

# WINLAB 20<sup>th</sup> Anniversary Event

## Introduction & Agenda Overview



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# Introductory Remarks:

## ■ Welcome to WINLAB's 20<sup>th</sup> Anniversary Celebration!



- A day to thank all our stakeholders to whom we owe our success
- Reflect on the future of wireless with talks from world-leading experts
- And, of course, a good excuse to have a big party!



# Introductory Remarks: WINLAB Origins

- WINLAB founded in 1989 with a mission to advance research and education in the field of wireless technology
- Rutgers one of the first universities to start a wireless research center; Prof. Goodman's concept was clearly ahead of its time...
- WINLAB true to Rutgers slogan "*Jersey roots, global reach*", with the center's origins in NJ's long history of industrial R&D on radio
  - **Fundamental telecom and wireless innovations at Bell Labs**
  - **Radio and TV broadcasting, satellite networks at RCA/Sarnoff**
  - **AT&T, Telcordia (Bellcore), NEC Labs, Thomson and other labs in NJ**
- Academic research seeded with expertise from Bell Labs to start, drawing on other NJ research labs (AT&T, NEC, ..) in later years

# Introductory Remarks: The WINLAB Difference...

- Factors behind WINLAB's 20 years of operation as an internationally recognized academic research center
  - Steady focus on wireless, but with enough breadth to cover the field
  - Merging of best practices from academic and industrial research
  - Effective industry collaboration model, keeps research relevant
  - Technology vision and systems concepts shared among faculty
  - Open, collaborative work culture with large “research commons”
  - PhD student research as the foundation for all projects
  - Interaction between theoretical and experimental research groups
  - Investments in research infrastructure, platforms and testbeds
  - Partnerships with other university research groups & research labs
  - And, of course, top-tier academic and industrial research talent

# Introductory Remarks: The Wireless Industry

## – Then and Now

- Wireless was an emerging mass-market technology in 1989, with the cellular industry starting to ramp up
  - 10M cell phones worldwide, 5M in the US
  - Wireless used for several specialized applications – satellite data/TV, point-to-point microwave, emergency, defense, ...
- In 2009, wireless is one of the most important enablers of the communications and IT industries
  - 3.5B cell phones worldwide; mobile operator revenue ~\$1 Trillion!
  - Market cap of mobile/wireless companies ~3-4x Internet industry
  - Mobile data growing at 100% CAGR → cellular – Internet convergence
  - WLAN mass market, with >500M WiFi enabled computing devices
  - Cameras, stereos, headsets, sensors, .. with embedded wireless

# Introductory Remarks: Wireless Product Timeline ~1989-2009

*Cellular/Voice products*



1980's AMPS phone



2G CDMA Base Station



2G CDMA



Personal Base Station



Mobile POS terminal



3G phone



3G data card



3G Netbook



ebook



2010

1990



VSAT data



NCR WaveLAN



802.11 Access Point



2000



802.11n MIMO



WiMAX

*Computing products*



LMDS radio



RFID tag



Bluetooth



Sensor Mote



Heart Monitor



Zigbee Meter



DSRC Car Radio

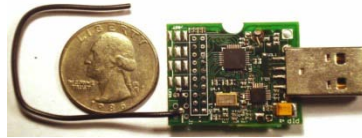


# Introductory Remarks: WINLAB R&D Timeline (sample outputs)

1st Gen SDR (1996)



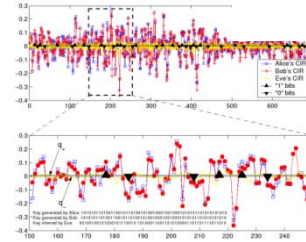
Infostation (2001)



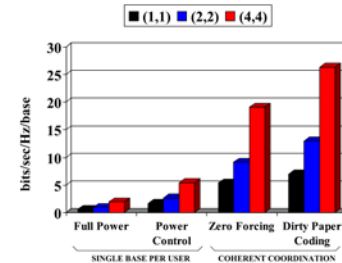
Active RFID (2005)



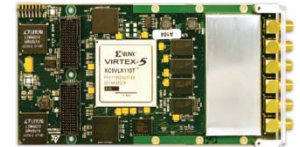
Multimodal ZnO sensor (2002)



Extracting secret key from radio channel (2006)



Network MIMO Capacity Result (2007)

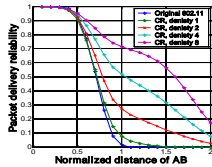


WINC2R software radio (2008) & Cognitive Networks

1990

2010

PRMA MAC (1991)



System Analysis For 2G Cellular (~1995)



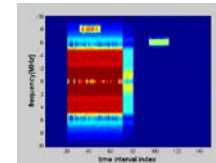
Dual-radio mesh router (2002)



ORBi Radio Node (2004)



ORBi Radio Grid Testbed (2005)



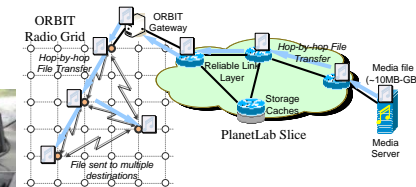
Spectrum Sensing with Cognitive Radios



Open WiMAX BS (2009)



ORBIT automotive node (2007)



Cache-and-Forward Network



# Introductory Remarks: WINLAB People



Dipankar  
Raychaudhuri



Roy Yates



Narayan Mandayam



Chris Rose



Wade Trappe



Predrag Spasojevic



Yanyong Zhang



Marco Gruteser



Ivan Seskar



Yicheng Lu



Zoran Miljanic



Larry Greenstein



Dick Frenkiel



Rich Howard



Richard Martin



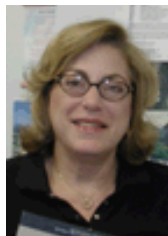
Shweta Jain



Sumit Rangwala



Arati Baliga



Melissa Gelfman



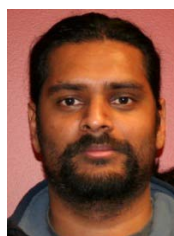
Noreen DeCarlo



Janice  
Campanella



Elaine Connors



Shridatt  
Sugrim



Khanh Le



Jaskaran Singh



~45-PhD & MS  
Students as of 2009  
(see [www.winlab.rutgers.edu](http://www.winlab.rutgers.edu) for photos)



# Introductory Remarks: WINLAB

## Sponsor Companies



### Previous Sponsors ~1989-2009

Agere	Mitsubishi
Agilent	Motorola
Ameritech	NEXTEL
AT&T	Nokia
BellSouth	Nortel
BoozAllen	NTT Data
Cingular	NYNEX
Cisco	Pactel
CNET	SBC
Comcast	Sony
CONTEL	Sprint
CSELT	Telcordia
Daimler-Benz	Telia
Eastman Kodak	Toshiba
EPRI	United Telecom
FCC	US West
Fujitsu	
GTE	
HP	
Hitachi	
Hughes	
IBM	
ITRON	
Lockheed	
MA/Com	
McCaw	
Mitre	

# Introductory Remarks: The Road Ahead

- Many years to go before wireless becomes a mature field
  - Mobile Internet a huge business opportunity along with research challenges – scale, architecture, services, ...
  - Major new opportunities in pervasive and M2M applications, with wireless as the “glue” for integrating physical and virtual worlds
  - Our challenge is to keep WINLAB’s research agenda fresh and relevant as we enter our 20’s....
    - Fundamental communications/information theoretic challenges
    - Enabling technologies and architectures for wireless networking
    - New mobility and pervasive applications
- Next, for the main event, we hear from our distinguished speakers on the future of wireless technology

# WINLAB 20<sup>th</sup> Anniversary Event: Agenda Overview

- Welcome to WINLAB's 20<sup>th</sup> Anniversary Event
  - Open House Posters & Demos – 10AM to noon
  - Distinguished Speaker Seminar on “The Future of Wireless Technology” – 1:30-4:45PM
  - Speakers Panel and Audience Q&A – 4:45-5:30
  - Brief address by Rutgers President, Dr. Richard McCormick – 5:30
  - Reception – 6:00 to 7:00PM
  - Celebration Dinner – 7:00 to 9:00PM

# WINLAB 20<sup>th</sup> Anniversary Event: Seminar & Panel Details

- Distinguished Speaker Talks (Moderator: Yanyong Zhang)
  - David Goodman, Professor, NYU Poly & Founding Director, WINLAB
  - Vincent Poor, Dean, School of Engineering, Princeton U
  - Andrea Goldsmith, Professor, Stanford U
  - Victor Bahl, Manager - Networking, Microsoft Research
  - Henning Schulzrinne, Professor, Columbia U
  - Kazuo Imai, CEO, DoCoMo Laboratories, USA
- Speaker Panel (Moderator: Narayan Mandayam)
  - Further discussion on future trends and audience Q&A