

Impact of Spread Spectrum Rules on the Wireless IEEE 802 standards

Vic Hayes

Former IEEE 802.11 Chair

Nearly,

- Vic was not here
- Ticket for March 11
- In hospital on March 4
- Released on a crash program on March 10

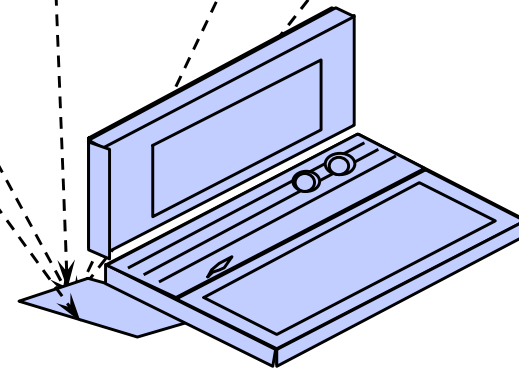
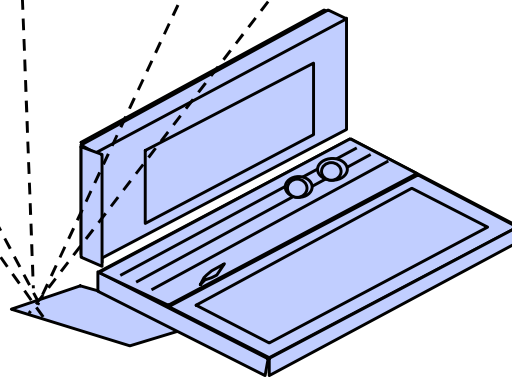
Nearly,

- None of us were here

Or, may be we would work like this

Illuminate ceiling

“Look” at ceiling to receive



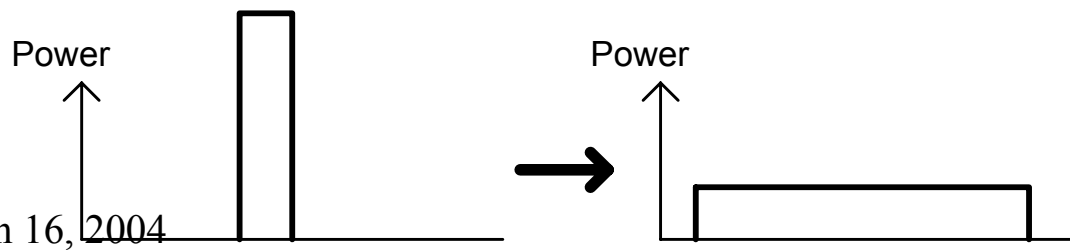
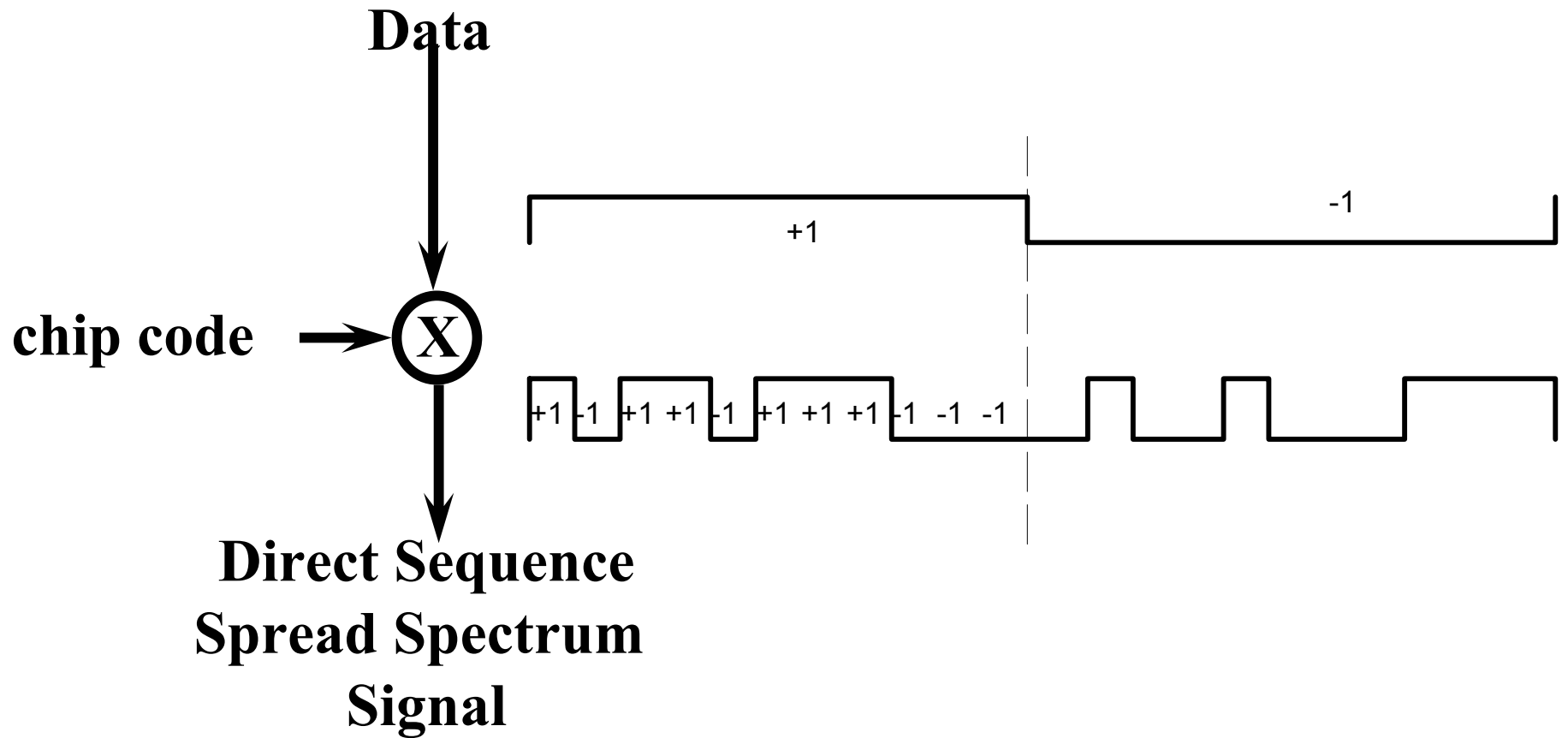
The third part of our standard:

Tuesday, March 16, 2004 “Diffuse Infrared” transmission

But thanks to Mike Marcus:

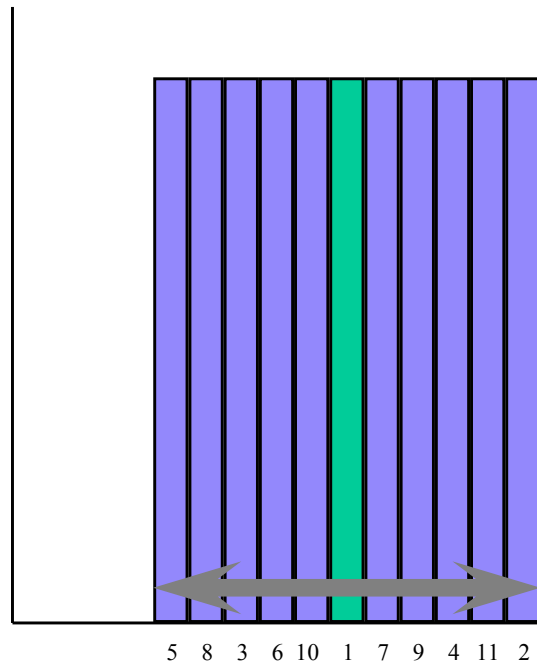
- We got meat to chew on in the late eighties
- Could have wonderful debates in the nineties
- And resolve on practical solutions:

Direct Sequence transmitter



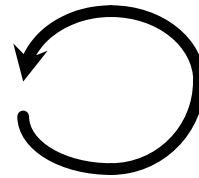
Frequency Hopping principle

Energy



Operate in one “channel”
at a time for maximum
300 ms.

Pick channel according
to pseudo-random code.



use all channels
before re-using
one

Frequency

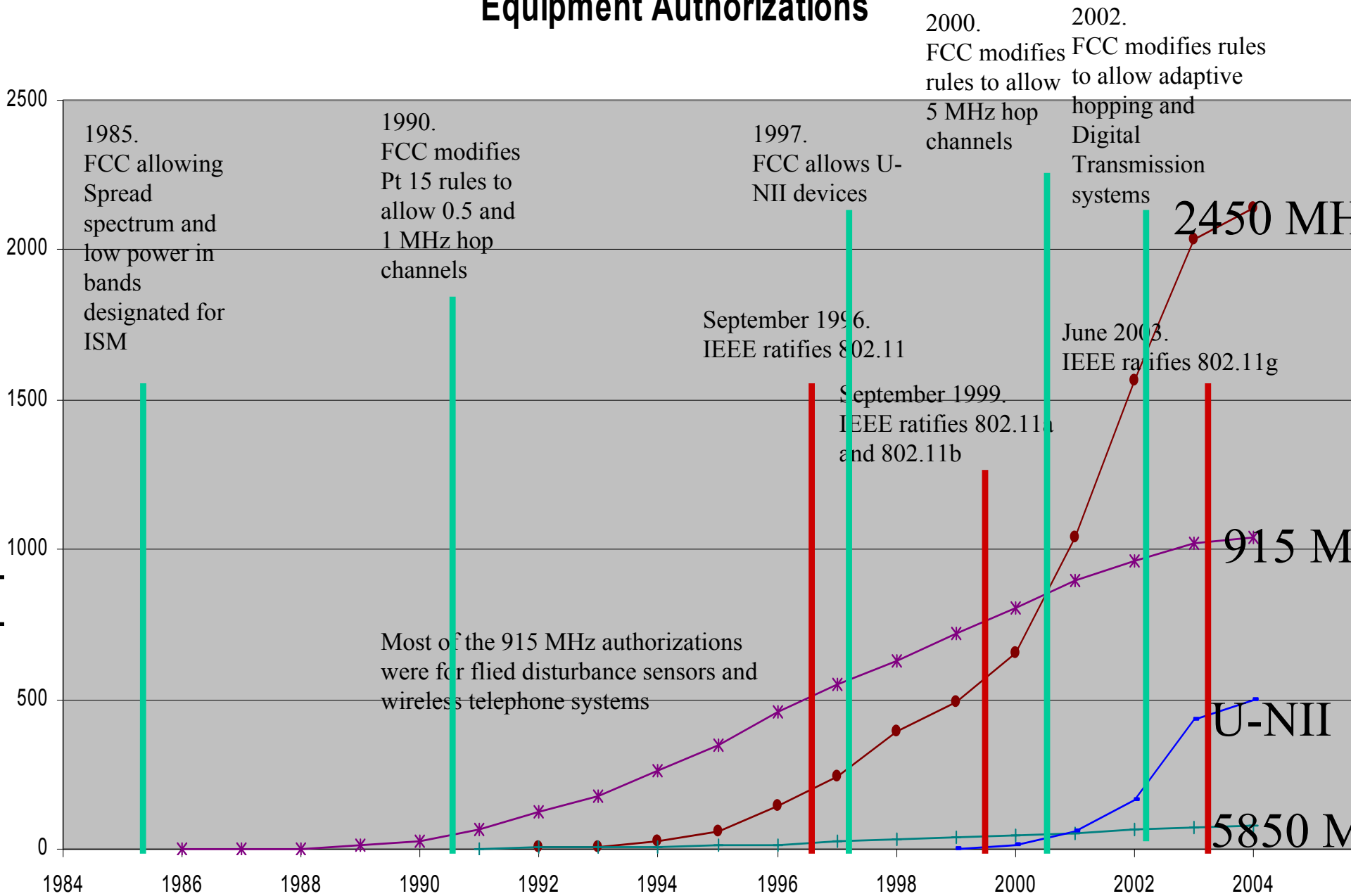
Why were the rules successful?

- The fact that no end-user license was required
- The rules provided a whole playfield of inventiveness
 - High data rates were possible and satisfied the data requirement
- Generous amount of spectrum
- Frequencies were exactly right for the technology

Needed a little time to mature

- Industry response was not immediately visible as seen from the chart with equipment authorizations

Equipment Authorizations



A lot of homework was required

- Research on the technology
- Understanding the new rules
- Understanding indoor channel response
- Selection of the best technology
- Making a good business plan
- Implementation
- Making a standard
- Internationalization for spectrum
- Equipment authorization

802.11 Project Authorization

- “The initial effort will be for the ISM bands and to consider the use of additional bands beyond ISM. However, these ISM bands are already heavily used, and it is felt that service degradation from other users will happen, increasing with time.”

Quote from the minutes

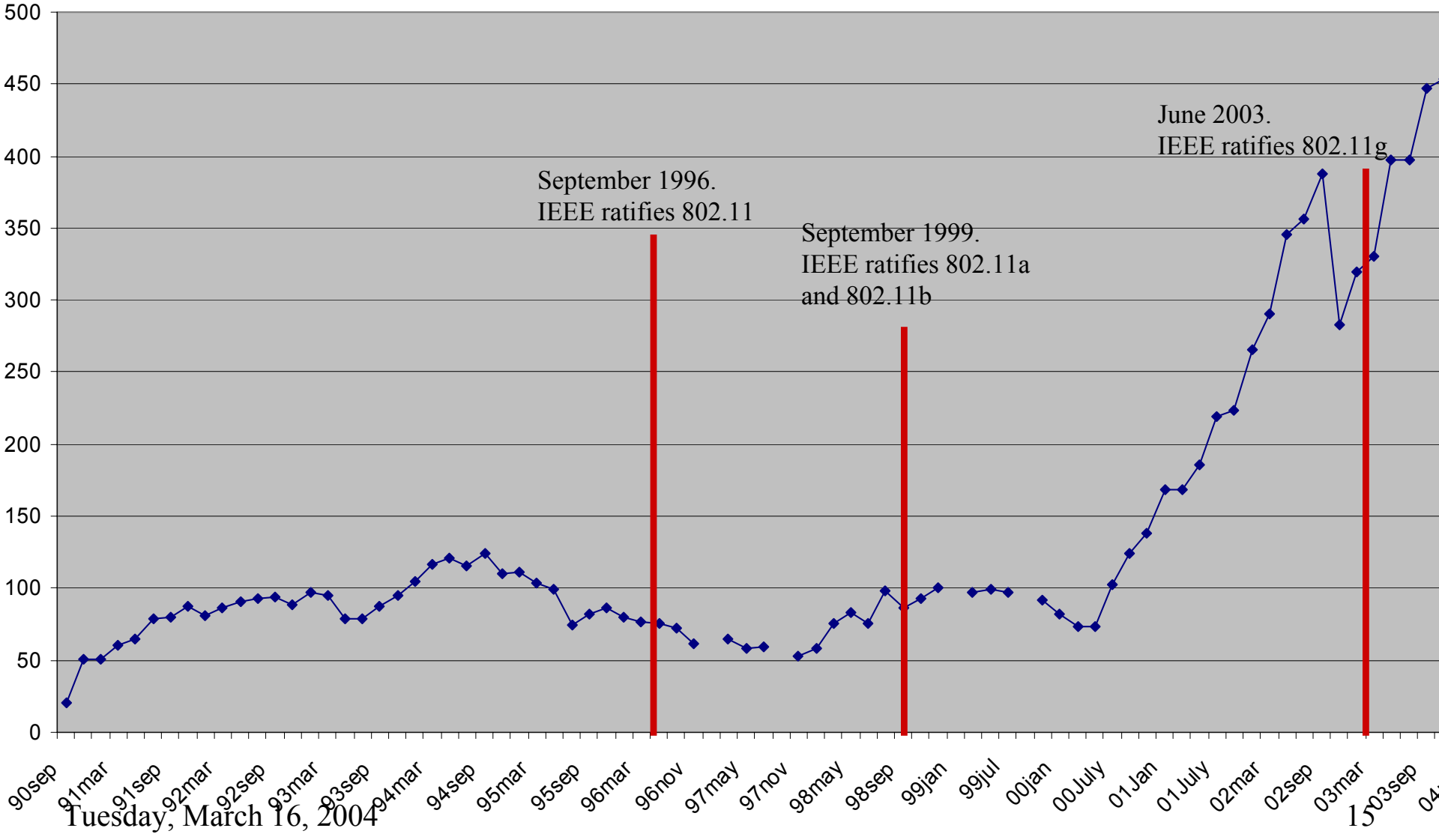
- **Fort Lauderdale, FA
November 11-15, 1991**
- **“The presentation by Dr. M. Marcus from the FCC at Worcester Polytechnic on Friday does invite further comment. The FCC remains interested in the voice of the people.”**

Motion to confirm use of Spread Spectrum

- Minneapolis, Minnesota
July 6-9, 1992
- ***Motion #9:*** IEEE 802.11 **shall support** ~~will pursue~~ at least the two PHYs allowed by FCC in the 2.4 GHz ISM band. It is the intent of the committee to monitor international regulations and accommodate those regulations where possible.
- Approved: 22 Opposed: 2 Abstain: 2

Motion #9 passes

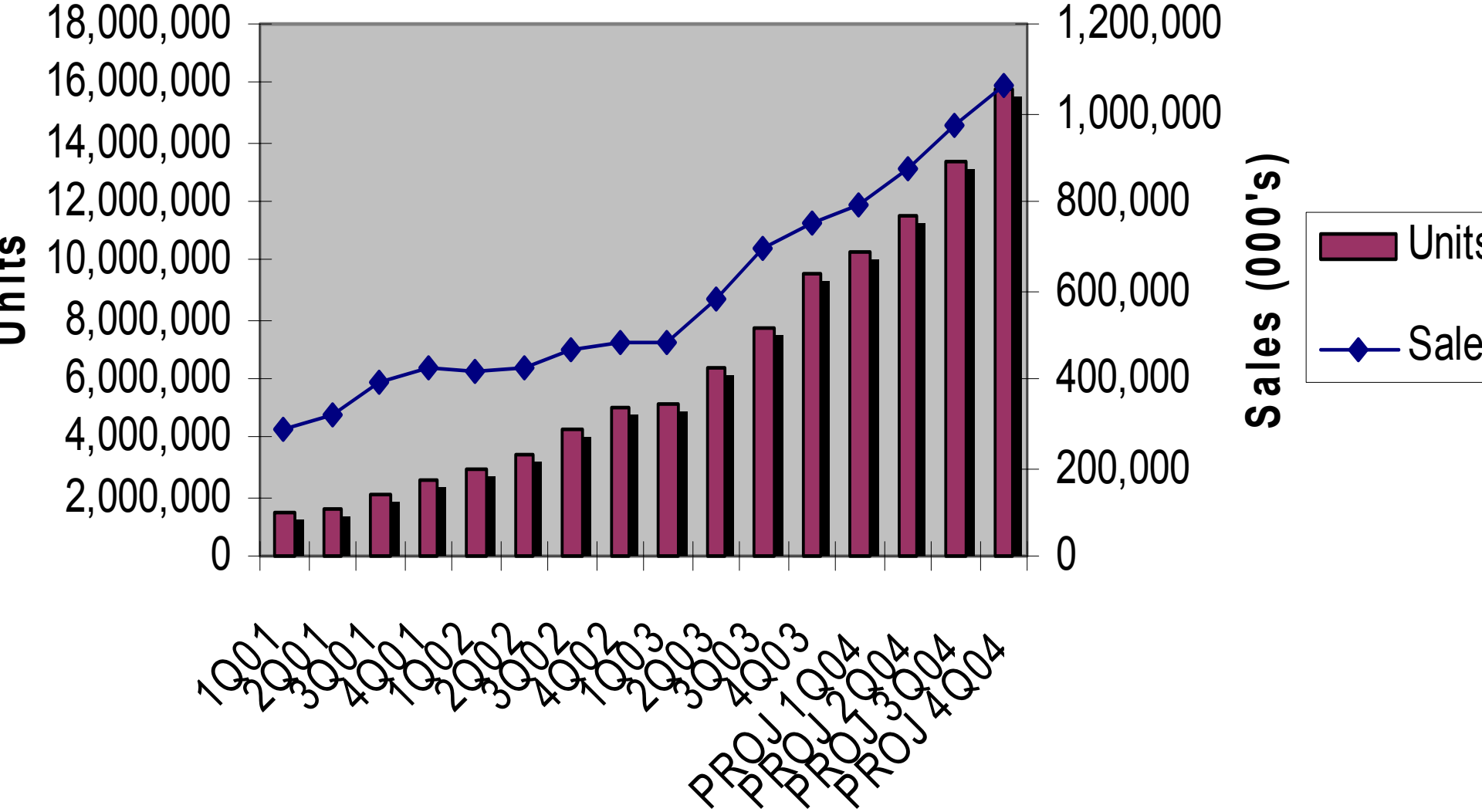
Number of Members



Additional Working Groups

- IEEE 802.15 and IEEE 802.16 were born

World Wide Wi-Fi® Sales and Forecast



Spread Spectrum is everywhere

- Just a few examples

Airports



Courtesy of Wi-Fi®

Tuesday, March 16, 2004

Airplanes



Airplanes



Coffee shops



Courtesy of Wi-Fi®

Tuesday, March 16, 2004

Schools



Courtesy of Wi-Fi®

Tuesday, March 16, 2004

Restaurants



Courtesy of Wi-Fi®

Tuesday, March 16, 2004

Korea has 80 % penetration of ADSL/Wi-Fi Combo

Home



Courtesy of Wi-Fi®

Tuesday, March 16, 2004

–Turn-around time from 5 hours to 5 minutes

Office/Conference



Courtesy of Wi-Fi®

Tuesday, March 16, 2004

(30 Euro per day in a German hotel)

Hotel



Courtesy of Wi-Fi®

Tuesday, March 16, 2004

Kofi Annan Expresses a Bold Wi-Fi Vision



"We need to think of ways to bring wireless-fidelity applications to the developing world so as to make use of unlicensed radio spectrum to deliver cheap and fast Internet access."

Tuesday, March 16, 2004 — **Kofi Annan, November 5th, 2002**

United Nations

- Conference “The Wireless Opportunity for Developing Nations”, June 2003
 - <http://www.w2i.org/pages/wificonf0603/index.html>
- ITU buildings
- WRC 03
 - World Radio Conference 2003, 2500 + delegates
 - Paperless, except for Chairs and editors

In conclusion

- Mike, I have shown the dramatic impact your actions at the FCC made to:
 - The public
 - The workforce
 - The economy
 - The world
- We would like to thank you for your effort