Telco Role and Assets for the Internet of Things (IoT) Infrastructure

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***Abstract*— The paper presents an analysis of what, an application provider willing to launch an IoT service, needs in terms of physical infrastructure in the urban scenario and how, a Telco (Telecommunications Company), can support such a scenario. The paper shows the different characteristics that the different Telco assets have and how they can be used to deploy IoT services, giving some practical real cases.**

Keywords*— *gateways; radio coverage; urban infrastructure; short range; site.

I. INTRODUCTION

When we deal with Internet Of Things (IoT) we might think about a scenario where not only humans but also machines and objects ("things") will be connected to the big internet. Nowadays only part of the IoT applications use a full Internet Protocol, since for many applications, IP gateways are used to interconnect short range devices to IP networks. Even if everybody is looking forward to a full IP IoT scenario, it is likely that for a long time we will still have to deal with nodes of the network that will be connected to internet through gateways. One of the consequences is that we will also deal in the next near future with "infrastructure" devices whose role will be to bridge and to route objects connected to Short Range Device (SRD) networks (e.g. ZigBee). Such devices will be more complex in terms of processing and storage capabilities compared to end nodes. In many cases such gateways could not be operated by batteries and hence one of the problem to solve, for those willing to deploy IoT applications, will be to find adequate sites to host the gateways ensuring power source and, in case of wireless applications, guaranteeing adequate radio coverage and level of capillarity. Such sites are hard to find and costly to manage and it is unrealistic to follow the approach that was taken for the radio mobile networks, since in that case, very expensive rental of building roofs for hosting mobile base stations (in Italy in some cases, rental went up to 80k euros per year for the most precious cities) was sustainable considering the interesting ARPU (Average Revenue Per Unit) for mobile terminals. In case of IoT, almost negligible ARPU of "things" lead to look for very cheap solutions for sites hosting the gateways and to share this infrastructure to reduce costs.

II. TELCOS ASSETS CHARACTERISTICS

Telecom operators can support this scenario and fulfill those needs since they own both physical assets and sites to host the gateway and the appropriate skill to plan, deploy and operate those additional networks. Specific sites for hosting devices should have some specific characteristics such as:

- Availability of power source (or possibility to install a solar panel, or remote power feeding)
- Possibility to install antennas
- Protection against vandalism
- Enabling good radio coverage (in case of wireless devices)
- Adequate level of capillarity with respect to the service to be provided
- Controlled access
- Non-intrusive integration with the environment
- Low rental costs
- Low authorization costs
- Low installation and maintenance costs
- Regional/National presence for specific services
- Preferably taking in advantage pre-existing infrastructure

Many different types of urban infrastructure are available in particular in the cities (e.g. street lighting, broadcasters, energy utilities) but very few of them manage to find a suitable tradeoff among all the mentioned requirements that is also suitable for a plurality of services. Telco operators managing fixed and mobile services have plenty of communication network infrastructure devices and related sites that according to specific needs for the IoT service to be deployed, can be used. Nevertheless not all Telco assets can host devices for capillary network infrastructure. For different locations it must be evaluated how these, fit the characteristics of the devices and how these are useful for the capillary network deployment (Table 1).

III. CASE STUDIES

The plethora of possible assets that a Telco can provide to host gateways (and repeaters) can simplify the difficult job of a service provider willing to deploy a wireless network for a specific smart city application. As an example in Figure 1 the set of mobile base stations (red pinpoints) and of street cabinets (green pinpoints) of a small town in the north of Italy is shown. It is clear how the two sets of assets already provide a good level of capillarity in the most "dense" areas of the city; if all the many available assets were shown (such as distribution network boxes or phone booths), the map would become unreadable. In Figure 2 the radio coverage that could be provided for that city is shown, such a radio coverage is provided using some of the mobile base stations of the Telco to host the data concentrators (gateways) of a Wireless MBus 169MHz [1] network (this communication protocol is used in

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TABLE I. Characteristics of the different assets

Telco Asset	Characteristics	Capillarity	Coverage	Suitable for
Switching Plant	Inside big cities Power source available No size constraints of devices	Poor	Good (limitatins only in historical city centers)	Both gateway and repeaters/ bridge
Distribution network street cabinets	Along the streets Remote power source available Easy to access Size constraints	Good	Poor	Repeaters / Bridge
Distribution network street boxes	Either along the streets or in building basements or building facade Limited remote power source available Easy to access Size constraints	Excellent	Poor / Good (in case of building façade)	Repeaters / Bridge
Distribution network street poles	Mainly in rural areas Limited remote power source available Difficult to access Size constraints	Poor	Good	Repeaters / Bridge
Mobile Base Stations	Power source available Difficult to access Sites may be shared among operators	Good	Excellent	Gateways / Data Concentrators
Phone boxes and booths	Power source available (only in cas of phone booth) Dismission plan running	Poor	Fair	Repeaters / Bridge

Europe for smart gas metering). In Figure 3 a radio coverage of a ZigBee network (2.4GHz) is shown; in this case only the street cabinets were used to host either ZigBee gateways or routers; since both devices (routers and gateways) could not be battery-operated, remote power feeding can be provided at the street cabinet using the copper pairs not only for transmitting data but also for transmitting energy remotely.

In this case a service provider interested in deploying a ZigBee network in that city for outdoor applications (e.g. waste management, pollution monitoring), could take advantage of the Telco street cabinets to obtain a good level of radio coverage (if a full mesh architecture was chosen where

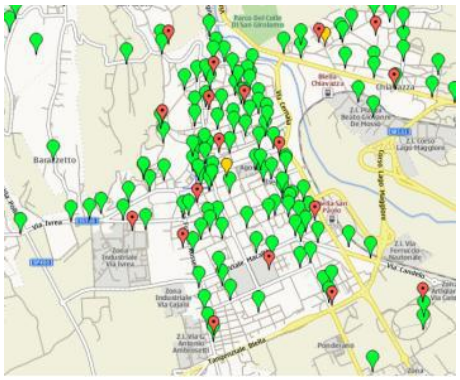

Fig. 1. Some of the available Telco assets in a small city

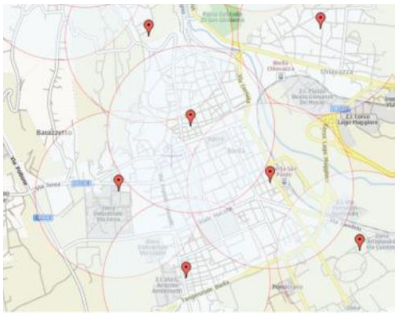

Fig. 2. WMBus 169MHz Radio Coverage achieved using Base Stations only

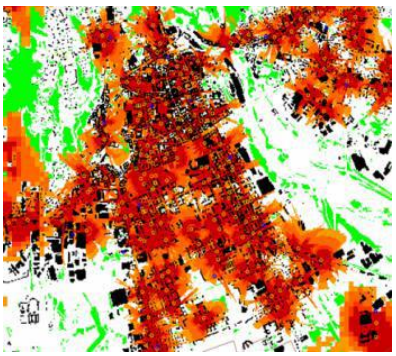

Fig. 3. ZigBee 2,4GHz Radio Coverage achieved using street cabinets

also the end nodes could act as routers, the coverage would be even better). The example shows how independently from the chosen wireless technology and from the type of service, Telco assets can fulfill the infrastructural need for IoT applications; this added value can be accompanied with the skill of a Telco, to plan those networks (to define how many and where gateways should be places) and to operate and manage them efficiently, making Telcos significant stakeholders in the IoT development [3].

IV. CONCLUSION AND FUTURE WORK

For some time, some IoT devices will be too constrained in terms of size and processing capabilities to manage IP protocols; this means that such devices will be connected to internet through gateways. Adequate sites for installing and managing those gateways is and will be an issue; Telcos can play an important role in such a scenario enabling, with all their assets, the creation of a Smart Urban Infrastructure. Future work to demonstrate such an approach is the deployment of a multi-utility (gas and water) smart metering network (according to the requirements of the Italian Authority for Energy [2]) in 4 Italian cities where the data concentrators are installed only on the assets (mobile base stations and distribution network boxes) of Telecom Italia and they will collect meter readings from around 20000 gas and water meters.

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