Live Cities and Urban Services – A Multi-dimensional Stress Field between Technology, Innovation and Society

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***Abstract* – Contrary to projections, which stated that the wide-spread distribution of high-speed Internet connections would render geographical distance irrelevant, cities have recently become the centre of interest in academic research. However, especially real-time monitoring of urban processes is widely unexplored. We present the concept of a *Live City*, in which the city is regarded as an actuated near real-time control system creating a feedback loop between the citizens, environmental monitoring systems, the city management and ubiquitous information services. Basically, there are four main barriers towards the implementation of the *Live City*: methodological issues, technical/technological problems, privacy and legislative questions, and quantification of economic opportunities. In this paper, we discuss those challenges and point out potential future research pathways towards the realisation of a *Live City*.**

Keywords-live city, pervasive sensor networks, urban services, real-time information services.

I. Introduction

Projections stated that the wide-spread distribution of high-speed Internet connections will render geographical distance irrelevant [1], and that cities are not more than mere artefacts of the industrial age [2]. As a side effect, cities were presumed to drastically decrease in importance as physical and social connections, and would play an increasingly ancillary role in socio-technical research.

In reality, the world developed completely differently – cities are back in the focus of academic research. Cities in their multi-layered complexity in terms of social interactions, living space provision, infrastructure development and other crucial human factors of everyday life have re-gained importance in scientific research. This arises from the fact – amongst others – that major developments of scientific and technological innovation took place in the urban context [3],[4].

However in research on urban areas, particularly real-time monitoring of urban processes and digital services are still widely unexplored. These research fields have recently received a lot of attention due to the fast rise of inexpensive pervasive sensor technologies which made ubiquitous sensing feasible and enriches research on cities with uncharted up-to-date information layers through connecting the physical to the virtual world, as shown in Fig. 1.

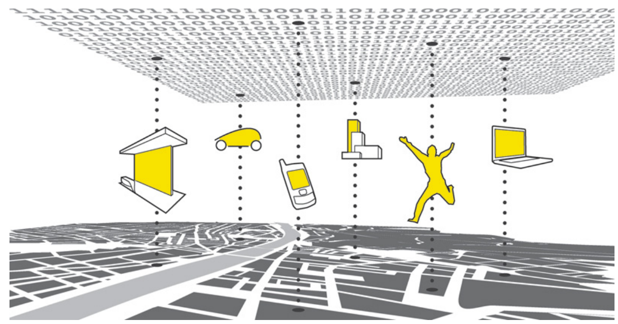

Figure 1. *Live City* – Connecting Physical and Virtual Worlds. [5]

One driver towards this vision is the diminishing digital divide on a global scale. While the digital divide within countries is still strongly affecting the degree of access to information and knowledge, the global digital divide is decreasing due to the fast rise of ICT markets in China, India, South-East Asia, South America and Africa. Mobile phone penetration (i.e. “mobile subscribers per 100 inhabitants”) has been at 76.2% of the world’s population in 2010. This rate is at 94.1% in the Americas and at 131.5% in CIS (Commonwealth of Independent States) [6]. The two fastest growing mobile phone markets China and India currently face a penetration rate of 64% and 70%.

This growth builds the basis for the installation of urban real-time services. In a recent report on Digital Urban Renewal [7], the author states that major demand-side drivers for digital urban projects are the increasing focus on sustainability and emissions reduction, continued pressure on the urban transport infrastructure, and increasing need for citizen services, amongst others. On the supply side, several drivers have been identified including the evolution of the Internet as an underlying framework for services, sensor networks, connectivity technologies, and augmented reality.

However, we are still facing a lack of experience in assessing urban dynamics in real time. One reason is that continuous monitoring is an enormous challenge, and this is particularly true in the urban context, which poses very specific challenges. These comprise technological questions, but also significant economical, societal and political ones, which are rapidly gaining importance.

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Generally speaking, we are experiencing fast progressing technology development, which is not only moving ahead quickly, but which is moving ahead of society. This development can be compared with a stream moving at high speed, on which we are paddling to remain on the same spot or at least not to drift off too fast. The question, which we have to tackle in this regard, is where our goal for the future lies: down-stream, somewhere near our current spot, or even up-stream?

In this paper, we try to illustrate possible pathways to answering this multi-dimensional question. We incorporate societal, technical, political, privacy and economic issues into our rationale. We are well aware of shortcomings in terms of completeness and technical thoroughness. The paper shall be considered a first leap towards a *Live City* 'Installation Guide'.

This paper is organised as follows: after this introduction we illustrate a few examples on existing approaches towards *Live Cites* in Section II before giving a disambiguation of the term 'live' in Section III. Section IV discusses challenges in current research on the *Live City* and Section V illustrates potential future research avenues, before Section VI summarises conclusions from the paper.

II. State-of-the-art – Live City in Action

One of the first implementations of a 'real-time city' has been done by the MIT SENSEable City Lab [5]. This research group has considerably coined the term '**real-time city**', particularly through visualising the city as a real-time and pulsating entity. In further research initiatives, the SENSEable City Lab investigated human mobility patterns, usage of pervasive sensors to assess urban dynamics, event-based anomaly detection in ICT networks, and correlations between ICT usage and socio-cultural developments.

A new and innovative idea for assessing urban dynamics in real time is the concept of **Living Labs**. According to [8], a Living Lab is a real-life experimentation environment where users and producers co-create innovations. Living Labs are promoted by the European Commission, which characterises them as Public-Private-People Partnerships (PPPP) for user-driven open innovation. A Living Lab is basically composed of four main components: co-creation (co-design by users and producers), exploration (discovering emerging usages, behaviours and market opportunities), experimentation (implementing live scenarios) and evaluation (assessment of concepts, products and services).

Also, much research is performed in the area of **smart cities** (in particular in South Korea also the term 'ubiquitous cities' is popular). For instance, IBM has implemented a number of urban services in the course of their 'Smarter Planet' programme [9]. Research is performed together with cities all over the world to implement applications in the areas of city management, citizen services, business opportunities, transport, water supply, communication and energy. The goal is to seize opportunities and build sustainable prosperity, by making cities 'smarter'.

A sensor-driven approach to ubiquitous urban monitoring is presented in [10] and in [11]. The authors present a measurement infrastructure for **pervasive monitoring** applications using ubiquitous embedded sensing technologies with a focus on urban applications. The system has been conceived in such a modular way that the base platform can be used within a variety of sensor web application fields such as environmental monitoring, biometric parameter surveillance, critical infrastructure protection or energy network observation. Several show cases have been implemented and validated in the areas of urban air quality monitoring, public health, radiation safety, and exposure modelling.

III. A Disambiguation of the Term 'Live'

The term '*Live City*' originates from the modification of the expression 'Real-time City' as definitions and usages of the latter are vague and vary on a quite broad scale.

Anthony Townsend presents a very mobile phone centric definition of a real-time city by stating that 'the cellular telephone […] will undoubtedly lead to fundamental transformations in individuals' perceptions of self and the world, and consequently the way they collectively construct that world' [12]. The author sees the real-time city as a potential platform for dedicated advertising and states that 'accessibility becomes more important than mobility'. This implies that it will be more critical to access urban services rather than moving around physically. This in turn means that the digital (mobile phone) infrastructure will be more important than the physical (transport) infrastructure.

A possible definition of *urban informatics* – a term closely related the real-time city – is 'the collection, classification, storage, retrieval, and dissemination of recorded knowledge of, relating to, characteristic of, or constituting a city' [13]. This definition gives a holistic, but rather general view on the term 'real-time city', which centres around information and knowledge while societal, political and privacy aspects remain greatly untouched.

In these interpretations of the expression 'real-time', its strict definition has been strongly mitigated. The term 'real-time' originated in the field of computer science, where it initially described a process, which is completed 'without any delay'. This broad view was then divided into hard and soft real-time demands. Soft real-time basically defines that deadlines are important, but the whole system will still function correctly if deadlines are occasionally missed. The latter is not true for hard real-time systems. Another term to express non-rigorous temporal requirements is 'near real-time', which describes a delay introduced into real-time applications, e.g. by automated data processing or data transmission [14]. Hence, the term accounts for the delay between the occurrence of an event and the subsequent use of the processed data.

As these definitions of the term 'real-time' have been set up for the domain of computer science it is important to evaluate and re-define the expression in the context of *Live Cities*. Naturally, strict real-time requirements are a central aspect in monitoring applications, whereby these demands are highly application-specific and can vary significantly. Therefore, they are not a fundamental goal in the field of *Live Cities*, as the term 'real-time' is primarily defined by an 'exact point in time', which is the same for all data sources

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to create a significant measurement outcome. Secondarily, the term defines the possibility to start a synchronous communication at a certain time, which might often be important for geographical monitoring applications, e.g. to enable the generation of an exact development graph for temporal pollutant dispersion over a defined period of time in precise intervals.

Additionally to the suggestion of assessibility of the environment in the 'now', the expression '*Live City*' also implies a feedback loop. The term 'city' does not only define the description of location-aware parameters, but also entails the exploration of causal patterns in these data. In the context of geo-sensor network and monitoring applications, this in turn means that the urban environment is not only analysed remotely by examining quasi-static data, but the procedure of sensing and processing live data offers the possibility of modifying the urban context in an ad-hoc fashion.

In conclusion, it can be stated that the strict term 'real-time' can be interpreted as 'at present' for urban monitoring applications. However, these topicality requirements can vary depending on the application context. For instance, an update on traffic conditions does not have to exceed a delay of a couple of minutes when this information is used for navigation instructions, whereas a 30 minute update interval can well be sufficient for short-term trip planning.

To account for this non-rigorous requirement, the term '*Live City*' seems better suited than 'Real-time City'. In this reflection, 'near real-time' appears to be closest to 'live', as it does not impose rigid deadlines and the expression itself suggests dynamic adaptation of a time period according to different usage contexts.

IV. Challenges in Current Research on the Live City

The urban context poses many challenges to pervasive monitoring and sensing systems. Particular issues arise for the deployment of near real-time information services in the city. These range from physical sensor mounting and other technical challenges to societal and privacy implications. Furthermore, the sensitive urban political landscape has to be accounted for, which might cause unforeseen challenges.

A. *Technological and Technical Issues*

The first essential technological challenge is the integration of different data sources owned by governmental institutions, public bodies, energy providers and private sensor network operators. This problem can potentially be tackled with self-contained and well-conceived data encapsulation standards – independent of specific applications – and enforced by legal entities, as discussed in sub-chapter V.B. However, the adaptation of existing sensors to new interoperability standards is costly for data owners and network operators in the short term, and so increased awareness of the benefits of open standards is required.

From a technical viewpoint, unresolved research questions for ubiquitous urban monitoring infrastructures are manifold. These challenges range from finding a uniform representation method for measurement values, optimising data routing algorithms in multi-hop networks, data fusion, and developing optimal data visualisation and presentation methods. The latter issue is an essential aspect in real-time decision support systems, as different user groups might need different views on the underlying information. For example, in case of emergency local authorities might want a socio-economic picture of the affected areas, while first-response forces are interested in topography and people's current locations, and the public might want general information about the predicted development of a disaster.

In addition, there are a number of well-known technical issues in the establishment of urban monitoring systems (energy supply, sensor mote size, robustness, connectivity, ad-hoc network connections, reliability, connectivity, self-healing mechanisms, etc.). These have to be addressed as the case arises depending on specific requirements of the end application. Thus, they are not part of the presented research.

B. *Various Stakeholders*

Other issues for the installation of a *Live City* are thematic challenges and socio-political concerns, which are rapidly gaining importance. The feedback loop depicted in Fig. 2 is a key factor in designing urban monitoring systems. In practice, various kinds of stakeholders have to be considered including citizens, information providers, research institutions, politicians, the city management, or other influential interest groups. This cycle involves all steps of the deployment process from planning, deployment, customised information provision, and feedback from the citizens and other interest groups. [15]

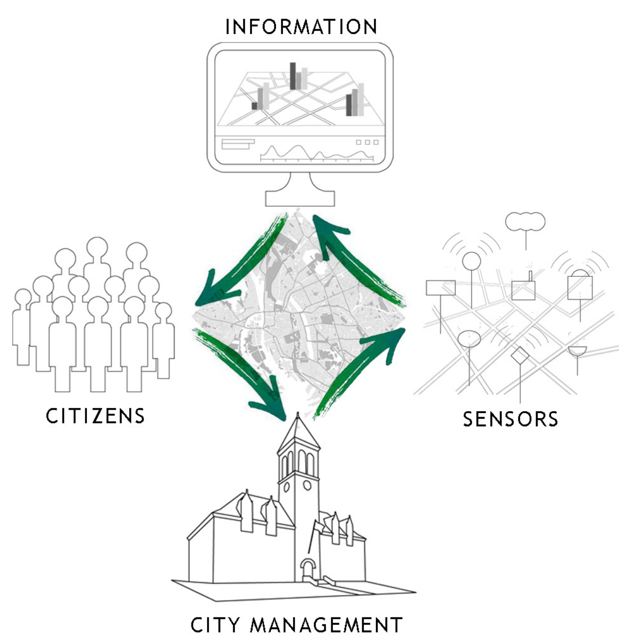

Figure 2. Feedback Loop Enabling the *Live City*.

Another important peculiarity of the urban context is that there are large variations within continuous physical phenomena over small spatial and temporal scales. For instance, due to topographical, physical or radiometric irregularities, pollutant concentration can differ considerably, even on opposite sides of the street. This variability tends to make individual point measurements less likely to be representative of the system as a whole. The consequence of this dilemma is an evolving argument for environmental regulations based on widespread monitoring data rather than mathematical modelling, and this demand is likely to grow.

C. *The Value of Sensing Collective Behaviour vs. Privacy Implications*

Although we experience quickly increasing awareness of the opportunities of digital mobile communication, the question arises how we can engage people to contribute actively being 'human data sources'. This is necessary in order to leverage collective information in areas such as environmental monitoring, emergency management, traffic monitoring, or e-tourism. One example, in which this kind of volunteered data was of invaluable importance, were the earthquake and the following tsunami in Japan in March 2011. In this case, the *Tweet-o-Meter* [16] application has been used to find anomalies in Twitter activity. Right after the earthquake, people started to post status reports, video streams, and conditions of destroyed areas, which could be interpreted in near real time as an indicator for an extraordinary event. Furthermore, information could be semantically extracted from personal comments and posts.

This development raises the challenge to find the balance between providing pervasive real-time information while still preserving people's privacy. Strategies to address this stress field are described in sub-section V.C. In addition, it seems self-evident that the provided information has to be highly accurate, reliable and unambiguous. Thus, quality control and error prevention mechanisms including appropriate external calibration will be discussed in sub-section V.A.

In terms of privacy, the claim might arise that we need to be aware of our personal and private data *before* we share them. The essential question in this context, however, is *how* we can raise awareness of ways to deal with that matter. Terms and conditions of digital services and technology are mostly hardly understandable to non tech-experts. Thus, more simple and binding ways of communicating this kind of information have to be found.

Finally, some more unpredictable challenges posed by the dynamic and volatile physical environment in the city are radical weather conditions, malfunctioning hardware, restricted connectivity, or even theft and vandalism. Moreover, there are a number of seemingly obvious but non-trivial challenges such as optimal positioning of sensors, high spatial and temporal variability of measured parameters or rapid changes in the urban structure, which might cause considerable bias in the measurements.

V. Discussion: Future Research Avenues

From the challenges described in Section IV we can derive a number of essential research questions, which have to be tackled in the area of *Live Cities*. These can be divided into methodological aspects, technical and technological issues, questions on privacy and legislation, and the assessment of economic opportunities.

A. *Methodological Research*

Over the last years prospects were made that 'data would be the new oil' [17],[18]. It has been stated that – like oil – data cannot be used without first being refined. This means that raw data is just the basic ingredient for the final product of **contextual information** that can be used to support strategic and operational decisions. Thus, a central issue in terms of providing real-time information services is the analysis of data according to algorithmic requirements, representation of information on different scales, context-supported data processing, and user-tailored information provision aligned with the needs of different user groups.

One way to reach this goal is to 'sense people' and their immediate surroundings using everyday devices such as mobile phones or digital cameras, as proposed by Goodchild [19]. These can replace – or at least complement – the extensive deployment of specialised city-wide sensor networks. The basic trade-off of this people-centric approach is between cost efficiency and real-time fidelity. The idea of using **existing devices to sense the city** is crucial, but it requires more research on sensing accuracy, data accessibility and privacy, location precision, and interoperability in terms of data and exchange formats.

In terms of geo-data sources, Volunteered Geographic Information (VGI) plays a key role in realising the idea of a *Live City*. We are already experiencing an overwhelming willingness of citizens to contribute their personal observations ranging from opinions posted on Facebook to Tweets about local events or commented photo uploads on Flickr. As mentioned in Section IV, this kind of **collective information** can potentially have a vital impact on operational real-time strategies in areas such as emergency management, dynamic traffic control or city management.

A central issue in VGI is the representativeness of volunteered information [19],[20]. We argue that defining or deriving consistent semantics in user-generated content possibly requires the combination of bottom-up and top-down approaches. In bottom-up approaches, user communities build their own semantic objects and connections between those by using their own personal taxonomies. In contrast, top-down approaches – mostly academically driven – try to define semantic rules and ontological connections in a generic way prior to and independently of the end application. Only the combination of those using Linked Data concepts (rather than rigid and inflexible ontology approaches) can lead to **domain-independent and comprehensive semantic models**, which are needed to cover the whole breadth of topics, users and applications in the *Live City*. In this regard, semantic search will be an essential concept to extract knowledge and information from user-generated data.

An aspect, which is strongly connected to availability of data sources, is **openness of data**. As argued by Jonathan Raper [21], quality of decision-support is increasing with the quality and the quantity of available data sources. We are currently facing a situation that in most cases, too little data are available to support well-informed decisions in near real time. This brings up the question how data owners such as

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companies in the environmental sector, energy providers or sensor network operators can be animated to open their data repositories for public use.

On the contrary, we might face a vast amount of data freely available in the near future, contributed by a variety of different data producers. This of course raises the concern of trustworthiness of these data. Thus, **automated quality assurance** mechanisms have to be developed for uncertainty estimation, dynamic error detection, correction and prevention. In this research area, we are currently seeing different approaches including Complex Event Processing (CEP) [10] for error detection, standardisation efforts for representing uncertainty in sensor data (e.g. Uncertainty Markup Language – UncertML) [22], or proprietary profiles to define validity ranges for particular observations. Only when these questions are solved, reliability and completeness of recommendations can be ensured.

Furthermore, measurements are only available in a quasi-continuous distribution due to the high **spatial and temporal variability** of ad-hoc data collection. Addressing this issue will require complex distribution models and efficient resource discovery mechanisms in order to ensure adaptability to rapidly changing conditions.

B. Technical and Technological Research

Apart from technical sensor network research on energy supply, miniaturisation, connectivity, etc., **standardisation and interoperability** are vital prerequisites for establishing pervasive and holistic monitoring systems. As current sensor networks are mostly built up in proprietary single-purpose systems, efforts to develop a uniform communication protocol will be needed [23]. One promising approach in this field is the Sensor Web Enablement (SWE) initiative [24] by the Open Geospatial Consortium (OGC). SWE aims to make sensors discoverable, accessible and controllable over the Internet. SWE currently consists of seven standards and interoperability reports, including the Sensor Observation Service (SOS) for observation data retrieval, Observations and Measurements (O&M) for sensor data encoding, Sensor Markup Language (SensorML) for platform description and the Sensor Alert Service (SAS) for event-based data transmission.

Furthermore, sensor fusion algorithms are a vital prerequisite to combine data stemming from different heterogeneous sensor networks. **Sensor fusion** basically stands for the harmonisation of data in terms of units of measure, time zones, measurement models and observation semantics. To be compliant with the requirements of a *'Live' City*, the fusion process has to happen in near real time. One approach for on-the-fly integration of measurements coming from different SOS instances using the free open-source server GeoServer (http://geoserver.org) is presented in [25]. The system harmonises measurements in real time and provides them on the fly via standardised OGC web service interfaces such as the Web Feature Service (WFS) and the Web Map Service (WMS). Although this implementation is still improvable in terms of fusion capabilities, it demonstrates a seminal approach towards sensor fusion.

The geo-analysis of real-time data sources can be implemented using the OGC Web Processing Service (WPS) in a standardised way. But the WPS architecture is very generic in its current version so that the developments of further specialised (domain-specific) application profiles are necessary as argued in [26] and [27]. The power of using WPS for implementing more complex analysis functionality for urban models has for instance been shown in [28].

Another technological issue is the availability of **ubiquitous communication media**. Today we are used to a functioning Internet to transmit information. However, in case of emergency, this layer is potentially not available, as we experienced for instance during hurricane Katrina in 2005 in New Orleans. Possible alternate solutions comprise long-range ad-hoc networks or a robust communication core network, which can withstand harsh external influences such as tsunamis, earthquakes, avalanches or even vandalism.

C. Privacy and Legislation Measures

A crucial question in the context of *Live Cities* is how we can **preserve people's privacy** dealing with ubiquitous information and partly personal data. One possible solution to address this issue is to make use of new 'collective sensing' approaches. This methodology tries not to exploit a single person's measurements and data, but analyses aggregated anonymised data coming from collective sources, such as Twitter, Flickr or the mobile phone network [29]. Like this, we can gain a coarse picture of the situation in our environment without involving personal details of single persons. In case of tracking applications or services, in which personal data are involved, people have to have an opt-in/opt-out possibility. This means that users can decide themselves whether they want to use the application – and also withdraw their consent – being aware of the type and amount of data that is collected and transmitted.

Another central issue in deploying monitoring systems in the city is the personal impact of fine-grained urban sensing, as terms like 'air quality' or 'pollutant dispersion' are only surrogates for a much wider and more **direct influence** on people, such as life expectation, respiratory diseases or quality of life. This raises the demand of finding the right level of information provision. This again can potentially entail a dramatic impact in a very wide range of areas like health care, the insurance sector, housing markets or urban planning and management.

A central question in this context is: can we actually achieve a system, in which transactions are not tracked or traced? Thinking about mobile phone calls, credit card payments or automated toll collection, each of the underlying systems has to have some kind of logging functionality in order to file payments and generate automated reports. In these cases it is probably just not possible prevent storage – at least for a short time. Thus, **legal frameworks** have to be developed on national and global levels. The dominant limiting factor in this regard is the varying interpretation of 'privacy' in different parts of the world. For instance, privacy can be traded like a good by its owner in the USA, whereas it is protected by law in the European Union. This means that supra-national legislation bodies and initiatives are called upon to set up appropriate world-wide regulations.

This also includes the critical question of **data ownership** – who owns the data: the data producers (i.e. the citizens or a mobile phone network operator), the institutions that host a system to collect data, or the data providers? Furthermore, if sensitive data is analysed to produce anonymised information layers, who is responsible if decisions that are based on this information are wrong due to lacking quality of the base data?

D. Assessing the Economic Value of Live Urban Services

Basically, the economic value of *Live City* services and applications can be either defined in **concrete revenues or as an after effect of improved quality of life**. The Economist Intelligence Unit's liveability ranking [30] assigns a score for over 30 qualitative and quantitative factors across five broad categories: stability, healthcare, culture and environment, education, and infrastructure. These five categories basically sum up 'what people want'.

The technologies that have been developed in the few last years, like pervasive sensors to assess urban dynamics and especially mobile technologies, offer new opportunities to 'tune' and 'fine-tune' urban processes. These processes can be transportation related, to monitor and direct traffic in real time, optimise parking spaces and navigate to available parking, or simply to help people with their daily tasks, finding jobs, finding housing, connecting people in spare time. Tools that bring the feedback loop directly to people make it easy to **promote events and give people instruments** to rate the attractiveness of these happenings.

Mobile technologies offer great **opportunities for young start-ups** to build GPS-enabled, crowd-sourced, location-based apps. Just one example is the Wikitude World Browser [31], which is tailored to individual needs. Igniting and funding a start-up scene can be the starting point for any government to build a connected *Live City*: start-ups create jobs and apps, which in turn – if tailored for locals – benefit people in the city and improve quality of life.

The improved economic **value of a 'tuned' city** can be enormous. On one hand there can be cost saving advantages, for instance in considerable fuel savings if available parking spaces are reserved on a first-come-first-served policy and the driver is routed to this parking space rather than having to circle looking for a parking space.

On the revenue side Google successfully leverages Internet advertisement by matching the search terms people enter in the Google search engine with ads. One key to generating revenue in the field of *Live Cities* may be to apply what Google did with the Internet to the real world, offering information and **search services** that focus on time, location, context and people rather than on simply search terms.

VI. CONCLUSION

Contrary to projections, which stated that the wide-spread distribution of high-speed Internet connections would render geographical distance irrelevant, cities have recently gained importance in academic research. Especially real-time monitoring of urban processes enriches research on cities with uncharted up-to-date information layers.

Hence, within this vision of a *Live City*, the city is not only regarded as a geographical area characterised by a dense accumulation of people or buildings, but more as a multi-layered construct containing multiple dimensions of social, technological and physical interconnections. Through this viewpoint of urban areas as an actuated **multi-dimensional conglomerate of dynamic processes**, the city itself can also be seen as a complex near real-time control system creating a feedback loop between the citizens, environmental monitoring systems, the city management and ubiquitous information services.

In the *Live City*, the everyday citizen is empowered to monitor the environment with sensor-enabled mobile devices. This feedback of 'sensed' or personally observed data, which is then analysed and provided to citizens as decision-supporting information, can change people's behaviour in how they use the city and perceive their environment by supporting their short-term decisions in near real time. This again requires promotion of the user sensitisation of information through awareness of limitations.

Basically, we identified four main barriers towards the implementation of the *Live City* concept: methodological issues, technical/technological problems, privacy and legislative questions, as well as quantification of economic opportunities. We discussed these challenges and future research avenues in Section IV and V.

We believe that promoting the *Live City* concept will trigger a profound rethinking process in collaboration and cooperation efforts between different authorities. Also, a people-centric view of measuring, sharing, and discussing urban environments might increase agencies' and decision makers' **understanding of a community's claims** leading to proactive democracy in urban decision-making processes.

In terms of privacy and personal data collection, it is evident that everybody has to have the right to decide what kind of personal data is collected by whom, and for which purposes these data are used. In this context, people have to have an **opt-out possibility** to withdraw their consent to personal data collection. One new paradigm to tackle the issue of privacy is 'collective sensing', which tries not to exploit single people's measurements and data, but analyses aggregated anonymised data coming from collective sources such as Twitter, Flickr or the mobile phone network.

As mentioned in the introductory section, we are experiencing a fast progressing technology development, which is already moving ahead of society. The deciding final question can be: If we compare this development with a **stream moving at high speed**, on which we are paddling to remain on the same spot or at least not to drift off too fast, where does our goal for the future lie: down-stream, somewhere near our current spot, or even up-stream? We argue that the issues of privacy, data ownership, accessibility, integrity and liability have to be tackled thoroughly all at once and not separately from each other. In the end, legislation bodies are called upon to set the legal stage for leveraging *Live City* technologies, exploit economic opportunities, but still preserve citizens' privacy.

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