

Going Anywhere, Being Everywhere: metaphors of mobility for ubiquitous computing

Position paper for Concepts and Models for Ubiquitous Computing Workshop, UbiComp 2002

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Abstract

If ubiquitous computing seeks to go anywhere and be everywhere, the challenge is to adequately design for context-awareness, where context is defined as fluid and unpredictable, and people, objects and meanings are all mobile. Various efforts in ubiquitous computing have sought to bring computers to "our world" (effectively domesticating *them*), rather than us having to adapt to the "computer world" (and domesticating *us*). But such simple dichotomies incorrectly assume there are easy distinctions to be made between the virtual and the actual, or human and machine. Metaphors of mobility from social theory and art draw attention to the mobile and stable elements inherent in the design and use of ubiquitous computing. I argue that a greater articulation of these elements is critical to understanding the foundations of, and future possibilities for, ubiquitous computing.

Context-awareness and the limits of network space

Moran and Dourish (2001:3) identify context as particularly important when we are designing computers to be dispersed and enmeshed in our lives, and context "refers to the physical and social situation in which computational devices are embedded." But how do we actually define context, and in particular, define it in ways that computers can use? The authors state that "this is more than simply a question of gathering more and more contextual information about complex situations. More information is not necessarily more helpful. Further, gathering information about our activities intrudes on our privacy."

Similarly, but without such explicit social concerns, Dey (2001:2) defines context as "any information that can be used to characterize the situation of an entity. An entity is a person, place or object that is considered relevant to the interaction between a user and an application, including the user and applications themselves."

This inevitably leads discussion to the breaking down of context into relevant and irrelevant information. First, it is assumed that there is something *out there* called context, or more precisely, many different (bounded) contexts, that can be revealed and abstracted for use in computational algorithms. Second, it is assumed that context is stable enough for us to discern computational, if not spatial/temporal/social, relevance and irrelevance. Even when Dey goes on to define relevancy as dependent on the user's task, it is still implied that computers and users and tasks are separate, if inextricably connected. In other words, even if context is understood to comprise specific locations, identities, activities and times, it is still implied that those factors themselves are homogeneous, and relatively stable, conditions or situations. Epistemologically, it is unity, purity and order that remain at the heart of this system.

Looking more closely at the core notion of context as information, Dervin (1999:37) outlines how we have understood the concept of information over time:

1. Information describes an ordered reality.
2. Information describes an ordered reality but can be "found" only by those with the proper observing skills and technologies.

3. Information describes an ordered reality that varies across time and space.
4. Information describes an ordered reality that varies from culture to culture.
5. Information describes an ordered reality that varies from person to person.
6. Information is an instrument of power imposed in discourse on those without power.
7. Information imposes order on a chaotic reality.
8. Information is a tool designed by human beings to make sense of a reality assumed to be both chaotic and orderly.

Definitions 2-7 are variations on definition 1: all rely on notions of a fixed and orderly reality against chaos. Definition 8, on the other hand, allows for the experience of a world simultaneously ordered and chaotic. While Dervin may partially rely on notions of unity, she moves us away from notions of order and denies notions of purity by creating a *hybrid* definition of information.

A related approach to context-aware computing taken by Tsibidis et al (2000:2) claims an interest in “representing this information first as a part of a network where all entities are considered to be nodes and... [where] the exchange of information is denoted by links between nodes. The links can be assumed to represent relationships between the entities... One of the assumptions considered is that there exists a constant dynamic rather than a static relationship between the entities of the network which leads to the emergence of context.”

Of interest here is the notion of context as emergent, as comprising dynamic links between nodes. In this model, there is only the network and the connections between nodes. Yet, with the network, there is still a tendency towards creating unity by bringing order to disorder.

In network space, whatever it is that moves between points or nodes must hold its shape in order to be successfully received at its destination. Rather than attending to (stable) “somethings” that move *within* (stable) networks, fluidity and flows describe something *outside* the network. In this scenario, people, objects and ideas move precisely because they *change shape* (Law and Mol 2000:4). Of particular interest to ubiquitous computing is the notion that

associations or forms of attachment shift and move, but they do so in a way that also allows the performance of continuity... There is a sameness, a shape constancy, which does not depend on any particular defining feature or relationship, but rather on the existence of many instances which overlap with one another partially... Fluid spatiality suggests that various configurations, rather than representing breakdown and failure, may also help to strengthen objects... Topologically... a shape achieves constancy in a relation between presence and absence: *the constancy of object presence depends on simultaneous absence or alterity* (Law and Mol 2000:5-6).

In other words, we can envision computational expressions as descriptions of the complex associations between what is *present* and what is *absent*. Context, then, comprises oscillations or movements between simultaneous presences and absences of people, objects and ideas. The terms of computational expressions, which represent materials and situations, thus describe a (contingent) stability that is maintained through presence and absence. This suggests we do not have to choose *either* relevant (present) or irrelevant (absent) information; instead we can define context as a performance dependent on the reciprocal constitution of both.

The mutual constitution of people, objects and ideas is not simple – and so it remains unclear where we may locate accountability. These assemblages are produced, reproduced and transformed *across* particular occasions and sites of use, and they do not necessarily constitute each other in symmetrical ways. In an attempt to account for asymmetry, Suchman (2000a:7-8) argues for a means to “tie humans and nonhumans together without erasing the culturally and historically constituted differences among them... This requires remembering that boundaries... are not naturally given but constructed, in particular historical ways and with particular historical consequences... Agency – and associated accountabilities – reside neither in us nor in our artefacts, but in our intra-actions.”

According to Suchman (2000b:2) the basic change in design terms involves moving away from the design of “discrete devices, or even networks of devices, to a view of systems development

as entry into the networks of working relations – including both contests and alliances – that make technical systems possible.”

Central to this endeavour is an acknowledgement that boundary-crossing involves encountering and negotiating difference, unexpectedness, unpredictability and ambiguity. But at the same time, this uncertainty does not absolve us of our responsibility to seek socially worthy or virtuous outcomes. For Suchman (2000b:10) part of our responsibility therefore lies in “establishing new bases for technology integration, not in universal languages, but in partial translations... [and in] valuing heterogeneity in technical systems, achieved through practices of artful integration, over homogeneity and domination.”

Mobility and the social

In recent decades, sociologists have moved away from structural notions of society, and its associations with wholeness, unity, purity and order. Central to this shift away from essentialist understandings, and towards more performative notions of the social and sociality, are concepts of hybridity and mobility.

According to Deleuze and Guattari (1987) every social phenomena faces escapes and inversions, and it is in these lines of flight, where there is leaking between segments, that sociality escapes organisation and centralisation. And so it is to these lines that we must look to find the socially meaningful. De-territorialisation is characterised in terms of nomadic subjectivity, and nomadism is based on freedom of movement, on choice, on becoming. Nomadic space is smooth, without features, undifferentiated from other spaces. Nomadology itself is a line of flight, a process which constantly resists the sedentary and the fixed (Deleuze and Guattari 1986).

Urry (2000a:2) claims that material transformations “are remaking the ‘social,’ especially those diverse mobilities that, through multiple senses, imaginative travel, movements of images and information, virtuality and physical movement, are materially reconstructing the ‘social as society’ into the ‘social as mobility’”. Global fluids are the “heterogeneous, uneven and unpredictable mobilities of people, information, objects, money, images and risks, that move chaotically across regions in strikingly faster and unpredictable shapes” (Urry 2000b:194). Urry (2000a:18) seeks to “develop through appropriate metaphors a sociology which focuses upon movement, mobility and contingent ordering, rather than upon stasis, structure and social order”.

Metaphors of mobility used to describe the social have included mobile peoples, such as Deleuze and Guattari’s (1986) nomad and Bauman’s (1993) vagabond or tourist. Gilroy (1993:16) evokes the image of the ship as a container in which the “Black Atlantic” moves: slave ships were the “mobile elements that stood for the shifting spaces in between the fixed spaces that they connected,” themselves active in cultural production. For Sheller and Urry (2000:739) the car, or more appropriately the car-driver, is a “hybrid assemblage, not simply of autonomous humans, but simultaneously of machines, roads, buildings, signs and entire cultures of mobility”. Clifford (1997) suggests the metaphor of hotel lobby or motel, characterised by being away from home, in movement, in ambiguity. Morris (1988:3) explains that motels “memorialise only movement, speed and perpetual circulation;” the motel then represents “neither arrival nor departure, but the ‘pause’”. Braidotti (1994:18-19) also focuses on the “places of transit that go with travelling: stations and airport lounges, trams, shuttle buses and check-in areas. In between zones where all ties are suspended and time stretched to a sort of continuous present”. To these metaphors of people, objects and places we may add notions of fluidity or flow.

Mol and Law (1994:641) argue that the “social doesn’t exist as a single spatial type. Rather it performs several *kinds of space* in which different ‘operations’ take place... There are other kinds of space [where] neither boundaries nor relations mark the difference between one place and another. Instead, sometimes boundaries come and go, allow leakage or disappear altogether, while relations transform themselves without fracture. Sometimes, then, social space behaves like a fluid”.

Shields (1997) explains that flows are spatial, temporal and, importantly, they are also material. "The significance of the material quality of flows is that they have content, beyond merely being processes... Flows signal pure movement, without suggesting a point of origin or a destination, only a certain character of movement, fluidity and direction... It is not that they are relational between objects or fixed points... but they are the being of relation" (1997:2). But, in this sense, "topological variables are external limits which give a level of predictability to flows across a surface... [and flows] are measured with respect to other bodies and materials in movement" (1997:3-4).

The mobile/stabile sculptures of Alexander Calder

In 1928, the Russian artist Alexander Archipenko created his work *Archipentura* or *Peinture Changeante*, one of the first efforts to introduce movement into a work of art. "*Archipentura* offers the possibility of executing and representing, in even the same point of space, different objects, movements, transformations, and displacements" (Archipenko as cited in Marter 1991:42). Continuing this tradition of kinetic sculpture, the American, Alexander Calder, is credited with inventing the mobile.

Jean-Paul Sartre (1948:1-2) describes Calder's mobiles as objects defined by their

movement and having no other existence... A 'mobile' does not 'suggest' anything: it captures genuine living movements and shapes them. 'Mobiles' have no meaning, make you think of nothing but themselves... The 'mobile'... never [has] precision and efficiency... [it] weaves uncertainty, hesitates and at times appears to begin its movement anew, as if it had caught itself in a mistake. Yet the motions are too artfully composed to be compared to those of a marble rolling on a rough board, when each change of direction is determined by the asperities of the surface...

These hesitations, resumptions, gropings, clumsinesses, the sudden decisions and above all that swan-like grace make of certain 'mobiles' very strange creatures indeed, something midway between matter and life. At moments they seem endowed with intention; a moment later they appear to have forgotten what they intended to do, and finish by merely swaying inanely... [and mobiles] do not seek to imitate anything because they do not 'seek' any end whatever, unless it be to create scales and chords of hitherto unknown movements...

Calder's works also included "stabiles," those stable sculptures that "capture" movement, as well as combination mobile-stabile works. Trained in mechanical engineering, Calder was well acquainted with kinetics (the effects of forces upon the motions of material bodies or with changes in a physical or chemical system) and entropy, or the degree of disorder or uncertainty in a system.

In "Reproducing Works of Calder," Lee et al (2001:1) argue that "the real characteristics of mobiles come from the motions generated by interactive external forces applied to their structures. Hence people [can] not fully enjoy them through static images or even static three-dimensional models." The team developed a virtual mobile system which employs an on-screen graphical mobile; users control the movement of the mobile by blowing on a microphone which then exerts external forces, or virtual winds.

Implications for ubiquitous computing

Understanding context will be critical in our attempts to design for ubiquitous computing and my position is that context is a performative process involving both mobile and stable elements, absence and presence. Drawing on metaphors of fluidity and flow, as well as Calder's mobile/stabile sculptures, we may understand context to be contingent and morphologically variable. As such, designing new computers may involve the development of social intelligence and interfaces that "change shape." In other words, for computers to become ubiquitous, they may need to embody elements of mobility *and* stability, and provide users with novel means for changing the ways humans and machines interact, according to particular, yet often unpredictable, contexts.

For example, a living room may contain sofas, chairs, tables, carpets and lighting. People may be sitting comfortably and chatting. But what if the people choose to move the furniture and roll up the carpets in order to create a dance floor? The room itself remains intact, and the people are still there, but its meaning and use have been changed. In practice, it is no longer a living room; it has been shaped into something else, a dance floor. As such, the living room is both mobile and stable, depending on what we want it to do and when.

Certain applications of ubiquitous computing will need to allow – even foster – a similar ability to “change shape” and to bring about something other than what was intended by the designers. Material architectures may remain stable, but artificial intelligence programs and interfaces may need to rely on mobility, or contingency and disorder. In many ways, this will involve rethinking our assumptions about networks and other architectures of control. And this does not necessarily mean developing computers that act on our behalf, and without instigation, as I would argue that in many cases it will be imperative to allow people to decide how and when the computer will respond.

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