

# **Broadband Wireless Access Technology and Standards**

**IEEE 802 Plenary Meeting  
Albuquerque, NM  
November 9, 1998**

**Roger Marks**

**National Institute of Standards and Technology  
Boulder, Colorado**

**NIST**

# **Broadband Wireless Access Technology and Standards**

**Monday, November 9, 6:30–8:00 pm**

- **Dr. Roger Marks, Director, NIST, Boulder, CO**
  - **“N–WEST Broadband Wireless Access Standardization Efforts”**
- **James Schellenberg, CTO, Nortel Broadband Wireless Access, Winnipeg, Canada**
  - **“Status and Evolution of the BWA Marketplace”**
- **Leland Langston, Technical Director for Broadband User Equipment, Raytheon Systems Co., Plano, TX**
  - **“BWA Standards: What Systems be Addressed and What to Standardize”**
- **Dr. David Palmer, Philips Broadband Networks, Manchester, UK**
  - **“BWA Standardization: A European View”**
- **Rami Hadar, CEO, Ensemble Communications, San Diego, CA**
  - **“BWA Standards Challenges”**

**N-WEST:**  
**The**  
**National Wireless Electronic Systems Testbed**

**IEEE 802 Plenary Meeting**  
**Albuquerque, NM**  
**November 9, 1998**

**Roger Marks**  
**National Institute of Standards and Technology**  
**Boulder, Colorado**

**NIST**

# NIST is:

- **the U.S. National Institute of Standards and Technology**
- **an agency of the U.S. Department of Commerce**
- **four components**
  - **Measurements and Standards Laboratories**
  - **Advanced Technology Program**
  - **Manufacturing Extension Partnerships**
  - **Baldrige Quality Award Program**

# **N-WEST is:**

- **a coordinated project of NIST and the National Telecommunications & Information Administration (NTIA)**
- **an experiment in how the U.S. Department of Commerce can promote the commercialization of new wireless frontiers**
- **a pro-active effort to accelerate development of the broadband wireless industry by encouraging voluntary standards**
- **a new way of doing business: applying NIST measurements to help forge industry consensus standards and specifications**
- **a measurement testbed at the Boulder Labs of NIST & NTIA**
- **closely tied to industry (advice, equipment, personnel, . . .)**
- **on the Web at <http://nwest.nist.gov>**

# Wireless Standards in the United States

- **FCC no longer regulates standards for wireless communications (spectrum auctions since 1994)**
- **no coordinated U.S. approach to wireless standardization**
- **standardization in newly-auctioned spectrum is slow**
- **multiple standards continue indefinitely**
- **equipment costs remain high**
- **for new services, licensees and vendors may hesitate**

# **N-WEST Philosophy**

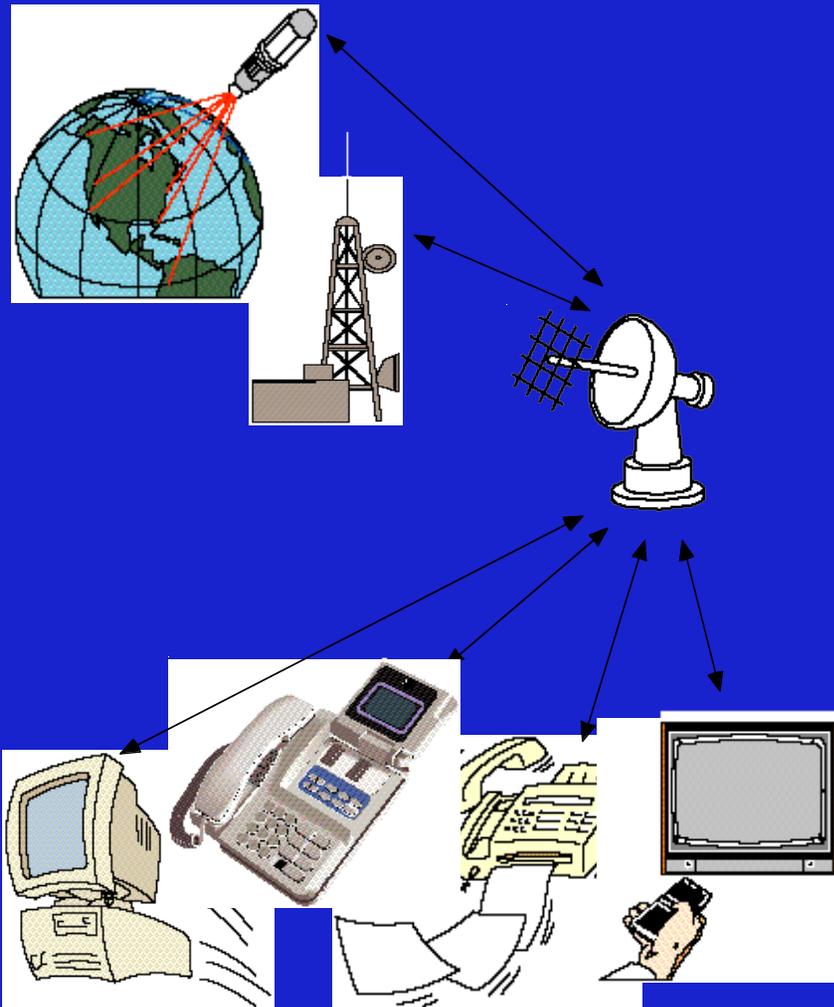
## **Goal:**

**Accelerated Commercialization  
of Broadband Wireless Access Systems**

## **Mechanism:**

- ↳ **equipment cost reduction (esp. at customer end)**
  - ↳ **mass production**
    - ↳ **standardization**
      - ↳ **voluntary industry standards bodies (IEEE)**
        - ↳ **unbiased measurement support**  
**(U.S. Dept. of Commerce: NIST and NTIA)**

# Broadband Wireless Communications

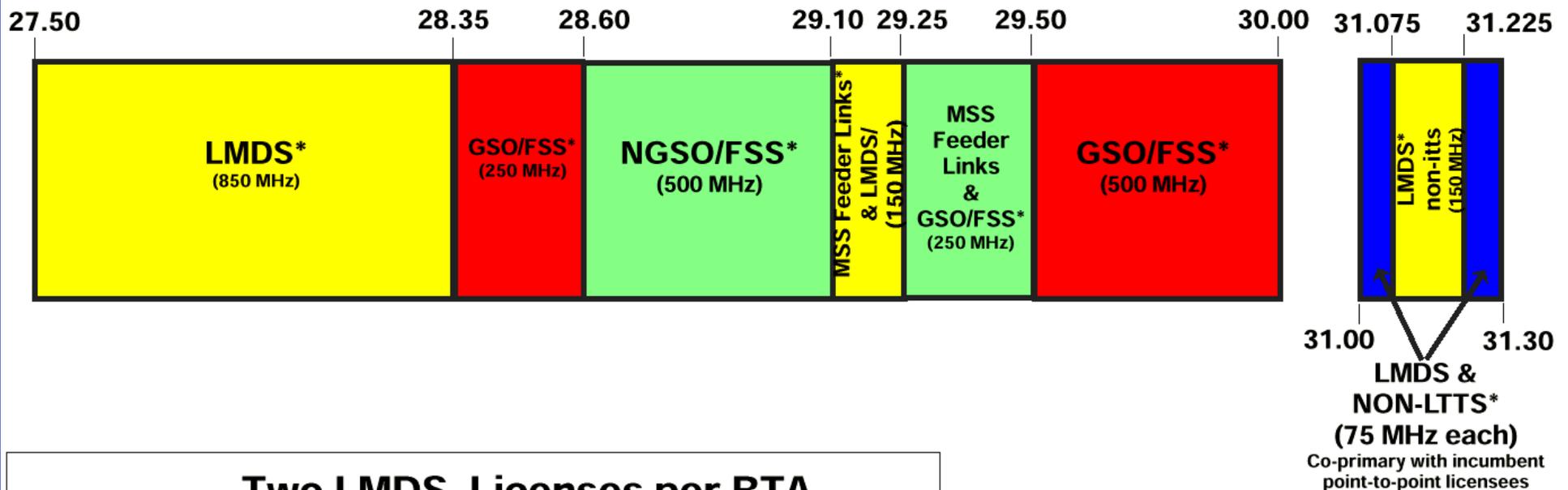


## Broadband Wireless Systems

- fixed (non-mobile) customer premises units
- base stations either:
  - fixed terrestrial
  - in orbit (LEO or GEO satellites)
  - in stratosphere (airplanes or blimps)
- broadband data into businesses, homes, etc.
  - ATM, TCP/IP, digital video, telephony
- potentially inexpensive and economically competitive with wired broadband
- The time is right for action:
  - no standards
  - spectrum auctions in 1998 and 1999

# LMDS Band Allocation (Local Multipoint Distribution Service)

## 28 & 31 GHz Band Plan



### Two LMDS Licenses per BTA

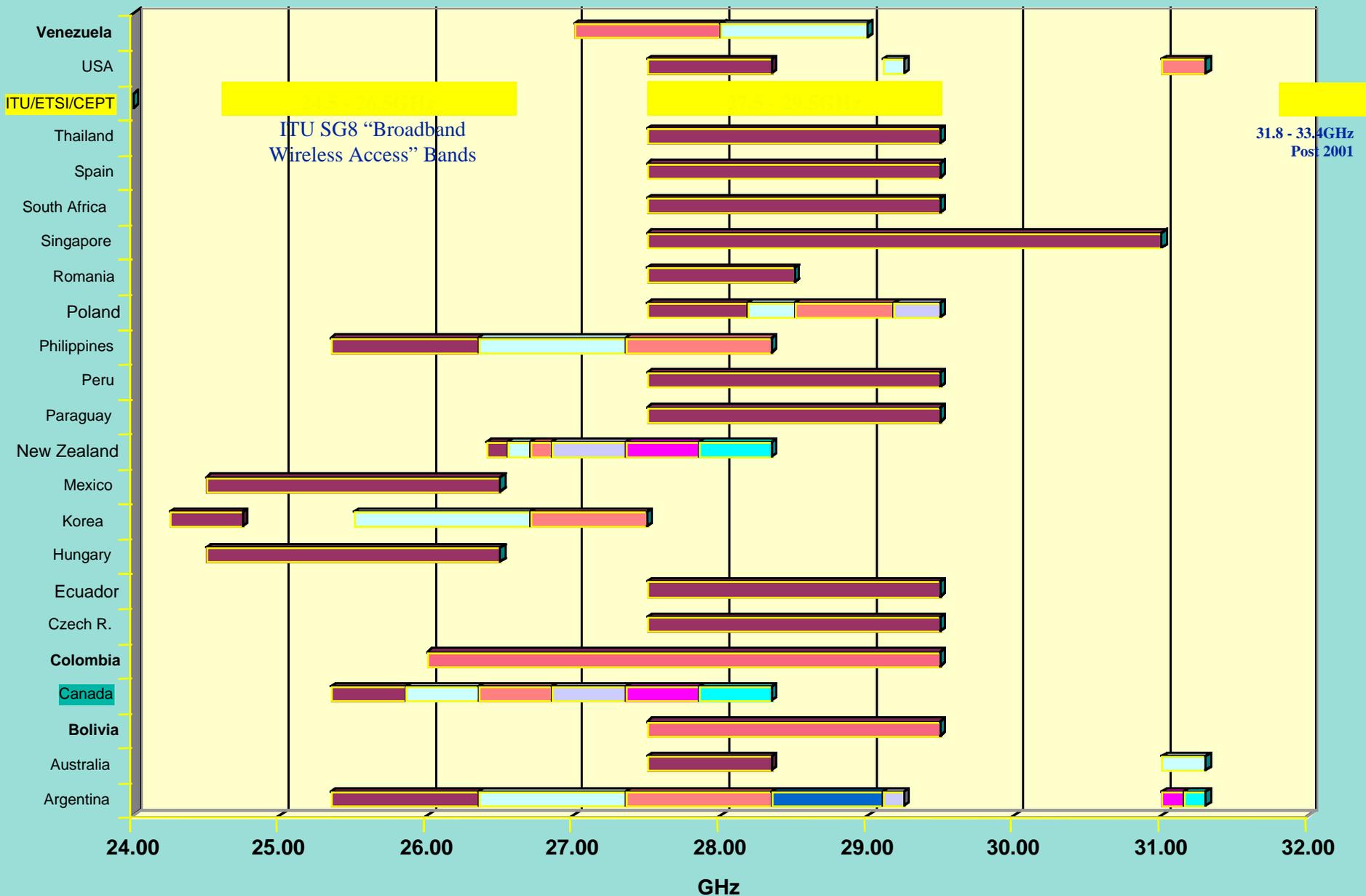
Block A - 1150 MHz:   
 27,500-28,350 MHz  
 29,100-29,250 MHz  
 31,075-31,225 MHz

Block B - 150 MHz:   
 31,000-31,075 MHz  
 31,225-31,300 MHz

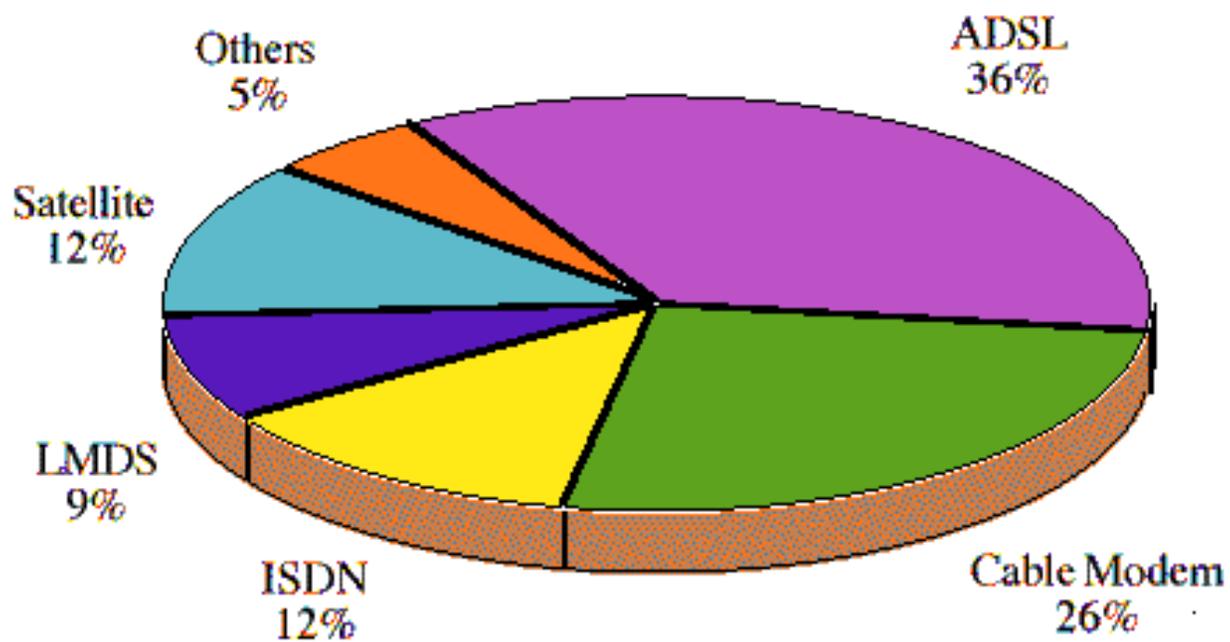
### Legend

\*\*\*\* - Primary Service  
 FSS - Fixed Satellite Service  
 GSO - Geostationary Orbit  
 NON-LTTS - Non-Local Television Transmission Service  
 MSS - Mobile Satellite Service  
 NGSO - Non-Geostationary Orbit

# LMDS Spectrum Worldwide

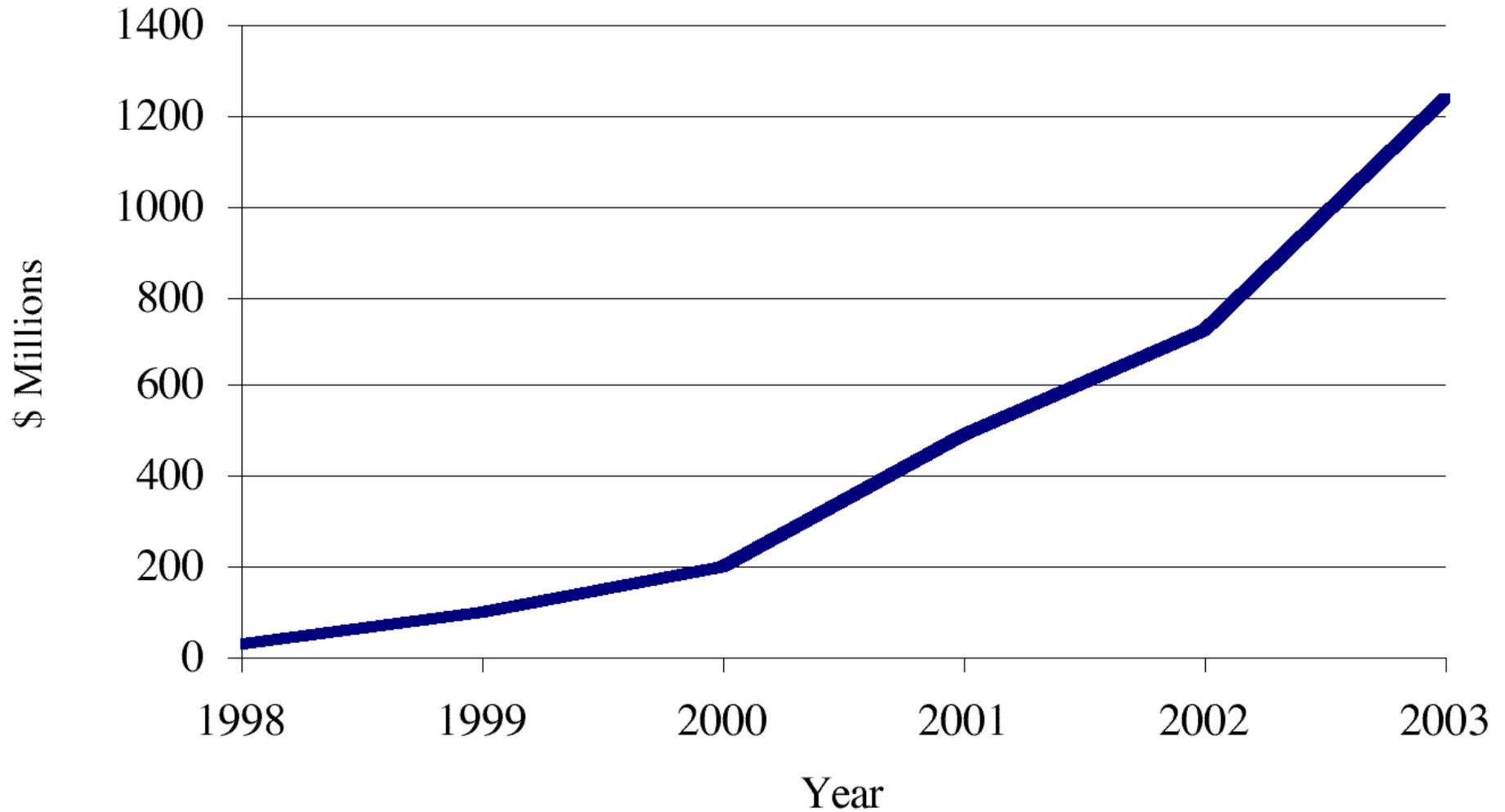


### Broadband Subscribers by Technology, US Market, 2003



Source: Allied Business Intelligence, Inc.

Shipments of Millimeter Wave Systems\*, World Market, 1998  
Auto Collision, LMDS, Satellite



Source: Allied Business Intelligence, Inc.

\*Point-to-Point Microwave not included

# **Business Case for Broadband Wireless Standards**

- “Subassembly and chip manufacturers simply cannot supply the performance that millimeter wave system manufacturers desire at a price which is feasible for significant penetration into the consumer market today.”**
- “LMDS may be closest to achieving this goal, but *its lack of a unified standard and lack of commitment to significant volumes will inhibit further price declines.*”**
- **“Millimeter Wave 1998: Broadband Wireless and Automotive Radar Markets, Opportunities & Forecasts,” Allied Business Intelligence (quotes from August 11, 1998 press release)**

# **N-WEST History in Brief**

- **January 22, 1998**
  - Roger Marks proposed N-WEST to NIST management
- **April 3, 1998**
  - N-WEST Web Site went on-line (<http://nwest.nist.gov>)
- **April 9, 1998**
  - N-WEST News #1 distributed by e-mail
- **April 23, 1998**
  - N-WEST “Supporting Company” defined
- **July 24, 1998**
  - Strategy Session attended by 10 people in Boulder
- **August 9-10, 1998**
  - Kickoff Meeting attended by 45 people
- **August 9-12, 1998**
  - 1998 IEEE Radio and Wireless Conference (RAWCON'98) attended by 300 people
- **November 9-10, 1998**
  - Second meeting, with 802 (>37 people)

# 44 N-WEST Supporting Companies

- **Industry Associations**
  - **Wireless Communications Assn.**
  - **Cellular Telephone Industry Assn.**
- **License Holders**
  - **WNP Communications, Inc.**
  - **US WEST Adv. Technologies**
  - **Formus Communications, Inc.**
  - **Antilles Wireless Cable TV Co.**
  - **Charles Brinkman**
- **Systems Equipment Providers**
  - **Lucent Technologies**
  - **Nortel**
  - **Ericsson Inc.**
  - **Alcatel Network Systems**
  - **NEC America, Inc.**
  - **ADC Telecommunications**
  - **3Com Corporation**
  - **P-COM**
  - **WaveSpan Corporation**
  - **Netro Corpopration**
  - **Ensemble Communications**
  - **Belstar Systems Corp.**
  - **Intraplex**
  - **Philips Broadband Networks**
  - **Wavtrace**
- **Subsystems (radios, modems, ...)**
  - **Hewlett-Packard Co.**
  - **AMP M/A-COM**
  - **Raytheon Systems Company**
  - **Stanford Wireless Broadband Inc.**
  - **Integrity Communications**
  - **BroadBand Wireless Inc.**
  - **Raychem Corp.**
  - **ETM Electromatic**
  - **SiCOM, Inc.**
  - **Millitech Corporation**
  - **CircuitPath Network Systems**
- **RF Semiconductors**
  - **Harris Semiconductor**
  - **Fujitsu Compound Semiconductor**
  - **Sanders, A Lockheed Martin Co.**
- **Test and Measurement**
  - **Anritsu Company**
- **Consultants/R&D/Misc.**
  - **Bellcore**
  - **C&W Systems, Ltd.**
  - **Hardin & Associates, Inc.**
  - **LCC International Inc.**
  - **EDX Engineering, Inc.**
  - **E B Systems Limited**
  - **Illinois Institute of Technology**

# **N-WEST Kickoff Meeting: 45 People**

- **Sanjay Moghe, Director, Hardware Engineering, Broadband Wireless Access, ADC Telecommunications**
- **Phil Salas, Senior Director-Radio Technology, Alcatel Network Systems**
- **Allyson Sharp, Director of Wireless Marketing and Business Development, Alcatel Network Systems**
- **Roy Hebert, Director, Business Development, AMP M/A-COM, Inc.**
- **Zev Bogan, Senior Principal Engineer, mm Wave Products, AMP M/A-COM, Inc.**
- **Hady Salloum, Director, Broadband Access, Bellcore**
- **Jack Van der Star, Chief Technical Officer, Belstar Systems Corp.**
- **Graham Schnare, Director, BELSTAR Systems Corporation**
- **Narisa Chu, President, C&W Systems, Ltd.**
- **Carlton O'Neal, Vice President, Marketing and Sales, Ensemble Communications**
- **Rami Hadar, Chief Executive Officer, Ensemble Communications**
- **Jay Klein, Chief Technical Officer, Ensemble Communications**
- **Asif Rahman, Product Manager, Ericsson Inc., Wireless Broadband Access Group,**
- **Peter Nohren, Director, Wireless Broadband Access, Ericsson Inc.,**
- **David Jones, Vice President-Technology, Formus Communications, Inc.**
- **Edmar Camargo, Manager-Microwave Design, Fujitsu Compound Semiconductor, Inc.**
- **T. Lauriston Hardin, Chairman & CEO, Hardin & Associates, Inc.**
- **Amarpal Khanna, Manager, Advanced Development, Hewlett-Packard Company, Wireless Infrastructure Division**
- **Thomas Wong, Director of Microwave Laboratory, Illinois Institute of Technology, Department of ECE**
- **Peter Papazian, Radio Research and Systems Applications, Institute for Telecommunication Sciences**
- **Kenneth Allen, Chief, Spectrum Division, Institute For Telecommunications Sciences**
- **Erol Yurtkuran, Senior RF Engineer, Integrity Communications**

# N-WEST Kickoff Meeting: (ctd.)

- **Douglas Greenwood, Director of Sales and Marketing, Integrity Communications, Inc.**
- **Zulfikar Ali, Product Marketing Manager, Integrity Communications, Inc.**
- **Douglas Gray, Director, Wireless Broadband Networks Division, Lucent Technologies**
- **Mohammad Shakouri, Director of Engineering, Lucent Technologies, Inc., Wireless Broadband Network Division**
- **Michael Heutmaker, Lucent Technologies, Engineering Research Center**
- **Robert Pham, Senior Systems Engineer, NEC America, Inc., Radio Communications Systems Division/Public Networks Group**
- **Elissa Sobolewski, Program Manager, NIST, Advanced Technology Program**
- **Roger Marks, Director, National Wireless Electronic Systems Testbed**
- **Dennis Friday, Chief, Radio Frequency Technology Division, NIST**
- **Jan Hakegard, Guest Researcher, NIST**
- **Jag Sharma, Director of Product Marketing, Nortel Broadband Wireless Access**
- **Ignatius Lam, Senior Manager, Product Marketing, Nortel Broadband Wireless Access**
- **Imtiaz Bahadur, Product Manager, P-COM**
- **Mark Golden, Senior Vice President, Industry Affairs, Personal Communications Industry Association**
- **Sanjay Kasturia, Director, Advanced Technology, Raychem Corp.**
- **J. Leland Langston, Distinguished Member of Technical Staff, Raytheon Systems Company**
- **Mark Peterson, Manager, Business Development, Raytheon TI Systems**
- **Dana Wheeler, Business Development Manager, Sanders, A Lockheed Martin Co.**
- **George Hendry, President, Stanford Wireless Broadband Inc.**
- **Vladan Jevremovic, Member of Technical Staff, U S WEST Advanced Technologies**
- **Terry Smith, Chairman and CTO, WaveSpan Corporation**
- **Andrew Kreig, President, Wireless Communications Association International**
- **Charles Bostian, Director, Center for Wireless Telecommunications, Virginia Tech**

Wireless camps' goal: affordable systems

## Open-systems push sweeps broadband

By Loring Wirbel

COLORADO SPRINGS, COLO. — Hustling to infuse life into a market perceived as pricey and arcane, proponents of broadband wireless services came to the IEEE Radio & Wireless Conference (Rawcon) last week with strategies for pushing standardization and, by extension, lower-cost, more-accessible systems.

Proponents of millimeter-wave broadband systems are still smarting from the lukewarm response to the FCC's 28-GHz auctions, which raised a less-than-stellar \$570 million from a smaller-than-expected pool of carriers. In a lunch address at Rawcon, National Telecommunication & Information Administration head Larry

Irving told local multipoint distribution service (LMDS) developers that they are perhaps the last great hope for "last-mile" broadband services. But much is riding on their ability to get the cost out of their systems.

"I have seven separate wireless systems in my household, but I'm still stuck with 56k in my wireline service," Irving said. "If we had 'calling party pays,' I'd give up my wireline phone completely tomorrow, because you guys will be giving me broadband data service a lot faster than my wireline phone company."

A new report from Allied Business Intelligence (Oyster Bay, N.Y.) states that the mul-



N-West's Marks: Nod for NIST as 'facilitator.'

► CONTINUED ON PAGE 126

## ***EE Times Report on N-WEST***

**“Proponents of broadband wireless services came to RAWCON’98 last week with strategies for pushing standardization and, by extention, lower-cost, more accessible systems.”**

- **“Open–Systems Push Sweeps Broadband,”  
*Electronic Engineering Times, August 17, 1998,*  
Page 1**



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#### **Federal Test-bed Promotes Standards For Wireless Broadband Systems**

*By Bennett Z. Kobb, Contributing Editor*

*The FCC has allocated 1300 MHz of spectrum at 28–31 gigahertz for local multipoint distribution services (LMDS)—the largest amount of bandwidth ever auctioned. This amount represents 43 times the bandwidth obtained by winning bidders in the first broadband PCS (personal communications service) auctions.*

*One of the issues LMDS suppliers and licensees face is the lack of accepted industry standards. LMDS infrastructure and customer premises equipment (CPE) from different vendors may not interoperate easily, which could increase uncertainty for vendors and consumers and possibly keep prices from falling as rapidly as they might otherwise.*

*Nor is there a standard for what LMDS is exactly, and this also represents uncertainty for investors and regulators. The National Wireless Electronic Systems Testbed (N-WEST), a government-sponsored program founded in late July, is addressing these challenges. It quickly attracted a long and impressive roster of supporters, including Alcatel, Ericsson, Inc., Lucent Technologies, Inc., Hewlett-Packard Corp., Nortel, Bellcore, Stanford Wireless Broadband, Inc., the Wireless Communications Association International,*

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# License Holder's View

**[In his RAWCON'98 Keynote Address, Barclay Jones, Chief Technical Consultant of WNP Communications, the dominant LMDS auction winner]**

**“cited the work of the recently formed National Wireless Electronic Systems Testbed and said that far more standards to drive interoperability need to be developed in LMDS services.”**

**- *EE Times Online*, August 13, 1998**

# Industry Association View

**“It’s a very important initiative by the Commerce Department to help jump-start this industry. It’s helpful to have a neutral party for manufacturers to be willing to share confidential information.”**

- **Andrew Kreig, President, Wireless Communications Association (over 250 member companies in fixed wireless), quoted in “Wireless Technology Catches New Waves,” *Rocky Mountain News*, August 17, 1998, Page B1**

## Industry Association View (ctd.)

**“[N-WEST] is a important new measurements and standards public/private partnership to promote the development of fixed wireless broadband by tests and measurements at the system and component level... We congratulated Secretary of Commerce William Daley in person on this initiative, and strongly encouraged members to join.”**

**- Andrew Kreig, Wireless Communications Association, *LMDS Update*, August 16, 1998, Page 1**

# U.S. Federal Government View

**“Certain costs, such as the cost of terminal equipment, may still prevent some wireless services from being used on a broad scale. We need to figure out how to lower these costs to make wireless technology more widely available. That is why I think the work of N-WEST is so important... Collaboration within the industry could help lower the cost of user terminals and, I hope, make broadband wireless an accessible alternative for more Americans.”**

- Larry Irving, Assistant Secretary for Communications and Information, U.S. Department of Commerce, August 10, 1998 (RAWCON'98 Banquet Address: “The Next Waves In Wireless Technologies”)**

# Testbed Status

- **FY2000 Funding Initiative passed Commerce Dept.**
- **FY1999 Funding in place**
- **Collaboration:**
  - **NIST's Electronics and Electrical Engineering Lab**
    - **direction and management**
    - **radio frequency technology**
    - **linking system performance to components**
  - **NIST's Information Technology Lab**
    - **algorithms, coding, modulation, error correction, ...**
  - **NTIA's Institute for Telecommunications Sciences**
    - **propagation**
    - **system characterization**
- **Advanced Technology Program looking to fund new wireless technology**

# **Standardization Process**

## **Institute of Electrical and Electronics Engineers (IEEE )**

- prestigious transnational technical organization**
- industry-weighted**
- two-pronged approach within IEEE**

### **(a) IEEE 802: LAN/MAN Standards Committee**

- co-located meeting on November 9-10, 1998**
- Albuquerque, New Mexico**

### **(b) Industry Standards and Technology Org.**

# **Broadband Wireless Access Standards Consortium**

## **– Broad Industry Cooperation**

- Industry Associations**
- License Holders**
- Service Providers**
- Systems Integrators**
- System Equipment Manufacturers**
- Subsystems Suppliers**
- Component Suppliers**
- Test and Measurement Providers**

## **– N-WEST provides:**

**coordination, technical data, and “push”**

# Project: IF Interface

- **Standard interface to the radio:**
  - radio link becomes a plug-in module
  - with appropriate plug-in, serve any medium
    - LMDS A
    - LMDS B
    - 24 GHz, 38 GHz, 47 GHz, ....
    - MMDS
    - allocated spectrum in any country
    - terrestrial, satellite, stratospheric, ...
  - cheap Customer Premises Equipment
  - extend market downward toward higher volumes

**Find out More About N-WEST**

**<http://nwest.nist.gov>**

**I encourage your  
ideas and suggestions!**

# Plans for this Week

- **Post-Tutorial Get-Together**
  - Tonight 8-10 PM, Enchantment C/D
- **Working Meeting**
  - Tomorrow, 8 am - 6 pm, Grand Pavilion 3
- **Proposed 802 Executive Committee Study Group**
  - will propose to Executive Committee on Thursday

## Future Plans

- Interim Meeting in January 1999
- PAR approval in March 1999