Public Computational Media

preliminary notes on a new practice

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Abstract
This paper outlines the first steps of a new practice - Public Computational Media - that aims to contribute to the re-invigoration of the public realm with situated IT-enabled design interventions. Several case studies are presented describing organizational approaches and concepts, as well as practical solutions found and impossible challenges encountered during the experiments.

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Urban Informatics; The Public Realm; The Communication Realm; Public Computational Media; Numeracy; New Practices

ACM Classification Keywords
H.1.m Information Systems: Miscellaneous J.5 Arts and Humanities: Architecture. K.4.1 Computers and Society: Public Policy Issues

General Terms
Experimentation; Design

Introduction
Public Computational Media (PCM) is an attempt to formulate a new practice that considers how and when

information systems (IT systems) can be effectively designed and used to support and re-invigorate the public realm; the event-spaces of shared concerns and contested territories experienced in daily life in contemporary societies.

The public realm and the communication realm

The ancient Greeks had a clear understanding of the public realm that was neither a building nor a place, but something shared by all and highly competitive [2]. The public realm consists of the contested spaces in which the differences between people are held together by that which is common to all. The most important task of the public realm in action is the formulation of procedures by which we can disagree, debate and manage the differences that can never disappear. Today, however, the public realm has become a phantom [7], under life support by ever increasing public institution machinery.

The communication realm is the domain of information, communication and the technologies (IT) that operate together under agreed upon rules and regulations. The communication realm is, as the public realm, a contentious area where conflict and disagreements are negotiated. The current debates on the role of and limits on regulatory control of the IT systems (such as Voice-over-Internet) show how conflicting interests play out in the communication realm, but also how strong the pressures from are to free the communication realm from all public interest regulation [14], and how 'freedom of speech' is really only one part of the larger issue of defining public interests within the communication realm.

IT in the public realm – it is not personal

This is precisely why IT is so important in the context of the public realm. It constitutes a 'thing' even in the Latourian sense [9] that is common to almost all, and it enables, at least in principle, established and new forms of disagreement. The fact that IT has achieved a scale and penetration level that reaches across the globe is a secondary feature, but one which makes it feasible and practical to build with this new method of disagreeing.

Without a doubt, the communication realm and the IT systems enabling it are impacting the public realm in the 21st century. All relevant aspects of IT are increasingly operational in some form of shared territory: regulations, data storage in the server farms, but also energy generation and waste management. The personal computer no longer exists in any useful sense of the term. Only the preference settings on a given commodity computer platform are personal (and far from unique).

The unpublic public cloud

The oddly coined term 'cloud' (cloud computing) is the system that massively accelerates the end of personal computing and formalizes the global reach of the communication realm expressed in IT in powerful and practical ways.

The concept and infrastructure behind the term cloud is useful in this context as it includes not only the Internet but the plumbing and control that enables and supports it, and also the everyday procedures that allow the Internet to 'happen' on a global scale. Furthermore, every part of the cloud is shared and essentially, even in Arendt's sense, a new and vibrant example of the 'Faktum der Pluralitaet' (the fact of plurality) [2].

However, the cloud is not being used to develop the potentials of this fact of plurality in a way that really serves the public realm. This is not surprising as the public realm has been under pressure from many sides for a long time, and the cloud is the new staging ground for countless players seeking gold in global IT.

The cloud as we know it is defined by a business model of services: infrastructure as service (IaaS), platform as service (PaaS), software as service (SaaS) and computing as a commodity [12, 19] with the significant ability to scale almost infinitely. It is not surprising therefore that the cloud industry has coined the term '*aaS': *everything as service* [13].

Despite the promising name, even the crop of cloud services coined 'public cloud' are not geared towards public interests [11, 13]. What goes by the name of public cloud are private clouds with dynamic and easy access: Interoperability features to manage data flows outside of a company's internal firewalled security. In other words, a gated playground with parental supervision. Unfortunately, the public clouds have nothing to do with a public realm institution outside of private interests. All forms of the current cloud model continue the commercialization of information processing previously situated in the business of the personal computer loaded with personal software packages. The success story and popularity of social networks is not a contradiction to this trend. Social networking is social, not public. It is geared to the needs of individuals to share mostly personal events and stories; the cloud version of the personal computer. The success story of information as service comes at a time when computing - finally- has become a cultural force, but one that comes of age while contained by narrowly defined interests.

The cloud is a perfect example of the how the seductive conveniences of the software service industry make what is now important (data and software) disappear not only into Weiser's background [20] but into an unknown mesh of flows that become most noticeable when dysfunctional. Indeed, the cloud *is* public, but in a completely unintended way. The cloud 'distributes' the consequences of incidents small and large, even up to destruction amongst its members in an all-encompassing way. In network snafus we are united as we are in volcano eruptions. The blackouts that used to 'only' disrupt electric power now disrupt electronic information. Even less spectacular and minor disturbances become shared problems as recent events with a major public cloud provider convincingly showed [5].

The cloud is the 21st century gold standard of connectivity, global reach, and immediacy. It is a new and powerful meeting ground of private, national and commercial interests to which the public realm is unprepared to respond to. At the same time, it has become clear that the cloud (and computing in general) enables and produces new forms of cultural conditions that might be suited to address some of the problems the public realm has been facing for a long time. These conditions are of interest to PCM.

Qualculation for the public realm

The cloud did not appear overnight. The rise of IT, set in motion by the last world war, changed most every aspect of industrial and daily life, so deeply that Thrift (after Collon and Law) [18] coined the term 'qualculation' to describe the often invisible second-order landscape of IT today, the persistent and pervasive conditioning of everyday life through computational procedures, including the actions in and around standard 'computers', but more importantly, those integrated into traffic control, money transactions, medicinal procedures, speech processors, risk management, identification systems, pollution monitoring, opinion polling; in short, the realm of automation systems that make life 'easy' to manage.

In Thrift's narrative, qualculation is something we are thrown into, something people are involuntarily subject to and have no agency over. Imagine the opposite: Qualculation as a design challenge. More to the point, imagine qualculation design as a way to selectively bend IT systems in order to re-invigorate the public realm; as a way to understand the communication realm as a new public realm.

There is no lack of critique of the global reach of information systems and no lack of critique of globalization in general. Calls for 'a different kind of globalization' have been voiced in many domains in different ways, including initiatives such as 'grass roots globalization'. More specifically, and of interest to the PCM agenda, Agrawal [1] developed the useful concept of *environmentality* to denote the conflux of antagonistic interests and forces within the area of environmental engagement: the social, cultural, and political shaping of our collective consciousness of people as environmental actors in a 21st century global arena. Closer to the focus of this text, Dourish [6] discusses, within the domain of Human Computer Interaction, the potential of the IT's ever increasing scale and reach to organize and coach global responses to shared environmental concerns.

Towards an outline of public computational media

The following discussion is based on several experimental systems, some of which were developed as art works that respond to the observations above in situated ways. The discussion does not offer direct solutions to the general problem, but rather tries to show how the PCM agenda generated specific responses and approaches to positioning IT systems, and how in turn these solutions inform the development of a theory of PCM. The experiments I describe only poke small, almost randomly placed holes into this seemingly intractable problem and they include three general themes:

One, the explicit inclusion of people in the making and managing of data artifacts. Questions concerning the 'wisdom of the crowd' have been discussed repeatedly [10] and remain polemic, but it seems clear that the voice of the crowd, wise or not, must be included in areas of shared concerns.

Two, the relationship between information and things. The Internet of Things community is heavily invested in this topic [16], but does not address it adequately as far as PCM needs are concerned.

Three, the embedding of IT into the dynamics of people in action, into specific and culturally situated events that allow people to better decide on how to manage conflicts and differences.

In general, PCM seeks to harness the potentials of scale offered by global IT and manifest in the cloud. PCM seeks to understand how the opportunities for action created by the efficiencies of the cloud can at once be localized for specific situated needs and at the same time be generic enough to contribute to needs beyond local and national boundaries.

The following projects and experiments deal (all in different ways) with these challenges. They share a single focus in addressing the commons and water resources in particular.

Case study #1 - Glass Bottom Float (GBF)

GBF (www.glassbottomfloat.org) is an experiment in IT-enabled water monitoring developed to evaluate the quality of recreational waters from a new perspective. The project is based on a monitoring philosophy outside of the standard risk-centric approach that defines water resources only with regards to the potential danger to human life.

The justification for the GBF approach is the observation that risk alone is not 'robust' enough to encourage a population to care about the environment. There can be no doubt that from the current state of affairs and a practical perspective, the concern for clean water and risk aversion is of paramount importance in industrial and post-industrial landscapes alike. However, while health and risk of illness are potent forces, they do not address religious or cultural constraints with possibly conflicting priorities. In India, for example, countless worshipers bathe in the holy river Ganga despite the fact that it is known to be highly contaminated [8, 17]. In Indonesia, drinking water from local waterwells routinely exceeds coliform contamination levels set by government guidelines, and users and officials all know this[1]. Effective environmental control is not just a matter of employing the best available technology. Even the most advanced environmental monitoring technology cannot be effective when incompatible with a cultural position or conflicting priorities.

GBF is a post-industrial experimental response to this class of problem, situated in a recreational setting of a hedonistic society. GBF is a beach water monitoring system consisting of a series of chemical and physical water quality sensors, combined with subjective data crowdsourced from beach visitors. The crowd=sourced data originates from short interviews held at a beach in western New York, and formalizes an inquiry into how people in body and mind (as biological sensors and as subjective arbitrators) perceive and experience the water they swim in. In this context of importance is the procedure of combining crowd-sourced data with sensor data such that 'something new' emerges in the mix, and this something new is of potential interest to computing in the public realm where people and data mix.

GBF introduced the 'Human Computer Resource Percept' (HCRP) to formalize this new mix. The HCRP divides sensory space into human (HRP) and sensor - computer (CRP) percepts. The basic formulation of the HCRP is as follows:

$$HCRP = HRP * \Pi(CRP(i))$$

[1] Private conversation with faculty at the *Universitas Islam*, Yogyakarta, Indonesia, November 2012.

The implementation details are application specific, but the idea is to position the significance of the sensor data such that it acts only as a control, a tuning operator when the human side (HRP) input is inadequate or incomplete. The idea is to prioritize the 'preferences of the people' but to offer a corrective measure when better knowledge from another source is possible. It is an attempt to marry the conflicting potentials of intuitive knowledge with knowledge from synthetic systems that can exceed human perceptual limitations.

The GBF system implements a version of the HCRP tailored to the experience of swimming [3] and shares the new metric with everyone via web and mobile media, making important information available to the public at all times[2]. Moreover, the HCRP concept can be applied to any system that is 'measurable' by sensors as well as by human experience. As such, the HCRP and its distribution path are a practical contribution to the PCM needs for new approaches to the mingling of people and data artifacts.

Case study #2 – WaterBar

WaterBar (www.realtechsupport.org/waterbar) responds to the ease with which one can know about events occurring around the networked world and the challenge of giving these events agency. WaterBar is an installation that delivers to PCM ideas on how to combine information on events pertinent to global water conditions with the experience of water quality made available by a public water fountain.

[2] The server hosting the data and the data analysis algorithms was managed by a public university with no stake in curtailing the flow of information.

WaterBar is a miniature water processing plant. It processes water first by passing it first through an anthracite filter followed by a remineralization stage through a filter bank with select chemical properties. Water in contact with these filters receives measurable trace amounts of magnesium, iron, calcium and other elements. But the filters also share, through origin and history, a connection to place. Water travels the world in endless cycles of evaporation and rainfall. A drop of water in Africa today may be a drop of water in Europe in the future. WaterBar accelerates the global flow of waters through many regions of the planet, and produces a drinkable water mix in the process.

WaterBar includes quartz-rich granite from Inada by Fukushima, home of the latest devastating high-tech catastrophe; sandstone from La Verna, Italy, where St. Francis cared for the poor; marble from Thassos, Greece, source of art and architecture and the beginning and possible end of democracy; limestone from Jerusalem/Hebron, Israel, a place of eternal conflict and shared hopes; and basalt from Mount Merapi, Indonesia, an unpredictable, active volcano.

The way the waters flow in WaterBar is based on information in the form of news flowing through the internet. A web crawler searches RSS feeds for texts relevant to water issues. Results from the search are parsed and sent to an algorithm that associates the news results with the filter media through a bag-of-words association scheme. For example, results in the category 'overconfidence in technology' are associated with the Inada granite originating close to Fukushima, site of a recent major high tech catastrophe. Results relevant to the topic category of 'disputes on shared water resources' are associated with the limestone filter originating from Hebron, and results related to the topic of 'overwhelming natural destruction beyond the scope of human action' are relegated to the basalt filter of Mount Merapi. This frequency mapping is then translated to a water mix ratio by translating the normalized frequency of occurrences to volume elements of the current mix of the day. This mix is then created by a control system operating a series of electronic valves. It is offered for public consumption as an antidote to the daily bad news on water, and available only as long as limited supplies last.

One PCM-related issue WaterBar faced was that of mediating between the time regimes of information, things and events. What is real time news data? How often are updates to any given story on environmental issues of importance? Which set of fluctuating events should such a system respond to? Mixing information and things requires various design considerations. Data updates occur globally on a continuous basis and news feeds are updated continuously, heightened by the media industry's self-interests and media consumers' news addictions alike. But the physical world has its own clock. Water that flows into the filter banks requires three to 12 hours to absorb the ions and cations available through contact with the filter media.

WaterBar takes a pragmatic approach to these conflicting time regimes. It collects the news 'early in the morning' (where morning refers to the morning of its current location) and uses the results from this one news fishing expedition to build the basis for the mix of the day formula. Only when the current supply of water in WaterBar is depleted (and more water is available in the filter banks) does the news aggregator again search for news feeds and defines a new mix ratio[3].

The mapping described here is without a doubt imprecise, but equally so across all the filters. The point is not to seek a precise and impossible to achieve representation (in a sea of change) but rather a 'presence' in the realm of news feeds, in a similar way as a fisher boat returning with a catch of the day that was actually found in the in the ocean without claiming that the catch represents all the fish in the ocean.

Case study #3 - AirKami

AirKami (Bahasia Indonesia for 'our water') is a water well monitoring system under design in city of Yogyakarta, Indonesia. AirKami is an experiment in combining IT-enabled waterwell monitoring together with long-established practices of responding to compromised drinking water situations. The goal is to use 'just enough' IT to prevent people who have to use periodically contaminated water wells from getting ill while keeping in place the existing social structure established to mitigate water problems in general.

Indonesia is experiencing rapid growth but insufficient infrastructure development. Cities are developing where small villages once stood. Many inhabitants still rely on water wells for their drinking water needs, while the quality of the water in the wells is being compromised by waste water seepage from an ever-growing and often inadequately designed number of waste water tanks. AirKami is a water monitoring and

[3] News feeds do not usually change substantially on a given day, especially if one searches the feeds topically and disregards details.

water sharing system that will allow inhabitants of a village to know about the drinkability of water in the water wells before they use the water, offer advice on what to do if a well is contaminated and suggest nearby alternate wells in exchange for offering one's own well when needed.

AirKami combines state of the art, field deployable coliform detection technology with SMS messaging to get the urgent data to well users before daily water usage occurs. The server hosting the data is located in a building of a public university. Furthermore, AirKami adds to the water contamination notification system a *house of public data*, collocated within a local health clinic, as an access point for all the water well data, allowing inhabitants to discuss water health monitoring while seeking other forms of health advice. This has added urgency in the Indonesian context as even 'clean' water wells tend to contain contamination levels above WHO suggested and government mandated levels. Inhabitants will have the opportunity, together with health care professionals, to set by group consensus acceptable levels of contamination and to choose and monitor the results of their own risk choices.

For the PCM agenda, the positioning of the IT framework into an existing pre-IT resource sharing network is important. PCM does not preference computing over other modes of action. Rather, PCM seeks to find suitable ways of situating IT in order to enable a qualitative turn to improve a specific aspect of the public realm. In this case, PCM stresses the benefits of designing the agency of IT for shared public resources without removing the already existing community-public response system.

Case study #4 - Biosensing in Everyday Life

For PCM, IT is part of a larger equation. This last discussion illustrates PCM's interest in how future IT-enabled public heath monitoring might generate massive problems for particular subsets of the public realm when focusing only on efficient operation.

A recent research project on "Biosensing in Everyday Life" (www.sirebi.org) sought to find out how young designers and artists might imagine a future in which biosensors (sensors that can sense the presence of biological elements as easily as current sensors detect light, sound and movement) become ubiquitous. One design imagined a future scenario in which public transportation systems would be equipped with biosensors capable of detecting the presence of active influenza viruses [15] and send the information to service personnel and public health agencies.

Just imagine how this scenario could unfold. A person with a nasty cold might be 'removed' from a bus for danger of infecting other passengers. Important in the context of PCM is the fact that this speculative IT-enabled biosensing system might radically alter how public (transportation) space is experienced. There is an unarticulated contract that manages the co-presence of people in public spaces. Today, no one knows who is sick when they enter a public space, and the risk of illness is a price paid for the presence of others. Knowledge of illness in public spaces disrupts this long established social contract. While disruption is in principle not problematic, the fact that the disrupting influence offers no new contract to organize the situation is a huge problem, and could change the way shared transportation resources are lived with.

PCM seeks to understand these dependencies and respond to the new conditions that disruptive forces of IT-like systems can bring to the public realm. Consequently, PCM is willingly dependent on expertise from many areas, including public health care, environment studies, sociology, and political philosophy. PCM seeks expertise and inspiration from these knowledge bases as it attempts to position and integrate IT-enabled systems into a situated context.

Towards a global public realm

Without a doubt these examples cannot do justice to the challenges PCM addresses. Furthermore, they hardly deal with the depth of the challenges to the public realm at large and operate in more easily identifiable areas of resource management.

If nothing else, this discussion could be one possible departure point for future systems of competitive disagreements for a 21st century global public realm. This is the raison d'être of IT for the public realm: The potential to expand the idea of the public realm from local and national levels to global proportions.

References

[1] Agrawal, A. (2005). Environmentality. Community, Intimate Government, and the Making of Environmental Subjects in Kumaon, India. Current Anthropology Volume 46, Number 2.

[2] Arendt, H. (1958). The Human Condition / Vita Activa Oder Vom Taetigen Leben. University of Chicago Press.

[3] Böhlen, M.; Clark, B.; Dalton, J.; Yang, L.; Blersch, D.; Atkinson, J. (2013). Another Day at the Beach (under review).

[4] Böhlen, M.; Maharika, I.; Sargent, P.; Zaianty, S.; Lee, N.; Delgado, A.; Niagolova, N.; Vogelsteller, F.; (2012). Prototyping Ubiquitous Biosensing Applications through Speculative Design, Intelligent Environments (IE), 2012 8th International Conference on , pp.198-205.

[5] Darrow, B. (2012). Amazon problems take down Reddit, other sites. Gigaom, Oct 22 2012. http://gigaom.com/cloud/amazon-problems-take-down-reddit-other-sites/

[6] Dourish, P. (2010). HCI and environmental sustainability: the politics of design and the design of politics. In Proceedings of the 8th ACM Conference on Designing Interactive Systems (DIS '10). ACM, New York, NY, USA, 1-10.

[7] Frei, H.; Böhlen, M. (2010). MicroPublicPlaces. The Architectural League of New York. http://www.situatedtechnologies.net/?q=node/104

[8] Joshi, S. (2012). Plan to save the Ganga going down the drain. The Hindu. August 15, 2012. http://www.thehindu.com/news/national/article3772571.ece, Accessed Dec 31, 2012

[9] Latour, B. (2005). From Realpolitik to Dingpolitik: An Introduction." Making Things Public: Atmospheres of Democracy. Ed. B. Latour and P. Weibel. Exh.cat. ZKM, Karlsruhe. Cambridge, Mass.: MIT Press. http://www.bruno-latour.fr/articles/article/96-MTP-DING.pdf

[10] Malone, T.; Laubacher R.; Dellarocas, C. (2010). The Collective Intelligence Genome, MIT Sloan Management Review.

[11] Public Cloud Service. Definitions VMware and Ubuntu; http://www.vmware.com/files/pdf/VMware-Public-Cloud-Service-Definition.pdf; http://www.ubuntu.com/cloud/public-cloud

[12] Sheng, Z.; Ma, Z.; Gu, L.; Li, A. (2011). A privacy-protecting file system on public cloud storage. In Proceedings of the 2011 International Conference on Cloud and Service Computing (CSC '11).

[13] Schubert, L.; Jeffrey, K.; Neidecker, B. (eds). (2010). The Future of Cloud Computing. Opportunities for European Cloud Computing Beyond 2010. Expert Group Report. European Commission. Information Society and Media. Public Version 1.0. http://cordis.europa.eu/fp7/ict/ssai/docs/cloud-report-final.pdf

[14] Singh, P. (2012). Hyping one threat to hide another. The Hindu. November 28th, 2012. http://www.thehindu.com/opinion/lead/hyping-one-threat-to-hide-another/article4140922.ece. Accessed Jan 2. 2013.

[15] Situated Relational Biosensing. A public health observation system. http://www.sirebi.org/?page_id=759

[16] The Internet of Things Council http://www.theinternetofthings.eu/

[17] The Times India. Ganga water contamination exceeds permissible limit. Aug 14, 2012, 04.21PM IST. http://articles.timesofindia.indiatimes.com/2012-08-14/pollution/33200261_1_industrial-effluent-oxygen-demand-ganga, Accessed Dec 31, 2012.

[18] Thrift, N. (2007) Non-Representational Theory. London: Routledge.

[19] Walker, G. (2010). Cloud Computing Fundamentals. IBM Developer Networks. http://www.ibm.com/developerworks/cloud/library/cl-cloudintro/index.html

[20] Weiser, M. (1991). The computer for the 21st century. Scientific American Special Issue on Communications, Computers, and Networks.