

Nomadic Communications Labs



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Ad Hoc Networks

Ad Hoc Networks (IBSS)

- ❑ The wireless LANs we usually know make use of the mode “infrastructured” which requires one or more Access Points
- ❑ The 802.11 standard specifies an additional mode:
 - Ad hoc mode**
- ❑ This mode let the 802.11 network card operate in what the standard defines a network configuration “Independent Basic Service Set (IBSS)”
- ❑ In IBSS mode there are no Access Points and the various network cards communicate directly among them in peer-to-peer mode

Ad Hoc Networks (IBSS)

- The Ad Hoc mode allows the users to constitute a wireless LAN autonomously
- Typical applications:
 - Files and resources sharing among laptops
 - application of first aid in emergency situations (disasters, accidents, fires, ...)

Ad Hoc Networks (IBSS)

□ Advantages/disadvantages:

- **Reduced costs:** no AP, no cost of infrastructuration
- **Reduced setup time:** It is enough that users have the wireless network cards
- **Performance:** In a communication among two clients is better the Ad Hoc mode, otherwise ... it depends
- **Reduced access to the net:** Generally there is no access to the wired net, in some cases a single client can share its connection to the others clients, however it is not a good solution!
- **Management of a complex network:** given the fluidity of the network topology and the lack of a centralized device, the security management and the performance analysis is extremely complex

Ad Hoc Networks (IBSS)

- The first station for a particular Ad Hoc network (that is, the first NIC radio) establishes the IBSS determining the BSSID address:
 - In a infrastructured network the BSSID is the address of the wireless interface of the AP
 - In an Ad Hoc network, the BSSID is generated in a random way

Ad Hoc Networks (IBSS)

- A BSSID is reserved, the broadcast BSSID (all the bits to 1):
 - Frames with broadcast BSSID jump all the BSSID filters on the MAC level
 - This address is only used when stations try to identify a net sending a probe request
 - Only the probe request frames can use the BSSID broadcast

Ad Hoc Networks (IBSS)

- ❑ Afterwards the first station starts sending beacons, needed to keep the synchronization among the stations
- ❑ Note that in infrastrucutured mode, only the Access Point can send beacons

Ad Hoc Networks (IBSS)

- ❑ The other stations of the Ad Hoc network will join to the net after receiving a beacon and accepting the parameters of IBSS (in particular the interval of beacon) sent in the beacon frame
- ❑ All the stations which join the Ad Hoc network must periodically send a beacon if they do not hear a beacon from another station after a very short random delay from when they presume that beacon had to be sent



Ad Hoc Network Reports

Ad Hoc Network: Setup

- ❑ Start the laptop in linux
- ❑ Login with user utente and password utente
- ❑ Setup the configuration of the AdHoc Network:
 - `sudo /sbin/iwconfig eth0 mode ad-hoc essid AHXX channel y rate xM`
(with $x = 1, 2, 5.5, 6, \dots, 54$)
 - `sudo /sbin/ifconfig eth0 10.10.10.zz`
with all the clients in the same Ad Hoc Network use different IP (different zz numbers)

Ad Hoc Network: Setup

- To verify the setup:

```
sudo /sbin/iwconfig eth0
```

You will obtain something like:

```
IEEE 802.11g  ESSID:"TEST"  
Mode:Ad-Hoc  Frequency:2.432 GHz  Cell: 02:15:00:E2:6F:3E  
Bit Rate:54 Mb/s  Tx-Power=20 dBm  Sensitivity=8/0  
Retry limit:7  RTS thr:off  Fragment thr:off  
Encryption key:off  
Power Management:off  
Link Quality=67/100  Signal level=-60 dBm  Noise level=-85 dBm  
Rx invalid nwid:0  Rx invalid crypt:0  Rx invalid frag:0  
Tx excessive retries:0  Invalid misc:40  Missed beacon:0
```

Ad Hoc Network: Setup

- ❑ To start IPERF in server mode (UDP):
 `iperf -u -s`
- ❑ To run iperf in client mode:
 `iperf -c xxx.yyy.zzz.www -u -b20M -i
 5 -t 20`
- ❑ Where:
 - -i 5 means a report every 5 seconds
 - -t 20 means a simulation 20 seconds long
 - -u means UDP transfer mode
 - -b 20M means a bandwidth of 20Megabits

Ad Hoc Network: the task

□ Performance Analysis:

- Start an Ad Hoc network using two, three, four laptops
- Run iperf server (use UDP) on one laptop and in client mode on the others, starting the clients in a "synchronized" way
- Evaluate the performance, using one client, then two, three, four
- How the throughput decrease? Remember to run iperf N times (with $N > 20$)

Ad Hoc Network: the task

□ Interferences between channels:

- Take 4 laptops and start 2 different Ad Hoc network on 2 different channels (i.e.: 1 and 7)
- Run 2 iperf server (suggestion: use UDP) on one laptop for both Ad Hoc Network, and in client mode on the others two, starting the clients in a "synchronized" way
- Evaluate the performance, remember to run iperf N times (with $N > 20$)
- Change the channels of one of the Ad Hoc network choosing a channel closer to the other (i.e.: 1 and 6, than 1 and 5, ..., than 1 and 1), and repeat the evaluation

Ad Hoc Network: the task

□ Play with MTU:

- Start an Ad Hoc network using two laptops
- Modify the MTU parameters on the wireless card (like: 1500 on both, 250 on both, 2500 and 250, 2500 and 512, ...)
- Run iperf (suggestion: use UDP) in server mode on one laptop and iperf as client on the second evaluating the throughput

Ad Hoc Network: the task

□ Play with speeds:

- Start an Ad Hoc network using two laptops
- Modify the speed parameters on both laptop
- Run iperf (suggestion: use UDP) in server mode on one laptop and iperf as client on the second evaluating the throughput