

● ● ● wireless networks

general overview and practical introduction to WLANs

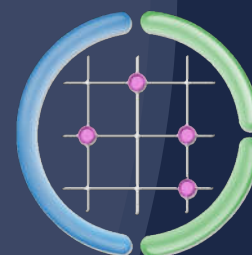
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of the ICTP-ARPL
Trieste, Italy



 **RadioCommunications**
Unit of the ICTP ARPL



Science & Technology Collaborium
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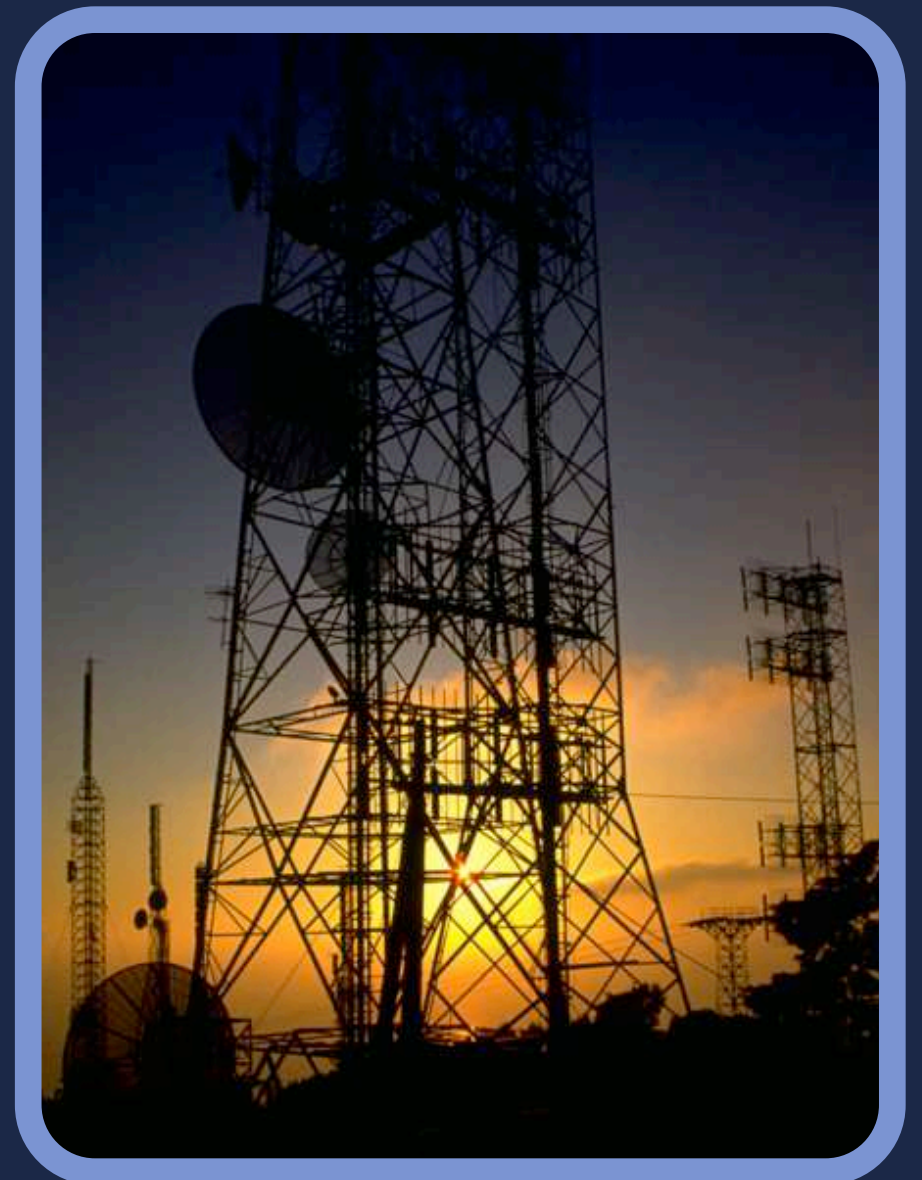
○ ● ● fixed or mobile ?

● Mobile Wireless Access:

- mobile phones (ETACS, GSM)
- mobile data (1G, 2G, 3G, ...)

● Fixed Wireless Access:

- last mile problem
- leapfrog poor or expensive telecom infrastructures
- voice/data integration



○ ● ● fixed or mobile ?

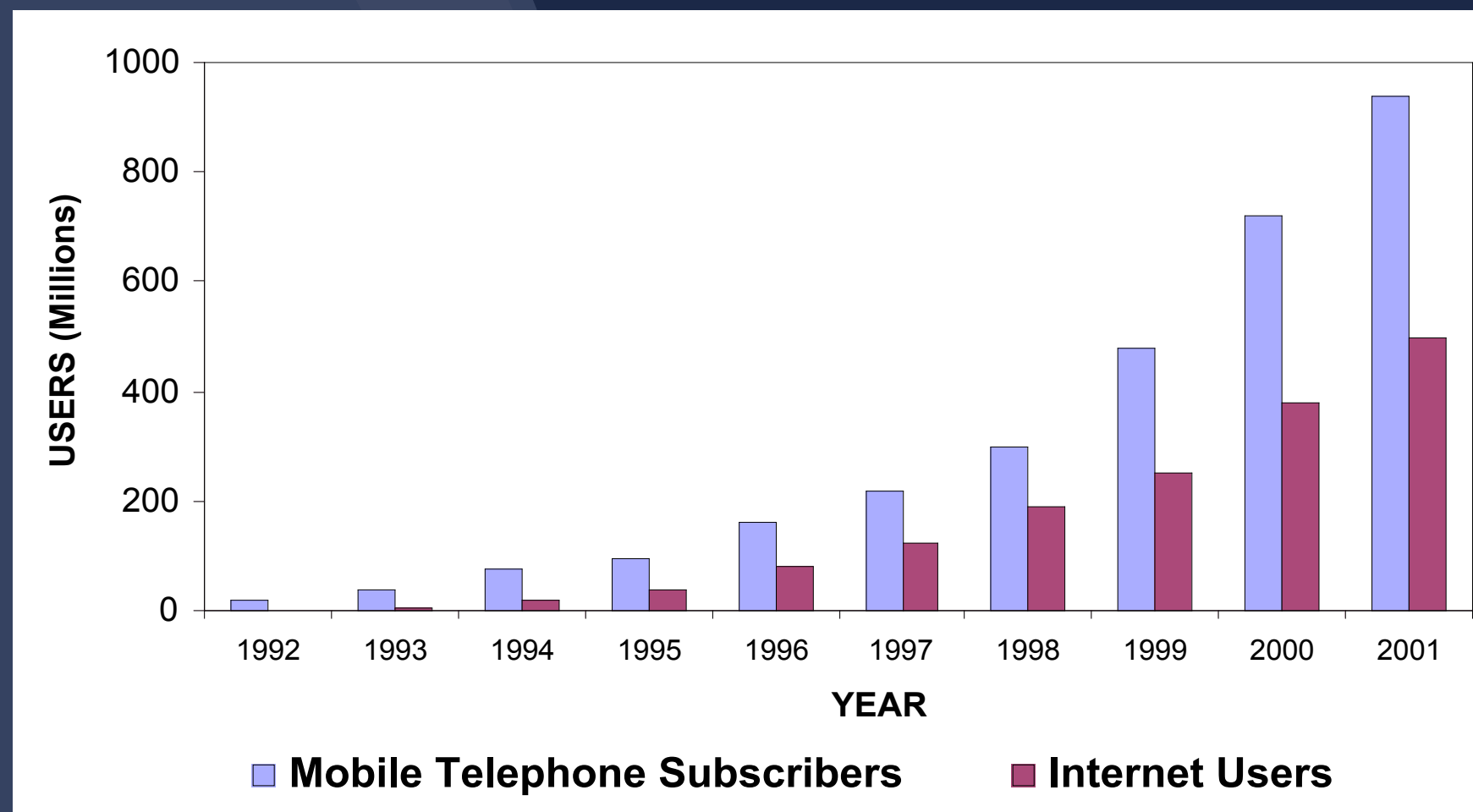
● Here and now, we are interested in technologies for fixed wireless access:

○ it's cheap

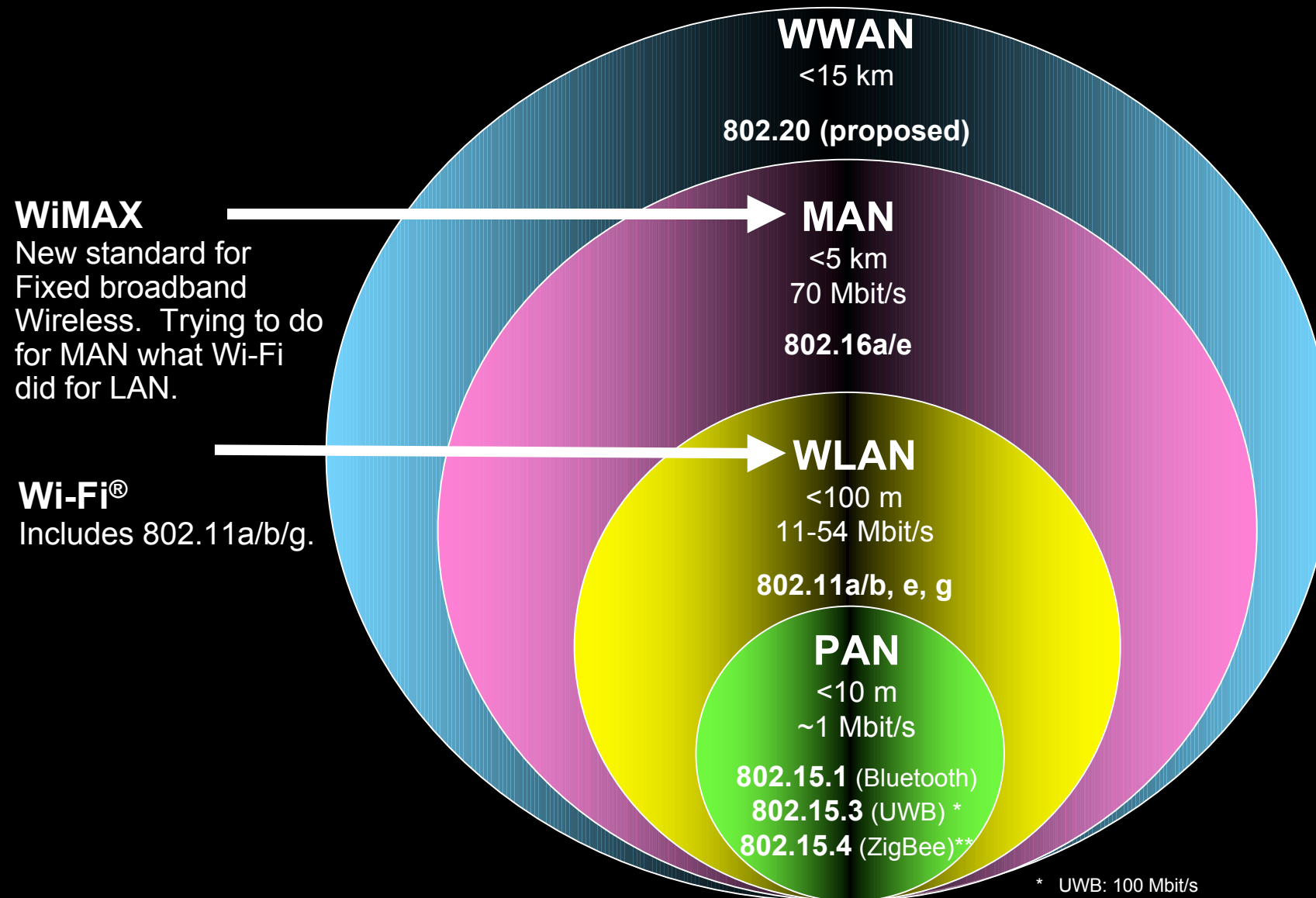
○ *PnP* easy

○ PTT-free

● In future: ?



IEEE STANDARDS VIEW OF WIRELESS NETWORK TECHNOLOGIES



Source: International Telecommunications Union, "Birth of Broadband", September 2003

* UWB: 100 Mbit/s
** ZigBee: 250 kbps

fixed wireless technologies

●●● WLANs & WMANs

- wireless networks were designed (in 90es) for the LAN (indoor) market, but in developing countries there are even much more useful outdoor, as MANs (or even WANs), for distances up to 10 Km (or 50 Km, WiMAX)

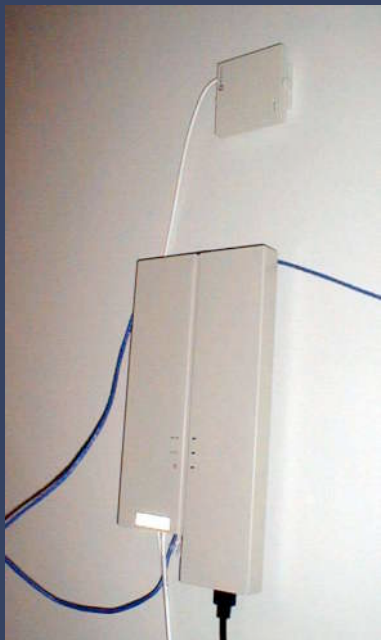


● ● ● cost of wireless

- the enormous success of this technology has led to a dramatic price reduction for the radio devices:

- >1000 US\$ in 1992

- <100 US\$ in 2004



● ● ● speed of wireless

- the available data transfer rate on the same radio channel (bandwidth of 20 MHz) has increased from 1 Mbps to 54 Mbps (even 74 Mbps for some applications)



● ● ● wireless standards

- wireless networking has grown incredibly fast thanks to a wide adoption of common standards:



- 802.11, 802.11a/b/g protocols

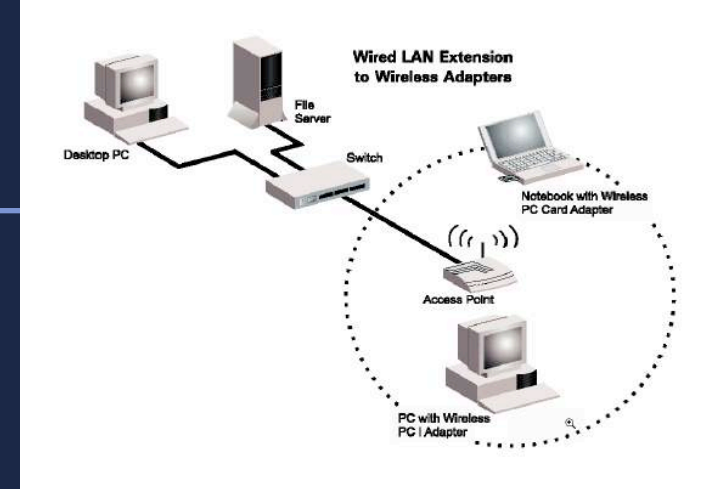
- WiFi™ certification



- brand/model interoperability



● ● ● wireless LANs



- indoor/outdoor network distribution among many clients

- typical distance: 10 - 100 m

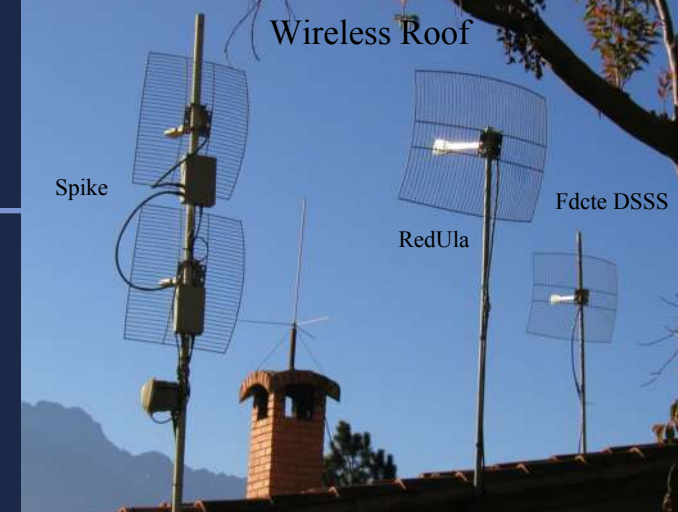
- Point-to-MultiPoint structure:

- master station (access point, AP)

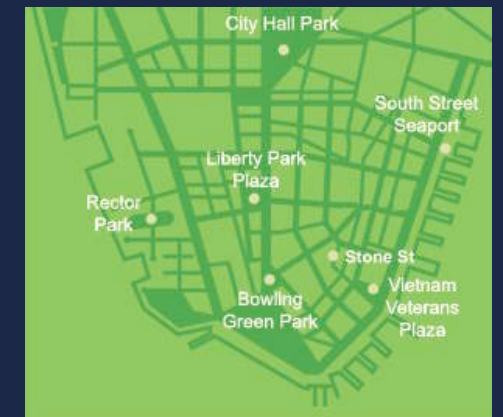
- client station (PCI card, PC card, USB device, wireless bridge)



● ● ● wireless MANs



- used by ISPs (Point-to-MultiPoint)
 - typical distances: 1-5 Km
 - a large number of clients
 - coexistence problems (max. 3 non-overlapping channels)
 - line-of-sight, security issues, remote management



● ● ● wireless MANs



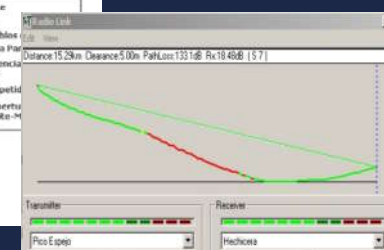
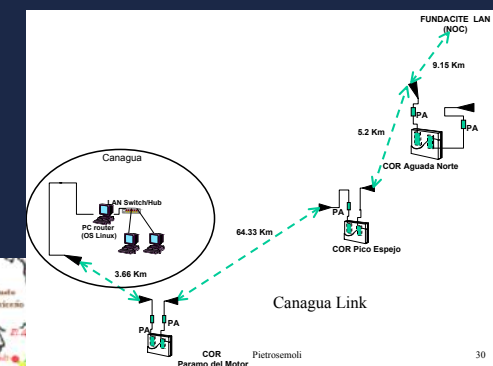
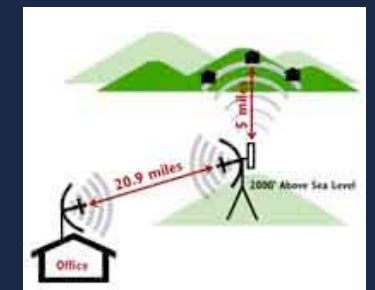
● for private institutions/companies:

○ Point-to-Multipoint

○ Point-to-Point (larger distance, less coexistence problems)

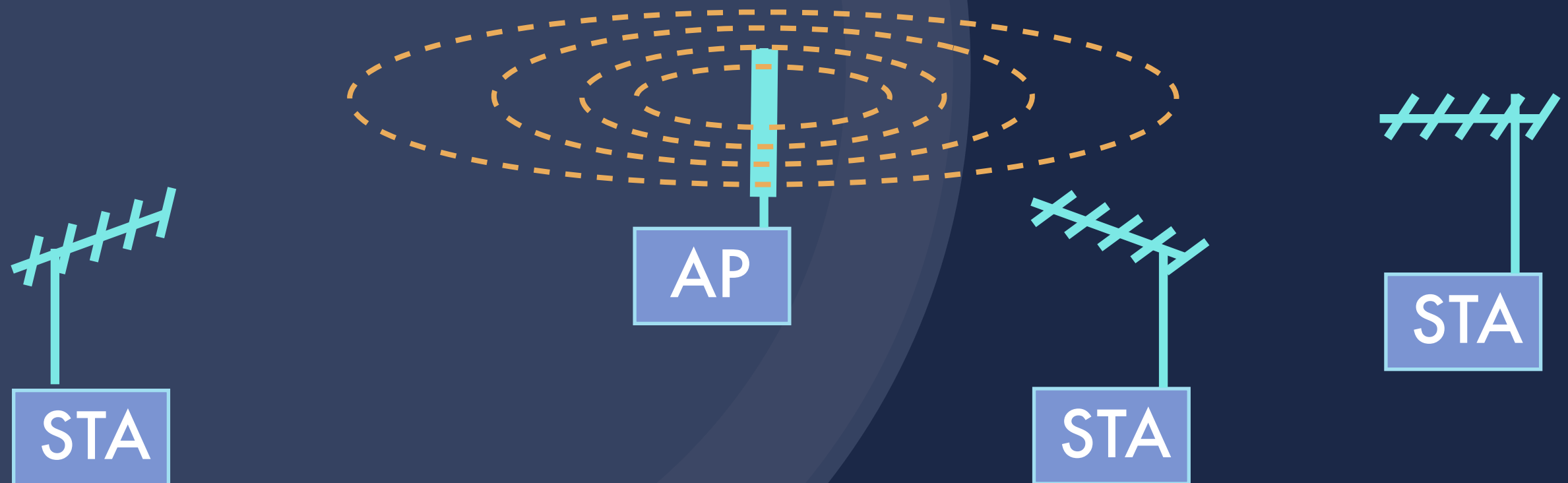
○ line-of-sight, security issues

○ radiolink planning and design



●●● P2MP MANs

- Point-to-Multipoint
- Star topology, one AP, many stations
 - Omnidirectional antenna for AP
 - Directive antennas for stations

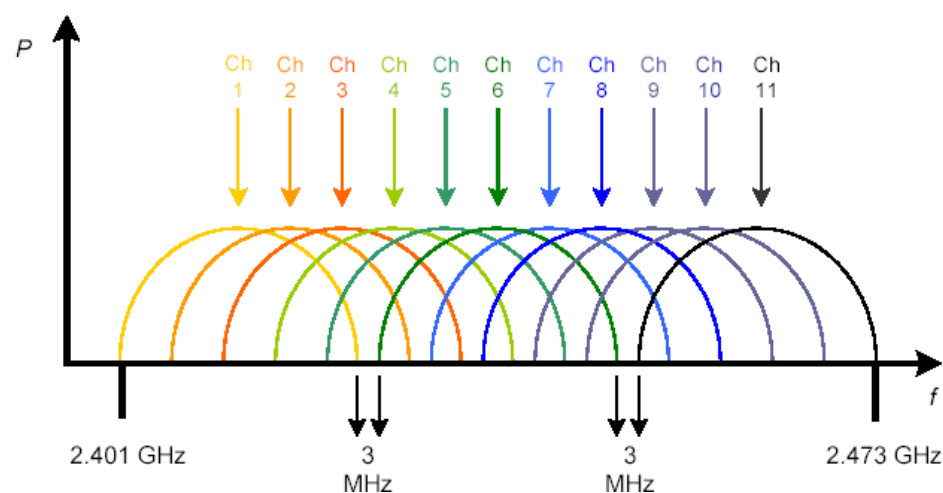


●●● P2MP MANs (cont.)

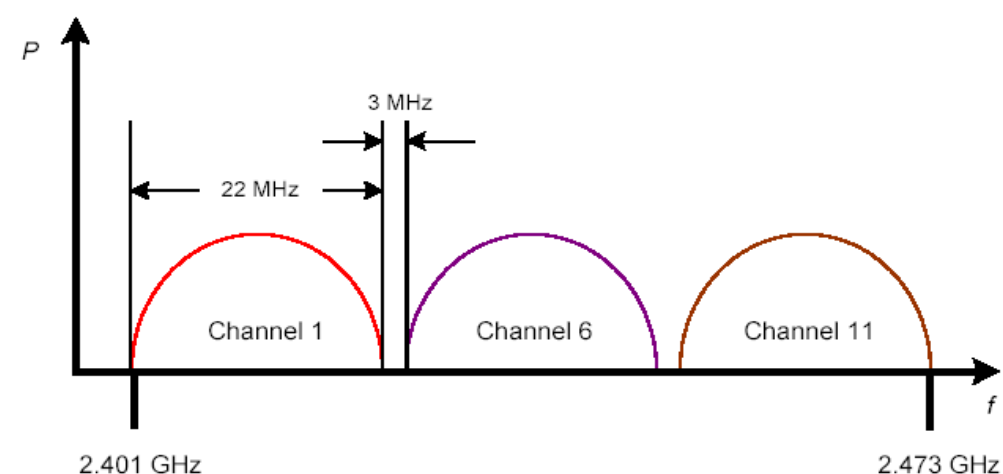
● coexistence problem:

- APs use omni antennas, so they may interfere with other APs or stations
- different channels can be used, but only 3 channels are non-overlapping
- coordination is required among APs

DSSS channel allocation and spectral relationship



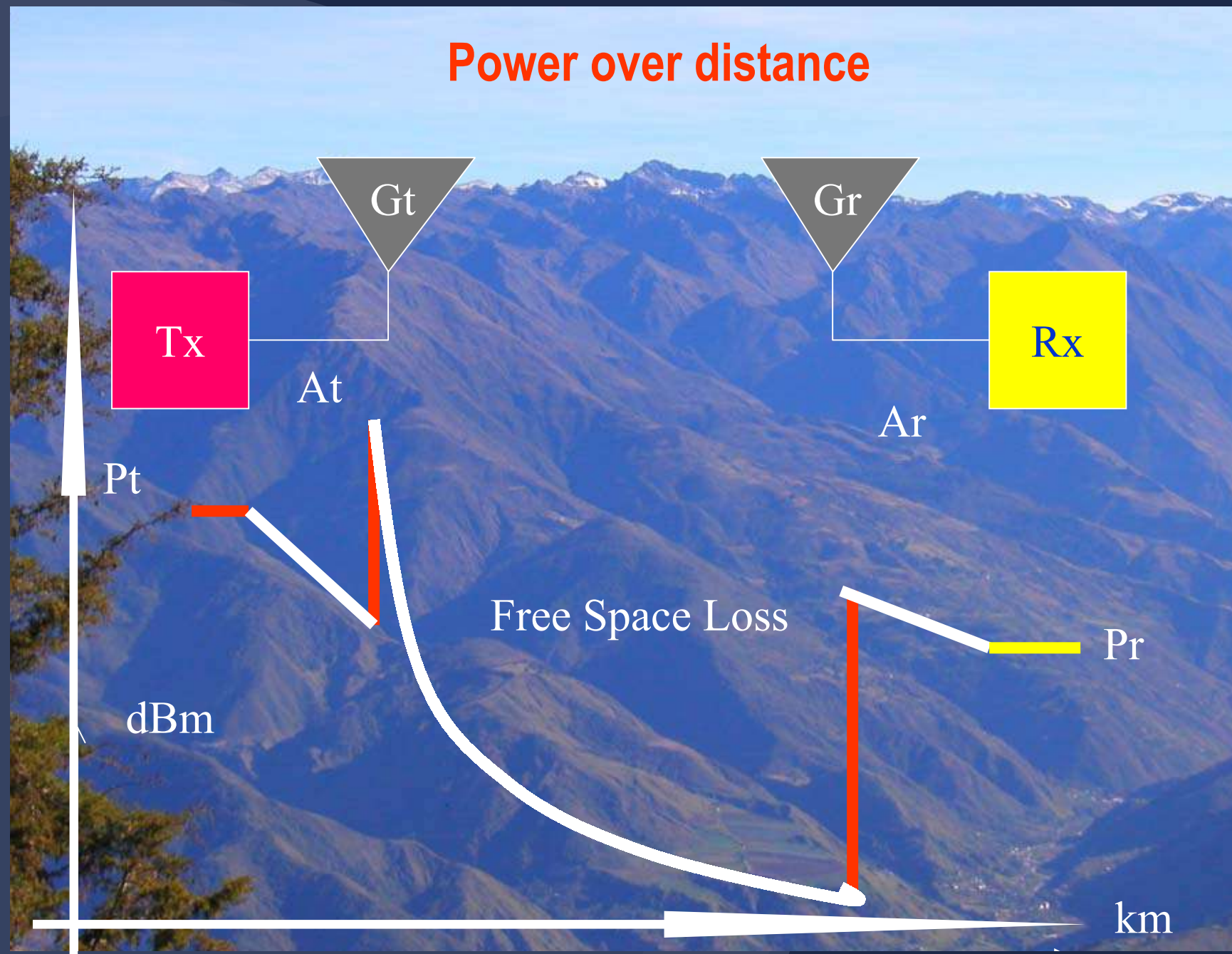
DSSS non-overlapping channels



●●● P2P MANs (WANs)

- wireless long distance links (<10 Km)
 - provide connectivity to remote sites
 - broadband (1, 2, 5, 11, 54 Mbps)
 - no monthly/traffic fee, no recurrent costs (unlike leased lines from PPT)
 - require skills for planning and installation (power budget)

Power Budget



● ● ● Low-cost links?

- It is possible to build inexpensive long-distance radiolinks, with old PCs, Linux OS, off-the-shelf WiFi devices (sold for indoor), home-made antennas:

- 200-500 US\$ per links

- skill is required, but you can find plenty of information and tutorials, just surfing the WWW

●●● Antenna making



Buying antennas?

>> New Products! << [Click Here](#)
Check out the latest products from HyperLink...

Wireless System Solutions

The image displays a variety of wireless system components arranged in a grid-like fashion. At the top, there are two large antennas: a flat patch antenna and a sector panel antenna. Below these are several smaller components including coaxial lightning protectors, signal splitters, cable products, connector/adapters, amplifiers, weatherproof enclosures, power-over-ethernet (PoE) units, and CAT5 lightning protectors. The components are connected by lines, suggesting their interconnectivity in a wireless system.

Antennas

Coaxial Lightning Protectors

Signal Splitters

Cable Products Connector/Adapters

Amplifiers

Weatherproof Enclosures

Power-Over-Ethernet (PoE)

CAT5 Lightning Protectors

Special Sale Price
\$249⁹⁵
802.11g Compatible
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as low as
\$79⁹⁵
802.11b and 802.11g
Compatible!

NEW Dual Coverage
Corner Mount Array
Wireless coverage
around two sides of
a structure.
2.4, 5.3 and 5.8 GHz

Sectorized Omni Array
Available in 14 dBi,
17 dBi and 20 dBi
360 Degree Coverage
Low Cost!! **NEW**

2.4 GHz Reflector Grid Antennas
Available in 15 & 19 dBi
Prices as low as
\$33³⁹ each in
5-Packs
[Click for Info...](#) **NEW!**

HG2424G Grid Antenna
5-Pack Savings!
as low as
\$44⁹⁵ each in
5-Packs
2.4 GHz 24 dBi

2.4 GHz Radome Enclosed Yagi
Antennas
as low as
\$35⁹⁵ Available in 9 dBi,
12 dBi and 14 dBi **NEW!**

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Loads of Options!
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• Heat & Cooling
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as low as
\$11²⁵ Big Savings On
MultiPacks

Mobile Antennas
Mobile Antenna Kits
Permanent Mounts
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Many models & options to choose!

Wireless LAN Radio Pigtails
We have great quality, all major
radio brands supported, hundreds
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Flat Patch Antenna
as low as
\$22⁹⁵
special price 4.5 inches square

HG2415U-PRO Omni
Quantity Discounts!
as low as **\$89⁹⁵** each **WOW!**
buy it 2.4 GHz 15 dBi antenna





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4, 6, 8 and
10.5 dBi **NEW**
2.4 GHz antennas

5.8 GHz 17 dBi Backfire
Antenna
as low as
\$37⁷⁵ **SALE!**
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Sector Panel Antennas
starting at
\$124⁹⁵ **New Models!**
[Check out the Horizontally
Polarized Model!!](#)

Buying antennas?

2.4 GHz Parabolic Grid Wireless LAN Directional Antennas

Model	Description	Gain	Sale Price	Buy Online
 HG2414D	14 dBi Backfire WLAN Directional Antenna, 25° beam	14 dBi	As low as \$31.45	▶ More Info..
 HG2415G	NEW! 15 dBi Mini-Reflector Grid WLAN Directional Antenna	15 dBi	\$34.95	▶ More Info..
 HG2415G-5PK	NEW! 5-Pack of 15 dBi Mini-Reflector Grid WLAN Directional Antennas		As low as \$164.95	▶ More Info..
 HG2419G	NEW! 19 dBi Reflector Grid WLAN Directional Antenna	19 dBi	\$40.95	▶ More Info..
 HG2419G-5PK	NEW! 5-Pack of 19 dBi Reflector Grid WLAN Directional Antennas		As low as \$174.95	▶ More Info..
 HG2424G	24 dBi Heavy Duty Grid WLAN Directional Antenna	24 dBi	\$52.95	▶ More Info..
 HG2424G-5PK	5-Pack of 24 dBi Grid WLAN Directional Antennas		As low as \$224.95	▶ More Info..
 HG2430D	NEW! 30 dBi Reflector Grid WLAN Directional Antenna	30 dBi	As low as \$269.95	▶ More Info..

2.4 GHz Radome-Enclosed Yagi Wireless LAN Directional Antennas

Model	Description	Gain	Sale Price	Buy Online
 HG2409Y	NEW! 9 dBi Radome Yagi WLAN Directional Antenna	9 dBi	As low as \$35.95	▶ More Info..
 HG2412Y	12 dBi Radome Yagi WLAN Directional Antenna	12 dBi	As low as \$44.95	▶ More Info..
 HG2415Y	14 dBi Radome Yagi WLAN Directional Antenna	14 dBi	As low as \$52.95	▶ More Info..

● ● ● How to learn more?



- <http://wireless.ictp.trieste.it>
- Yearly ICTP-ARPL School on Wireless Networking (February)
- Radio Handbook:
 - on Antenna Building
- Join us in the Lab! ;-)

