POLIS

Local Opportunities for Digital Parking

Parking Paper 2018

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1 Scope of this paper

A smart modern parking management system is essential for a sustainable urban mobility system. It shall enable transport planners to manage supply and demand without detrimental effects, air quality improvements and reduce carbon emissions whilst keeping equal access to the city functions.

The digitalisation of parking develops rapidly. New apps, sensors and algorithms allow more precise assessment of occupancy, improved routing to empty parking spaces and payment. Next to chances for traffic routing, the rapid development holds risks to drivers and to authorities building policy processes on digital processes. They wonder how long applications will survive, where to invest? The market is growing, but cannot be considered mature.

Polis members, local governments managing parking, see this digitalisation of parking in a wider context. For them, it is about r**eaching wider mobility and transport policy goals – embedded in a global spatial, economic and social vision for the city**. They understand parking is an emotional and sensitive topic for citizens and economic stakeholders. Thus, in this paper, the members of Polis explore digital parking management with the perspective of the user and the authorities.

Services to the user:

- What can digital parking deliver to the citizens apart of facilitating the payment?

Services to the local authority's services:

- How can digital parking management support the implementation and development of policies, measures and planning documents such as SUMPs?
- How can parking technology inform decision makers about mobility and urban planning?

Previous research of the joint European Parking Association (EPA)-Polis working group assessed the potential of digital parking as under-utilised: so far, the interaction between sensors, algorithms and apps remains focused on optimising the (cost-)efficiency of parking processes. Options to fundamentally change parking policy and services are seldomly explored. Reasons for this limited use of the potential of these technologies include a lack of knowledge on the side of the parking operator and/or city authority about digital parking options and implementation timeline, unclear data ownership or licenses, insufficient data sharing and management, technical challenges and procurement issues. On the other hand, some of the solutions offered through digitalisation of parking are (currently) not deployed because they don't meet cities' needs or seem infeasible (e.g. fully dynamic pricing, on-street reservation, etc.): don't fit local decision making processes or simpler and cheaper solutions lead to similar impact.

In this paper we analyse:

- Digital parking solutions implemented by Polis members
- The market of apps, sensors, clouds and algorithms: its stakeholders and the services they offer. Some of these services could cause disruption in local parking practices.
- Policy mechanisms that can govern the data sourcing and sharing for planning purposes. And mechanisms that allow the transport authority to influence the scope of parking solutions, particularly egarding unlocking large quantities of private parking and the privatisation of public parking.

The analysis provided input for the recommendations, which shall help enhanced parking management and allow authorities to control the parking developments in line with broader transport policy goals. In particular:

- Transport planning that is 1) data driven, 2) evidence-based and 3) based on clear policy definition;
- Pricing policies based on improved knowledge about parking behaviour and aligned to broader policy goals.
- Data policies and sharing agreements for real-time information of users (indirect through data processing but also directly displayed), and that feed back information to the authorities.

The recommendations in the final chapter were developed together with the members of the Polis working group on parking, highlighting the needs and objectives of local transport authorities in Europe.

2 What policy-makers expect

European cities are world leaders in parking management. Parking management is part of an integrated urban mobility policy. In their evaluation of European parking policy, Mingardo et al (2015) suggest to substitute the parking centred policy approach by a strategic transport policy approach: what we talk about when we talk about parking is mobility. For parking policy they see "four main objectives:

1. To contribute to a better accessibility and mobility of the urban area
2. To contribute to a better quality of life in the city [...]
3. To support the local economy
4. The raise municipal revenue" (Mingardo, van Wee and Rye, 2015, p. 271). (This revenue can either be used for general means or can be earmarked for transport funding)

While the industry might have different goals when developing parking applications, for transport authorities it is important that the digital transformation of parking supports these goals, and certainly doesn't circumvent them. Today, data is often considered at the core of policy-making for improving accessibility and the quality of life, as it helps developing evidence-based policies.

In 2016, the Polis working group released a largely quantitative survey (n=26) on the current and future application of parking data application on the operational, tactical and strategic level (Batool and Cré, 2016). They were defined as follows:

- **Operational level:**
  - Client-centred services such as search, compare, select and reserve parking spaces before and during the trip, routing, payment and loyalty schemes;
  - Services of the parking operator, such as maintenance, revenue optimization, financial management).
- **Tactical level**: Regulatory decisions that only relate to parking such as parking capacity, regulation of on- and off-street parking, choices of regulatory models i.e. parking fees or resident permits.
- **Strategic level**: Decisions that target the urban mobility system of which parking is a i.e. by a sustainable urban mobility plan or urban planning. Such decisions may influence parking provision, but can also be fed by data from parking.

Overall, the outcomes show that the expected and current uptake of data usage for operational application, tactical planning and strategic policy making was high, with slightly lower expectations and current uptake among the public stakeholders when comparing it to the service providers of parking solutions (see Figures 1 and 2).

The analysis suggests, that the link is strongest where people perceive to be their core business today: private stakeholders see a strong link of parking data with payment solutions, authorities engage particularly in enforcement. Both groups agree on the high usability of data for tactical purposes, such as parking capacity, regulation and service models. For strategic policy making, the current uptake is rather low, although private and public stakeholders have large expectations for the use of data in this field.

Polis members highlight the tension between using digital parking processes for value added services for drivers on the one hand, and for enforcement on the other hand. The use of digital data for enforcement can erode the uptake and acceptability of digital parking services.

Figure 1: Current and Expected Use of Parking Data (Local Authorities)

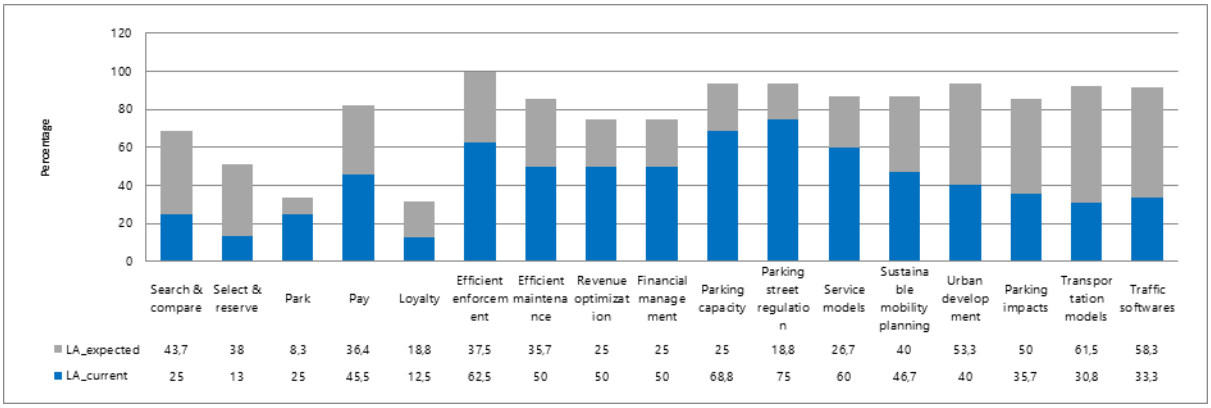
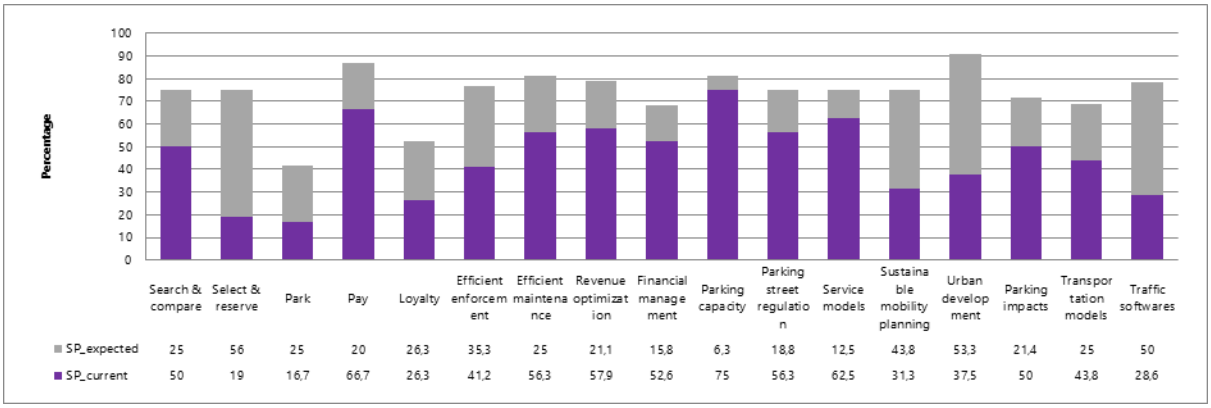


Figure 2: Current and Expected Use of Parking Data (Service Providers)



The survey found considerable evidence that both the public or the private stakeholders perceived the data usage as less important for user-centric services such as searching, reservation, parking assistance and loyalty programmes. Parking as a process and loyalty schemes scored particularly low, as reservation among the public stakeholders. Overall the survey found evidence, that parking data is regarded as a strategic and tactical tool, that could support planning and the implementation of a mobility strategy. The survey found sufficient evidence for the future use of parking data in the following fields:

- **Analysing mobility patterns**: Parking data might aide the comparison of transport modes and understand or even anticipate multimodality.
- Parking data can help to **determining prices and maximum stay** periods for parking spaces.
- Data would not directly influence the number of parking spaces, but create an base or **evidence for according polities** for spatial redistribution.

However, processing large quantities of data is still a novel field for many local authorities which only slowly invest in new planning systems that can incorporate it into the planning process. The market offering these applications for strategic use is only slowly emerging.

For future utilisation, governance of parking applications should nevertheless envisage this link, as it will become more relevant in the future. For the smart city, real-time processing of data will become more significant. In future, algorithms are likely to react to situations in real-time, i.e. deviating traffic to another route in case of disruption on the planning way.

Data about parking is essential, as it strongly impacts the behaviour at the destination, which has an accentuated potential to disrupt the traffic flow. Thus, local administrations will want to tap into the parking clouds understanding more about occupancy and origin and destination data.

3. Analysis: Digital Parking and its Impact

3.1 Developments in parking

Digital parking applications have been developed by public and private stakeholders, which largely complement each other, but focus on different functions. Private stakeholders, such as the car industry, app developers and data handling companies focus on services that help users to have a better parking experience directly through their product. Public stakeholders improve the user experience by taking a broader approach, such as streamlining the transport system and increasing the overall quality of life. Nevertheless, as the following analysis shows, the activities complement each other.

3.1.1 City and operator owned digital parking assets

Since the introduction of parking guidance and parking tickets, cities have been active in digital solutions for parking management. Initially, parking solutions were very much based on the aspect of revenue generation and guiding car drivers to the nearest free parking spot. Lately, the focus changed towards sourcing data for other purposes, such as planning and real-time traffic guidance. Increasingly they incorporate broader transport goals, such as cutting emissions or air pollution. Digital parking applications rolled-out by local authorities include a broad range of services and interfaces:

- **Digital parking rights repository:** most digital parking schemes are built on a digital repository (a server) that holds the parking rights allocated to vehicles (through number plates). These rights can be temporary (by means of payment), or permanent (residents parking, parking for people with disabilities). They are always location based (e.g. the right to park as a resident would be limited to your neighbourhood), but locations can differ in size (street, zonal, city wide). This **database is the reference for enforcement, and will function as the datahub for parking management**, ideally 'plug-and-play'-ready for other digital parking services.

- **Digital parking permits issuance:** one of the low threshold digital services that cities install is the digital residents parking permit with online application/payment. This replaces windscreen paper permits.
- **Smart metering:** Also the pay and display machines become smarter in an environment where licence plates are the basis for parking management. The machines require alfa-numerical input. Initially, parking meters and later parking ticket vending machines have been solely relying on pre-estimated parking time as terminator for price. Increasingly, they are **able to incorporate other factors, such as vehicle emission class, discounts or time of the day** of issuing a ticket. In the future, other determiners such parking space utilisation might be incorporated too. However, the idea of a pre-payed ticket for on-street parking limits the ability to pay minute based. Within the Polis membership, there is a trend to move away from pay and display machines. Some members will even phase out this approach.
- **Electronic (App/SMS) payment:** For various reasons, operators have been rolling out payment solutions based on smartphone apps or text messages. After an initial registration, they allow to incorporate the above mentioned factors, including pay-per-minute with a check-in/check-out function **without the need for expensive payment infrastructure or cash**. Transaction and communication costs remain a factor. This form of payment is a good example of historic/big data that is not or seldomly used to inform mobility policy (potentially providing information about unique visitors, staying time, zonal occupancy, overnight staying etc.)
- **Value added services**, such as providing charging facilities for electric vehicles with integrated billing are occurring, in on- as well as off-street applications.
- **Space detection:** next to the existing data on off-street parking garages, increasingly information on on-street parking spaces is detected by sensors and cameras that allow better routing, but also for an occupancy analysis. However, this requires **precise GIS maps of the existing parking spaces within a city**, including frequent updates (i.e. when in case of a temporary change of rules). Many Polis members are busy ensuring that all relevant stakeholders contribute to such maps, but mention ongoing challenges, that require additional work for the enforcement officers.
- **Parking guidance and information:** existing routing technology using signs is complemented by open data APIs that allow to feed data about availability into online maps and routing applications.
- **Enforcement tools:** Devices that guide parking enforcement officers, scan number plates and issue (paperless) fines/retribution tickets. Lately, number plate recognition by scan cars became implemented in many Polis member cities. While the technology is fairly mature, **regulatory issues complicate their effective introduction**, such as the need to double-check recognised parking offences in person or difficulties to access the national number plate registry for data protection reasons or national regulations for disabled people.

Publicly owned car parks in the UK are legally not allowed to administer and enforce their car parks by automatic number-plate recognition. Privately owned car parks can use the tool.

- **City Parking Dashboard:** Several market players offer dashboards that aggregate information generated by the above mentioned digital tools, collecting data from different sources, integrating and analysing it: occupancy, financial return, etc. are available at a glance. These solutions could be situated at the tactical level of management. Their strategic value remains to be determined.

3.1.2 Digital parking services of OEMs, data handlers and apps developers

The car industry is increasingly investing into smart parking services. In 2018, the BMW Group bought the US market leader Parkmobile and announced that they became leading international provider of digital parking solutions (BMW Group, 2018). Volkswagen advertises their parking payment services under slogan "park, click, done" (Volkswagen We, 2018). The car manufacturer's services have in common that they aim at helping the driver finding an empty parking spot and pay for their parking. They usually also remind drivers about possible restrictions such as a time limit or a parking permit. Daimler's services are even further reaching. The so-called Mercedes me service offers services that include

- **On-Street Prediction** – a navigation map indicating the probability of an available parking space on the street using both real-time and historical data
- **Off-Street Information** – the system aggregates real-time data from parking garage operators to show parking spaces available in garages.
- **Real-Time Information** – Sensors in vehicles recognise when a vehicle leaves a parking space and detect available spaces on the street when driving by. The data is aggregated in the cloud and the results distributed among users. (Singer, 2018)

The engineering company Bosch rolls out the sensors for driving by parking space detection to other vehicle manufacturers and currently runs pilots in 30 cities in Europe and North America for parking clouds (Bosch, 2018). In 2016, HERE Technologies, a digital maps provider owned by the German car industry announced their parking cloud employing sensor data from multiple car brands (Stevenson, 2016).

Start-ups, such as Cleverciti Systems and Parkhere operate **sensor networks** (camera or road based, some are even induction powered) that provide real-time data and associated control panels about occupancy detection. Appyparking offer statistic and spatial analysis of on-street parking availability.

Numerous apps enable parking payments and some offer routing capabilities to the next parking spot, some allow trading/exchanging on-street parking spots in real-time, registering freed parking spots in the cloud. Others aim at **unlocking additional capacity by enabling access to otherwise private off-street parking** (and facilitate the payment). Specialised

suppliers focus on parking with additional services, such charging infrastructure and payment solutions or parcel drop off.

Although the market cannot be considered mature, the industry reached a point at which the development direction became more predictable. In the coming years, **the market is likely to consolidate.** The car industry or rather their subsidies but also technology companies, such as Google, Uber or Apple and the providers of traffic analytics such as PTV or TRL Software will most likely try to secure their bit. From their perspective, a consolidation has scaling effects particularly for data mining cost. Similar to the MaaS world, the ability to integrate further services offers competitive advantages, as it enables even more comprehensive services to the customer. It will be interesting to observe the **integration with further services**, such as public transport, new mobility services but also providers of Mobility as a Service (MaaS) applications.

Also integration beyond mobility services could occur. The reported 'safe parking' information of Mercedes – giving scores to neighbourhoods in view of security and vehicle break-ins or theft – was a very visible case of how data can be merged for unexpected or even disruptive value added services.

It remains to be determined if these **developments will lead to a difference in pricing and behaviour**. Currently, new offers such as flat-rate pricing for parking of a vehicle are imaginable, but also reservation systems that guarantee a parking space within a particular area or rate.

3.2 Implications for parking policy

The digital transformation is likely to impact multiple dimensions of parking. It will ease the short-term provision of parking spots and possibly their utilisation, i.e. using AirBnB-style apps, where unused parking can be rented out on a regular or ad-hoc basis. Such applications might add **additional capacity to the market**, that is likely to be price sensitive and competitive. However, their market significance remains unclear at this stage.

New routing technology could improve the park search traffic. In 2011, an ITDP study estimated that as much as 50% of traffic congestion was caused by drivers cruising around in search of a cheaper parking space in Europe (Kodransky and Hermann, 2011). Transparency, reservation of a desired space and routing technology is likely to **reduce park cruising traffic significantly and increase utilisation of parking space**. However, driving might become even more appealing if the time consuming and stressful cruising can be avoided convincing more people to drive and thus, **add to the overall traffic volume**. Flat-rate or package offers will most likely lead to similar consequences, as they take some burden from parking by hiding the pay-what-you-use behind a monthly subscription. Whilst the advantages of new technology on congestion, air quality and driver satisfaction are clear, we need to be careful

that we do not make the process so easy that we see modal shift from walking, cycling and public transport.

Nevertheless, improved in vehicle occupancy detection, routing and digital payment offer a range of **chances for parking management**.

3.2.1 Operational level

- **Improved pricing** using digital parking interfaces that allow for pay-per-minute billing and flexible parking tariffs. They might adjust to vehicle (Euro) class, daytime and conditions in real-time, such as utilisation of parking, air quality or local traffic conditions. Digital parking interfaces allow for a better understanding of usage patterns of the parking space level but also on the user level, which could lead to insight for policy development. The extend to what extent such data will be available, is a question of negotiation when drafting agreements and terms with the providers of payment solutions, based on more general data protection regulations. However, the governments will need to design its planning models fit to utilise such data and set out interoperable specifications for standards of data exchange. The UK is looking at dynamic pricing which changes depending on utilisation and demand. This is not easy to comply with regulations regarding signage advising of tariffs etc and is more difficult on-street than off-street.
- **Real-time occupancy detection** is a key service for routing. The technology ranges from dedicated mounted sensors to occupancy detection by mobile sensors mounted to specialised vehicles, such as cars or drones and in-vehicle sensors that car manufacturers built into new cars and that send the data to the cloud. Assuming that all solutions will come up with satisfying results, the in-vehicle technology is likely to be utilised by car manufacturers for detection of on-street parking on busy streets, as it provides sufficiently accurate data and roll-out is fairly inexpensive. However, other solutions will be needed for on-street parking on less busy roads and off-street parking. Off-street parking is widely covered by existing technology based on counting the incoming and leaving vehicles, but streets in residential areas may require new solutions. For every solution, the sharing of harvested data will be critical for local administrations; as they want to utilise the data for their purposes, such as planning models, but also to feed real-time mechanisms, such as changes in pricing etc.
- **Dynamic, and segmented permission management** is strongly interlinked with payment and routing but could be applied independently by signage. It would allow to influence the parking capacity of defined groups in real-time and adapted to the local conditions, such as the mentioned air-quality or traffic conditions. It could also accommodate contingents for special events or residents according to needs. For example, residents parking could be opened for businesses in daytime and vice versa.
- **Fair and efficient enforcement** is partly based on devices that guide parking enforcement officers on a random routes but also increasingly automatic payment solutions that

decreases the chance of avoiding parking fees. At a more advanced stage, automatic detection by scan cars and robots might also come into play.

- **Optimised traffic management** through harvesting and interlinking data from different sources, such as parking data and traffic data, allow for a more precise analysis of origin and destination, but more importantly and opportunity to optimise traffic flow by routing drivers differently using matrix signs or routing applications. However, this depends on the systematic handling and sharing of data and appropriate APIs for the exchange of data before it is processed.

3.2.2 Tactical level

- **Statistic occupancy detection** determines the occupancy based on statistical data that can be sourced from any of the above-mentioned sources and by low-tech and low-cost solutions. With the advantage of no need for a fully-fledged sensor network, it might be a more appropriate solution for planning purposes in areas without high pressure. For many spatial and transport planning and policy purposes, an indication of utilisation is sufficient.
- **Revenue optimisation** is very important for the income, but also for efficient parking policies. Examples from the Netherlands show, that a carefully developed fee structure not only increase the revenues, but also improve parking pressure. A link between occupancy level detection and payment apps might allow for further analysis, including experimental fee changes and real-time adaption technology based on algorithms that may account also for parking pressure in the surrounding areas. Throughout enforcement might also aid the revenue of parking.
- **Market segmentation of parking offer:** Taking into account pluralistic attributes, enables to utilise parking space better. Data about the users allows for applying tactical measures, that in reverse can be tailored to the user group, such as allowing users to use municipal parking garages where necessary, or choosing to limit on-street parking to mobility impaired groups.

3.2.3 Strategic level

- **Data for planning** would allow evidence-based planning and could develop more precise measures causing less disruption and better results. At current stage, this is largely dependent on the data sharing agreements that authorities can reach with the respective data owners and harvesters and the ability of planning procedures to incorporate data such as visitors monitoring. Nevertheless, for planning purposes, such as planning of parking capacity, statistic data will be largely sufficient as also for the reallocation of road space and kerbside reuse, i.e. for deliveries, parklets (parking spaces that are temporary or permanently reversed for other functional use), or bike parking. Nevertheless, parking data

would have to be supplemented by other sources to avoid reviving the predict-and-provide paradigm, as parking is influenced by multiple factors.

- **Strategic policy** such as parking standards for buildings can be based on statistic data too, allowing for determining precise develop of a measure but also measuring the success of a policy. Historic data sets can also inform transport related policies such as connected and automated vehicles or air quality standards.

This overview shows that the industry will be able to establish a digital parking environment that is largely independent from local authorities, as data for services can be sourced independently.

Digital parking can be highly beneficial for parking management and policy. However, the sharing of data and the higher incentives to drive remain issues that might cause rebound effects. Policy-makers are well advised to think about policy packages that harvest the advantages and prevent a contradiction of (existing) strategic policy goals.

Digital payment provides are a viable entry for harvesting data about occupancy, as providers of payment solutions will need to provide such data for enforcement reasons. The challenge remains if more sophisticated data shall be collected, such as user centric information. This could be realised by data exchange agreements. Similar approaches apply to the occupancy data. To a large extent, the industry will be able to solve their issue without the help of local authorities, particularly in the most interesting, high-pressure zones. Yet, the service is likely to improve with greater coverage. Data exchange agreements might be an option if the municipality has something to offer in return that cannot be harvested from other sources.

On APIs, all stakeholders will need to work on common standards for their different use cases to ensure that data exchange will be seamless (esp. when applied real-time) and will be able to feed all envisaged applications. Future models and planning helpers, as well as the standard might need to adopt in the future specifications, and thus should be kept versatile.

On a broader policy level, the market consolidation of parking providers might add new influential players in the policy environment. These players are likely to represent the car driver's perspective when lobbying but moreover could develop the power to substantially influence parking policy on own initiatives, such as offering discounts, flat-rates and reservations based loyalty or payment (by the user or third parties). They might also want to influence the number of available parking spaces for their business practices. Consequences could go as far, as providers use the routing function to suggest alternative routes off the beaten track or might even suggest an alternative location (such as another shopping mall) if the parking situation is difficult. This might increase pressure by local businesses on administrations to provide additional parking and very welcoming conditions if not regulated sufficiently.

4.What to do?

Strategising for digital parking

Cities should develop a strategic approach to digital parking, such as avoiding to piecemeal ad-hoc steps. This strategic approach should adhere to the following principles:

1. Get the basic policies right: Digitalisation will not (entirely) solve or insufficent parking planning. The overall parking concept needs to make sense before it can be digitised.
2. Be ambitious and think out of the box: These basic policies can be more ambitious than in the analogue parking era: the digital parking process allows for a targeted, tailored and cost-effective management of space, designation of long-stay/short stay parks, pricing levels, number of permits etc.
3. Avoid to block future progress: Look ahead a decade of how you see digital parking evolve, what you want to achieve and how to get there in terms of new hardware, processes, regulations, service providers needed etc. An important new development is the transition towards management of the kerb space as a tool to manage mobility and new mobility services (for people and goods delivery) in cities.
4. Establish a timeline for digital parking implementation, based on expected market entry dates of new technologies. This timeline should identify quick wins, medium term measures (integration with smart cities measures etc.) and a long term perspective on acquiring new hardware, integrating data etc..

Creation of an effective and dynamic digital parking ecosystem

5. Open and standardised parking data: a first step is to enable all parking actors to communicate with each other, and to share and generate data that enables real time management as well as analysis on the basis of (big) historic data. The practice of open and standardised data can be required within the procurement and concessions procedures in place in the city.
6. Create win-wins within the open data environment: to ensure that data is returned, cities can establish licences that require return of additional information. This means a private or public parking actor can only access the data ecosystem if they also contribute with own data, or share (part) of the added value information generated through the use of this data.
7. Cities should ensure that also new players (start-ups) can enter public procurement processes. Requirements in terms of active years, consolidated accounts, proof of profitability etc. are hampering the market entry of newer companies.
8. Engage with parking apps developers: it is important that cities are in dialogue with these service providers – even with those who do not need local authorities. Cities can

establish a mechanism to identify, approach and involve these companies. A register/portal can be established and/or endorsements can be granted.

9. Exploit digital data to the fullest for internal management processes: Digital parking data will also improve the management and financial information. Planning a smart response to the information gathered this way is key. Up-front scenario development identifying measures that will be implemented when certain goals are met can help this process to be efficient.
10. Don't be nice to the bad guys: It is also clear that cities should act against apps suppliers that go against the law, local policies and/or regulations. Questionable practices such as the private trading of public space, or reselling of private parking spaces without adhering to local or general safety regulations cannot be tolerated.

Informed policies through digital parking

11. Informed smart cities policies: Digital parking data can inform mobility policies such as electrification of vehicles, multimodality, access regulations etc. Cities need to map how digital parking can better inform parking, mobility and urban planning policies, and what data they require from the parking sector, in real time, and as aggregated historic data.
12. Informed urban development activities: Make informed decisions about land use, building regulations and new parking infrastructure: the data generated by parking can be merged with other data sets to establish a detailed picture of the actual mobility needs and patterns for specific sites. This can inform decisions about parking standards in buildings, new construction of publicly accessible parking spots etc.
13. New frameworks = new indicators: Cities can also start building new indicators to better understand the parking situation, such as occupancy, peak occupancy, accumulative zonal occupancy, revenue, returning visitors, origin of visitors and others.

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About Polis

Polis is the leading European network of cities and regions focusing on urban transport innovation. We cooperate to develop sustainable urban mobility solutions for the city of today and tomorrow. Polis draws its expertise from a network of decision makers, technicians and managers working in authorities at local and regional level across the European Union. Building on results developed in European projects and in thematic working groups that touch upon key transport challenges, we link innovation and public policy orientations on urban and regional mobility with European policy development.

Polis has an active Parking Working Group, and a successful partnership with the European Parking Association. The networks co-organise an annual workshop on the topic, in addition to the Polis Parking Working Group meetings.

The Parking Working Group of Polis is managed by Ivo Cré (icre@polisnetwork.eu) and Michel Arnd (marnd@polisnetwork.eu)