



Some Reflections on The Future: Dipping A Toe in the Datastream

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[Technology Trends]

- Costs of storage, processing and communications are dropping
- Devices are becoming:
 - Smaller and cheaper
 - More capable
 - Communicative and Interconnected
 - Uniquely identified
- From centralized to distributed-Pervasive Computing
- New tools emerging for aggregating, sharing, searching and distributing data

Societal Trends Encourage Proliferation of Devices and Data

- Increased concerns about security
- Pressure for greater efficiency and productivity
- Environmental protection and disaster prevention
- Aging of population
- Desire to be able to connect to anyone from anywhere at any time

Explosion of Devices with Increased Capabilities

- RFID's — “Internet of Things” All objects can communicate
- Growth of portable communications appliances--cell phones, PDA's etc.-- and in-vehicle navigation devices
 - Provide location information
 - Read and relay RFID data
- Sensor networks
- Surveillance cameras/camera phones

Plans for Sensor Networks are Proliferating, Bridging Physical and Virtual Worlds

- Smart buildings
- Smart transport
 - Smart cars/smart highways
 - Secure transport
- Home monitoring for the elderly
- Environmental scanning
- Detection of bio-terrorism or WMD's
- Making the supply chain transparent

More Devices and Transactions Create a Torrent of Data

- By the year 2020
 - One billion computers
 - Ten billion appliances
 - One hundred billion sensors
- Total amount of data connected to the Internet*
 - 2001: One petabyte (10^{15})
 - 2006: One exabyte (10^{18})
 - 2010: One zettabyte (10^{21})

*Source IBM ®

[Hurricane Katrina – 2015]

- Monitor environment
 - Structural integrity of levees
 - Presence of water
 - Presence of toxic substances
- Monitor people
 - First responders tracked via improved communication devices
 - Victims located via building monitoring systems
- Monitor goods
 - Inventory and distribution of emergency supplies
 - Automatic reordering
 - Location of high value medical and rescue equipment

Existing Privacy Model Challenged

- Fair Information Practices
 - Designed for centralized data controller and personally identifiable information
 - Notice
 - Choice/consent
 - Minimization/collection
 - Security
 - Access
 - Accountability

New Model – Surveillance Without Conscious Action

- Every object is a collector
- Always on
- General purpose
- No obvious monitoring cues
- Broadly shared data
- Data that is communicated can be intercepted

[Issues]

- Who is gathering what data?
- Who has access to the data?
- What is happening to the data?
- Who is responsible for the data?
- Can a new model be built on the principles underlying fair information practices?

[Barriers are Eroding]

- Power limitations—but this will change
- Limited transmission range—but this will change
- Stand alone networks—but this will change
- Isolated data—but this will change
- Size of devices provides some notice—but this will change

[Privacy and Security by Design]

- Authentication
- Encryption
- Anonymous data mining
- Aggregated data
- Blockers/scanners
- Privacy preferences attached to data
- Liability
- End to end security

[Other Challenges]

- Managing increasingly complex networks and relationships
- Transforming data into intelligence
- Spectrum availability
- Health effects
- Employment and education

[A Last Word about Openness]

- RFID built on open standards
- “Open Innovation” emerging as a powerful force
 - Provide broadest possible access to problem/challenge
 - Invite contributions from anyone, anywhere
- Applications limited only by our imaginations

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