Mobile and Ubiquitous Computing

Cristiano André da Costa
cac@unisinos.br

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How Do You See Computing In The Future?


MISSION OPS
ENGINEERING

JB Online

Remote Control Anarchy

Mobile Computing

Mobile Computing

- “Information at your fingertips anywhere, anytime"
- Very popular mainly by innovations in:
  - wireless technology
  - energy-efficient portable hardware
  - adaptive software”
- Comes from advances in two main areas: wireless network and portable devices

(SATYANARAYANAN, 2010)

Characteristics

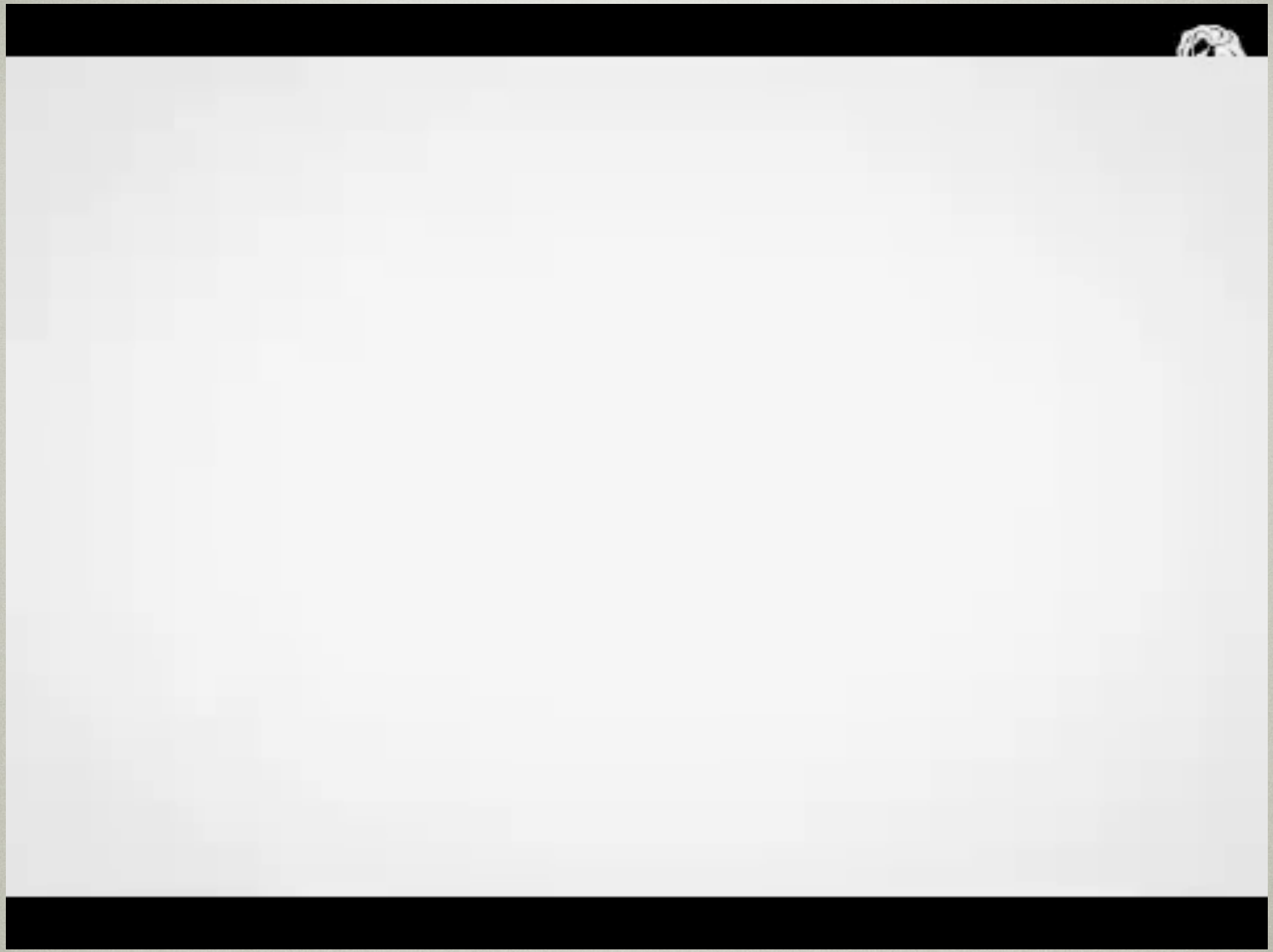
- Mobile elements are resource-poor relative to static elements.
- Mobility is inherently hazardous
- Mobile connectivity is highly variable in performance and reliability
- Mobile elements rely on a finite energy source.

(SATYANARAYANAN, 2010)

Tendencies

- Mobile devices are still as a "Swiss Army Knife"
- Focus should be: Usability and Interface
- Different means of interaction
- Context Awareness
- User Behavior and Profile

(SATYANARAYANAN, 2010)



Tesco Homeplus Virtual Subway Store in South Korea

Today Apps

- Location-Based Services
- Integration with Social Networks
- Cloud Computing Based
- Many use of sensors embedded on the device or other appliances

Sensors In Smartphones

- GPS
- Accelerometer
- Compass
- Proximation
- Luminosity
- Pressure
- Temperature
- Humidity
- Gesture
- More…


Hidden Innovation in the GALAXY S4
GALAXY S4 gets you closer to what matters in life, bringing your world together
Gesture Sensor
Recognizes the user's hand movements using infrared rays
- Air Gesture
Proximity Sensor
Recognizes whether the mobile phone is located near the user by using infrared rays
- Direct Call
RGB Light Sensor
Measures the red, green, blue, and white intensity of the light source
- Samsung Adapt Display
Gyro Sensor
Detects the mobile phone rotation state based on three axes
- Smart Rotation
Hall Sensor
Recognizes whether the cover is open or closed
- S View Cover
Accelerometer
Detects the mobile phone movement state based on three axes
- S Health : Walking Mate
Barometer
Identifies the atmospheric pressure at the user's current location
- S Health: Walking Mate
Geomagnetic Sensor
Detects magnetic field intensity based on three axes
- Digital Compass MAP
Temperature/ Humidity Sensor
Checks temperature and humidity levels
- S Health : Comfort Level
Life companion
12:45
SAMSUNG TOMORROW

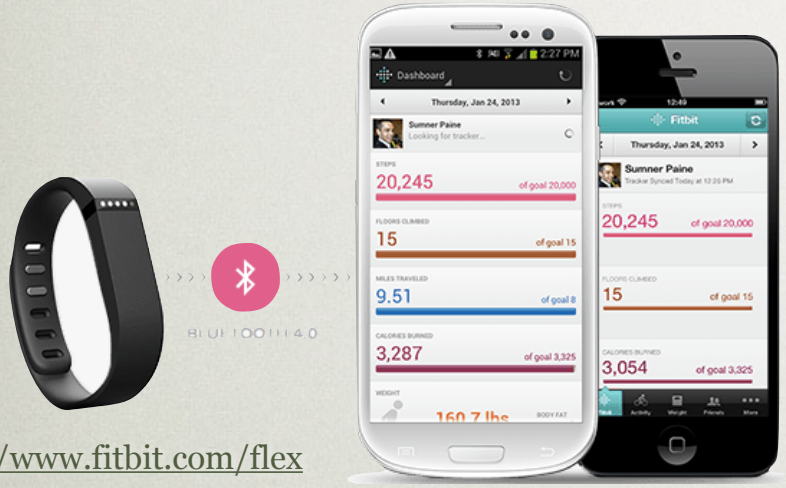
samsung.com

LifeWatch V: Android-based Healthcare Smartphone Packed with Medical Sensors

Communication In Smartphones

- 3G, 4G, EDGE
- WiFi
- Audio
- Bluetooth
- Camera
  - Barcode
  - QR Code
- NFC

Exemples



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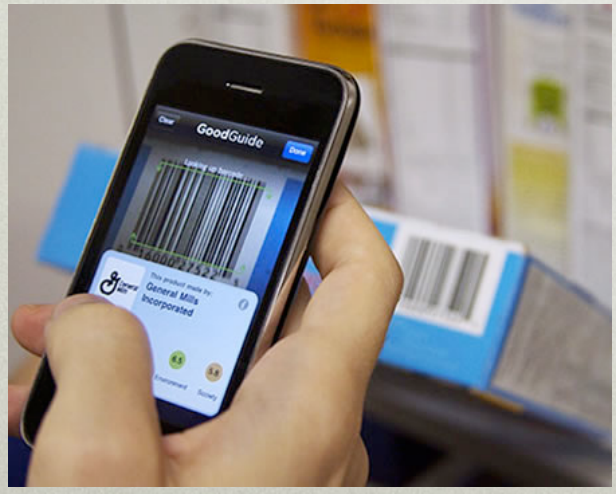
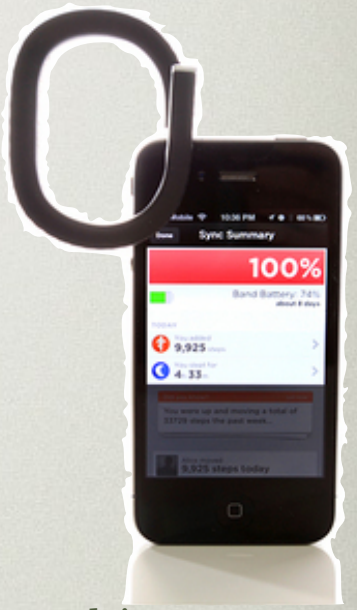


newlaunches.com

repairs-gadgets.blogspot.com



dvice.com

QR Codes

Gerado em
http://www.the-qrcode-generator.com

- Quick Response Code
- 2D Bar Codes
- Developed in Japan in 1994
  by Denso Wave (Toyota subsidiary)
- Track veicules during production
- Store numbers, characters or binaries

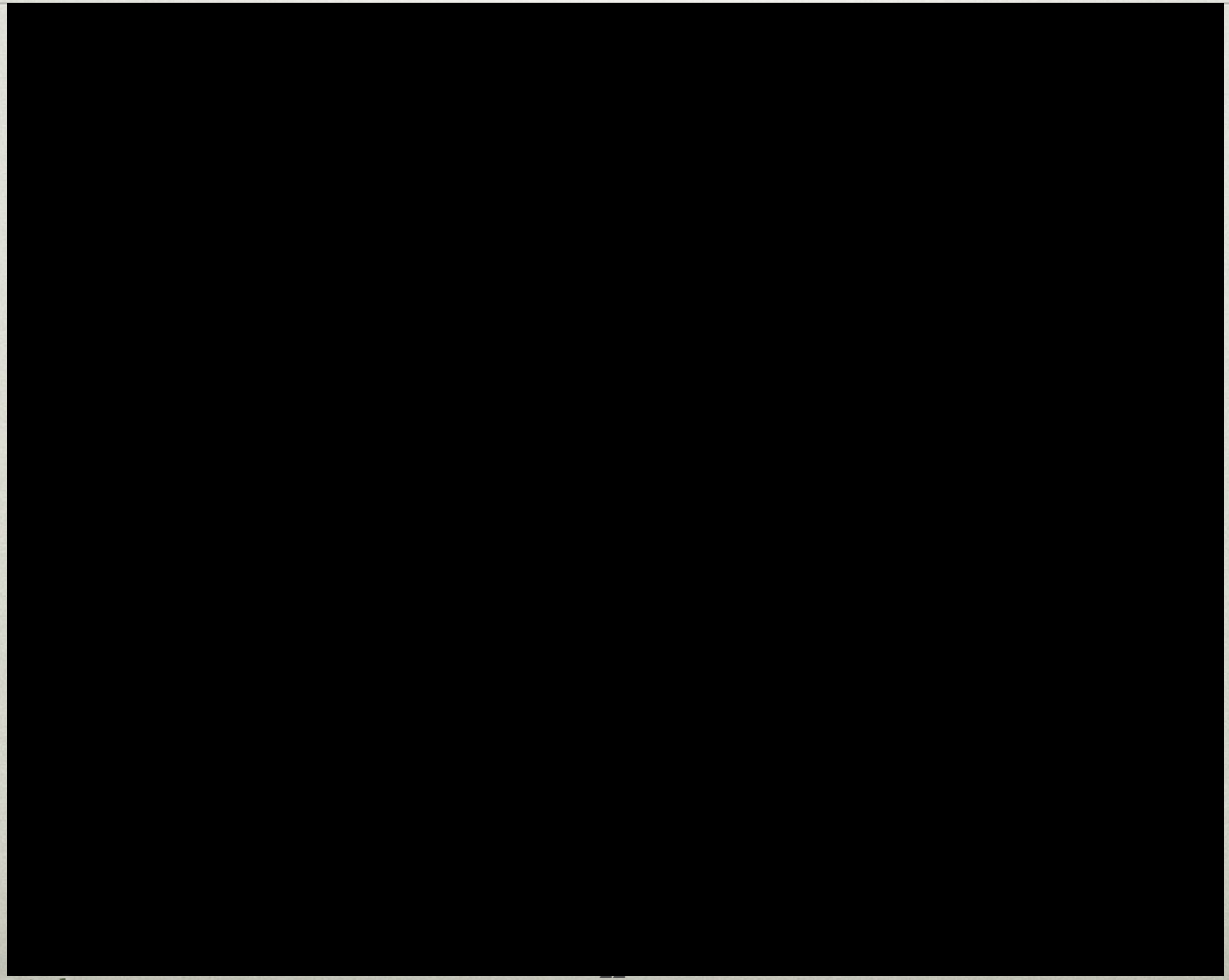
QR Code Model 1and Model 2	Micro QR Code	iQR Code	SQRC	LogoQ
				
[Feature] Model 1 is the original QR Code. The largest version of this code is 14 (73 x 73 modules), which is capable of storing up to 1,167 numerals. Model 2 is an improvement on Model 1 with the largest version being 40 (177 x 177 modules), which is capable of storing up to 7,089 numerals. Today, the term QR Code usually refers to this type.	[Feature] Only one orientation detecting pattern is required for this code, making it possible to print it in a smaller space than before. This code can be viable even if the width of its margin is 2 module-worth (QR Code requires a margin of 4 module-worth at least around it). The largest version of this code is M4 (17 x 17 modules), which can store up to 35 numerals.	[Feature] Code that can be generated with either square modules or rectangular ones. Can be printed as a turned-over code, black-and-white inversion code or dot pattern code (direct part marking). The maximum version can theoretically be 61 (422 x 422 modules), which can store about 40,000 numerals	[Feature] QR Code that has a reading restricting function. Can be used to store private information or manage a company's internal information) Its appearance is no different from the regular QR Code.	[Feature] QR Code that can incorporate high-levels of design features such as illustrations, letters and logos. Since proprietary logic is used in generating this type of code, its readability is not compromised.

http://www.qrcode.com/en/codes/

bb.com.br

Marketingcomentado.com.br

Social Interaction with QR Codes



Case Harry's Bar: QR Code

NFC E BLE

- *Near Field Communication (NFC)*
  - Communication standard via radio frequency
  - Contactless communication

BullsEye™ NFC, NXP Mifare Classic 1k

- *Bluetooth Low Energy (BLE)* or *Bluetooth Smart*
  - Wireless communication standard (til 100mts)
  - Many compatible devices

Payment using NFC

Health Devices compatible with BLE

Monitor de Pressão Sanguínea da Bosch

Balança Bluetooth da A&D Medical

Continua Health Alliance

ACCU-CHEK Combo System

Oxímetro de Pulso Wireless da Nonin

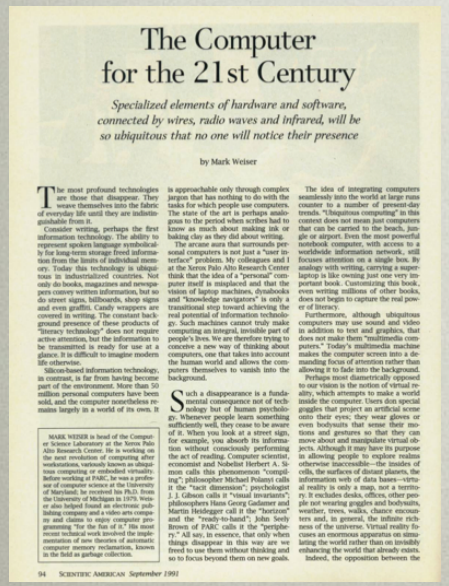
Ubiquitous Computing

Ubiquitous Computing

"The most profound technologies are those that disappear. They weave themselves into the fabric of everyday life until they are indistinguishable from it."

"a new way of thinking about computers in the world"

Mark Weiser, 1991



The Computer for the 21st Century

Specialized elements of hardware and software, connected by wires, radio waves and infrared, will be so ubiquitous that no one will notice their presence

by Mark Weiser

The most profound technologies are those that disappear. They weave themselves into the fabric of everyday life until they are indistinguishable from it.

Consider writing, perhaps the first information technology. The ability to represent spoken language symbolically for long-term storage freed information from the limits of individual memory. Today this technology is ubiquitous in industrialized countries. Not only do books, magazines and newspapers convey written information, but so do street signs, billboards, shop signs and even graffiti. Candy wrappers are covered in writing. The constant background presence of these products of "literacy technology" does not require active attention, but the information to be transmitted is ready for use at a glance. It is difficult to imagine modern life otherwise.

Silicon-based information technology, in contrast, is far from having become part of the environment. More than 50 million personal computers have been sold, and the computer nonetheless remains largely in a world of its own. It is approachable only through complex jargon that has nothing to do with the tasks for which people use computers. The state of the art is perhaps analogous to the period when scribes had to know as much about making ink or baking clay as they did about writing.

The arcane aura that surrounds personal computers is not just a "user interface" problem. My colleagues and I at the Xerox Palo Alto Research Center think that the idea of a "personal" computer itself is misplaced and that the vision of laptop machines, dynabooks and "knowledge navigators" is only a transitional step toward achieving the real potential of information technology. Such machines cannot truly make computing an integral, invisible part of people's lives. We are therefore trying to conceive a new way of thinking about computers, one that takes into account the human world and allows the computers themselves to vanish into the background.

Such a disappearance is a fundamental consequence not of technology but of human psychology. Whenever people learn something sufficiently well, they cease to be aware of it. When you look at a street sign, for example, you absorb its information without consciously performing the act of reading. Computer scientist, economist and Nobelist Herbert A. Simon calls this phenomenon "compiling"; philosopher Michael Polanyi calls it the "tacit dimension"; psychologist J. J. Gibson calls it "visual invariants"; philosophers Hans Georg Gadamer and Martin Heidegger call it the "horizon" and the "ready-to-hand"; John Seely Brown of PARC calls it the "periphery." All say, in essence, that only when things disappear in this way are we freed to use them without thinking and so to focus beyond them on new goals.

The idea of integrating computers seamlessly into the world at large runs counter to a number of present-day trends. "Ubiquitous computing" in this context does not mean just computers that can be carried to the beach, jungle or airport. Even the most powerful notebook computer, with access to a worldwide information network, still focuses attention on a single box. By analogy with writing, carrying a superlaptop is like owning just one very important book. Customizing this book, even writing millions of other books, does not begin to capture the real power of literacy.

Furthermore, although ubiquitous computers may use sound and video in addition to text and graphics, that does not make them "multimedia computers." Today's multimedia machine makes the computer screen into a demanding focus of attention rather than allowing it to fade into the background.

Perhaps most diametrically opposed to our vision is the notion of virtual reality, which attempts to make a world inside the computer. Users don special goggles that project an artificial scene onto their eyes; they wear gloves or even bodysuits that sense their motions and gestures so that they can move about and manipulate virtual objects. Although it may have its purpose in allowing people to explore realms otherwise inaccessible—the insides of cells, the surfaces of distant planets, the information web of data bases—virtual reality is only a map, not a territory. It excludes desks, offices, other people not wearing goggles and bodysuits, weather, trees, walks, chance encounters and, in general, the infinite richness of the universe. Virtual reality focuses an enormous apparatus on simulating the world rather than on invisibly enhancing the world that already exists.

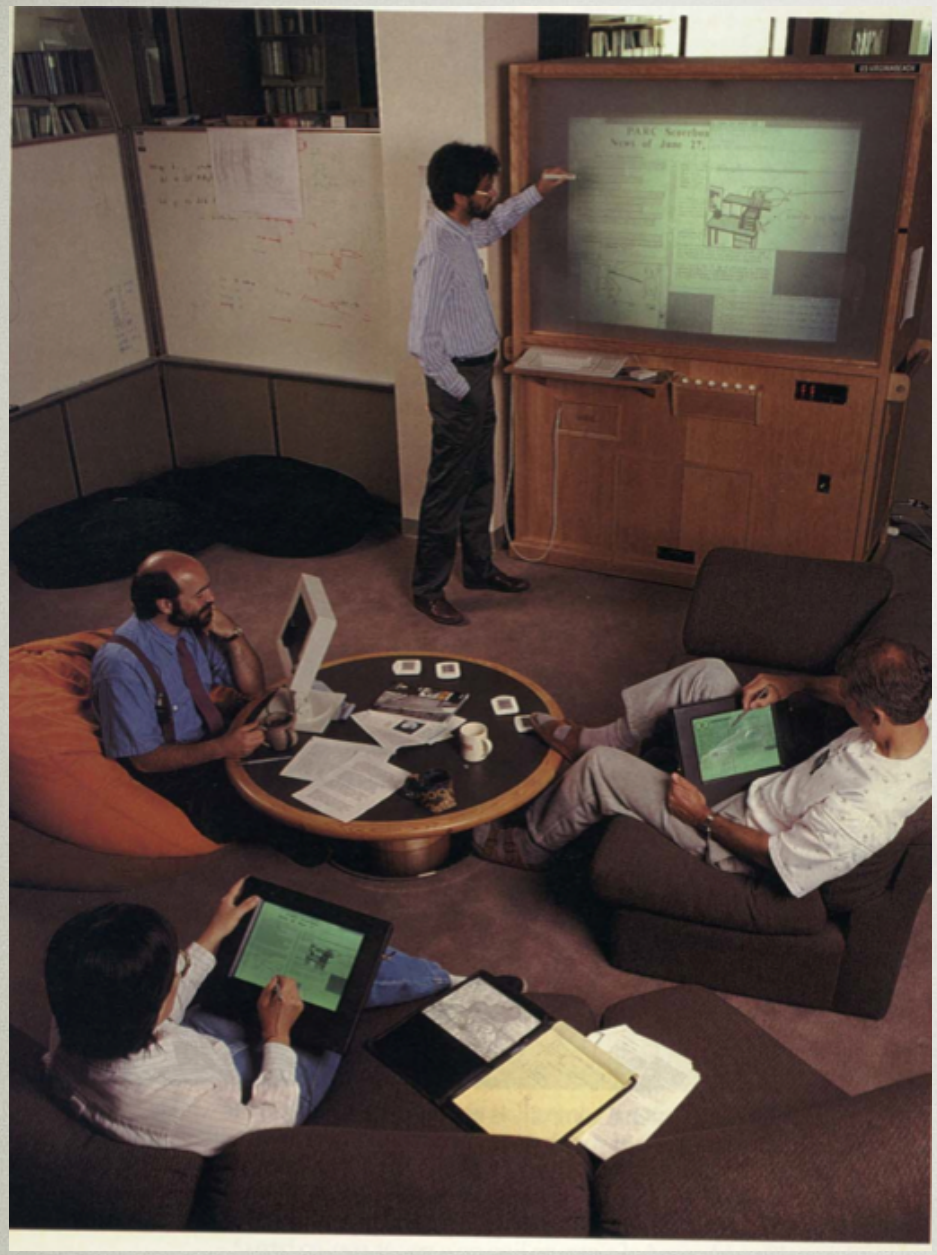
Indeed, the opposition between the

MARK WEISER is head of the Computer Science Laboratory at the Xerox Palo Alto Research Center. He is working on the next revolution of computing after workstations, variously known as ubiquitous computing or embodied virtuality. Before working at PARC, he was a professor of computer science at the University of Maryland; he received his Ph.D. from the University of Michigan in 1979. Weiser also helped found an electronic publishing company and a video arts company and claims to enjoy computer programming "for the fun of it." His most recent technical work involved the implementation of new theories of automatic computer memory reclamation, known in the field as garbage collection.

94 SCIENTIFIC AMERICAN *September 1991*

More About Mark Weiser

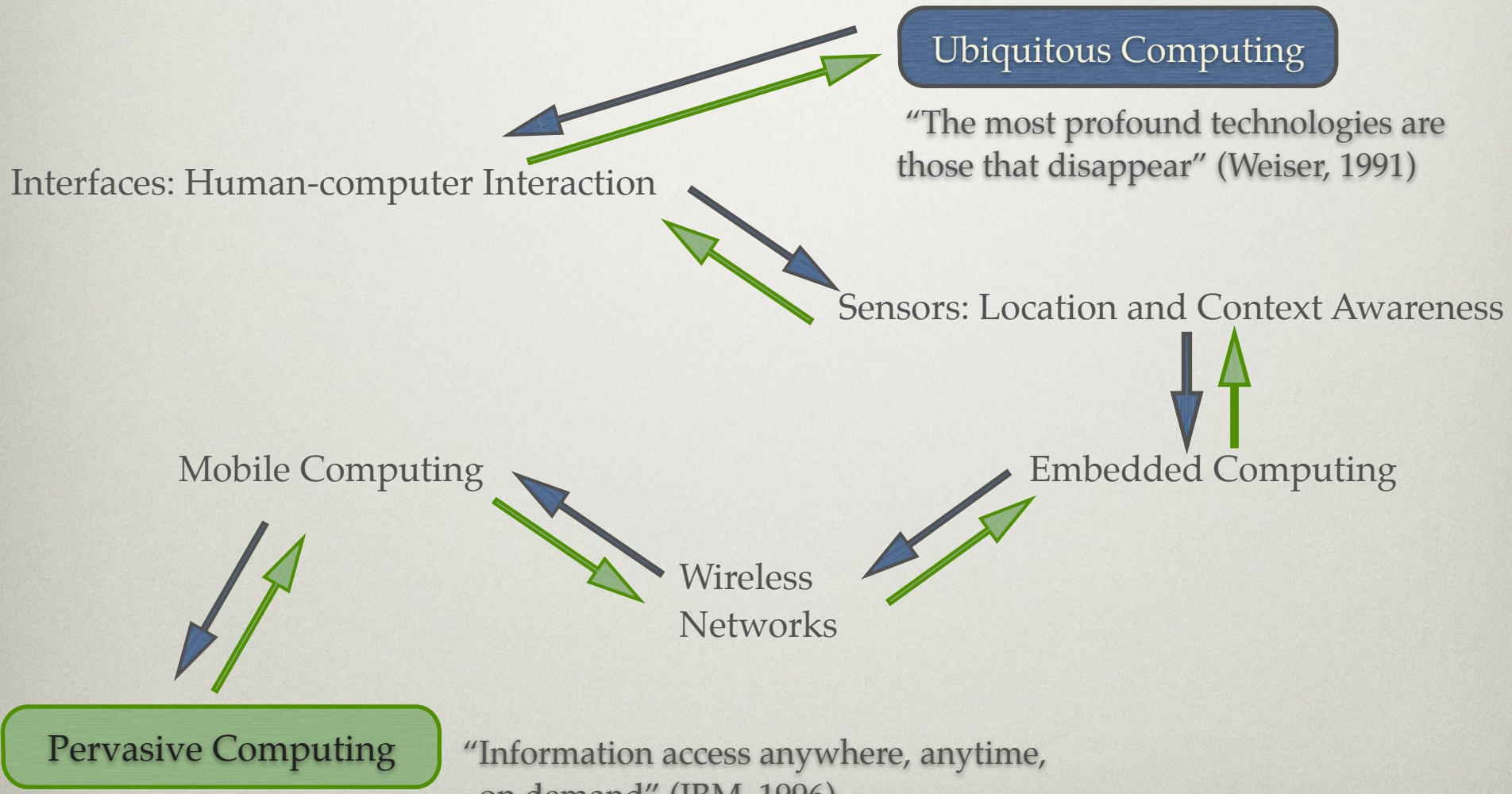
- Researcher at Xerox PARC - *the Palo Alto Research Center* na Califórnia, EUA
- Passed away in April 27, 1999
- Defined the “Ubiquitous Computing" designation in a 1991 article published in the *Scientific American* magazine



Pervasive Computing

- "Convenient access, through a new class of appliances, to relevant information with the ability to easily take action on it when and where you need to" (IBM, 1996)
- "Environment saturated with computing and communication capability, yet so gracefully integrated with users that it becomes a 'technology that disappears" (SATYANARAYANAN, 2001)

Ubiquitous Computing and Pervasive Computing



(ROBINSON et al., 2005)

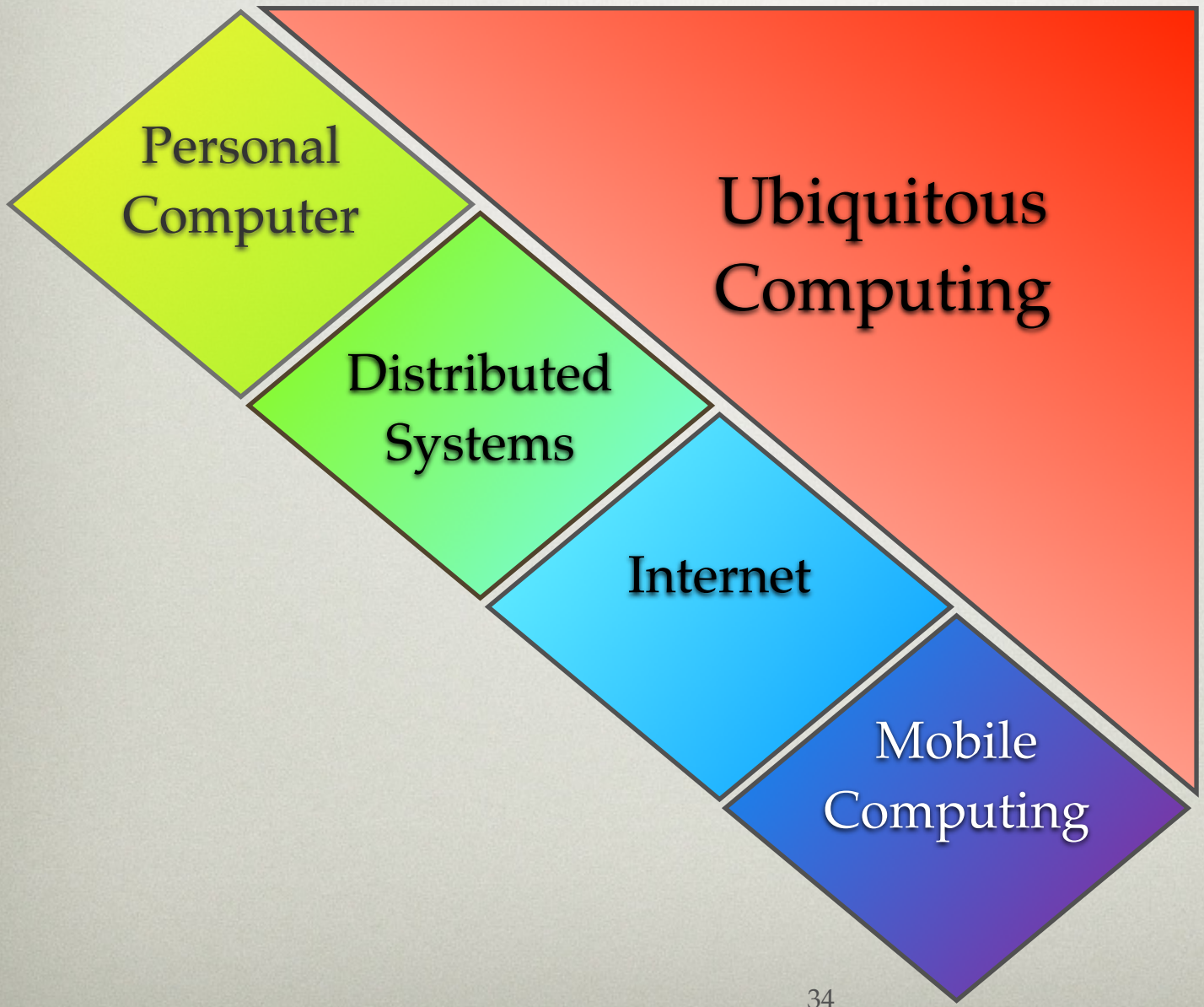
Ubiquitous Computing

- Characteristics
  - Portability
  - Everywhere and every time access
  - Mobility
  - Context Awareness
- Ubiquitous Computing is equivalent to Pervasive Computing

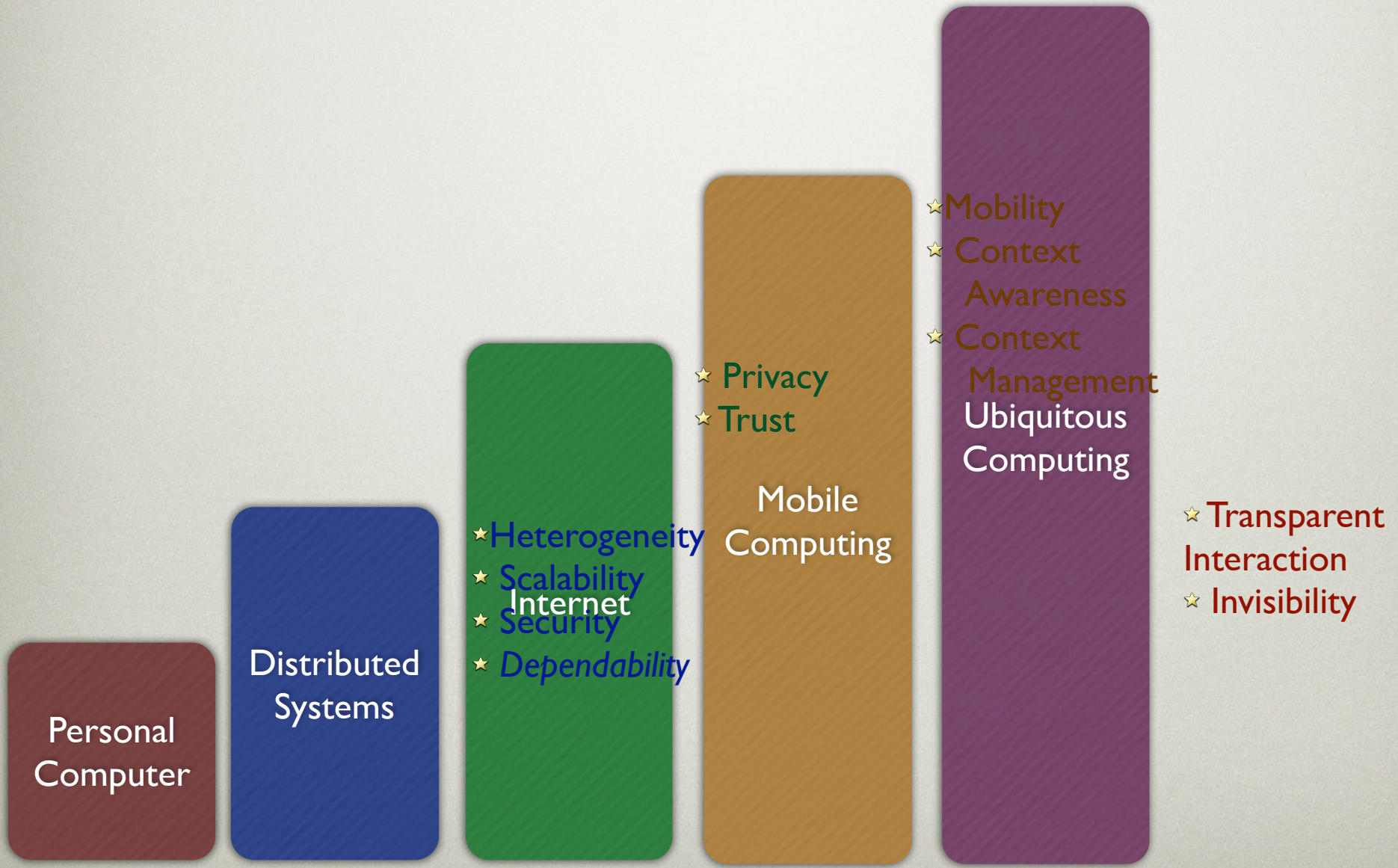
Augmented Reality

Augmented Reality Cinema

Evolution


Personal Computer
Distributed Systems
Internet
Mobile Computing
Ubiquitous Computing

Challenges



(COSTA, 2008)

Challenges Summary

Characteristic	Focus Area	Motive
Heterogeneity	Distributed Systems	Different types of devices, networks, systems,...
Scalability	Distributed Systems	Large scale, increase in the number of devices
Dependability	Distributed Systems and Mission Critic	Avoid defects more frequent or severe than acceptable
Privacy and Trust	Internet and Mobile Computing	Protect personal data. Allow the trust of components
Spontaneous Interoperation	Mobile Computing	Allow association and interaction
Mobility	Mobile Computing	anywhere, anytime access
Context Awareness	Mobile Computing	Perceive context, infer intention and detect changes
Context Management	Mobile Computing	Adjust environment to the perceived information
Transparent Interaction	Ubiquitous Computing	Mix user interface and real world. Focus on interaction
Invisibility	Ubiquitous Computing	Allow that computers disappear in the background


3
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Heterogeneity

- Support varied collection of networks, hardware, operating systems, programming languages, implementations

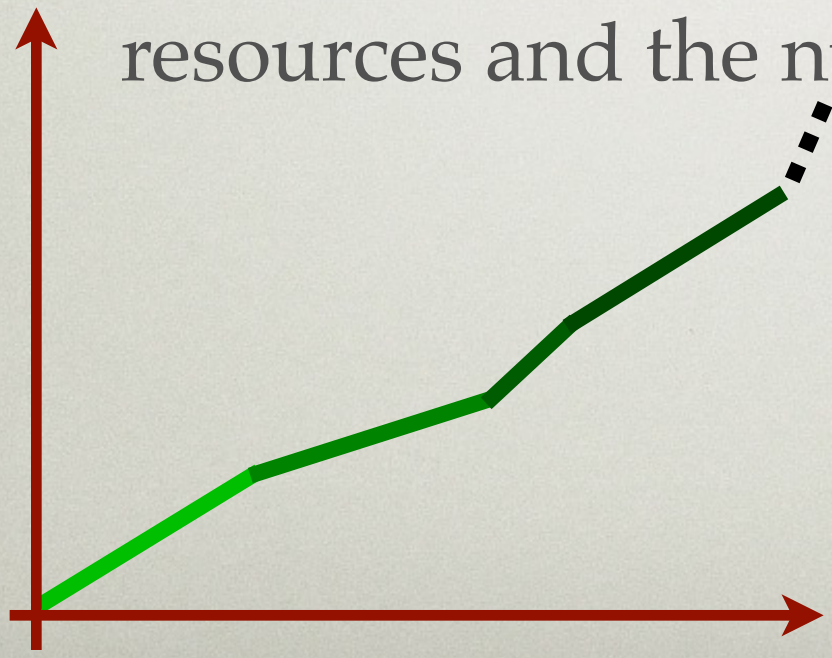






Scalability

- A system is described as scalable if it will remain effective when there is a significant increase in the number of resources and the number of users



Dependability and Security

- *Dependability*: capacity to avoid defects in the service that are more frequent or severe than allowed
- Security: concurrent existence of...
  - availability
  - confidentiality
  - integrity

Privacy and Trust

- Privacy
  - Legislation Subject
  - Risk of too much exposition of personal informations, many times without knowing
  - set and precision of collected data
- Trust
  - Interdisciplinary concept
  - Establish trust among components

Spontaneous Interoperation

- allow interoperation among assorted devices, allowing communication and understanding

  > " interacts with a set of communicating components that can change both identity and functionality over time as its circumstances change. "
  > (KINDBERG e FOX, 2002)

  - Spontaneous comportes support frequent change and easy interaction with the communication partners

Mobility

- User access data and applications independently of location or displacement
- Environment goes with the user
- Types
  - Logical: components (applications, data and services)
  - Physical: users and equipments

Context Awareness

- Context "is an
  characterize the situation of an entity. An entity is a person, place, or object that is considered relevant to the i a use
  ing the user and applications themselves."

  (DEY, 2001)
- Types

  "I keep six honest serving men (they taught me all i knew); Their names are What and Why and When And How And Where and Who"

  Rudyard Kipling

Environmental Context

Emotional Context

Functional Context

Motivational Context

Temporal Context

Historical Context

Location Context

Social Context

Volkswagen Smileage

Context Management

- Make decisions based on context information
  - Smartness
  - Need of abstract elements to support different changes
- Many authors consider as part of context awareness

Adaptation

- Origin in Natural Selection
- Respond to changes in the environment
  - System conditions
  - Limitations of devices
- Dynamic balance between available resources and application needs

Transparent Interaction

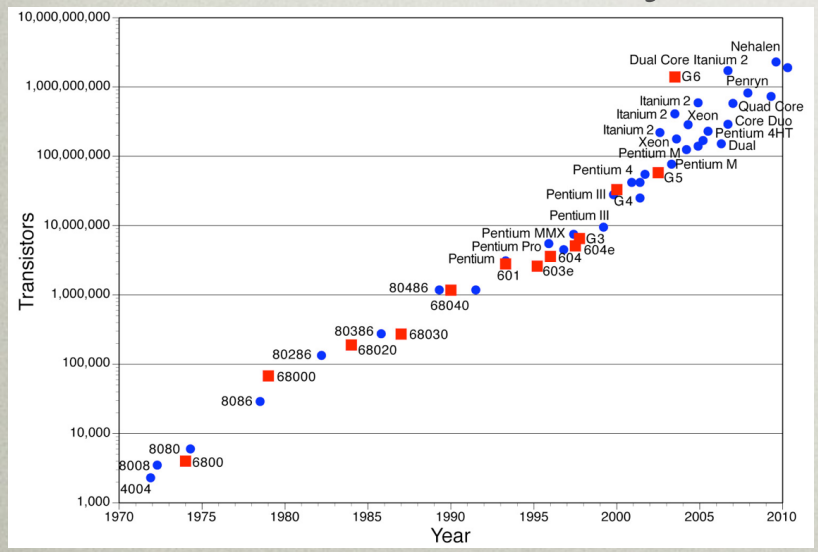
- Use interfaces adapted to devices and integrated with the real world
  - Consider the most natural way of interacting with the user
  - Use contextual information and users behavior
  - Need minimal user intervention

Invisibility

- make computers disappear in the surroundings (integrate with the environment)
- most difficult characteristic to obtain
- high level of automation
- research topic

Invisibility (cont.)

- The most import resource is the user
  - Keep user focused on the task
  - Focus on the activity
  - Minimal system intervention



Conclusion

Computing Today

- Advanced hardware development



- Computer are still machines that execute programs in a virtual environment
- Softwares are created to explore the capacity of devices

Ubiquitous Computing

- Devices must be portals to a space of applications and data
- An application is a way by which a user accomplishes a task
- Computing environment is the physical space with advanced information

Challenges

- User focus should be on the task, not on the computer
- Devices must be spread along the environment
- Task length is variable, involve many devices, people, places
- Tasks change all the time
- Resources degrade frequently

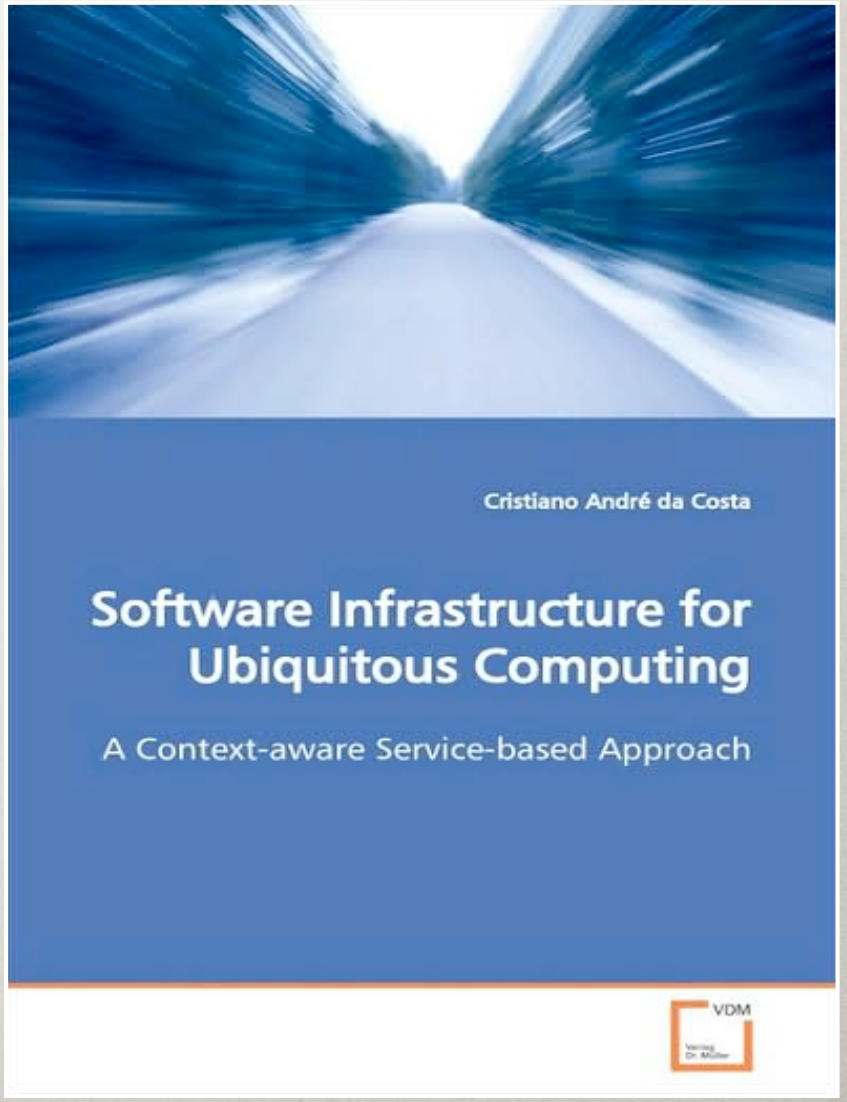
To Know More...

References

- WEISER, Mark. The Computer for the Twenty-first Century. **Scientifc American**, New York, p. 94-104, Set. 1991. (reimpresso na IEEE Pervasive Computing, New York, v. 1, n. 3, Sep. 2002).
- SATYANARAYANAN, M. Pervasive Computing: vision and challenges. **IEEE Personal Communications**, New York, v. 8, n. 4, p.10-17, Aug. 2001.
- COSTA, C.; YAMIN, A.; GEYER, C. Towards a General Software infrastructure for Ubiquitous Computing. **IEEE Pervasive Computing**, New York, v. 7, n. 1, p. 64-73, Jan. - Mar. 2008.
- ROBINSON, P. et al.. Some Research Challenges in Pervasive Computing. In **Privacy, Security and Trust within the Context of Pervasive Computing**. Springer Science, Boston, MA, 1-16. 2005.
- SATYANARAYANAN, M. Fundamental Challenges in Mobile Computing. In: SYMPOSIUM ON PRINCIPLES OF DISTRIBUTED COMPUTING, 15, 1996. **Proceedings...** Philadelphia: ACM Press, 1996. p. 1-7.
- DEY, A. K. Understanding and using context. **Personal and ubiquitous computing**, v.5, n.1, p.4-7, 2001.
- KINDBERG, T.; FOX, A. A system software for ubiquitous computing. IEEE Pervasive Computing, Los Alamitos, v.1, n.1, p. 70-81, Jan. 2002.

Book

- Available in main bookstores: Amazon, Barnes & Noble, ...



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