Networking technologies and applications

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April 22, 2015

Slides

- https://www.tmit.bme.hu/vitma341_2015_en

PCF vs. DCF

- PCF and DCF can operate in parallel inside the same cell
  - Distributed and centralized control in the same time?
    - Is possible, if carefully defined timers are used
    - After the sending of a frame, a certain guard time is required before any other transmission
- Four specific timers
  - SIFS – Short Inter-Frame Spacing
    - The shortest spacing, to support those devices that currently occupy the channel for a short conversation
    - After the SIFS, a receiver can send a CTS to an RTS
    - After the SIFS, a receiver can send an ACK for a given part of the data frame
    - A new part can be sent, without a new RTS

SIFS

Here we can send a new control or data frame

ACK
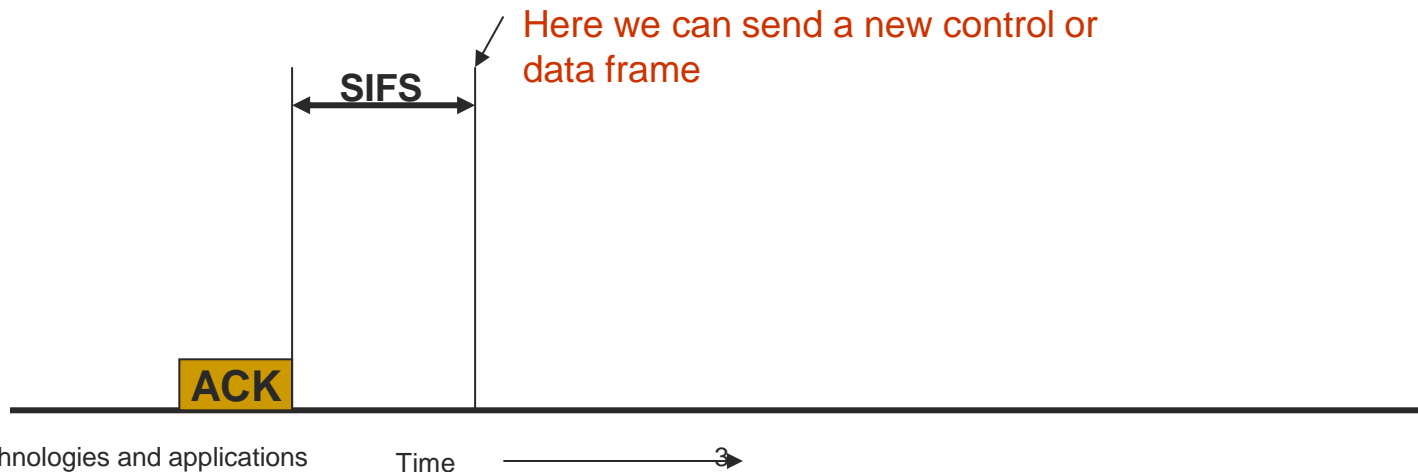
PCF vs. DCF

- **PIFS – PCF Inter-Frame Spacing**
  - After an SIFS, only one specific station can send
  - If nothing is sent until the end of the PIFS, the AP has the possibility to take over the channel, and send a new beacon or a polling frame
    - An ongoing conversation can be finished without disturbing it
    - The AP can access the channel without a contention
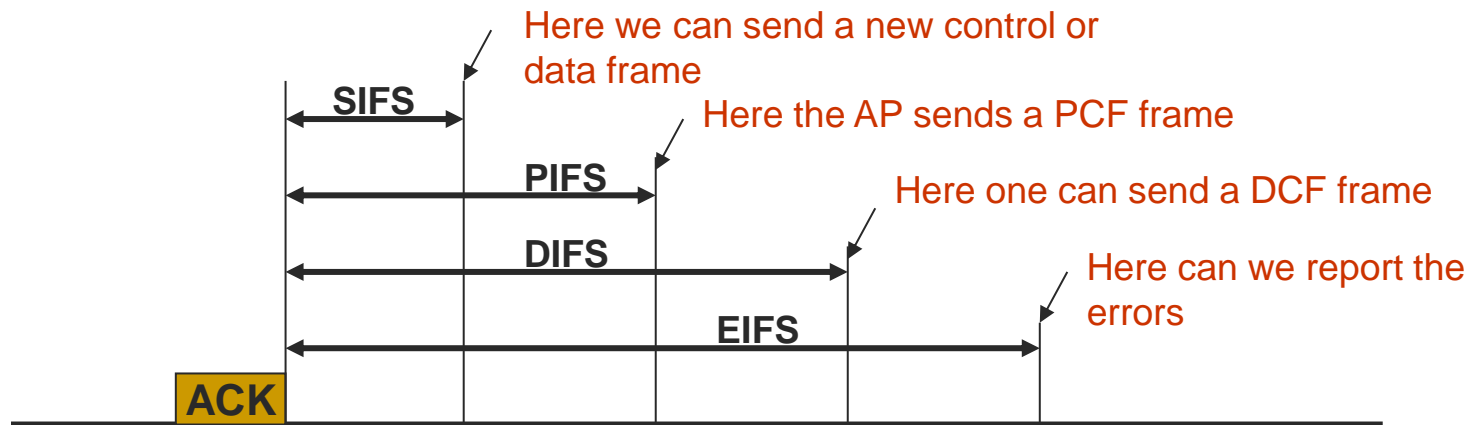   - No contention with the greedy users

Here we can send a new control or data frame

Here the AP sends a PCF frame

SIFS

PIFS

ACK
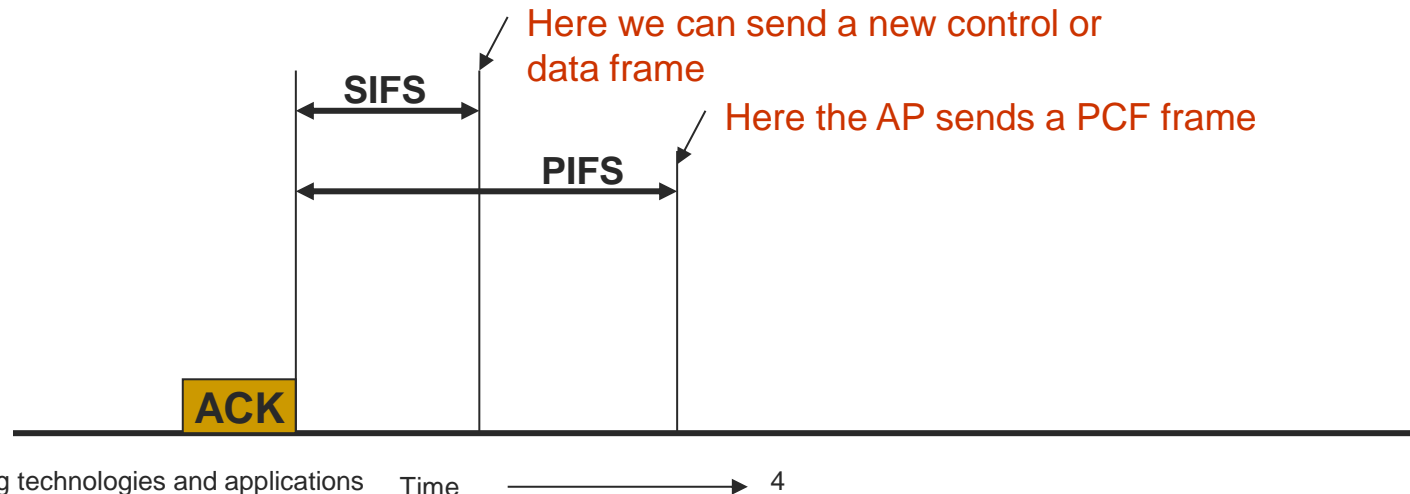
PCF vs. DCF

- ## DIFS – DCF Inter-Frame Spacing
  - If the AP does not have anything to send, after the DIFS anyone can try to gain access to the channel
    - Usual contention rules
    - Exponentially increasing back off interval, if collision
- ## EIFS – Extended Inter-Frame Spacing
  - Used to signal am error or an unknown frame
    - Lowest priority

Here we can send a new control or data frame

Here the AP sends a PCF frame

Here one can send a DCF frame

Here can we report the errors

SIFS

PIFS

DIFS

EIFS

ACK

Hotspot

- *Providing public broadband internet access, in a given geographical region, for mobile users, through a WLAN technology*
  - Usually in crowded places
    - Airports, train stations, shopping malls, hotels, internet cafes, etc.
  - Usually quite restricted areas

Hotspot finders

Hotspots in Hungary

- ## Hotspotter.hu
  - Hungarian hotspot database
    - > 1100 hotspots, >120 cities
  - Budapest (567), Siófok (32), Sopron (32), Eger (28), etc.
  - restaurants (280), hotels (204), cafes (113), shopping malls (91) schools/universities (20), etc.
  - Service providers:
    - Pay service: T-Com, Wiera, T-Mobile
    - Free of charge: HuWiCo
    - FON hotspots
- ## HuWiCo – Hungarian Wireless Community
  - Non-profit community
  - Increasing the popularity of wireless technologies
  - Creating a large Wi-Fi network, free of charge

www.HUWICO.hu

Hotspots in Budapest
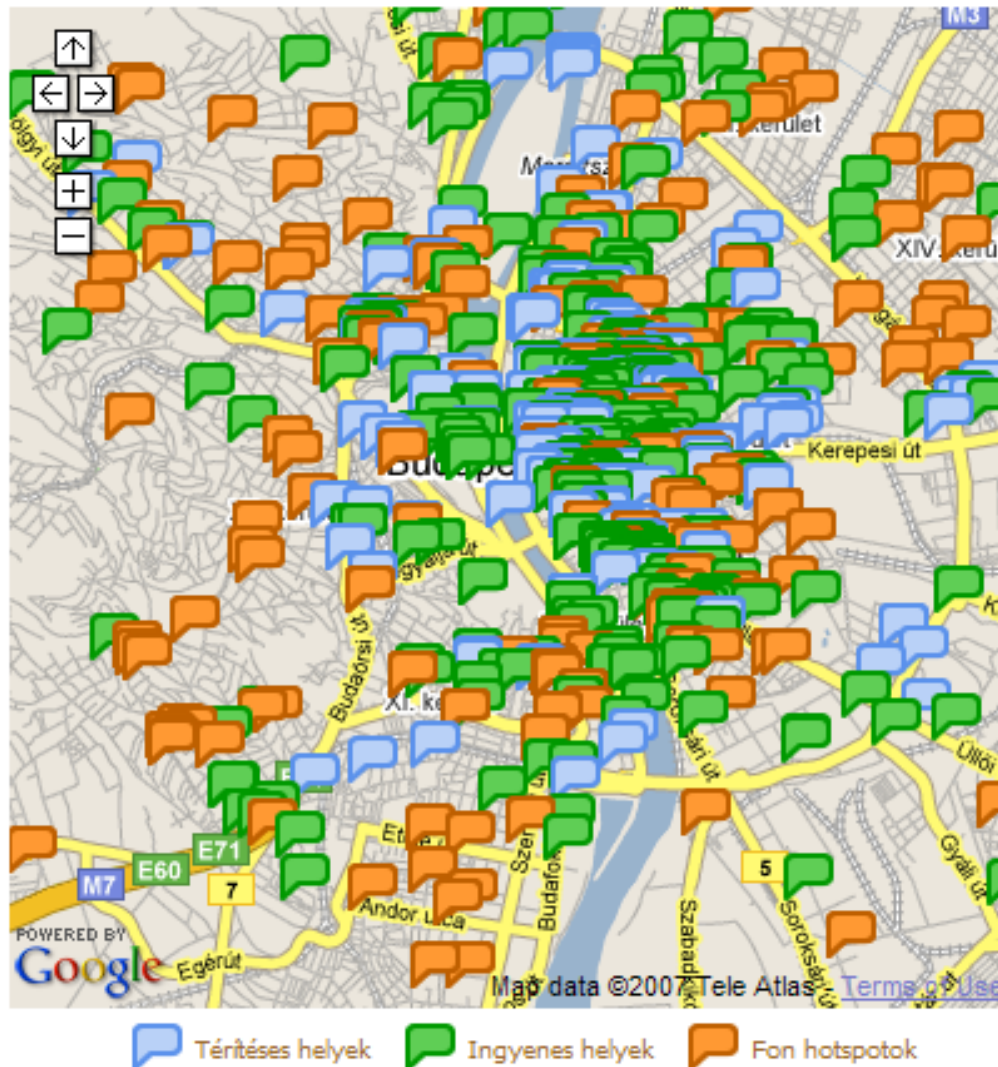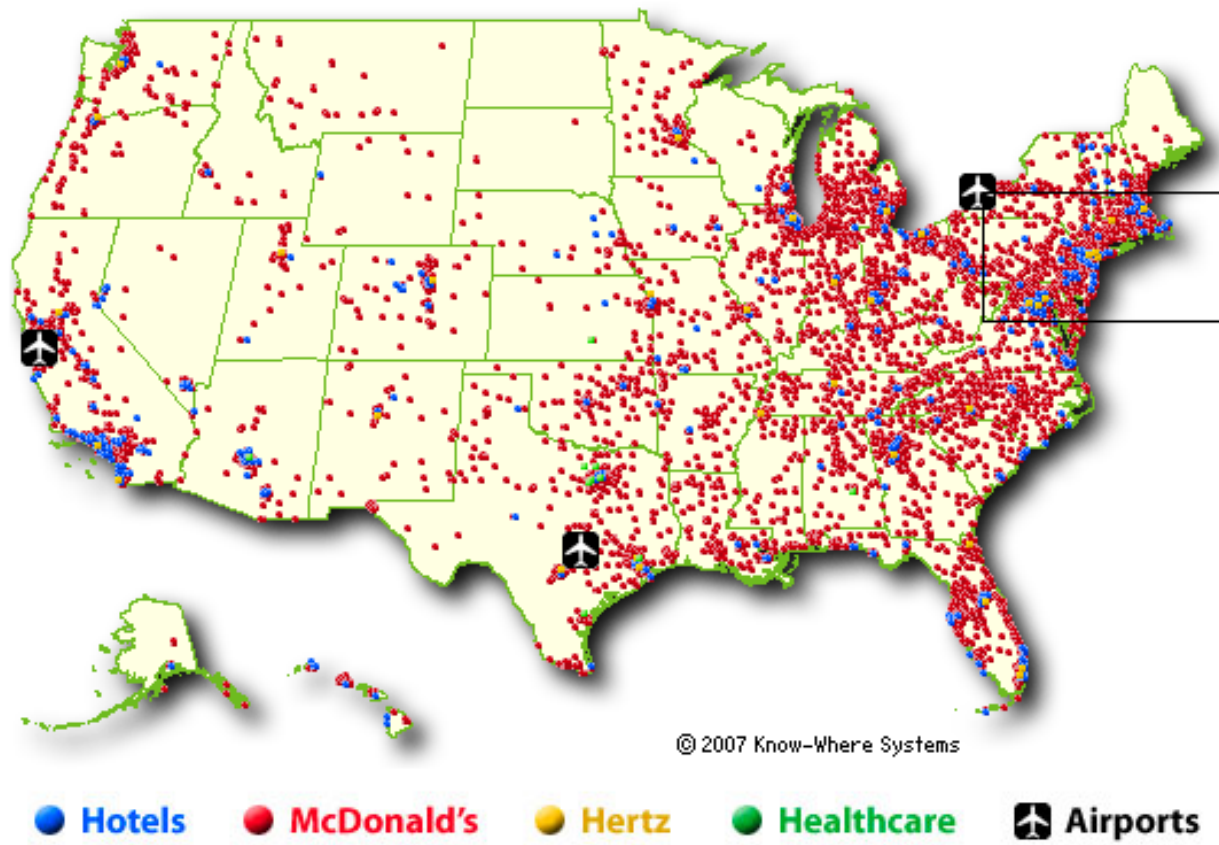
WLAN systems abroad

- **MobileStar**
  - Founded in 1996
  - One of the first hotspot operators
    - Network covering the entire US
  - WiFi hotspots in the Starbucks Coffee chain
 - Acquired in 2001 by VoiceStream Wireless
- **Cometa Networks**
  - Common project of AT&T, IBM and Intel
  - In the McDonald's restaurants – 1 hour free internet if buying a menu
    - In 2004, McDonald's sign a contract with Wayport to build a nationwide WiFi network
   - Cometa closes

Wayport network

More than 12.000 hotspots, in 35 countries

© 2007 Know-Where Systems

🔵 **Hotels**   🔴 **McDonald's**   🟡 **Hertz**   🟢 **Healthcare**   ✈ **Airports**
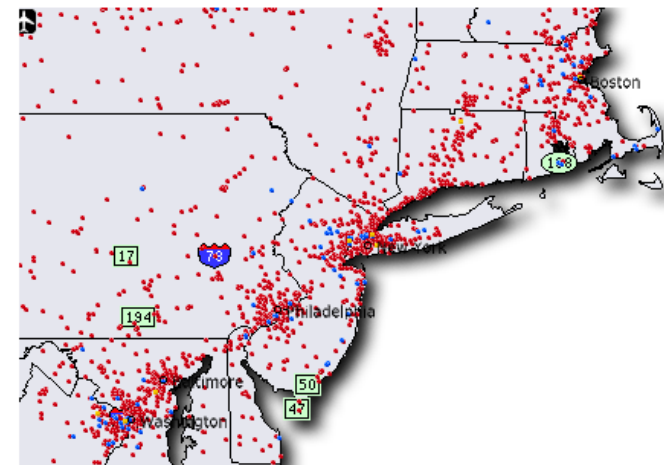
WLAN systems abroad

- Boingo
  - One of the world's biggest hotspot operators
  - More than 100.000 hotspots
    - More than 10.000 in the UK and Russia
    - 143 in Hungary
  - $21.95 unlimited monthly subscription
- iPass
  - More than 90.000 hotspots, in 70 countries
  - More than 40.000 in Europe, 75 in Budapest
- Several other big operators
  - Korea Telecom, Metronet, Netcheckin, NTT DoCoMo, SingTel, Sonera, Starhub, etc.
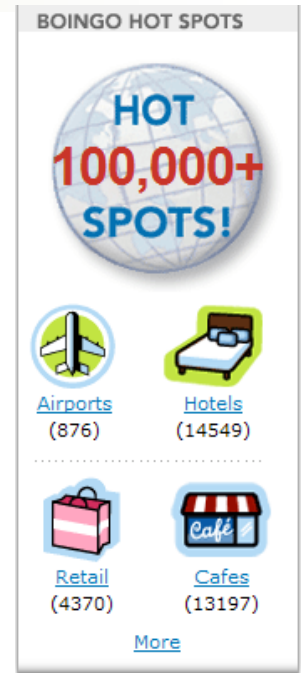
Municipal Wi-Fi networks

- Many US cities planned or already deployed municipal Wi-Fi networks covering the entire city, or specific neighborhoods
  - Los Angeles, Boston, Philadelphia, etc.
  - In Budapest as well?
- Many are against the idea
  - Costs a lot, from our taxes
  - The municipal funds are usually quite narrow, there should be other priorities
  - The technology can become obsolete very fast, before the return on investment
  - Bad effect on the small, local operators
  - Many think it brings economic growth to a city
    - Hard to demonstrate the exact connection
- B. Cox, et. al, "Not In The Public Interest - The Myths of Municipal Wi-Fi Wireless Networks, Why Municipal Schemes To Provide Wi-Fi Broadband Services Are Ill-Advised, " New Millennium Research Council, Wash. D.C. Feb. 2005.
  http://www.heartland.org/custom/semod_policybot/pdf/17737.pdf

P2P-based WiFi networks

- Instead of a centralized, uniform system, let the users build it
  - The example of the Spanish company FON
    - With the support of Google and Skype (21.7 million USD, February 2006)
  - Why should I pay for a hotspot service, if i have already a broadband subscription at home?
- Three categories of FON users
  - Linus
    - The home broadband subscription is extended with a mini hotspot
      - In return, it can use the hotspots of all the other FON users, free of charge
  - Alien
    - Can't /doesn't want to share his subscription, but wants to use the FON network
      - Casual user, will pay for it
  - Bill
    - Users who are not interested in free roaming
      - Shares his home access, but wants money in return
        - Gets some part of the money paid by Alien users

FON

- Special WiFi router (La Fonera)
  - At the beginning for $5 or 5€, today 34 €
  - You should activate the FON service in return
    - Share your access

Fontenna

- Special antenna to extend wireless coverage
  - 200 m radius
  - More possible alien users who pay
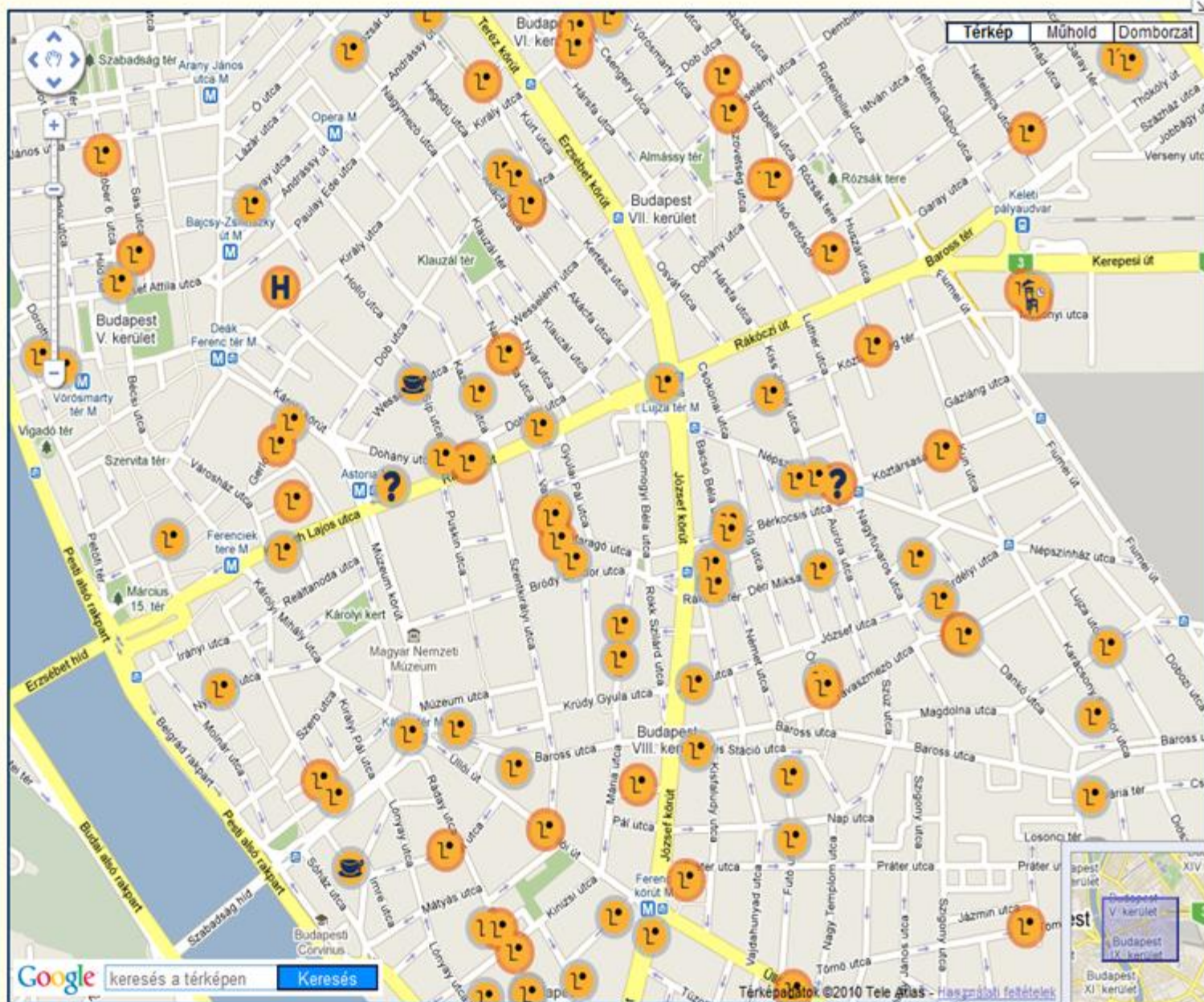
P2P-based Wi-Fi network

- ISPs will not like it very much
  - Usually they do not allow sharing
    - If I share my access with my neighbor, they loose a potential subscriber
    - They like even less if a become a reseller (Bill)
  - It might still be beneficial for them
    - ISPs could get a part of the money
    - Each peer still has to pay for the wired broadband service it shares
      - The more subscribers, the more efficient the service is
  - Security issues
    - Who is responsible for illegal content that is downloaded through my Wi-Fi router?

Drawbacks of the „chaotic" network building

- A network of several hotspots, deployed in a „chaotic" manner
  - Not a well planned network
    - In some places might be very dense, elsewhere very sparse
      - Interferences between densely deployed APs
      - APs are not configured to lower these interferences
  - Not a managed network
    - The management and maintenance of the hotspots is not harmonized
      - SSID, security issues, placing of APs, controlling the transmission power
    - Most of the users use the default settings
      - E.g., they usually use the default channel 6
  - A self-management solution would greatly increase the quality of the communication

Drawbacks of the „chaotic" network building

- Study on chaotic network building:
  - Aditya Akella, Glenn Judd, Srinivsan Seshan, and Peter Steenkiste. „Self-Management in Chaotic Wireless Deployments", Proc. of ACM Mobicom 2005. Aug. - Sept. 2005, Cologne, Germany

- An AP map for several US cities
  - GPS coordinates for each AP
  - Interferences if closer than 50 meters
    - Two APs become neighbors in the AP graph
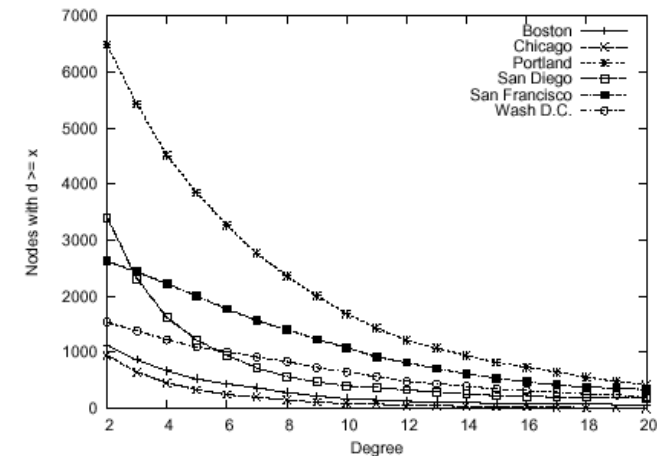
City	Number of APs	Max AP degree (i.e., # neighbors)	Max. connected component size	No. of connected components
Chicago	2370	42	54	369
Washington D.C.	2177	20	226	162
Boston	2551	85	168	320
Portland	8683	54	1405	971
San Diego	7934	76	93	1345
San Francisco	3037	39	409	186

Biological risks

- **WLAN is a new technology**
  - Widely deployed only after '98
  - Too early to say if it has long term risks

- **The 2.4 GHz domain is biologically dangerous**
  - At a high power, it transforms the proteins in the human body
  - The microwave oven works at this frequency, but at much higher power (750-800 W)

- **The WLAN power is controlled**
  - In the US maximum 1000 mW
  - In Europe 100 mW

HOW MANY TIMES HAVE I TOLD YOU, NOT TO HIDE BEHIND THAT ACCESS POINT? THE RADIATION IS HARMFUL TO YOUR BRAIN!