

# SOME COMPUTER SCIENCE ISSUES IN UBIQUITOUS COMPUTING

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*(Weiser, 1993)*

*Seoul National University  
College of Computer Science and Engineering  
Distributed Information Processing*

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# OVERVIEW

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- Introduction & Background
- *Calm* technology
- What is *Ubiquitous Computing*?
- Early stages
- Approaches
- Issues
- Future: IoT

# **INTRO**DUCTION & BACKGROUND

# ABOUT THE AUTHOR

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## Mark Weiser



- Chief scientist at Xerox PARC (Palo Alto Research Centre Incorporated).
- Father of Ubiquitous Computing (Weiser, 1991).

# CONTEXT (1990'S)

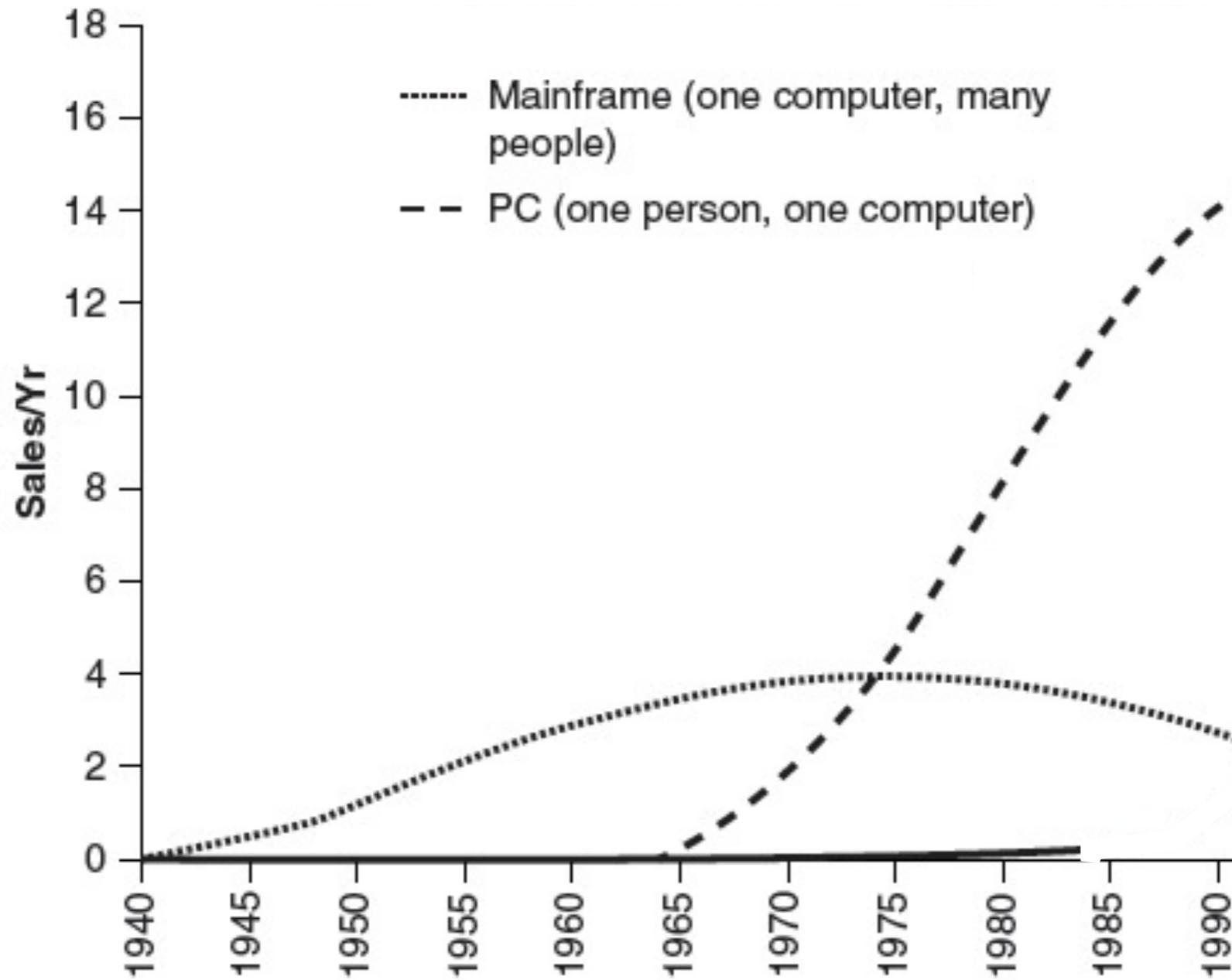
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- 91 — First web browser & first web site goes online (CERN)
- 92 — **SOCKS** Internet Protocol was made public.
- 93 — Intel starts selling first **Pentium** chips.
- 93 — Term *Spamming* was conceived by Joel Fur.
- 93 — First version of **PDF** format.



# CONTEXT CON'T (TRENDS IN COMPUTING)

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**UBICOMP**

WWW  
UBIRCOMP  
2021!

# UBICOMP

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- Next generation computing **environment** (framework).
- **Goal:** Allow user to interact with many interconnected computers, and making it **invisible** to the user.
  - Invisible? So naturally embedded, that users use it without thinking about it
- **Results:** Allow users to connect effortlessly to many familiar details (*locatedness*).

# CALM TECHNOLOGY

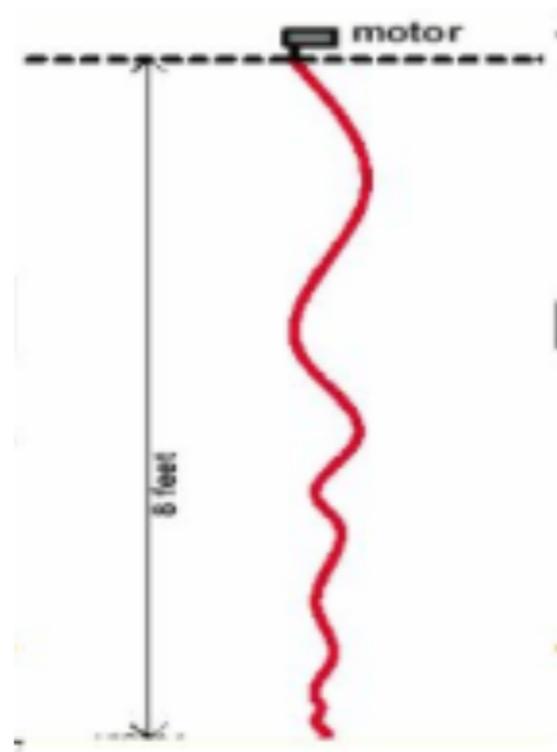
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- Calm Technology: Increase peripheral reach to increase knowledge, without increasing information overload.
  - Increase in “familiar” information
  - **Characteristics:**
    - From being centre of attention to a dormant state.
      - *Center >> Peripheral >> Center.*
    - Enhance Peripheral Reach

# CALM TECHNOLOGY (CON'T)

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- Calm Technology Examples (Dangling String)
  - Ambient interface
  - Not obtrusive



(Invented by Natalie Jeremijenko)

# CONCLUSION

Computing *today*\* rather than being a tool through which we work, disappearing from our awareness, it remains the focus of attention

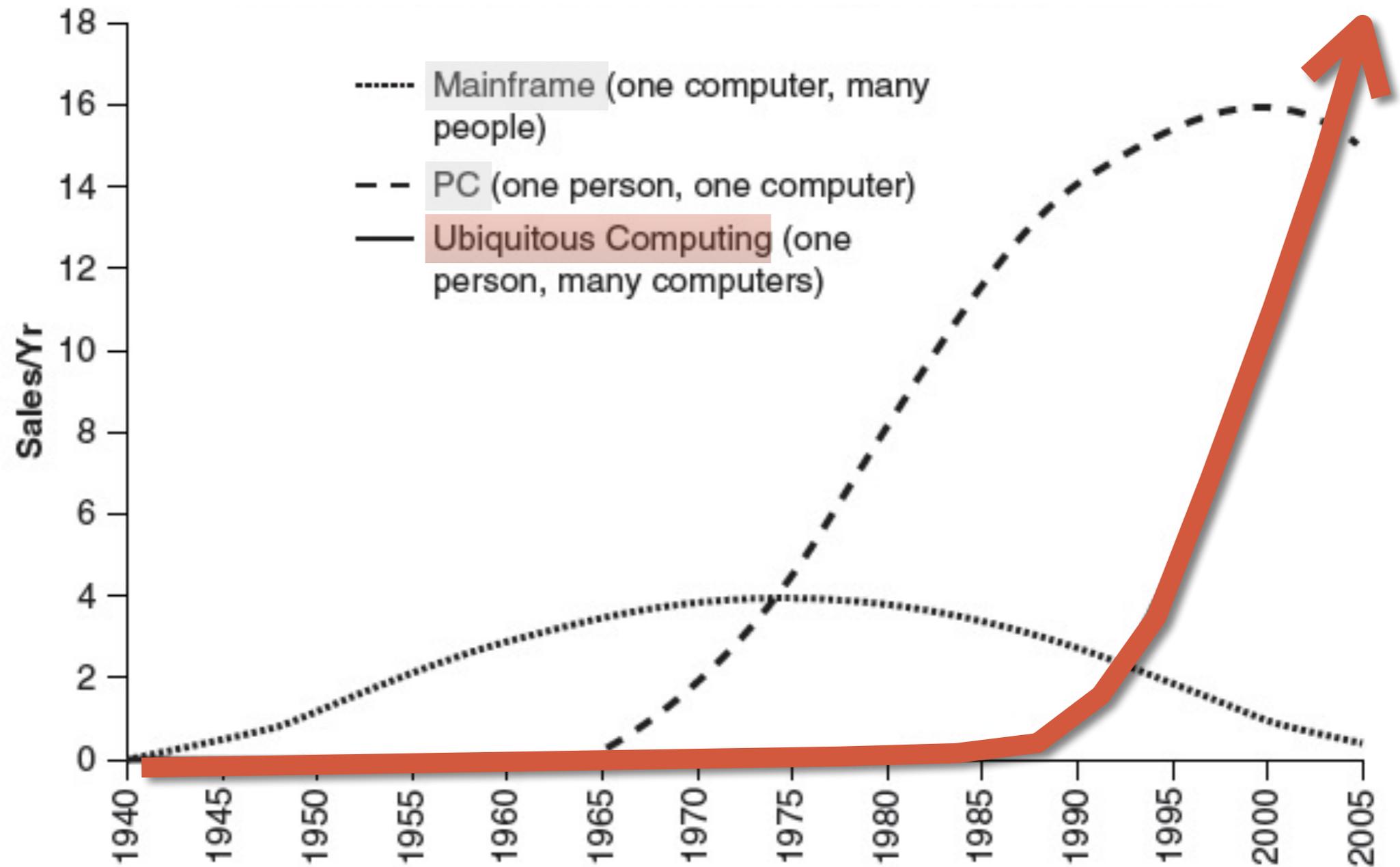
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Ubiquitous computing names the **third** wave in computing... The age of calm technology...

*-Mark Weiser*

# MAJOR TRENDS IN COMPUTING

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# EARLY STAGES OF UC

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- Virtual Reality

- **Problems:**

- Takes over peripheral of user

- Can't fool the user (Its goal is to do it)

- Personal Assistance?

- **Problem:**

- Not invisible (Need of explicit orders)

- Imagine you want to lift something heavy what do you do?

# XEROX PARC DEVICES

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- **Approach:** tempt and construct new artefacts computing artifacts to use everyday (Phase I).
  - Putting the computer out into *this* world
- Inspired by **everyday objects** in homes and offices
  - Must be:
    - Various sizes & Shapes
    - Inexpensive

# XEROX PARC DEVICES (CON'T)

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- 3 sizes with 3 different quantities

Hundreds of Small devices: **Tabs** inspired by post-it

Tens of Medium size devices: **Pads** inspired by Notepad

One/Two Big (wall size) devices: **Boards** inspired by White-board

# XEROX PARC DEVICES (CON'T)

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ParcTab



XPad / MPad



Live board

# XEROX PARC DEVICES (CON'T)

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## Problems:

- Size
- Power



ParcTab

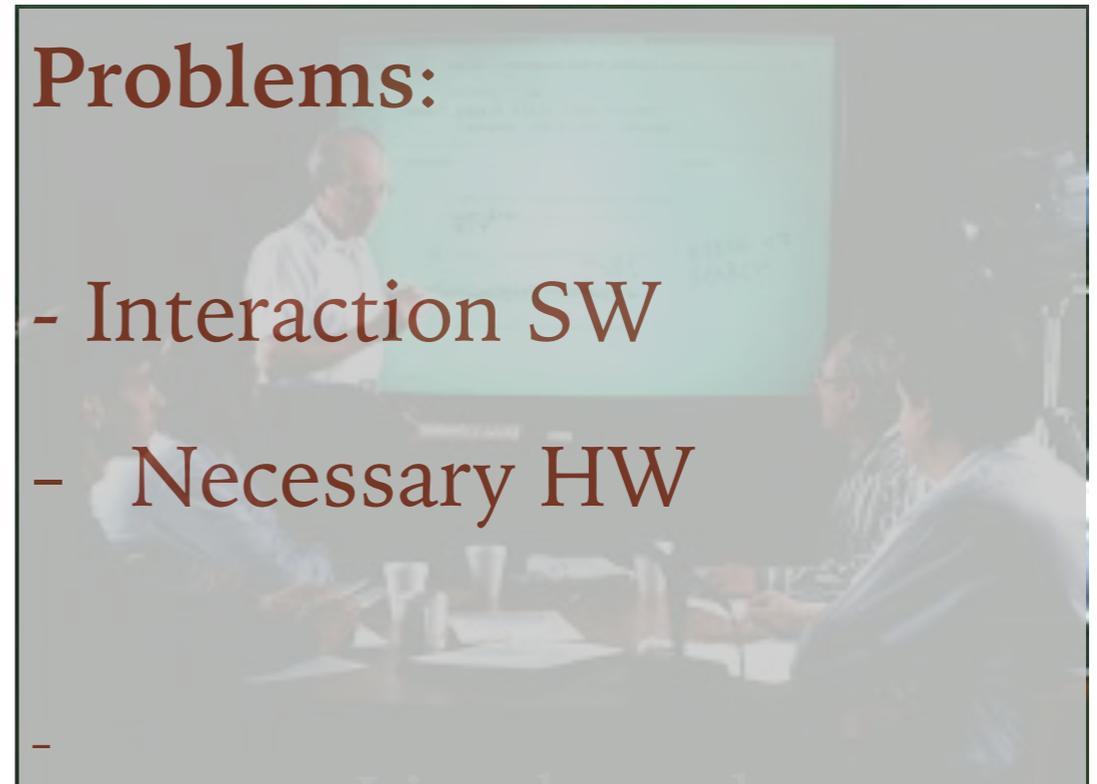
## Necessities:

- Ease of expansion (FPGA)
- Pen for interaction
- Communication

XPad / MPad

## Problems:

- Interaction SW
- Necessary HW



Live board

# XEROX PARC DEVICES (CON'T)

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## Problems:

- Size
- Power

ULTIMATE GOAL?:

**BALANCE**

## Necessities:

- Ease of expansion (FPGA)
- Pen for interaction
- Communication

XPad / MPad

Problems:

- Interaction SW
- Necessary HW

Live board

# UBIQUITOUS COMPUTING

## ISSUES

# WHAT IS NEEDED FROM CS?

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- Hardware components
- Network protocols
- Interaction substrates
- Applications
- Privacy of location
- Computational methods

# HW COMPONENTS ISSUES

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- Low power
  - Tradeoff between power consumption, size and performance
- Wireless
  - Reuse same frequency (no need of FCC license)
  - Transceivers at low power
- Pens (using IR)
  - Capable of large area operation
  - No need of a touch screen



# NETWORK ISSUES

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- Media access wirelessly
  - **Multiple Access Collision Avoidance**
    - Handshake with RTS/CTS
    - Solves hidden terminal problem
    - **Fairness:** Using same *backoff* parameter
    - **Realtime:** NCTS( $n$ ) packet (Not clear to send)
  - CSMA/CA

# NETWORK ISSUES (CON'T)

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## ➤ Mobility support

- Allow media access in different regions (moving devices)
  - **Solution:** Virtual IP (Sony) , or Mobile IP (Columbia Unv.)
- Allow IP networks interoperate transparently with roaming hosts
- **How?** Adding a second layer of IP address
  - Requires, packet forwarding
  - keeping track of “real address”



# INTERACTION ISSUES

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## ➤ Tabs

- Have a very small interaction area
- “Touch typing” that uses only a tiny area

## ➤ Liveboards

- Using conventional pull-down or pop-up menus
  - Requires walking across the room
- Location-independent interaction is need

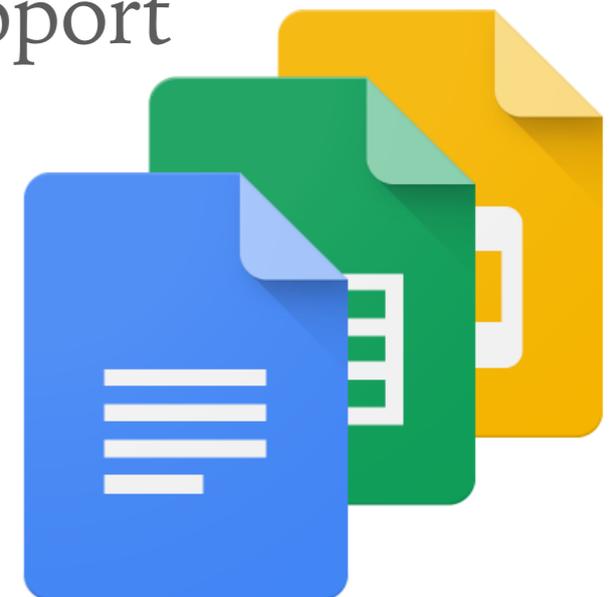
## ➤ X-window system

- User may move from device to device, and want to bring windows along
- Window migration tools
  - Lower bandwidth needed

# APPLICATIONS ISSUES

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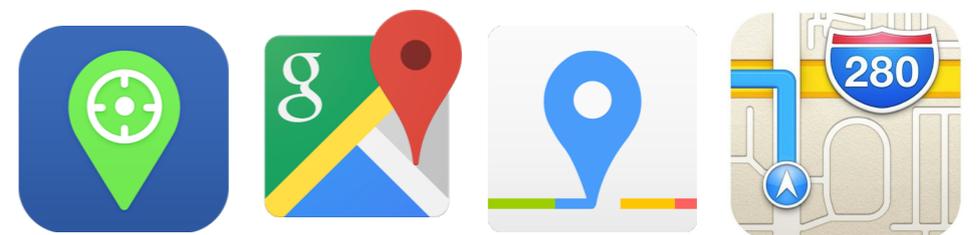
- The location of people
  - Can be deduced from logins or collected from an active badge system
  
- Shared meeting tools
  - Pen-based drawing on a surface
  - Simultaneous and independent multi-user support
    - On different / same pages



# PRIVACY ISSUES

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- In cellular system
  - Traveling pattern of cellular phone user can be deduced from the roaming data
- Preserving privacy of location
  - Central DB of location information
  - Store information at each person's PC
    - Short-term **accumulation** of location information
- Transmission and sharing of data must be evaluated in a social context



# COMPUTATIONAL METHODS

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- Optimal Cache Sharing Problem

- Why? Low bandwidth and high processing power!

- Solution:

- Strategy for partitioning memory between **compressed** and **uncompressed** pages

- Requires methods to handle cache misses over high latency mediums

# CONCLUSION

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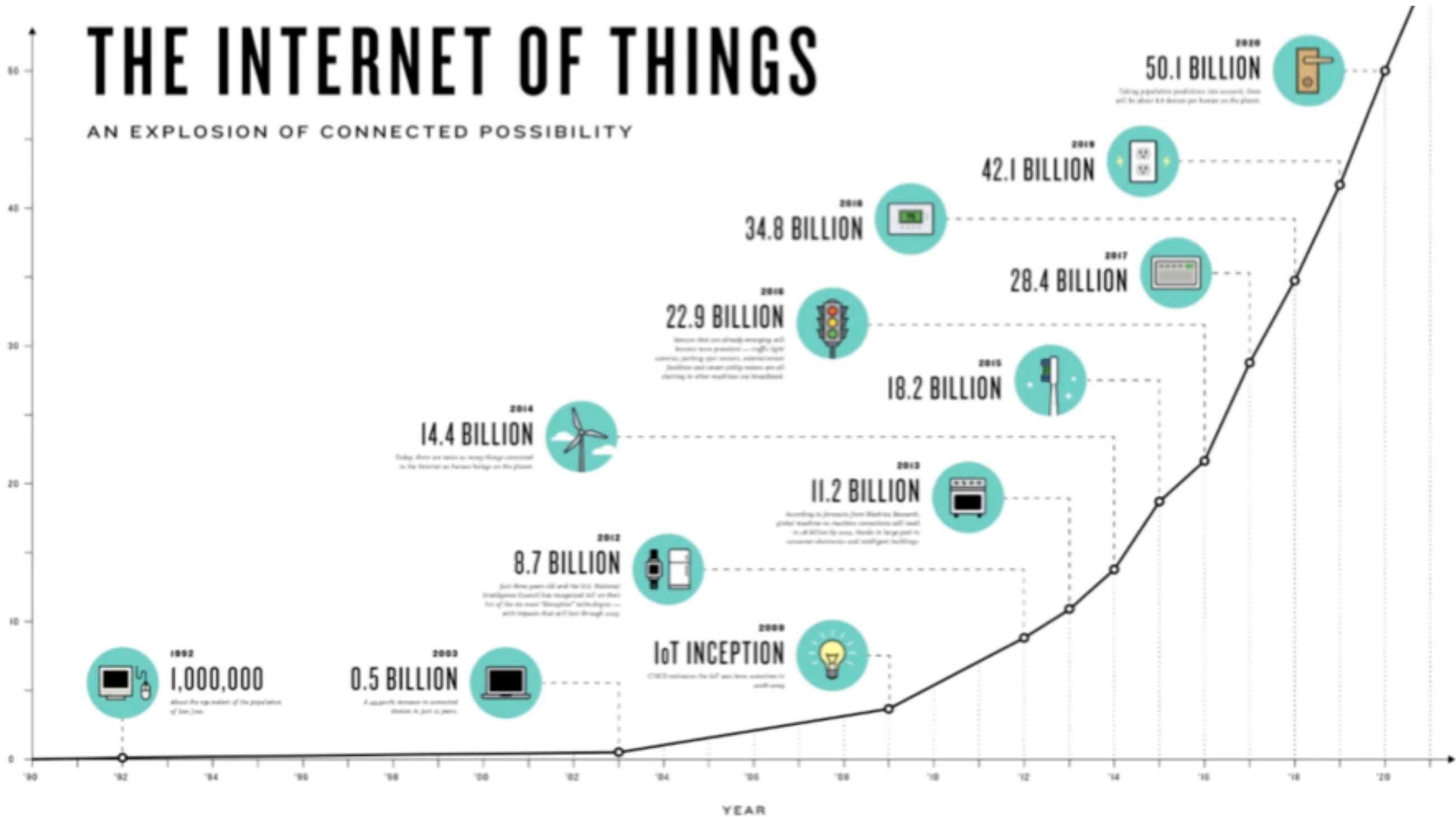
- Ubiquitous Computing is
  - Making many computers available throughout the physical Environment while making them effectively invisible to the user.
- *Ubicomp* seems likely to provide a framework for interesting and productive work for many more years
- Many of the issues and challenges had been solved already
- Have much to learn about the details

**BACK TO 2015**

# THE INTERNET OF THINGS

AN EXPLOSION OF CONNECTED POSSIBILITY

BILLIONS OF DEVICES



# REFERENCES

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- Weiser, M. “The Computer for the twenty-first century.” *Sci. Am.* (Sept. 1991) 94–104.
- Weiser, M., Demers, A. and Hauser, C. “The portable common runtime approach to interoperability.” In *Proceedings of the ACM Symposium on Operating Systems Principles* (Dec. 1989).
- M. Weiser. "Some Computer Science Issues in Ubiquitous Computing," *Communications of the ACM (CACM)* Vol. 36, No. 7, July 1993, pp. 74-84

**GRACIAS**  
**THANK YOU**