

View from the USA

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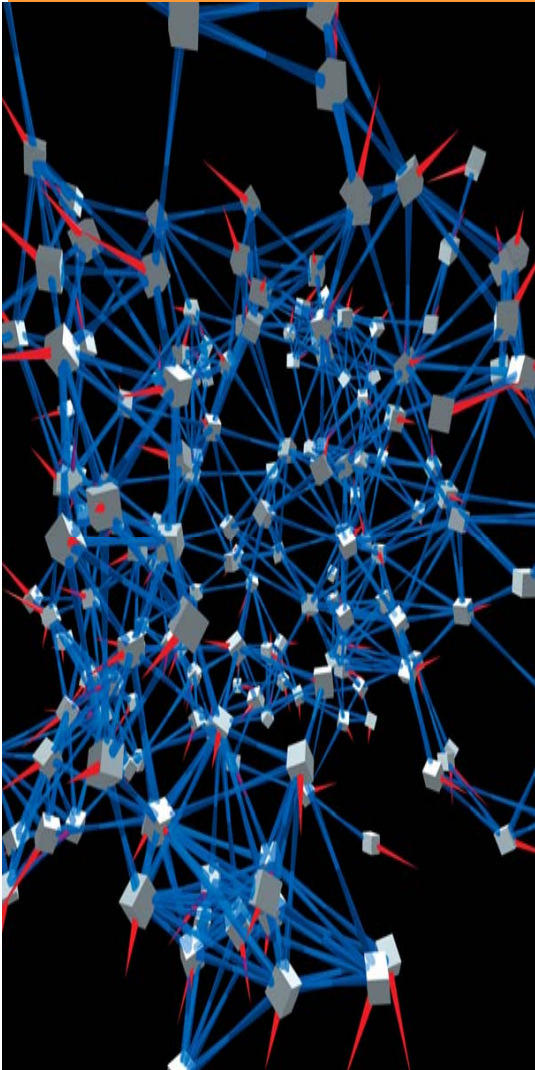


ADS Seminar, Edinburgh, 7th September 2006

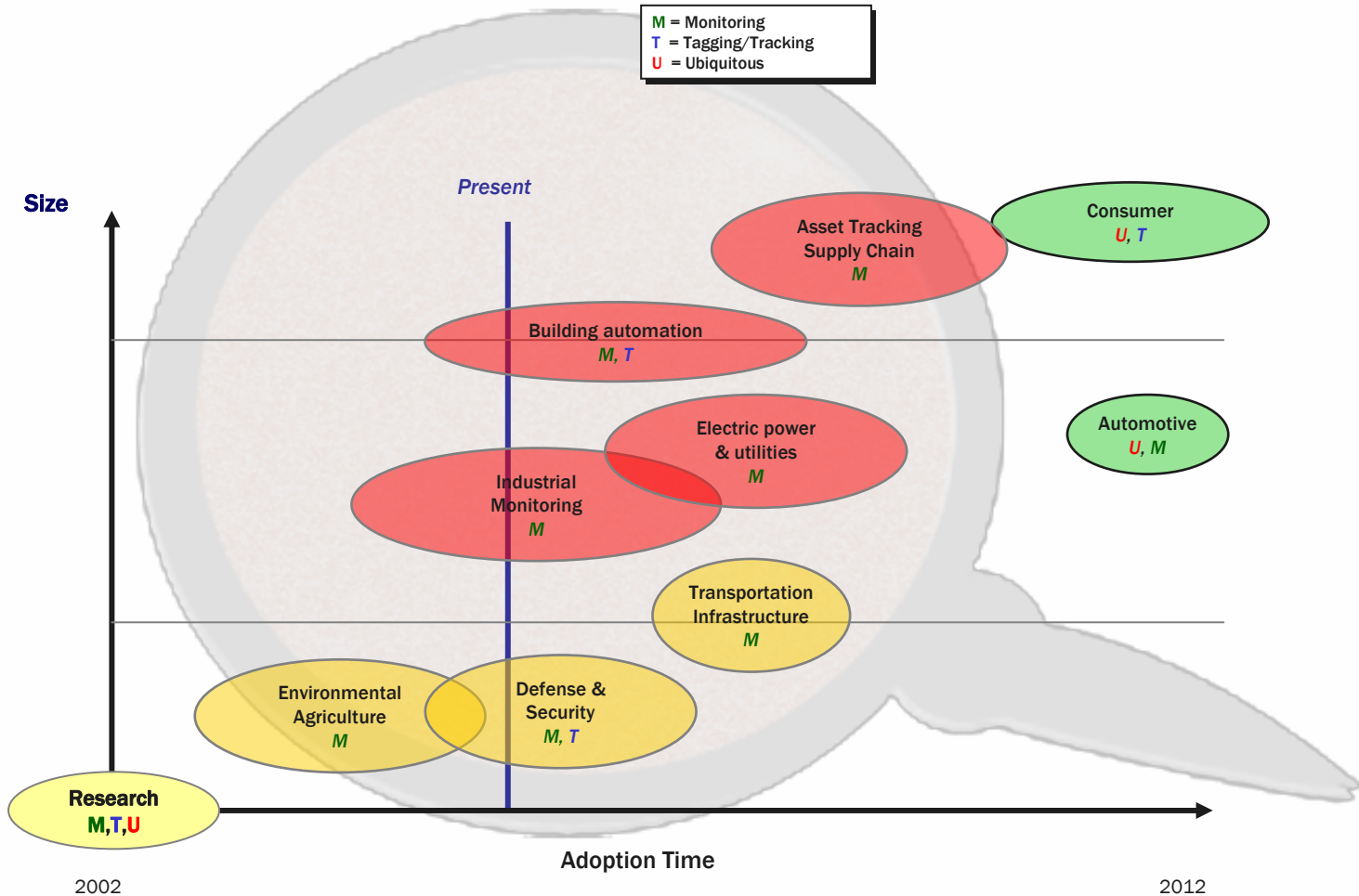
Outline

- Applications and Markets for WSN
- Partnerships b/w Academia, Industry and Government in the USA
- Way Forward

http://www.dti.globalwatchonline.com/online_pdfs/36494MR.pdf

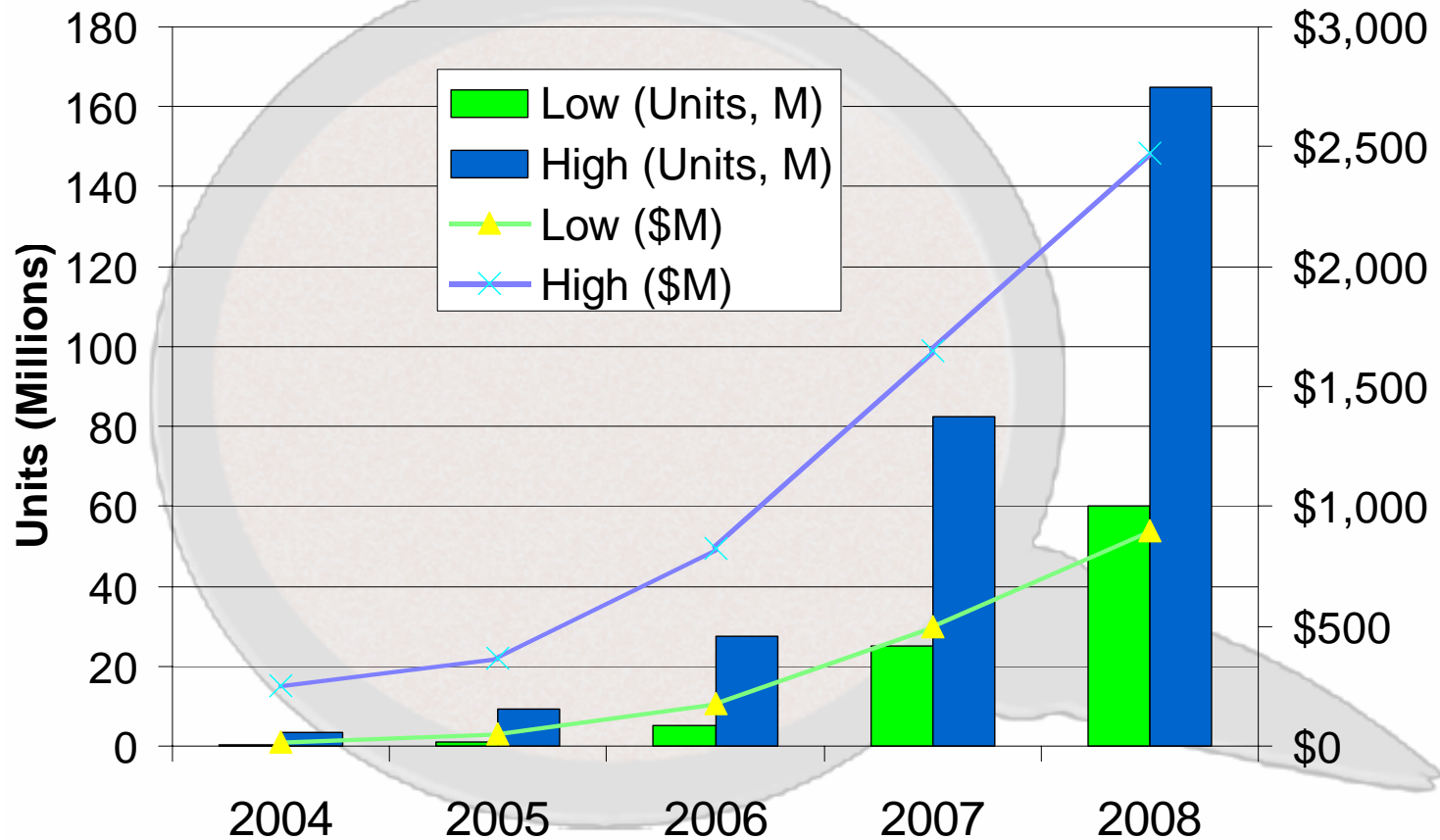


Projection of relative market sizes and adoption times



Courtesy Crossbow Technologies

Market Size in WSN



Courtesy Crossbow Technologies

Key Partners in WSN in the US

- **Universities**
- Multidisciplinary Research Centres
- Government agencies
- University Spin-Out Companies
- Industrial Research Laboratories

Key Academic Research Projects

- “Smart Dust” – University of California at Berkeley
- “Wireless Integrated Network Sensors” – University of California at Los Angeles
- WSN research funding in US universities *circa* \$100M since 1998 from DARPA, NSF, Industry

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Research Centres

- Berkeley Wireless Research Center (BWRC@UCB)
- Center for Embedded Networked Sensing (CENS@UCLA)
- California Institute for Telecommunications and Information Technology (Calit2@UCSD)
- Center for Information Technology Research in the Interest of Society (CITRIS@UCB)

- CITRIS is a “Center or Centers”
- Provide “.. IT solutions to grand challenge social and commercial problems affecting the quality of life of Californians and people around the world.”
 - Energy
 - Environment
 - Rapidly-deployable Infrastructures for the Third World
 - Water
- Significant state and industrial support
- > 60 Industrial partners; > 30 Research Centres;
> 200 Research Faculty

- Grew out of the DARPA-funded InfoPad project
- Early industrial collaborators: Ericsson, Lucent, TI, ST Microelectronics, HP and Cadence
- Build on industry base to do advanced research
- Senior researchers from the industrial partners spend time at BWRC
- Precompetitive research and results in public domain
- 50 researchers in 11,000 sq ft in off-campus sit

Focus: Design of single chip low-power CMOS wireless transceivers

- Taking ideas beyond theory into practice
- Development and deployment of prototype infrastructure for testing new solutions in a real-world context
- Annual subscription of \$120K for companies to gain privileged access to research results

“Create programmable, autonomous distributed, multi-modal, multi-user observatories to address compelling science and engineering issues”

- 2002-07, \$40M, NSF-funded
- Environmental Monitoring: Aquatic, Contamination, Seismic, Terrestrial
- National Ecological Observatory Network

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Government Agencies

- Defense Advanced Research Projects Agency (DARPA)
- National Science Foundation (NSF)
- California Energy Commission (CEC)
- National Ecological Observatory Network (NEON)

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University Spin-out Companies

Crossbow
TECHNOLOGY INC.

Impinj

ember

DUST
NETWORKS

Millennial Net

sensoria

TE_{DRIL}

ARCHROCK

Speckled Computing



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Industrial R&D in WSN

- Agilent
- Intel Berkeley Labs
- IBM
- SUN Microsystems, Menlo Park
- PARC

Factors driving collaboration

- Funding Policy
- Industrial Partnerships
- Shared IP and Open Standards
- Rewarding of Collaboration
- Compelling Practical Demonstrations
- Community of Users

Shifts in Funding Policy

- DARPA – early champion since '94
- Shift in emphasis after the Cold War
- Homeland Security concerns after 9/11
- Emphasis on Disaster Mgmt
- Power distribution and Energy Mgmt – California Energy Commission
- Gray Davis's \$100M Discovery Grant

Shared IP and Open Standards

- Long history of open IP policy in UC, e.g. BWRC
- Open standards for wireless protocols
- TinyOS and nesC – rapid experimentation with WSNs

Community of Users

- Place WSNs in the hands of young developers
- Author WSN applications and drive developments in hardware and software
- Future users of WSN technology

Outstanding technical challenges

- Application Development Environment
- Standards
- Reliability
- Security
- Longevity
- Miniaturisation
- Privacy
- Integrated Technology Push

Message to take home

- Culture of collaboration between academia and industry in WSN
- Strong presence of government agencies, DARPA, NSF, NEON, CEC
- Changing climate of funding – new imperatives
- Collaborative infrastructure projects – demonstrators for WSN technology
- Open IP policy
- Community of WSN users

Opportunities for Scotland

- Sensitise developers to WSN technology
- End-users adopt WSN technology in their products to maintain competitive edge
- Commercial development of WSN is likely to follow the embedded systems market (rather than the PC industry)
 - component manufacturers (radio, sensors, processors)
 - system integrators
 - firmware developers
 - WSN applications developers

Way Forward

- Beacon projects in collaboration b/w industry and academia
- Technology transfer to industry, especially SMEs
- Design kits and reference designs
- Training and Education
- Participation in standards meetings and disseminate to SMEs