

Ubisafe Computing: Vision and Challenges (I)

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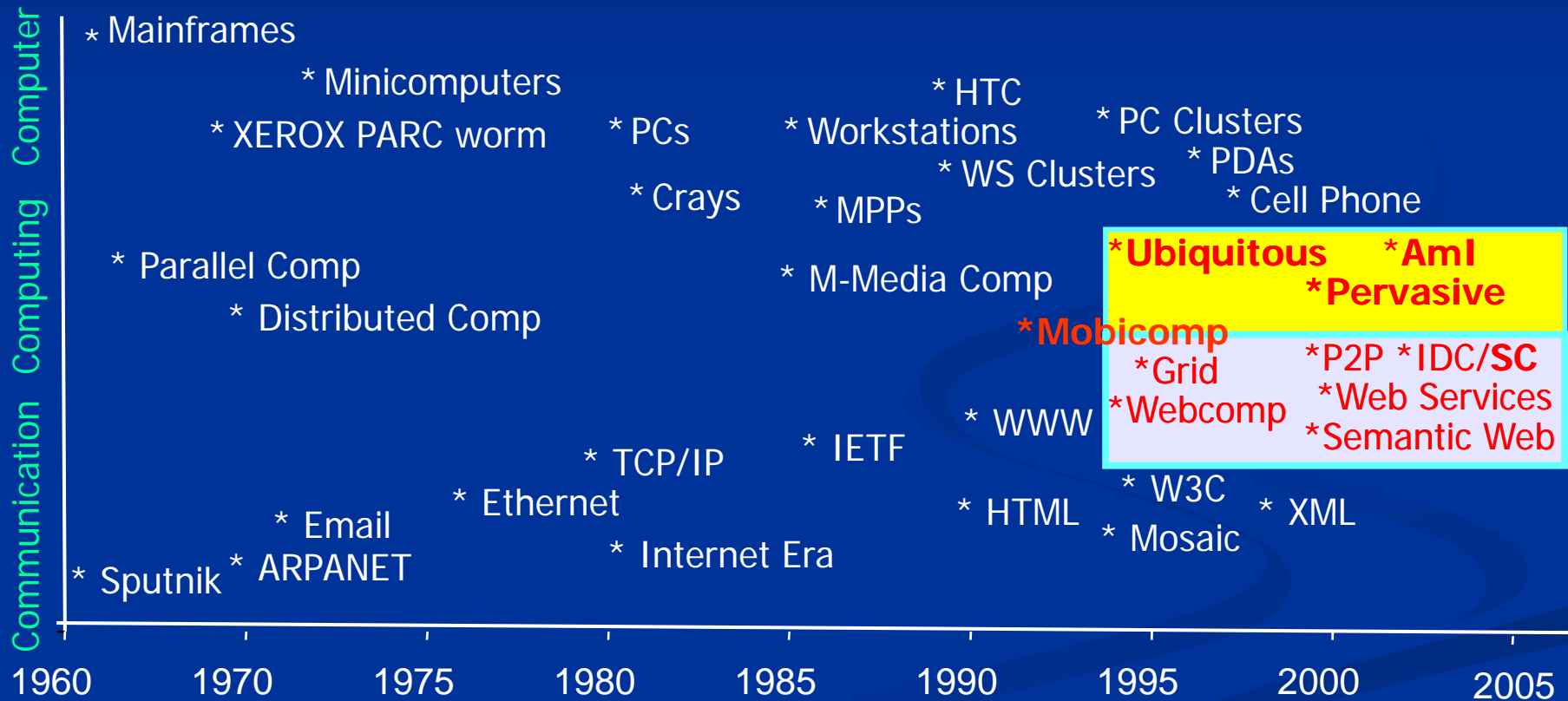
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Backgrounds

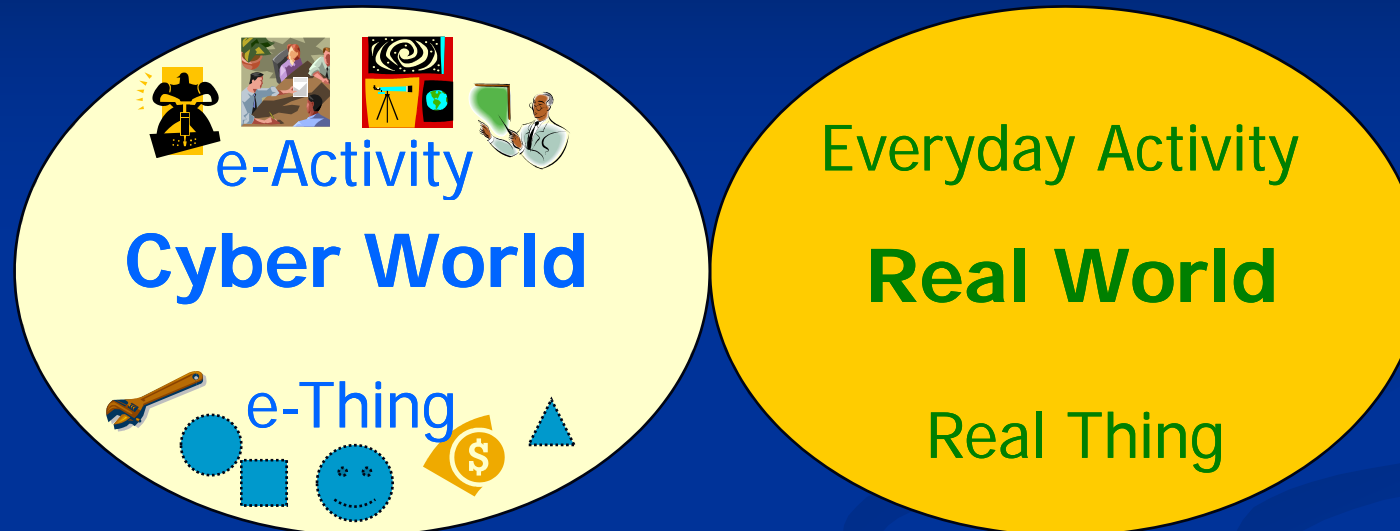
- Meeting: Okinawa (Japan), Dec. 1-2, 2005
 - Jianhua Ma, Qiangfu Zhao, Vipin Chaudhary, Jingde Cheng, Laurence T. Yang, Runhe Huang, Ismail K. Ibrahim, Thomas Grill, (Qun Jin)
- Theme: What's the Ubi-Next?
 - Check a variety of representative computing
- Idea: Ubiquitous Safe – *one common desire to ubicomp sys/serv.*
 - Coined "Ubisafe"
 - *You're safe, I'm safe, all are safe, ...*
- Discussion: in Dec. 2005 – May. 2006
 - Via email/telephone/tele-meeting/meeting
 - Brainstorm, debating, writing, arguing, revising, arguing, revising, ...

Computer, Computing and Communication Tech. Evolution



Cybercomp → e-Thing & e-Activity

Ubi-comp → Real Thing & Real Activity



Web, WbS, Grid, P2P, Agent, Sem., etc.	UC, ID, Context, Emb. Sys., etc.
Computers & Networks/Internet	Sensor/M/NEMS, Comps & Per. Nets

Ubi-comp: a field on a physical world richly and invisibly interwoven with sensors, actuators, displays, and computational elements, embedded seamlessly in everyday objects of lives and connected through a continuous network.
- Mark Weiser in his last article in IBM Sys. Journal, 1999.

Fundamental Technology Trends

- Various computers/devices → small → tiny → invisible
→ disappear → hidden in real objects and spaces
- Various networks → computers/devices → connectable
→ talk-able → interact-able → complex relationship
- **u-Things: Real Things Attached, Embedded, Blended (AEB)**
with computers, networks, RFIDs, IC-tags, sensors, actuators, etc.
e-things → u-things, e-booming → u-booming
- **Weiser's Ubicomp → many new computing paradigms**

Ubicomp-Inspired Computings

➤ Universal Identification

- RFID, E-Tag, AV/Biomedical
- Location aware computing

➤ Physical & Social Awareness

- Sensor networks
- Context based computing
- Privacy/trust computing

➤ Digital Enhanced Object

- Embedded computing
- Wearable/augmented computing
- Everyday computing (*Georgia Tech*)
- Sentient computing (*AT&T*)

➤ Platform & Middleware

- WS, UPnP, Jini, SLP, OSGi, ...
- Smart-Its, T-Engine, eTRON, ...
- Aura, Gaia,, iROS, RCSM, MetaGlue, ...

➤ Interface & Interaction

- Calm technology (*Weiser & Brown*)
- Invisible/disappear computing
(*UoW, CMU, DARPA & EU*)
- Palpable computing (*PalCom, EU FP6*)
- Proactive computing (*Tennenhouse, CHI'04-P*)

➤ Deployment & Management

- Sustainable pervasive comp (*SPC'04*)
- Autonomic computing (*IBM, ICAC-04*)
- Organic computing (*Müller-Schloer, ARCS'04*)

➤ Model & Design

- Massive multi agent (*MMAS'04, Kyoto*)
- CW Axioms & Cellular Modeling (*Kunii*)
- Amorphous computing (*MIT*)
- Spray computing (*Zambonelli*)

➤ Intelligent Environment

- Ambient intelligence (*AmI, AmI-03, IE-05*)

Common Features

- Common Assumption
 - Surrounded by u-things and hard to escape from them
- Common Any-Vision
 - Anywhere, anytime, any means, ...
- Common Goal
 - Novel services in everyday life of the real world
- Common Desire
 - **Safety** and **Satisfaction**

Ubisafe Essentials

- Fundamental Question:
 - Can we construct, in a unified methodology, an any-oriented computing environment that can gratify all the people in all situations with (almost) perfect safety and satisfaction?
- Desired States
 - *ubiquitous safety* and *ubiquitous satisfaction*
to diverse people under complex situations in the real world
- Ultimate Goal
 - to build a computing environment in which all people and organizations can benefit from the any-oriented ubiquitous services with desired and assured satisfaction without worrying or thinking about safety.

Basic Ubisafe Aspects: S-A-F-E

- Weiser-Brown's ideal ubicomp state: calm
- 4 Ubisafe Aspects/Axes: **S-A-F-E**
 - **S**: Safe, Secure, Social,
 - **A**: Assured, Aware, Autonomous,
 - **F**: Fit, Friendly, Faithful, Fair,
 - **E**: Easy, Equal, Emotional, Ethical,
- Arguments → no convergence/consensus yet !
 - necessary/enough, clear/fuzzy, exact/open, ...

Ubisafe: Ubiquitous Safety

- Three Questions

(1) Do we really understand all kinds of new risks in using novel computers/networks that are attached, embedded or blended into real objects and environments?

(2) Do we really have efficient and effective solutions to precisely predict and further prevent the risks under various situations in the complex computing environment?

(3) Can we create risk-less computing environments in which all people can really enjoy ubiquitous services without any anxiety about safety problems covering reliability, security, privacy, persistency, trust, disaster, out of control, and so on?

- One of main purposes of ubisafe computing is to provide a unified solution for solving various safety problems related to all kinds of u-things and u-services.

Safety-related Computing

- Safety-related Computing
 - Not new, studied for decades
 - Reliability, security, fault tolerance, survivable, dependable, safety-critical sys., human factor, etc.
- Trust/Trusted/Trustworthy Computing (TC)
 - A general paradigm to cover security, privacy, reliability, risk, reputation, maintenance, after-service, and so on
 - Trust is only one factor in cooperation
 - Cooperation is only one relation between computing entities
 - US DoD: A trusted component can break the security policy
 - TC pushed hard by industry (Microsoft, ...), true motivation?
- Reliability → Security → Trust → Ubisafe (?)

Novel Features and Unsafe Factors

- Unobtrusive AEB in real objects and environments
 - *Physical characteristic oriented* unsafe factors
 - Limited computation, open/changing/worse working conditions
 - Used consciously or unconsciously
- Diverse users with different backgrounds/demands
 - All people from baby to elder, normal to disabled,
 - *Human characteristic oriented* unsafe factors
 - No comp knowledge, no expected usage, no awareness of dangers, no ability of handling,
 - Safe/unsafe is not absolute, → relative, up to individual/situation
- Life-like systems, smart u-things from small to large scales
 - Passive → Interactive → Active → Life-like
 - *life-like system characteristic oriented* unsafe factors
 - Imprecise sensing data, insufficient context, complex relation,

Terminology and Concept

- *u*-object (*u*-thing)

- Anything in a ubiquitous environment
- Anything with or related to AEB computing element

- *u*-object Categories

- *u*-atom, *u*-complex
- *u*-element, *u*-system, *u*-environment
- *u*-artifact, *u*-person, *u*-organ

- *u*-object Features & Relationships

- negative, non-negative, positive
- passive/active, steady/dynamic, cooperative/non-cooperative, ...
- absolutely safe, relatively safe, degree of safe, reliability, trust, ...

Ubisafe Computing Vision

- Ultimately General

→ A u-environment in which any u-person can get satisfactory services safely anytime and anywhere in any situations, and do not have to worry or even think about the safety problem.

- Extremely Ideal

→ A u-environment in which all u-objects including u-persons are both non-negative and reliable (thus completely trustable, no risk/attack at all), and thus all u-persons are absolutely safe.

- Relatively Ideal

→ A u-environment in which some anti-risk/attack u-systems are so powerful that any u-person can be isolated from outside risks/attacks; all risks/attacks from a u-person-self can be predicted and prevented.

- Practically Perfect

→ A u-environment in which some u-systems can predicate and detect all possible risks/attacks, and take proper actions to prevent or protect u-persons from the risks/attacks.

Ubisafe Computing Challenges

- To study all possible unsafe sources of various u-objects from the physical, human and life characteristics.
- To model and detect all possible risks, attacks, dangers and so on → known and unknown
- To form safety u-systems: centralized/distributed, part/whole safe, local/global, autonomic/controllable
- Meaning, measure and semantics of “safe” and “ubisafe”: absolute, relative, degree/level, subjective, objective,
- Situated or context-related ubisafe interwoven with the diversity/complexity of the real world and various people
- Non-technical issues: law, regulation, ethics, ...
- How to combine technical and non-technical forces

Remarks

- Ubisafe comes from profound novel features and unsafe factors in u-objects and u-services pervasive in the real world
- Ubisafe calls for unified theory/methodology and systematical technical solutions to solve conventional and new safety problems faced by u-objects and u-services.
- Ubisafe is intended to offer safety guarantee to all u-persons no matter what the age, sex, race, profession, culture, preference, etc.
- Ubisafe envisions that all people can fully enjoy the u-environment provided by ubisafe computing – without worrying or thinking the safety problem any more.
- Ubisafe is open, inclusive, not yet having concrete result, answer, ...
- [2007 IEEE Sym. on Ubisafe Computing \(UbiSafe-07\)](#), Niagara Falls