

Microsoft® Research

# Faculty Summit 2010

Guarujá, Brasil | May 12 – 14 | In collaboration with FAPESP

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## Microsoft Research: Ensuring Microsoft's Future

Henrique (Rico) Malvar

Distinguished Engineer, Microsoft Corporation, and  
Managing Director, Microsoft Research, Redmond

# Contents

- Motivation & MSR overview
- Technology transfer
- External collaborations and impact
- Examples of MSR technologies
- Q&A

# Contents

- Motivation & MSR overview
- Technology transfer
- External collaborations and impact
- Examples of MSR technologies
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# Complex ecosystem



desktop PC



laptop PC



media center PC



Xbox 360



MS Surface



tablet PC



IP phone



pocket PC



mobile phone



servers



RoundTable



portable media center



Zune



cable TV box



data centers



dn.sapo.pt - Translator - Windows Internet Explorer

http://www.microsofttranslator.com/bv.aspx?ref=SERP&br=ro&mkt=en-US&dl=en&lp=pt\_en&a=http%3a%2f%2fdn.sapo.pt%2f

diario de noticias

dn.sapo.pt - Translator

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Translate URL  Portuguese English Views

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sapo.pt Acesso Blogs Fotos Mail Messenger Spot Videos

Descubra as Soluções de Financiamento Cetelem.

Última hora Arquivado caso contra polícia por "sexo virtual"...

Diário de Notícias

PASS.

INÍCIO DESPORTO CARTAZ BOLSA GENTE ESPECIAIS GALERIAS ARQUIVO

Portugal Globo Economia Ciência Artes TV & Media Opinião Pessoas

IRAQUE: DUPLO ATENTADO

Novo balanço aponta para 132 mortos e 520 feridos

As autoridades iraquianas informaram que subiu para 132 o número de mortos no duplo atentado ocorrido hoje no centro de Bagdad, o mais sangrento do ano, que provocou ainda 520 feridos.

- Atentados mais graves desde a queda de Saddam Hussein
- Presidência da UE condena atentados de hoje em Bagdad

VEJA AQUI A FOTO GALERIA

CASAMENTO HOMOSSEXUAL

Francisco Louçã manifesta-se contra eventual referendo

O líder do Bloco de Esquerda Francisco Louçã defendeu hoje e Condeixa não se justificar que o casamento homossexual seja referendado no país como ponderam solicitar diversas associações ligadas à defesa...

BAQUETEBOL

Jogador da Ovarense faleceu ao intervalo do jogo

O basquetebolista norte-

Cartão de Crédito Citi com anuidades GRÁTIS. Adira já!

Last minute officially ...Venezuela: Chavez drew Filed against the police by "virtual" sex ... centres ...

Diário de Notícias

PASS.

BEGINNING SPORT POSTER SCHOLARSHIP PEOPLE SPECIAL GALLERIES FILE

Portugal Globe Economy Science Arts TV & Media View People

IRAQ: DOUBLE ATTACK

New balance points to 132 dead and 520 injured

The Iraqi authorities have reported that rose to 132 the number of killed in double attack occurred today in the Centre of Baghdad, the more bloody year, which caused even 520 injured.

- The most serious attacks since the fall of Saddam Hussein
- EU presidency condemns today's attacks in Baghdad

HERE'S THE PHOTO GALERIA

GAY MARRIAGE

Francisco Louçã against possible referendum

The left block leader Francisco Louçã Condeixa today defended not justified gay marriage in the country is curriculum will need How to balance request various defence-related associations.

BASKETBALL

Player ad ovarense died while game range

The American basketball Kevin Wildemond, ad ovarense, died today in time with the

Done

Internet | Protected Mode: Off

100%

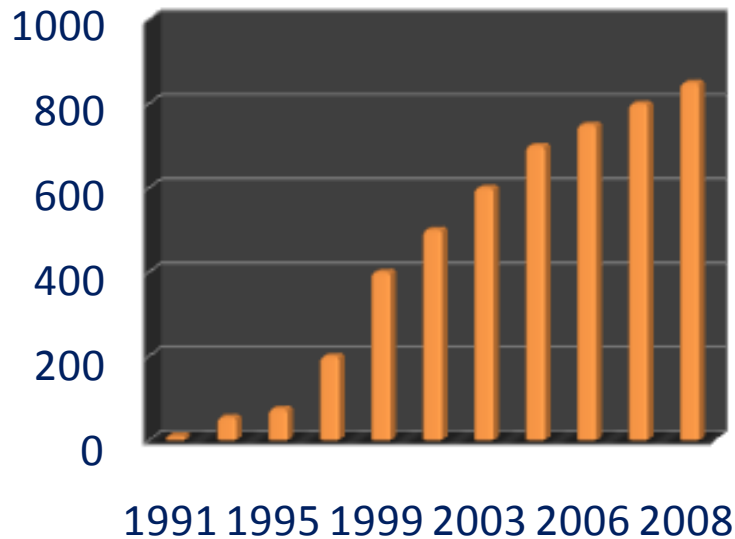
# New challenges / opportunities

- Secure computing / communication
  - Worm/virus removal
  - Web search spam, click fraud
- Information search / retrieval:
  - Internet, Intranet, and personal
  - Social metadata
- Federated / distributed databases
- Media management
- Mining of high-volume data
  - Bio, medicine, scientific applications
  - Increasingly in business applications, as well
- Cloud services with mobile clients



# Microsoft Research

- Redmond, Washington (Sep 1991)
- San Francisco, California (Jun 1995)
- Cambridge, England (July 1997)
- Beijing, China (Nov 1998)
- Silicon Valley, California (July 2001)
- Bangalore, India (Jan 2005)
- Cambridge, Massachusetts (July 2008)



■ # PhD Researchers



MSR Redmond



MSR Asia



MSR Silicon Valley, CA



MSR Cambridge, UK



MSR India



MSR New England



# World-class talent



11

IEEE Fellows

2

IEEE Emanuel R. Piore Awards

4

Royal Academy of Engineering Awards

1

National Academy of Sciences Award

2

Draper Prizes

8

ACM Fellows

1

Kyoto Prize in Advanced Technology

6

American Academy of Arts & Sciences Fellows

1

CHI Lifetime Achievement Award

1

Fields Medal

3

Turing Awards

1

Foreign Member, Royal Swedish Academy of Sciences

19

National Academy of Engineering Members

2

John von Neumann Medals

3

Royal Society Fellows

1

American Association for the Advancement of Science Award



# MSR mission statement

- Expand the state of the art in each of the areas in which we do research
- Rapidly transfer innovative technologies into Microsoft products
- Ensure that Microsoft products have a future

# Value of Microsoft Research to Microsoft

- Source of IP and new product technologies
  - Microsoft Research generates about 20% of Microsoft's patents
  - MSR patents are more "fundamental"
- Problem solving
  - Ability to bring smart people together to rapidly address hard problems confronting products, product groups, or the company
- Early warning system
  - Ears to the ground in new areas, across a broad range of technologies



Microsoft Patent Award

# Inventing the future

- Interactive Visual Media
  - Graphics and multimedia
  - Digital photography and video
- Platform Elements
  - Networking, operating systems
  - Mobile phones and services
  - Sensor networks
  - Security, protection against malware
- Software Development
  - Languages, tools, compilers
  - New SWEPT cross-lab effort for the creation of new SW development tools
- Data and Documents
  - Data solutions for a petabyte world
  - Search
  - Fighting junk communications
- UI and Collaboration
  - Speech, ink, natural language, gesture
  - Machine Translation
  - Meetings and collaboration
  - Modeling of people and groups
- Science
  - CS-designed vaccines (HIV), quantum computing, astronomy



# MSR culture

- Corporate funding
  - we use a small part of Microsoft's ~\$9.5B R&D budget
- Typical profile of a Researcher:
  - went through extensive hiring process
  - significant freedom
  - incentive to publish
  - staff software engineers for efficient prototyping
  - support from "special projects" engineering team
  - support from MSR legal team – quick path from idea to patent
  - collaborations with world-class experts in multiple areas

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# Collaborations with product groups

- It's a social process
  - campus environment is key
- TechFest in March, ~5,000 attendees
- MSR must understand needs of product teams
  - Burden is on us to break prejudice
  - Staff engineers key to building robust prototypes
  - Program Management team helps establish/foster connections
  - MSR must write code (good code, not just "math dump")
- MSR must help with long-term vision
  - What will be possible in 5-10 years?
  - Map that into concrete steps with short- and mid-term goals

# Examples of MSR tech transfers

- New ranking algorithms for Bing
- **Sensors in Xbox "Natal"**
- Superfecth for Vista and Windows 7
- Speech & handwriting recognition
- Network management tools and algorithms
- Software design/testing tools - used to build Windows
- Data cleaning, auto admin
- **StreamInsight: SQL 2008 R2**
- ClearType, media formats (WMA, JPEG XR, H.264)
- **Microsoft RoundTable & Surface**
- **Microsoft Tag**
- Junk e-mail filters
- Desktop search
- Machine translation in Bing
- Audio processing in Windows
- **Many, many more...**





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# MSR external impact

- Hundreds of publications per year
- Dozens of conference chair positions
  - General, technical, program committees, etc.
- Conference impact:
  - 40% of papers at UIST 2009
  - > 30% of papers at SOSP 2009, OSDI 2008, PLDI 2001
  - 22% of papers at SIGCOMM 2008
  - 18% of papers at SIGIR 2008, STOC 2005, SIGMOD 2006
- Largest single contributor to many conferences:
  - SIGGRAPH 2004, SIGIR, SIGMOD & OSDI 2004, SIGCOMM & ICASSP 2008, SOSP & UIST 2009, etc.

# Strong interactions with academia

- Active participation in community
  - Conference committees
  - Editing of key journals
  - Professional service – NSF, NRC, DARPA, ...
- Strong ties with universities
  - Faculty Summits
  - Worldwide Academic Summits
- Extensive visitor and speaker program
  - Students, faculty, research scientists
  - Post-docs, sabbaticals, interns
  - ~300 interns in MSR Redmond in 2009~1,000 worldwide  
largest intern program in IT industry

# Worldwide talent support

80

students from around the world selected in 2008 for Ph.D. fellowships and scholarships

MORE THAN **100 top Ph.D. research students** from leading European academic institutions currently supported by Microsoft Research fellowships

10

computer science students selected each year under the GRADUATE WOMEN'S SCHOLARSHIP PROGRAM

ABOUT **400**

TOP STUDENTS from dozens of universities participate each year in Microsoft Research Asia's Stars of Tomorrow internship program

25

Microsoft Research Faculty Fellowships awarded since 2005 in the U.S. and Canada

MORE THAN **25,000**

scientists, academic researchers, faculty and students have attended Microsoft Research-sponsored summits, conferences and workshops since 2005

Microsoft Research collaborates with more than

**100**

top universities in North America

NEARLY

**1,000**

students selected annually for internships at Microsoft Research labs in the U.S., China, India and the UK

ABOUT **100**

students and young faculty attend the annual MICROSOFT RESEARCH INDIA SUMMER SCHOOL PROGRAM

**250**

RESEARCHERS FROM

**50**

UNIVERSITIES IN

**16**

COUNTRIES

have joined with Microsoft Research in the Latin American and Caribbean Collaborative ICT Research Federation (LACCIR)

**1,500**

attendees at Microsoft Research India's TechVista 2008 research symposium in Chennai

**465**

students from more than

**35** countries

have interned at the Microsoft Research Cambridge (UK) lab during the past seven years

**3,000**

students, faculty and research scientists attended Microsoft Research Asia's Computing in the 21st Century conferences in Beijing and Singapore

MORE THAN **30**

collaborative institutes and technology learning labs supported worldwide in research areas such as parallel computing, games for learning, artificial intelligence, computational and systems biology, and computational thinking

**250**

Ph.D. fellowships granted to students from 50 universities in the Asia-Pacific region since 1998

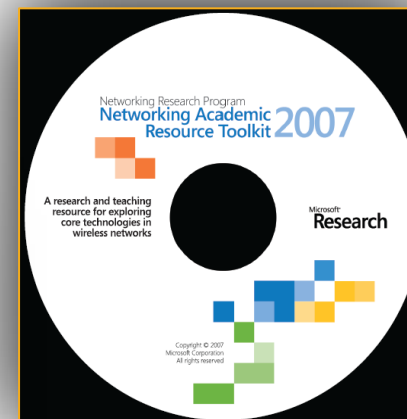
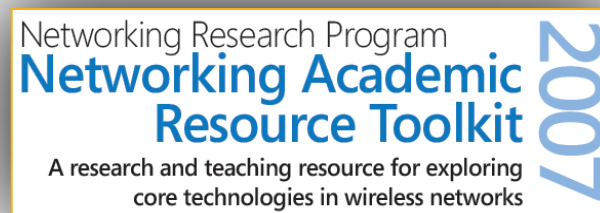
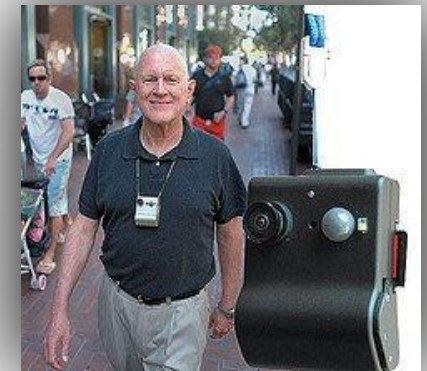


# Academic programs

- Support programs
  - Gift grants
  - Young faculty awards
  - Request for Proposals
  - Conference support
  - Technology Centers
  - Research Institutes
  - Graduate Fellowships
  - Young faculty awards
- Collaboration
  - Royalty-free patent licensing
  - Joint research programs
  - Technology sharing



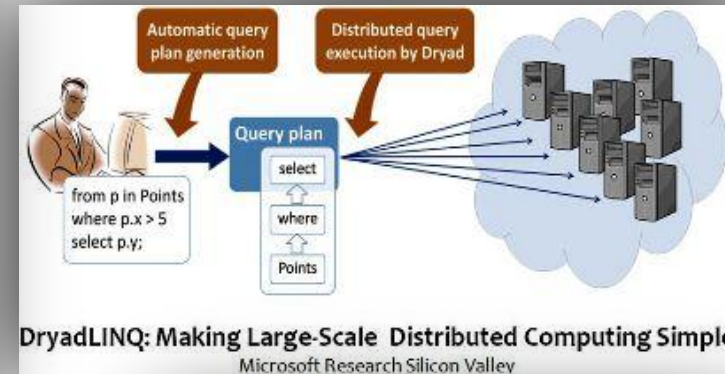
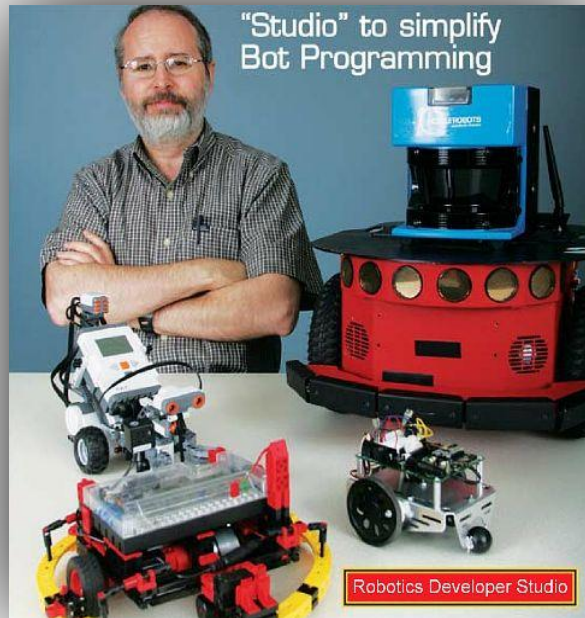
MSR Cambridge  
SenseCam



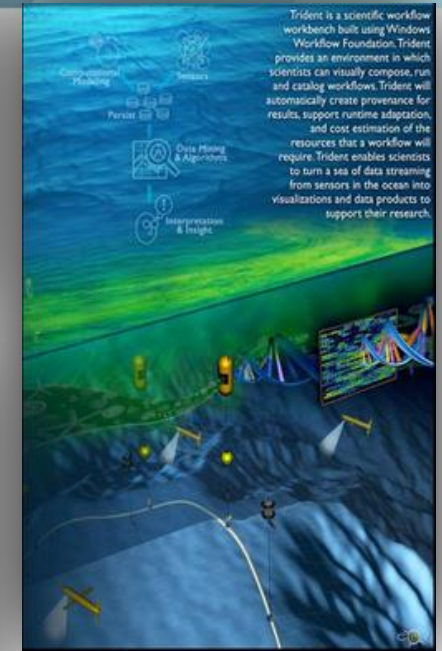
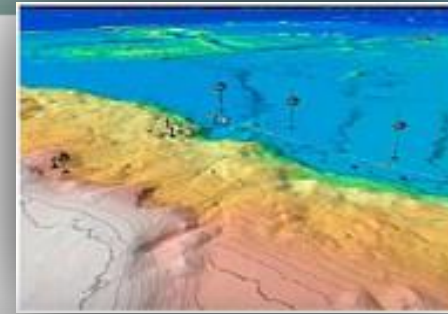
# Tools for collaboration with academia

- Trident – scientific workflow
- DryadLINQ – distributed computing

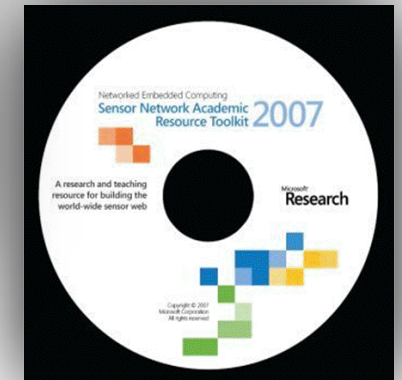
- MS Robotics Developer Studio



DryadLINQ: Making Large-Scale Distributed Computing Simple  
Microsoft Research Silicon Valley



- MSR Sensor Network Academic Toolkit



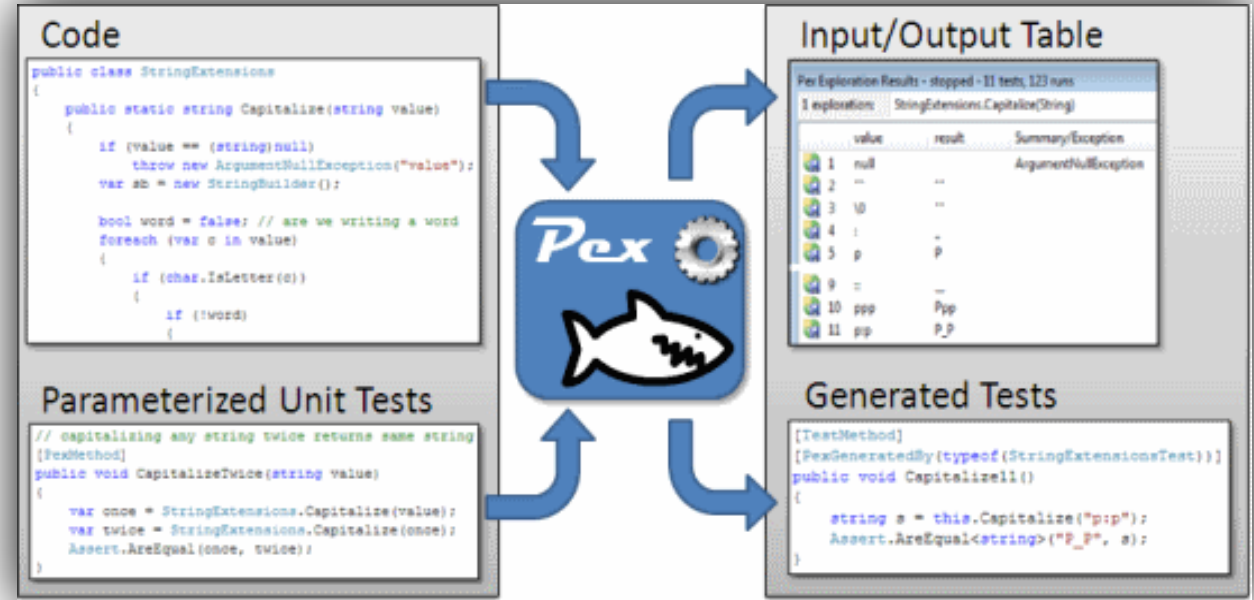
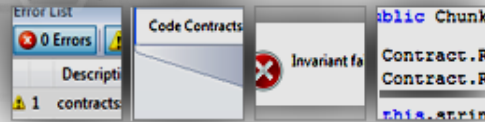
# MSR software engineering tools

- Pex - Automated white box testing for .NET
- Z3 – efficient SMT solver
- Code Contracts now in VS 2010

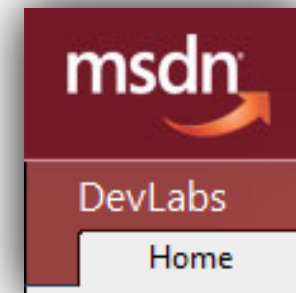
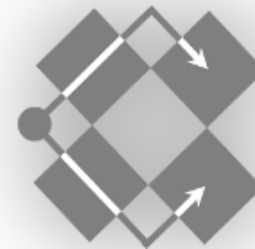


Code Contracts

Specify code with code



- CHES – find and replace heisenbugs





# WikiBABEL

- Tool for creating multi-lingual content
- Community creation of parallel data
- Light user interaction, efficient architecture

The screenshot shows the MSDN website in Portuguese, displaying the 'Regular Expression Syntax' article. The page is split into two columns: English on the left and Portuguese on the right. A red circle labeled '3A' highlights the English text: 'A regular expression is a pattern of text that consists of ordinary characters (for example, letters a through z) and special characters, known as metacharacters. The pattern describes one or more strings to match when searching text.' A second red circle labeled '3B' highlights the Portuguese translation: 'Um expressão regular é um padrão de texto que consiste em caracteres comuns (por exemplo, letras a z) e caracteres especiais, conhecidos como metacaracteres. O padrão descreve um ou mais seqüências de caracteres para corresponder ao pesquisar o texto.' A third red circle labeled '3C' highlights a 'Sugerir tradução' (Suggest translation) box that has appeared over the Portuguese text, containing the English text from circle 3A. The page includes a navigation menu, a search bar, and a footer with the Microsoft logo and copyright information.

Figure 3: wikiBABEL on MSDNwiki Data

# IP licensing

- Technology licensing to dozens of companies:

- Pex (code analysis):

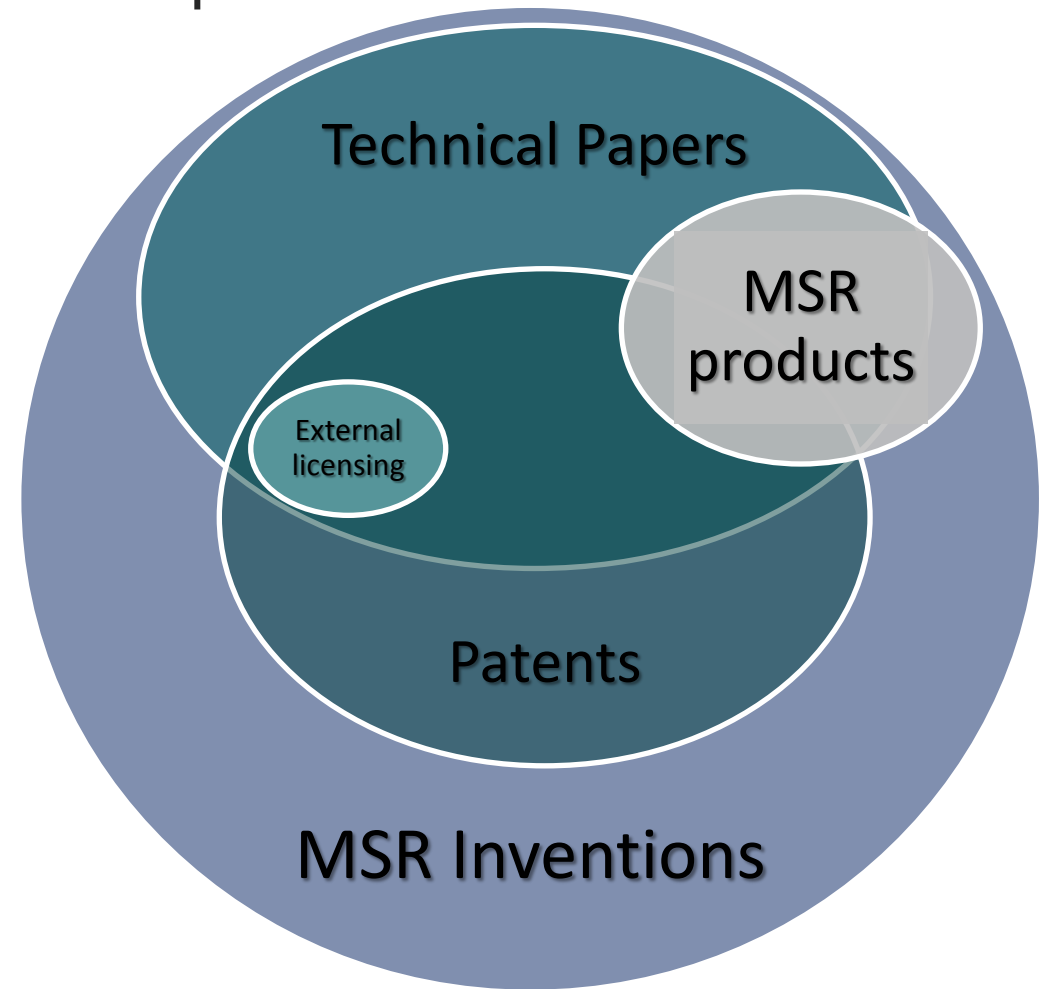
- 3M
    - Credit Suisse
    - Electronics Arts

- **Audio search**

- State of WA, Montana digital archives
    - ORLive.com
    - Office of Science and Technology
    - Information

- **SearchTogether**

- Coleman research
    - Glaxo Smith Kline





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# Microsoft Tag: MSR → SBG

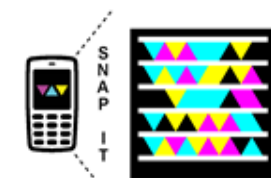
- New color barcode easily readable by cell phones
- Customizable:



- One-touch mapping of physical world to Web services
- Available on all Microsoft's business cards
- Many partners in early phase: Wal-Mart, Ford, P&G, Best Buy, NL Transit...

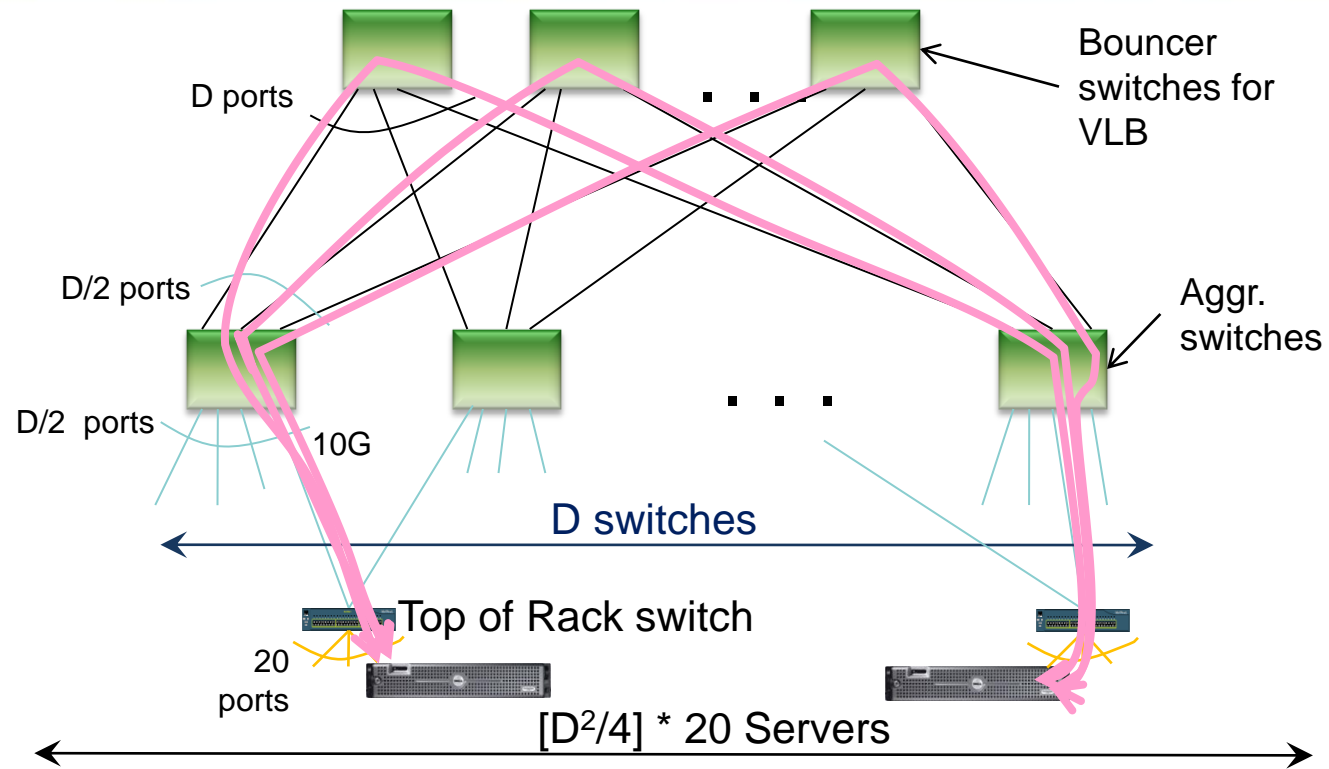


If you have **Microsoft Tag** reader on your phone, snap the tag below to get my vCard:



Get the free app for your phone at <http://gettag.mobi>

# Monsoon – new data center switching



Node degree (D) of available switches & # servers supported

| D   | Servers in Pool |
|-----|-----------------|
| 24  | 2,880           |
| 48  | 11,520          |
| 144 | 103,680         |

ON THE WAY TO \$100  
PER 10G PORT

- Mesh-like w/ programmable commodity layer-2 switches and servers
- Topology with multiple paths and huge bisection bandwidth
- Valiant Load Balancing used to cope with traffic volatility
  - Every flow “bounced” off a random intermediate switch
  - Provably hotspot free for any admissible traffic matrix

# Audio search

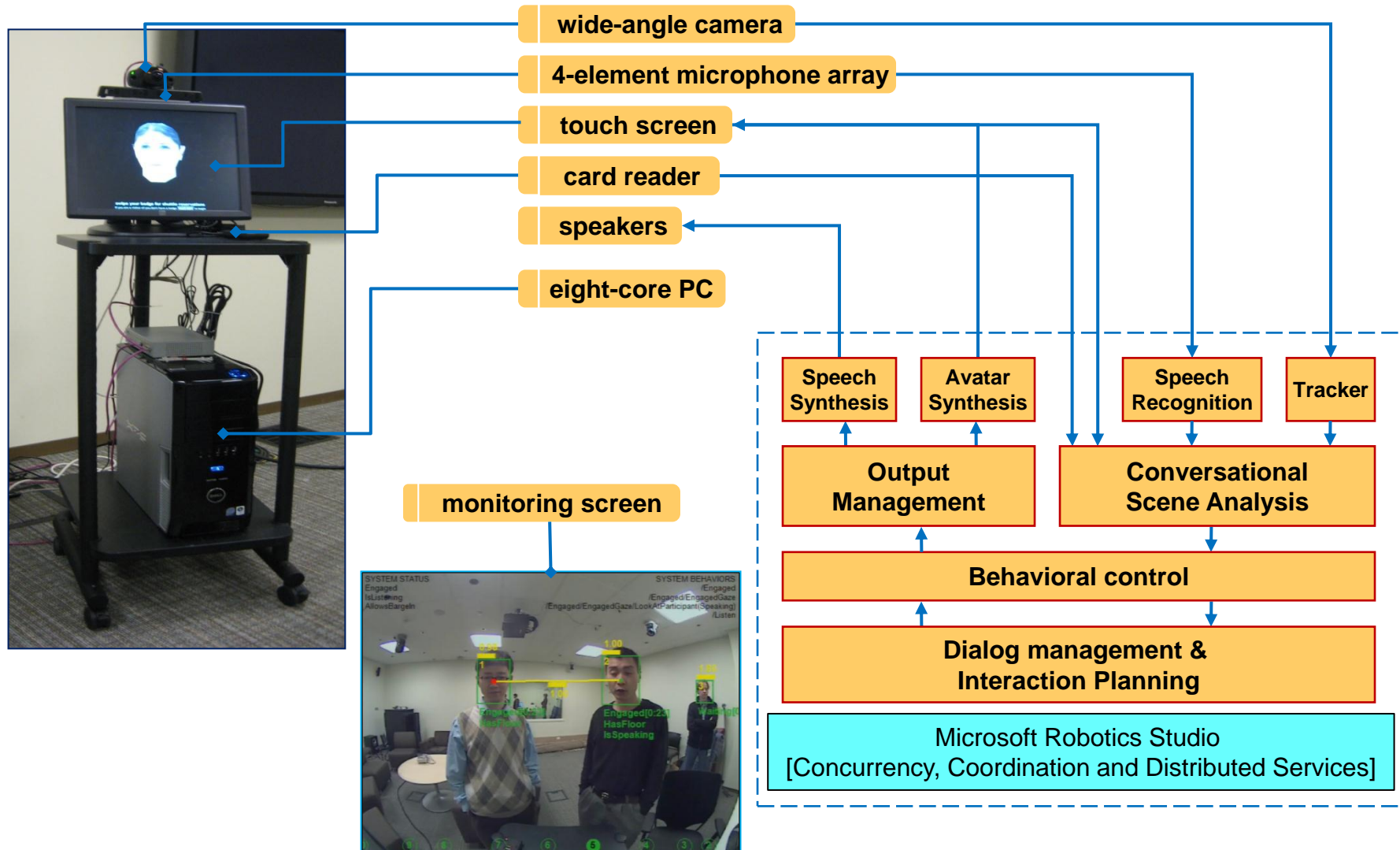
- Search for speech in audio recordings
- Does not use speech recognition technology
- Maps search terms to audio patterns
  - search for such patterns in waveform
  - better results than ASR

The screenshot displays the Washington State Digital Archives website. At the top, there is a header with the Washington State logo and the name of the Secretary of State, Sam Reed. Below this is a navigation bar with links for Digital Archives Home, Search, Collections, News, eRecords Management, About Us, View Cart, and My Recent Searches. The main content area is titled "Detailed Search" and contains a search form with the following fields:

- Record Series:** Audio Recordings (with a dropdown arrow and a link "What Does this include?")
- County:** -- All Counties -- (dropdown)
- Title:** -- All Titles -- (dropdown)
- Source:** -- All Sources -- (dropdown)
- Keywords:** energy (text input)

Below the search form, there are examples of search queries and a date range selector (From: To: Year:). The search results section shows two entries, each with a date, duration, title, and source. The first entry is dated 1980/07/09 and the second is dated 1983/01/27. Both entries have titles and sources related to the House of Representatives Committee Meeting Recordings. The search results are displayed as a list of text snippets with the word "energy" highlighted in blue. To the right of the search results, there is a "Have a research question? Ask An Archivist!" button and a "Search" button. At the bottom right, there is a small audio player interface with a play button and a volume slider.

# Auto-Receptionist – prototype





# Auto-Receptionist – demo

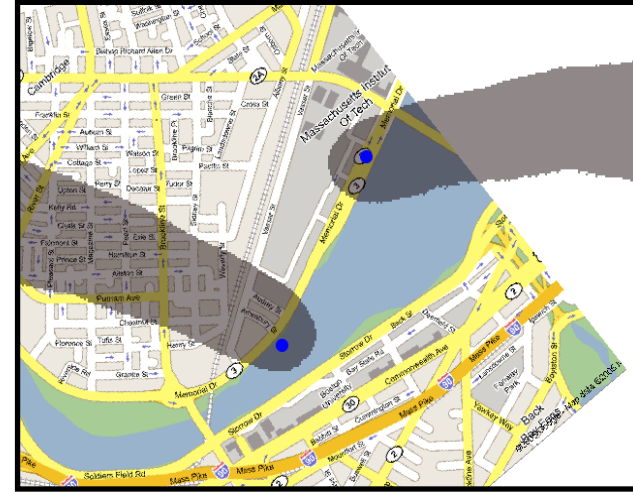


# Auto-Receptionist – demo

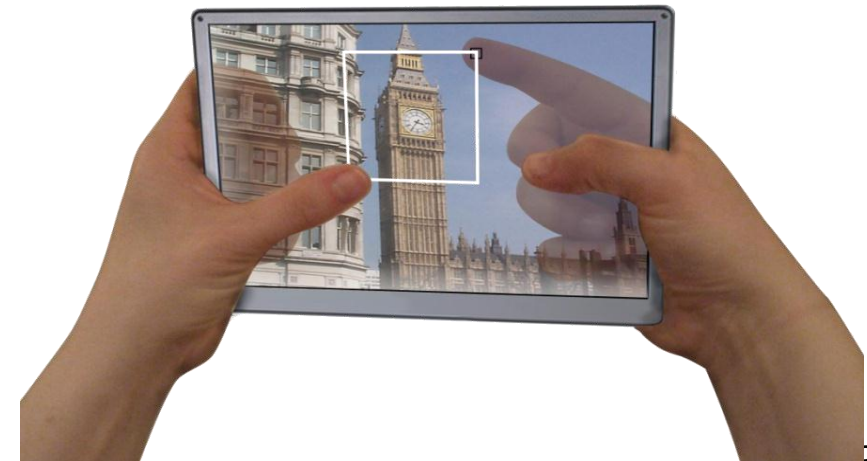


# Lucid touch

- Touch screen from the back

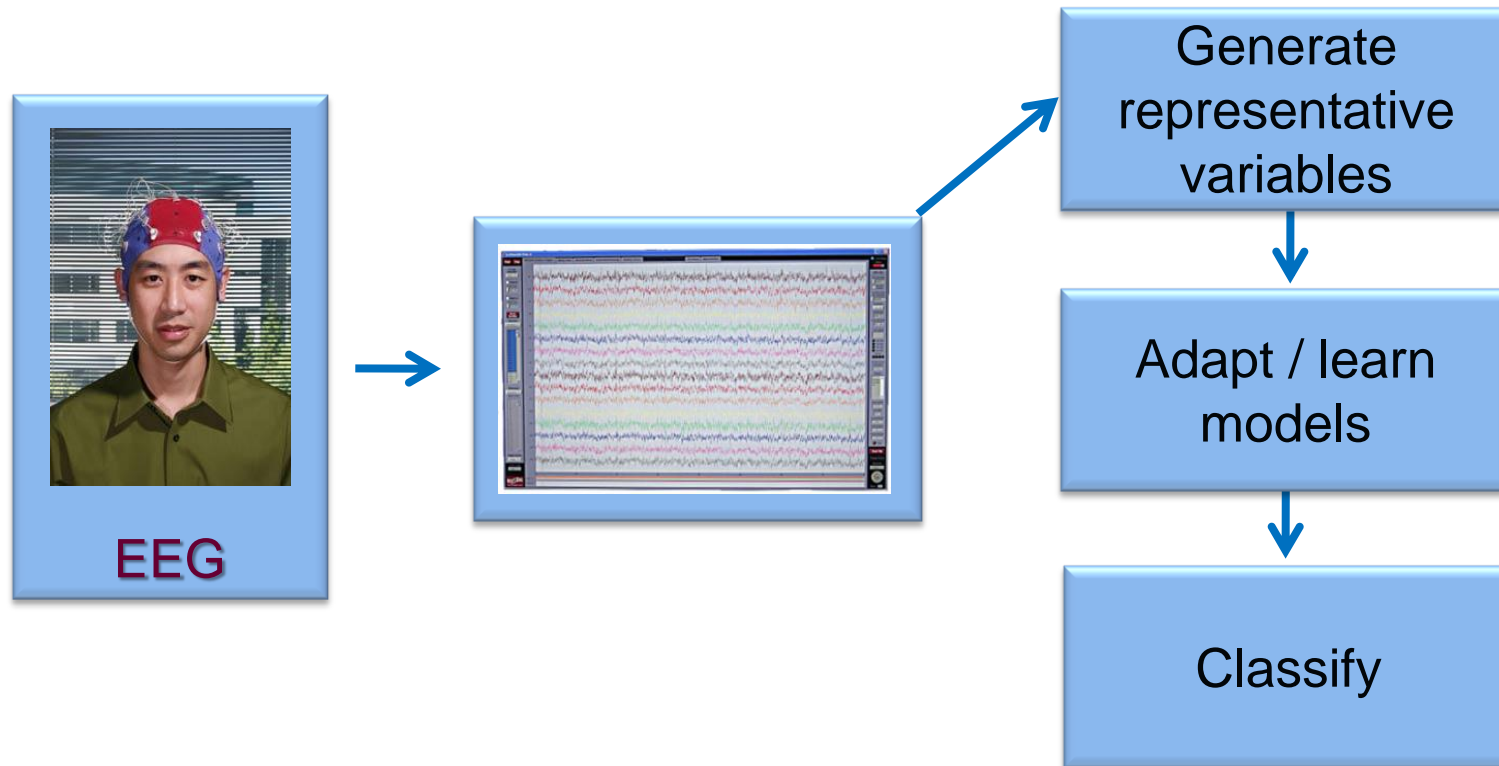


- Synthesize virtual shadows of fingers
- Fingers can point to displayed objects without blocking view



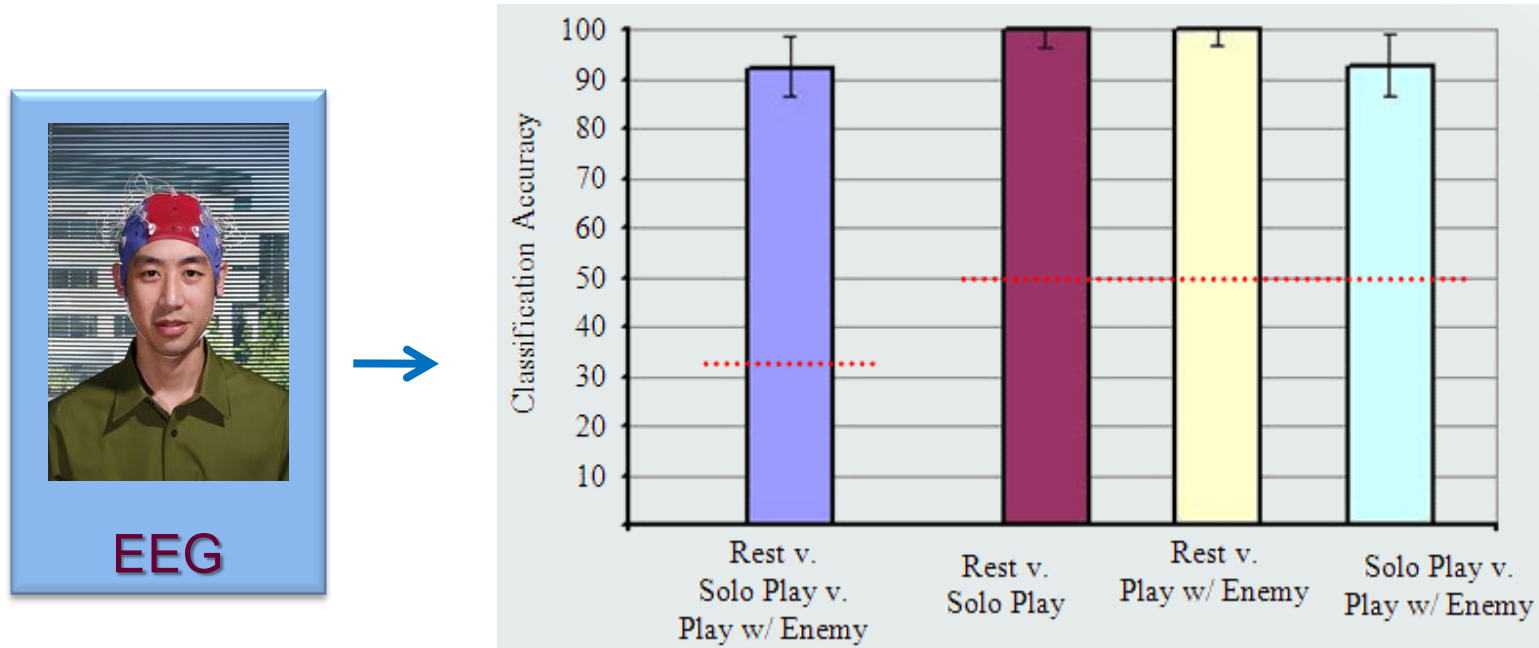
# Brain interfaces

- Understanding thoughts



# Brain interfaces – initial results

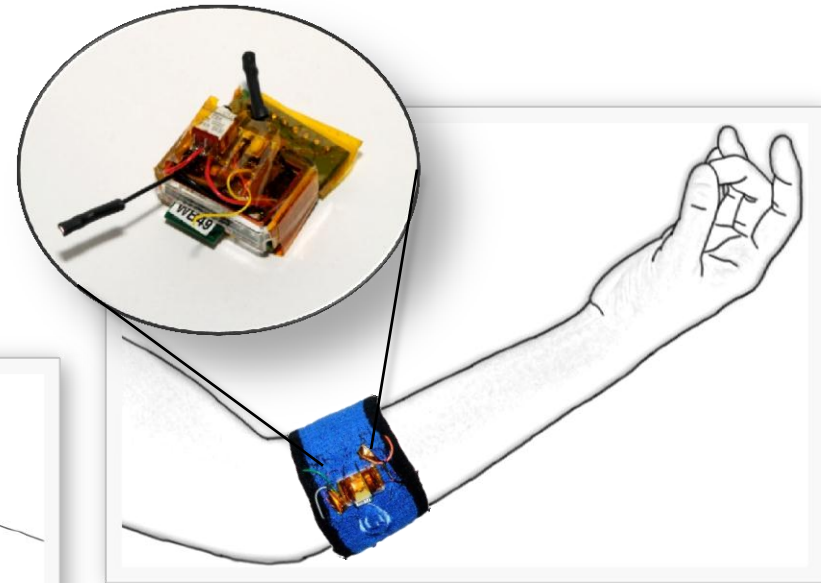
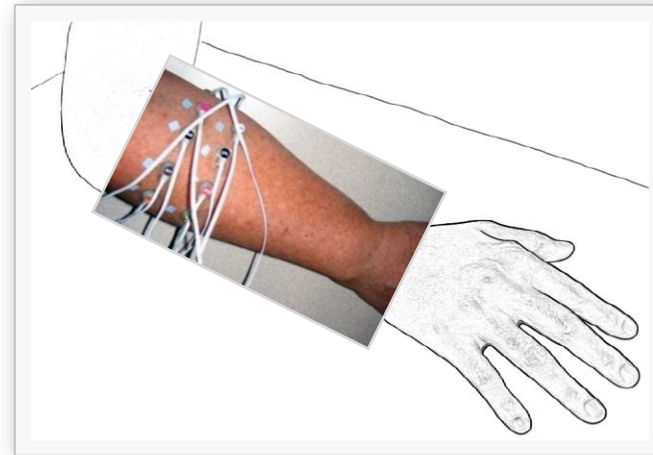
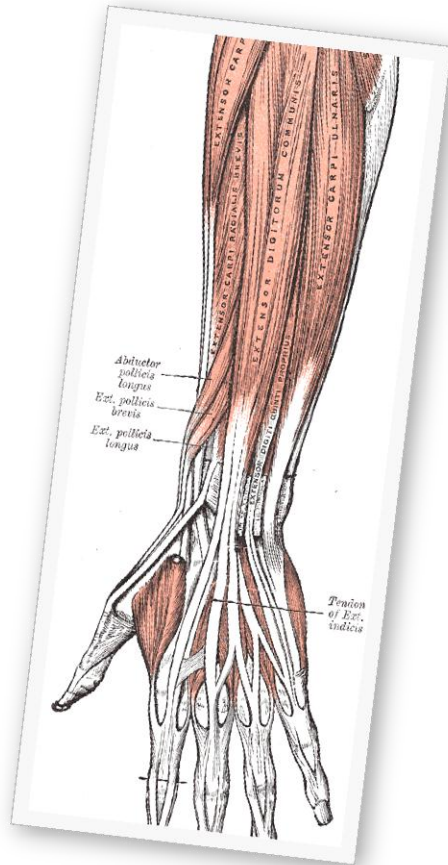
- 84% to 94% classification precision



Desney Tan received a 2007 MIT Technology Review TR35 Award



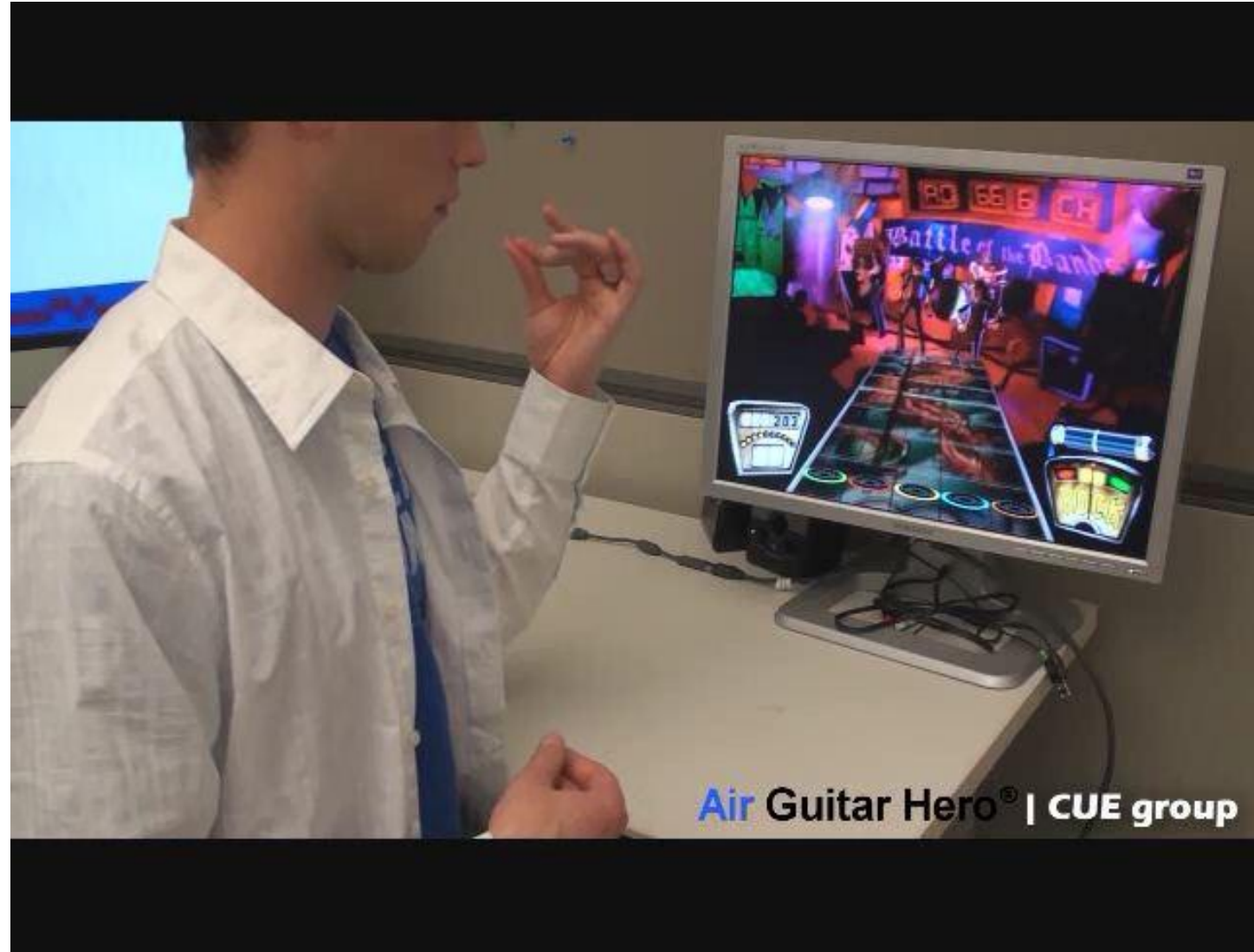
# Muscle sensing armband



Measure electrical activity with Electromyography (EMG)

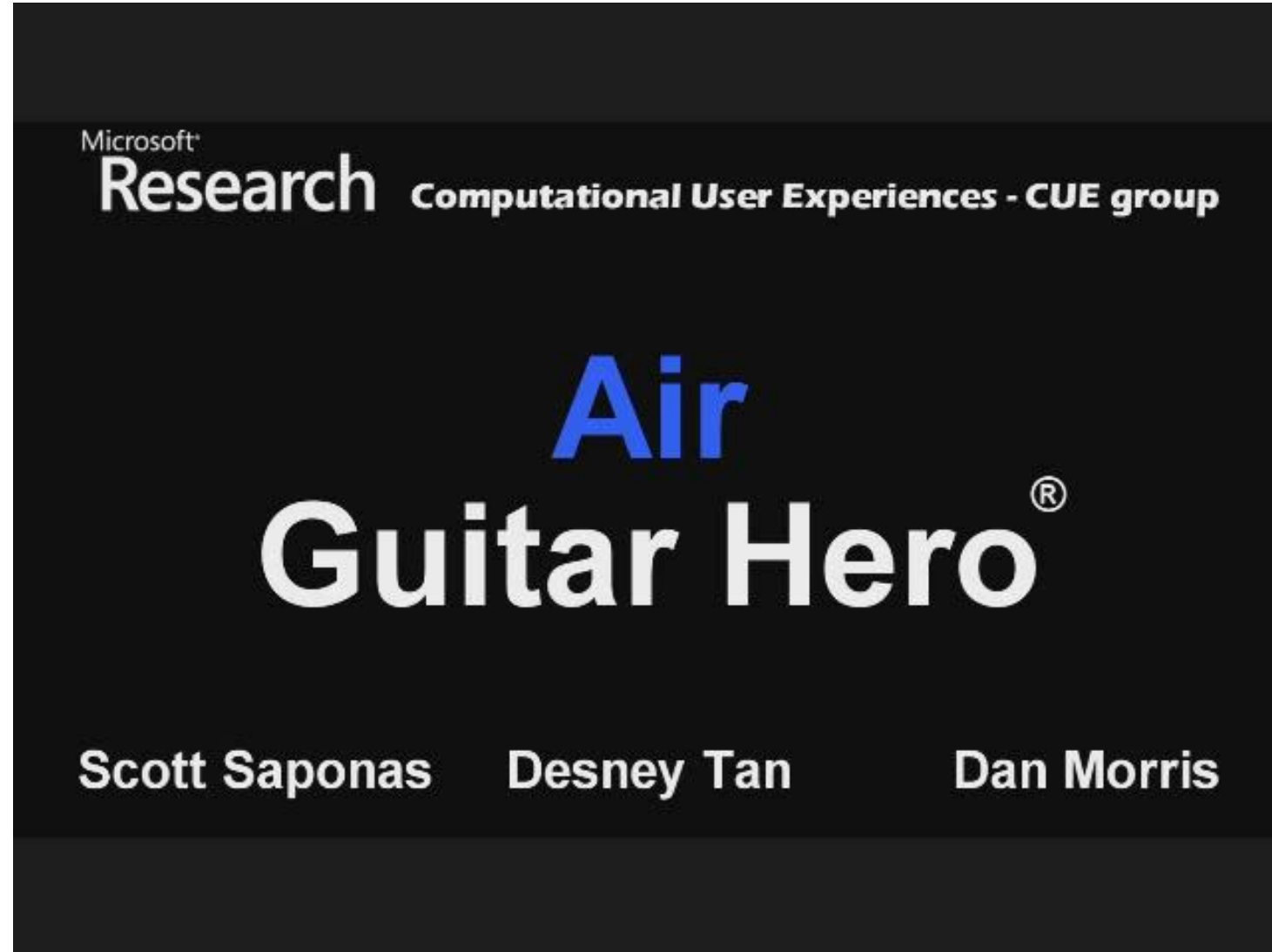
# Muscle sensing armband

- “Air” Guitar Hero
- Real-time signal classification & game control



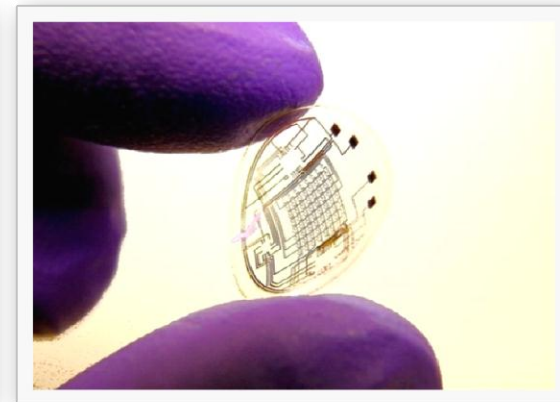
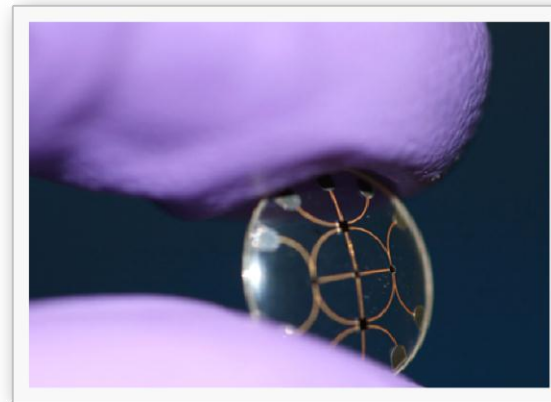
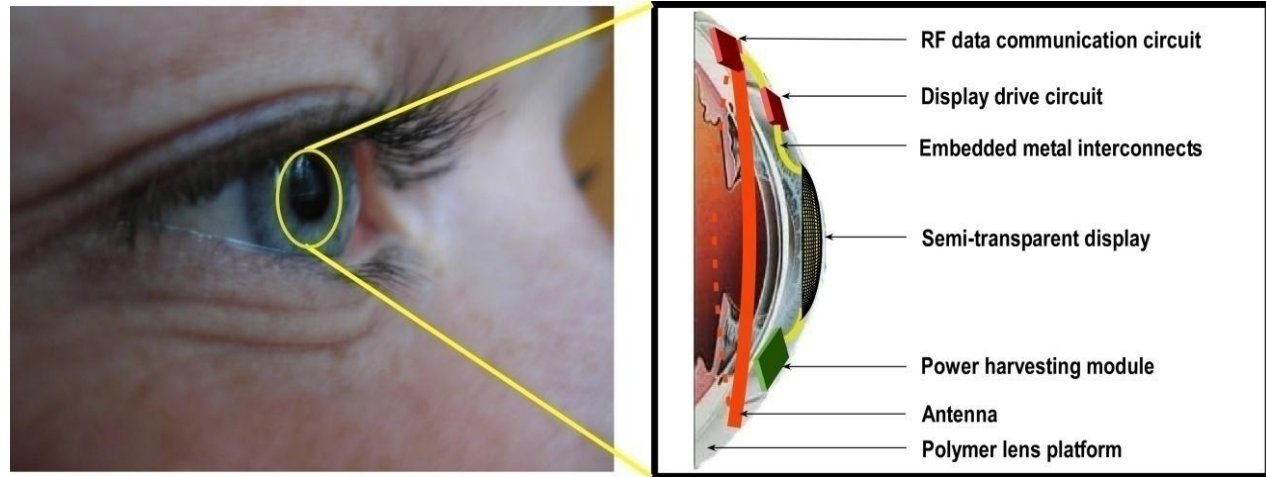
# Muscle sensing armband

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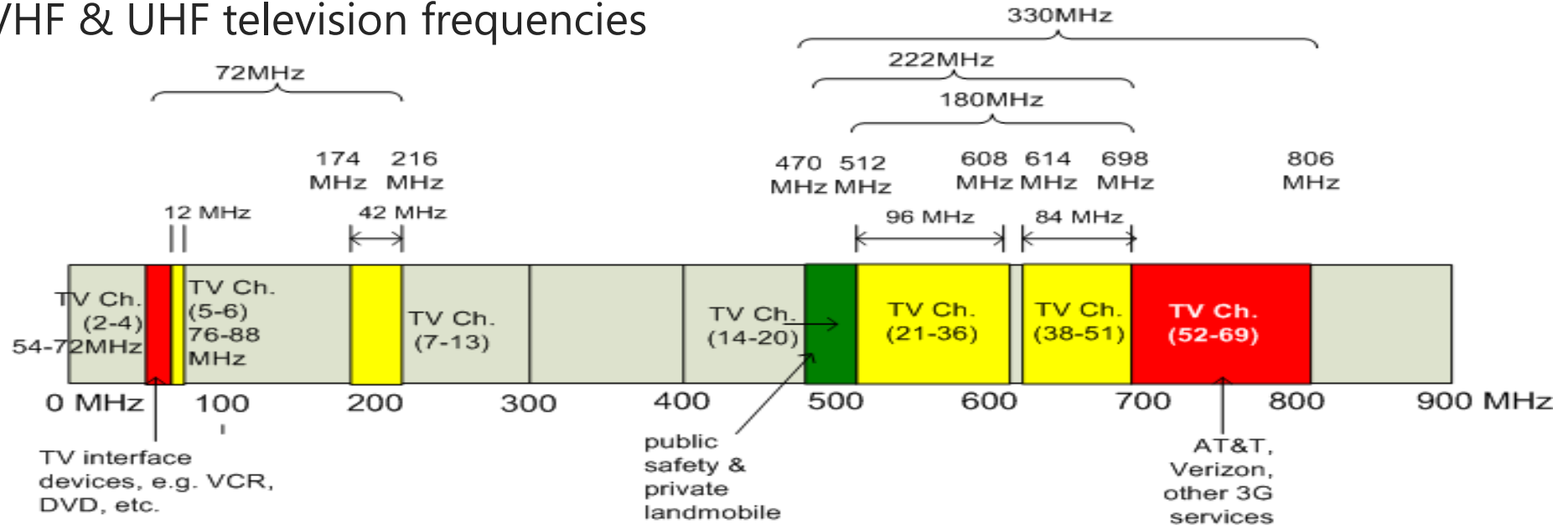
# Bionic lenses

- Display info without disrupting perceived attention
- Great display for augmented reality
- Resolution still low, will improve with time
- Power must be very low, recharge by eye movement



# White Spaces

- Unused VHF & UHF television frequencies



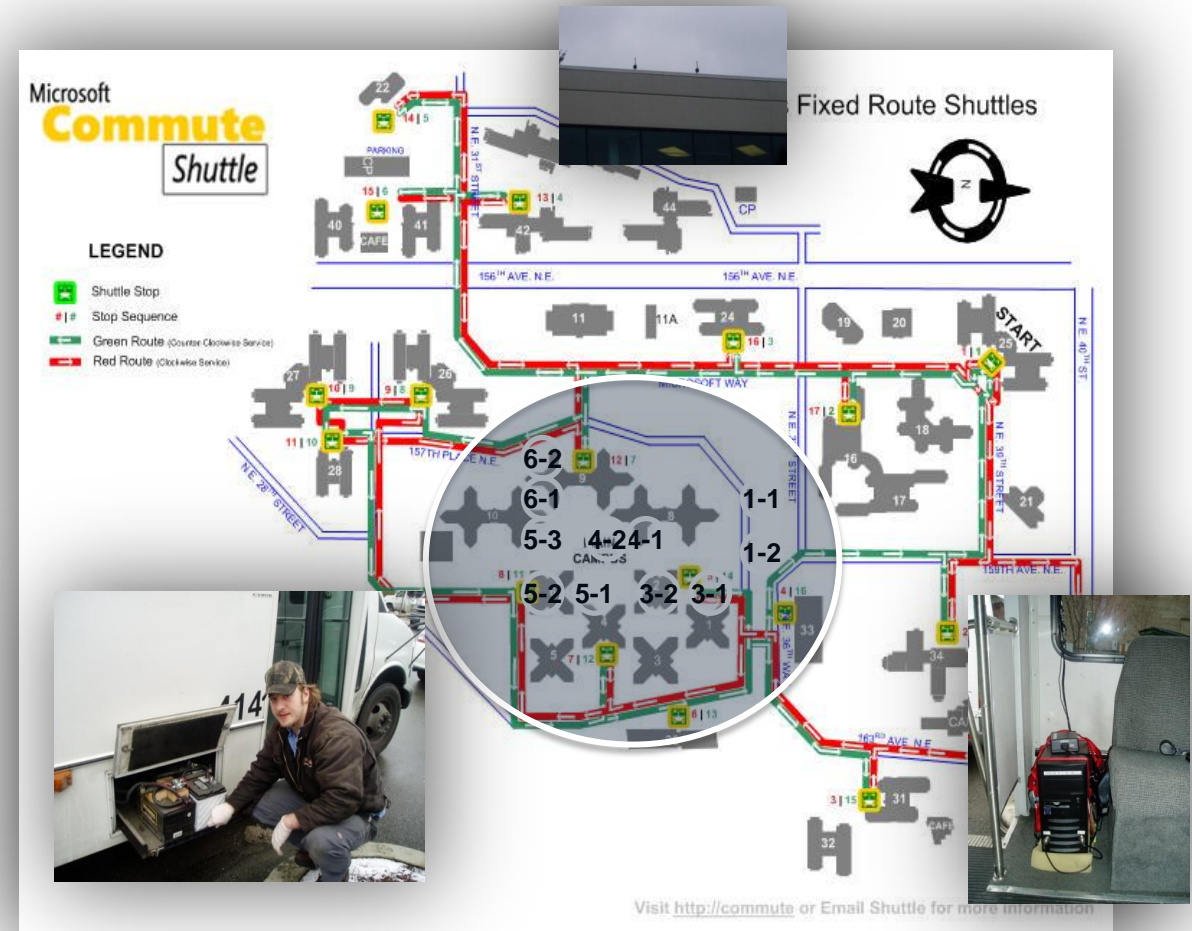
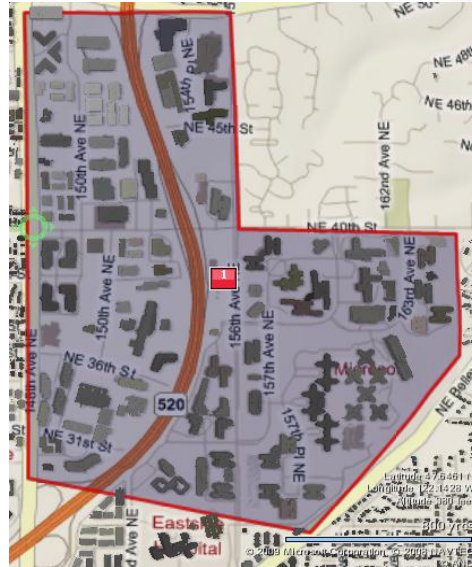
- In the US: primarily the upper UHF "700 megahertz" band (TV channels 52 to 69)
- White Spaces Coalition: Microsoft, Google, Dell, HP, Intel, Philips, Earthlink, Samsung
- Inexpensive technology for last-mile broadband access



# First White Spaces campus network

- WhiteFi + Geolocation
- FCC Experimental License July '09

- Area: 1 square mile
- Perimeter : 4.4 miles
- WSD on 5-10 campus buildings
- Fixed BS operate at 2 W EIRP
- WSD inside shuttles at 63 mW



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***Microsoft***<sup>®</sup>  
*Your potential. Our passion.*<sup>™</sup>