTIFIQUE a qué parte del artículo académico corresponden los fragmentos seleccionados. **JUSTIFIQUE.**

Resumen	*Introducción*
Metodología	*Resultados*
Discusión	*Conclusión*
Anexos	*Bibliografía*

8- COMPLETE con los subtítulos correctos en el extracto `A` (véase pags. 9 y 10). Tres de los subtítulos no corresponden al texto.

Smart Parking	***Smart Lighting***
Air Quality	***Noise Monitoring***
Automation and Salubrity of Public Buildings	***Virtual Schools***
Security Home Policing	***Remote Riot Management***
Structural Health of Buildings	***Waste Management***
Traffic Congestion	***City Energy Consumption***

➢ Gramática.

9- SUBRAYE en el extracto`A` las palabras/frases claves que le permitieron identificar los subtitulos en cada caso.

10- RELEA el texto y **COMPLETE**el cuadro, consignanado a qué refieren las palabras o frases de la primer columna.

Palabra o frase	Refiere a ....
this market	The Smart City market
such as	
these sectors	
this roadblock	
this gap	
Which	
such as	
they	
these services	
we	

11-En el cuadro anterior, **IDENTIFIQUE**qué palabras o frases ejemplifican el uso de exóforas, anáforas o catáforas.

12-En el extracto `B` (véase pags. 11 y 12), algunas de las palabras o frases que facilitan la interpretación creando cohesión no están claras. **LEA** atentamente y **SELECCIONE** la opción que a suparecer facilita la comprensión del texto.

13-En el extracto 'B' faltan algunas palabras o frases. Luego de su lectura, **UBÍQUELAS** en el texto**. (identifique la frase extra).**

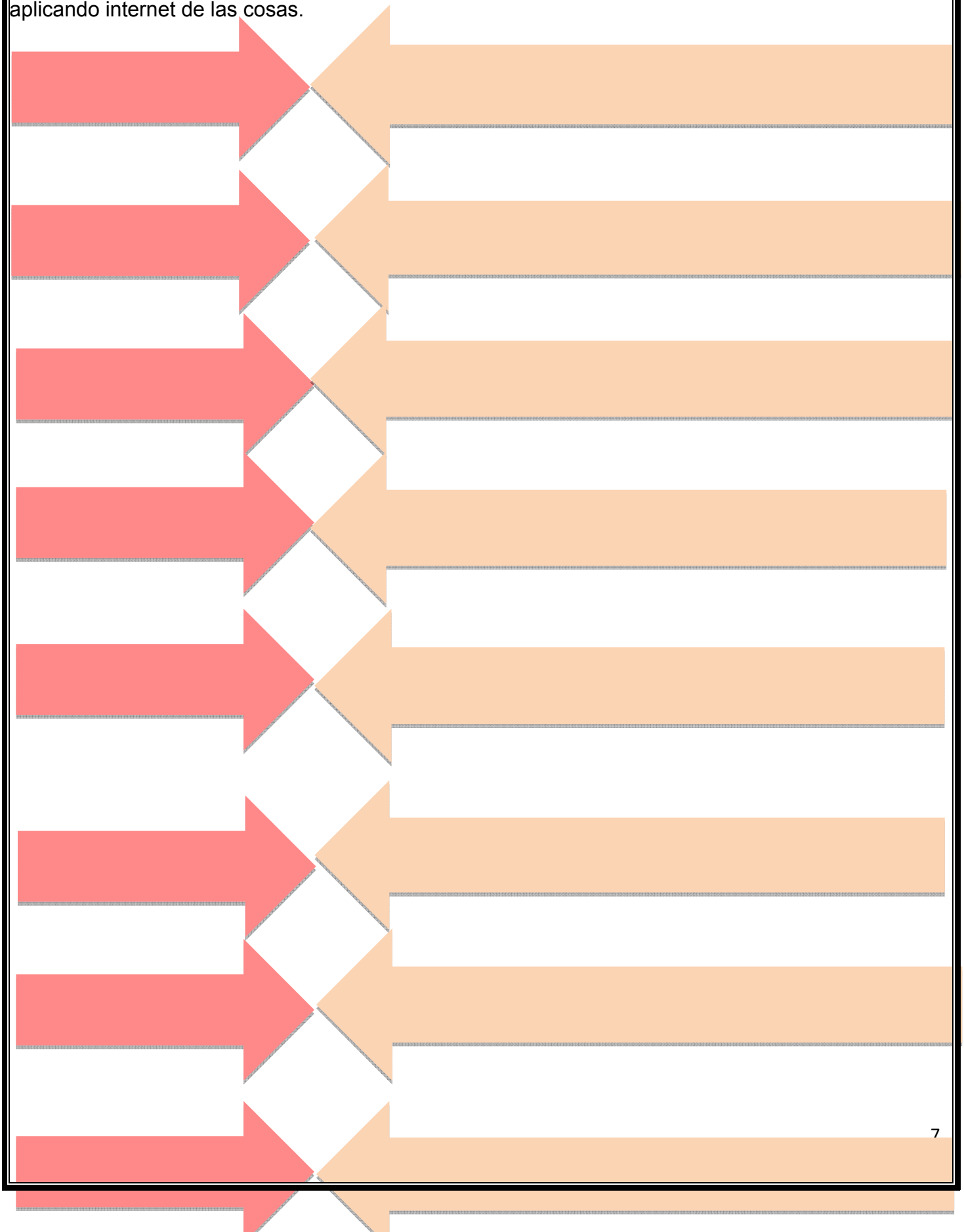
which		We	
It		this objective	
their city		Those	
the former		Its	
Their		this paper	

14-RELEA el material y **ELIJA** la opción correcta en cada caso:

a. ¿Qué es Internet de las cosas?
   i. Un paradigma de las comunicaciones que propone la interconexión de dispositivos de la vida diaria
   ii. Un sistema de comunicación que facilita la independencia de los dispositivos
   iii. La aplicación de aplicaciones conectividad a redes sociales en electrodomésticos
   iv. Una plataforma de Android para la experimentación libre
b. ¿Cuáles son los posible beneficios para usuarios?
   i. Las personas podrían acceder a su información en la nube
   ii. Las ciudades dejarían de requerir trámites personales
   iii. Las escuelas contarían con conectividad gratuita
   iv. La información generada permitirá múltiples aplicaciones y servicios para empresas y la administración pública.
c. ¿Cuáles son los desafíos en la implementación del nuevo paradigma?
   i. Pocos desarrolladores están interesados en el desafío
   ii. Falta tecnología accesible para experimentar
   iii. Falta de estandarización de prácticas de desarrollo y modelo de negocio para atraer inversiones.
   iv. Los inversores no tienen interés en una tecnología experimental
d. ¿ Cuál es el objetivo de las ciudades inteligentes?
   i. La vigilancia de los ciudadanos y reducción de los índices de criminalidad
   ii. Mejorar el uso y la calidad de los recursos públicos.
   iii. Propiciar la reducción de personal estatal
   iv. Llevar servicios a los suburbios de las ciudades.
e. ¿ Por qué no se ha implementado el proyecto europeo para crear ciudades inteligentes?
   i. Existen obstáculos políticos, técnicos y económicos.
   ii. Las ciudades prefieren métodos tradicionales de gestión.
   iii. Existen pocas ciudades con conectividad ilimitada.
   iv. Los ciudadanos desconfían de tecnología que limite su privacidad.
f. ¿Cómo puede superarse la barrera tecnológica para la creación de ciudades inteligentes?
   i. Se pueden alojar los datos en servidores gratuitos.
   ii. Con la distribución de dispositivos móbiles.
   iii. Con la creación de una plataforma urbana IoT para las tecnologías.
   iv. Se puede pedir a los ciudadanos que aporten horas de trabajo en testeo de las aplicaciones.
g. ¿Cómo ha afectado la crisis global el desarrollo de ciudades inteligentes?
   i. Ha habido una reducción en la inversión pública.
   ii. Ha subido el costo del petróleo
   iii. Los ciudadanos se oponen a este tipo de inversiones
   iv. Las multinacionales proponen financiar estos proyectos.
h. ¿Cuál sería el beneficio político de la creación de ciudades inteligentes?
   i. Los ciudadanos podrían acceder a información sobre las políticas e inversiones públicas y mejorar la imagen de los funcionarios.
   ii. Los ciudadanos podrían identificar a los funcionarios corruptos.

iii. El intercambio de información facilitaría desacreditar a los ciudadanos.
iv. Las elecciones locales podrían realizarse desde dispositivos personales.

15- COMPLETE el siguiente cuadro con problemas de las ciudades y soluciones posibles aplicando internet de las cosas.



- **Actividades de post- lectura.**

16- **RELEA** los problemas urbanos de Tandil o de su ciudad de origen**. REDACTE**un párrafo explicando su opinión sobre la factibilidad de la solución propuesta en el texto para el caso específico de Tandil/su ciudad de origen.

17- **REDACTE** un resumen del material sobre internet de las cosas para ciudades inteligentes. (Material de consulta en la página web de la cátedra: 'El resumen')

EXTRACTO A

SMART CITY CONCEPT AND SERVICES

According to Pike Research on Smart Cities,2 ***the Smart City market*** *is estimated at hundreds of billion dollars by 2020, with an annual spending reaching nearly 16 billions. This market springs from the synergic interconnection of key industry and service sectors, such as Smart Governance, Smart Mobility, Smart Utilities, Smart Buildings, and Smart Environment. These sectors have also been considered in the European Smart Cities project (http://www.smart-cities.eu) to define a ranking criterion that can be used to assess the level of "smartness" of European cities. Nonetheless, the Smart City market has not really taken off yet, for a number of political, technical, and financial barriers [6].Under the political dimension, the primary obstacle is the attribution of decision-making power to the different stakeholders. A possible way to remove this roadblock is to institutionalize the entire decision and execution process, concentrating the strategic planning and management of the smart city aspects into a single, dedicated department in the city [7].On the technical side, the most relevant issue consists in the non-interoperability of the heterogeneous technologies currently used in city and urban developments. In this respect, the IoT vision can become the building block to realize a unified urban-scale ICT platform, thus unleashing the potential of the SmartCity vision [8], [9]. Finally, concerning the financial dimension, a clear business model is still lacking, although some initiative to fill this gap has been recently undertaken [10]. The situation is worsened by the adverse global economic situation, which has determined a general shrinking of investments on public services. This situation prevents the potentially huge Smart City market from becoming reality. A possible way out of this impasse is to first develop those services that conjugate social utility with very clear return on investment, such as smart parking and smart buildings, and will hence act as catalyzers for the other added-value services [10].*

In the rest of this section, we overview some of the services that might be enabled by an urban IoT paradigm and that are of potential interest in the Smart City context, because they can realize the win–win *situation of increasing the quality and enhancing the services offered to the citizens while bringing an economical advantage for the city administration in terms of reduction of the operational costs [6]. To better appreciate the level of maturity of the enabling technologies for these services, we report in Table I a synoptic view of the services in terms of suggested type(s) of network to be deployed, expected traffic generated by the service, maximum tolerable delay, device powering, and an estimate of the feasibility of each service with currently available technologies. From the table, it clearly emerges that, in general, the practical realization of most of such services is not hindered by technical issues, but rather by the lack of a widely accepted communication and service architecture that can abstract from the specific features of the single technologies and provide harmonized access to the services.*

(a)……: *Proper maintenance of the historical buildings of a city requires the continuous monitoring of the actual conditions of each building and identification of the areas that are most subject to the impact of external agents. The urban IoT may provide a distributed database of building structural integrity measurements, collected by suitable sensors located in the buildings, such as vibration and deformation sensors to monitor the building stress, atmospheric agent sensor sin the surrounding areas to monitor pollution levels, and temperature and humidity sensors to have a complete characterization of the environmental conditions [11]. This database should reduce the need for expensive periodic structural testing by human operators and will allow targeted and proactive maintenance and restoration actions. Finally, it will be possible to combine vibration and seismic readings in order to better study and understand the impact of light earthquakes on city buildings. This database can be made publicly accessible in order to make the*

citizens aware of the care taken in preserving the city historical heritage. The practical realization of this service, however, requires the installation of sensors in the buildings and surrounding areas and their interconnection to a controlsystem, which may require an initial investment in order to create the needed infrastructure.

(b)……..:*This is a primary issue in many modern cities, due to both the cost of the service and the problem of the storage of garbage in land*fills. *A deeper penetration of ICT solutions in this domain, however, may result insign*ificant *savings and economic and ecological advantages. For instance, the use of intelligent waste containers, which detect the level of load and allow for an optimization of the collector trucks route, can reduce the cost of waste collection and improve the quality of recycling [12]. To realize such a smart waste management service, the IoT shall connect the end devices, i.e., intelligent waste containers, to a control center where an optimization software processes the data and determines the optimal management of the collector truck* fleet.

(c)……..:*The European Union of*ficially *adopted a 20-20-20 Renewable Energy Directive setting climate change reduction goals for the next decade. The targets call for a 20% reduction in greenhouse gas emissions by 2020 compared with 1990 levels, a20% cut in energy consumption through improved energy ef*ficiency *by 2020, and a 20% increase in the use of renewable energy by 2020. To such an extent, an urban IoT can provide means to monitor the quality of the air in crowded areas, parks, or* fitness *trails [13]. In addition, communication facilities can be provided to let health applications running on joggers*' *devices be connected to the infrastructure. In such a way, people can always* find *the healthiest path for outdoor activities and can be continuously connected to their preferred personal training application. The realization of such a service requires that air quality and pollution sensors be deployed across the city and that the sensor data be made publicly available to citizens.*

(d)……..:*Sounds can be seen as a form of acoustic pollution as much as carbon oxide (CO) is for air. In that sense, the city authorities have already issued specif*ic *laws to reduce the amount of noise in the city centre at specif*ic *hours. An urban IoT can offer a noise monitoring service to measure the amount of noise produced at any given hour in the places that adopt the service [14]. Besides building a space-time map of the noise pollution in the area, such a service can also be used to enforce public security, by means of sound detection algorithms that can recognize, for instance, the noise of glass crashes or brawls. This service can hence improve both the quiet of the nights in the city and the con*fidence *of public establishment owners, although the installation of sound detectors or environmental microphones is quite controversial, because of the obvious privacy concerns for this type of monitoring.*

(e)……..:*On the same line of air quality and noise monitoring, a possible Smart City service that can be enabled by urban IoT consists in monitoring the traf*fic *congestion in the city. Even though camera-based traf*fic *monitoring systems are already available and deployed in many cities, low-power widespread communication can provide a denser source of information. Traf*fic *monitoring may be realized by using the sensing capabilities and GPS installed on modern vehicles [15], and also adopting a combination of air quality and acoustic sensors along a given road. This information is of great importance for city authorities and citizens: for the former to discipline traf*fic *andto send of*ficers *where needed and for the latter to plan in advance the route to reach the of*fice *or to better schedule a shopping trip to the city centre.*

(f)……..:*Together with the air quality monitoring service, an urban IoT may provide a service to monitor the power consumption of the whole city, thus enabling authorities and citizens to get a clear and detailed view of the amount of energy required by the different services (public lighting, transportation, traf*fic *lights, control cameras, heating/cooling of public buildings, and so on). In turn, this will make it possible to identify the main energy consumption sources and to set priorities in order to optimize their behavior. This goes in the direction indicated by the European directive for energy ef*ficiency

improvement in the next years. In order to obtain such a service, power draw monitoring devices must be integrated with the power grid in the city. In addition, it will also be possible to enhance these service with active functionalities to control local power production structures (e.g., photovoltaic panels).

(g) ……..:*This service is based on road sensors and intelligent displays that direct motorists along the best path for parking in the city [16]. The bene*fits *deriving from this service are manifold: faster time to locate a parking slot means fewer CO emission from the car, lesser traf*fic *congestion, and happier citizens. The smart parking service can be directly integrated in the urban IoT infrastructure, because many companies in Europe are providing market products for this application. Furthermore, by using short-range communication technologies, such as Radio Frequency Identi*fiers *(RFID) or Near Field Communication (NFC), it is possible to realize an electronic veri*fication *system of parking permits in slots reserved for residents or disabled, thus offering a better service to citizens that can legitimately use those slots and an ef*fi*cient tool to quickly spot violations.*

(h)……..:*In order to support the 20-20-20 directive, the optimization of the street lighting ef*fi*ciency is an important feature. In particular, this service can optimize the street lamp intensity according to the time of the day, the weather condition, and the presence of people. In order to properly work, such a service needs to include the street lights into the Smart City infrastructure. It is also possible to exploit the increased number of connected spots to provide WiFi connection to citizens. In addition, a fault detection system will be easily realized on top of the street light controllers.*

(i) ……..:*Another important application of IoT technologies is the monitoring of the energy consumption and the salubrity of the environment in public buildings (schools, administration of*fi*ces, and museums)by means of different types of sensors and actuators that control lights, temperature, and humidity. By controlling these parameters, indeed, it is possible to enhance the level of comfort of the persons that live in these environments, which may also have a positive return in terms of productivity, while reducing the costs for heating/cooling [17].*

EXTRTACTO B

*T*he Internet of Things (IoT) is a recent communication paradigm that envisions a near future, in *who/which/ then/ hope/hypothetical* the objects of everyday life will be equipped with microcontrollers, transceivers for digital communication, and suitable protocol stacks that will make *objects/ people/who/ what/ them*able to communicate with one another and with the users, becoming an integral part of the Internet [1]. The IoT concept, hence, aims at making the Internet even more immersive and pervasive. Furthermore; by enabling easy access and interaction with a wide variety of devices; *these/ they/ such as/that/ several,* home appliances, surveillance cameras, monitoring *sensors, actuators, displays, vehicles, and so on; the IoT will foster the development of a number of applications that make use of the potentially enormous amount and variety of data generated by* such objects/ the objects with IoT/they/ *home appliances, surveillance cameras, monitoring* sensors, actuators, displays, vehicles, and so on *to provide new services to citizens, companies, and public administrations*. A paradigm proposing the interaction/ This paradigm/ Paradigms/ They*indeed*finds *application in many different domains, such as home automation, industrial automation, medical aids, mobile healthcare, elderly assistance, intelligent energy management and smart grids, automotive, traf*fic *management, and many others [2].*

However,such a heterogeneous field of application makes the identification of solutions capable of satisfying the requirements of all possible application scenarios a formidable challenge. *The latter/ It/Impossibility to identify solutions capable of satisfying requirements/This difficulty*has led to the proliferation of different and, sometimes,incompatible proposals for the practical realization of IoT systems. Therefore, from a system perspective, the realization of an IoT network, together with the required backend network services and devices, still lacks an established best practice because of its novelty and complexity. In addition to the technical difficulties, the adoption of the IoT paradigm is also hindered by the lack of a clear and widely accepted business model that can attract investments to promote the deployment of these technologies [3].

In this complex scenario, the application of the IoT paradigm to an urban context is of particular interest, as **…….. (a)** respondsto the strong push of many national governments to adopt ICT solutions in the management of public affairs, thus realizing the so-called Smart City concept [4]. Although there is not yet a formal and widely accepted definition of "Smart City," the final aim is to make a better use of the public resources, increasing the quality of the services offered to the citizens, while reducing the operational costs of the public administrations. **……..(b)** can be pursued by the deployment of an urban IoT, i.e., a communication infrastructure that provides unified, simple, and economical access to a plethora of public services, thus unleashing potential synergies and increasing transparency to the citizens. An urban IoT, indeed, may bring a number of benefits in the management and optimization of traditional public services, such as transport and parking, lighting, surveillance and maintenance of public areas, preservation of cultural heritage, garbage collection, salubrity of hospitals, and school. Furthermore, the availability of different types of data ,collected by a pervasive urban IoT, may also be exploited to increase the transparency and promote the actions of the local government toward the citizens, enhance the awareness of people about the status of **…….(c)**, stimulate the active participation of the citizens in the management of public administration, and also stimulate the creation of new services upon **…….(d)** provided by the IoT [5]. Therefore, the *application of the IoT paradigm to the Smart City is particularly attractive to local and regional administrations that may become the early adopters of such technologies, thus acting as catalyzers for the adoption of the IoT paradigm on a wider scale.*

The objective of ***…….(e)*** *is to discuss a general reference framework for the design of an urban IoT. We describe the specific characteristics of an urban IoT, and the services that may drive the adoption of urban IoT by local governments.* ***…….(f)*** *then overview the web-based approach for the design of IoT services, and the related protocols and technologies, discussing* ***…….(g)*** *suitability for the Smart City environment. Finally, we substantiate the discussion by reporting our experience in the "Padova Smart City" project, ……* ***(h)*** *is a proof-of-concept deployment of an IoT island in the city of Padova (Italy) and interconnected with the data network of the city municipality. In this regard, we describe the technical solutions adopted for the realization of the IoT island and report some of the measurements that have been collected by the system in* ***…….(i)*** first *operational days.*

The rest of the paper is organized as follows. Section II overviews the services that are commonly associated to the Smart City vision and that can be enabled by the deployment of an urban IoT. Section III provides a general overview of the system architecture for an urban IoT. More in detail, this section describes the web service approach for the realization of IoT services, with the related data formats and communication protocols, and the link layer technologies. Finally, Section IV presents the "Padova Smart City" project, which exemplifies a possible implementation of an urban IoT and provides examples of the type of data that can be collected with such a structure.