Wireless LAN:

(1) WN

(1) idea : Just a LAN, but without wires.

(2) Not as easy since signals are of limited range.

(3) unlike wire LAN, if A can hear B and B can hear C, not necessarily true that A can hear C.

(Hidden A story)

(4) uses unlicensed spectrum, low power. small cell (SDN)

(5) 802.11 from 2Mb to 54Mb (versions)

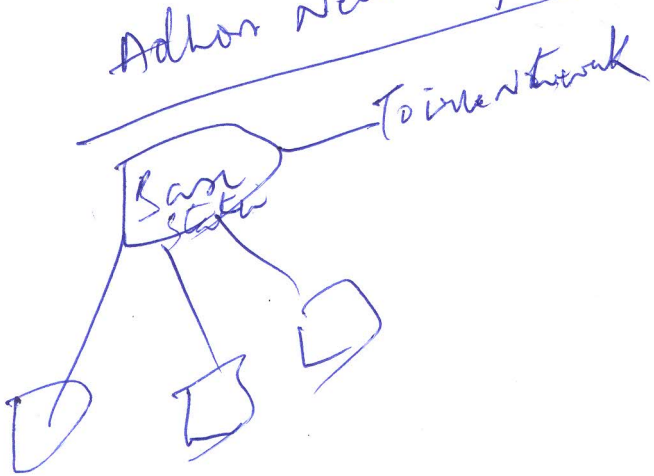
(6) Bluetooth (PAN)

(7) WiB (802.16) wireless MAN.

2 Modes of operation

- In the Presence of a Control Module (CM) - often called a "Base station" or 802.11 calls them "Access Points".
- Adhoc, or Peer to Peer Connectivity when there is no CM.

Applications: LAN Extensions, Cross building interconnection, Nomadic Access, Adhoc Networking.



WLAN Requirements

1. Good use of bandwidth (high throughput)
2. Number of Nodes – may be large – 100's
3. Good Connecti to LAN backbone required
4. Good Service Coverage (range)
5. Minimal battery Power Consumption
6. Transmiss security and Robustness
7. Collocated Network operation
8. Licence free Operati (ISM band – Industrl, Scientif Medical band) 2.4 GHz)
   Any one can contribute.
9. Cell handoff and network roaming
   – Dynamic managmt – adaptive MAC addrss managmt dynamic and automated additi, deleti, relocati

(10) choice of Physical Solution:

Eg: Infrared (IR), Spread spectrum, narrowband microwave.

(4) WN

Evolution of standard

IEEE 802.11 Committee started (1995)

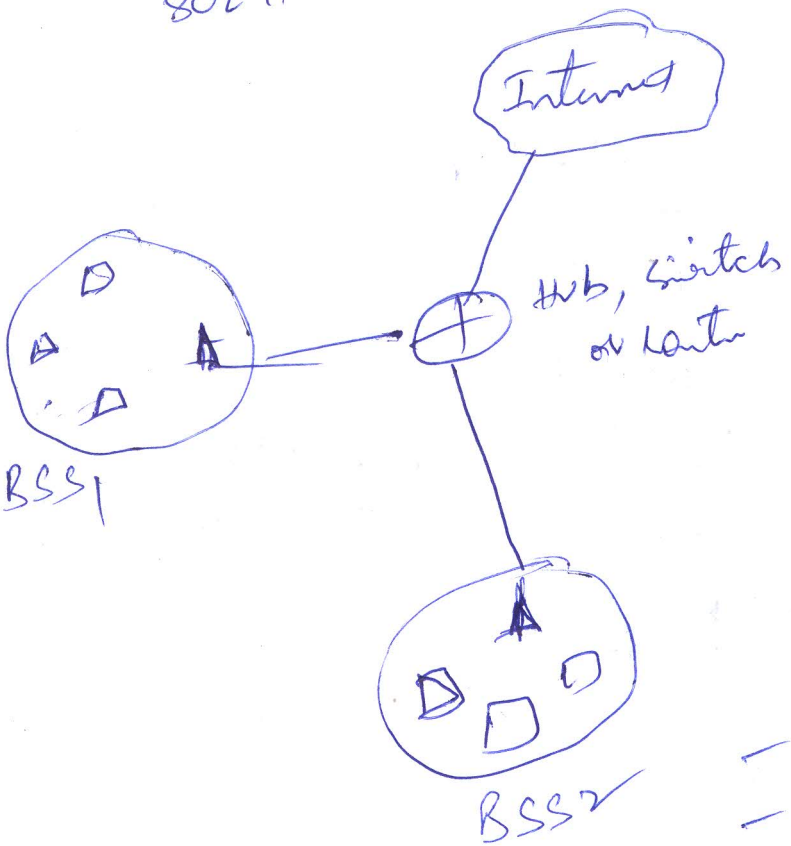
802.11 Diffused IR using 1 or 2 Mbps (1997)

802.11, 2.4 GHz ISM band FHSS, 1 or 2 Mbps DSSS, 1 or 2 Mbps

(2000) 802.11b, 2.4 GHz ISM band HR-DSSS, up to 11 Mbps with DSSS compatible

(late 2001) 802.11g, 2.4 GHz ISM band OFDM, upto 54 Mbps

802.11 LAN architecture



Basic Service Set (BSS) (cell)

in infrastructure mode contains:

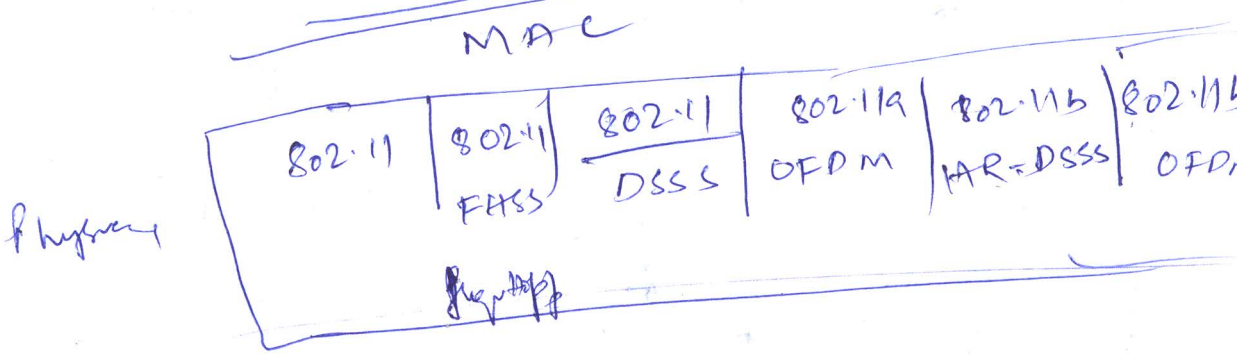
- wireless hosts
- Access Point (AP) base station
- ad hoc mode: hosts only

IEEE 802.11 Physical layer

Upper layer

LLC

MAC



IEEE 802.11 : multiple acc

- avoid collisions
- CSMA
- no collision detection → difficult to receive (sense collisions) when transmitting due to weak signals

MAC layer management entity (MLME)

→ radio management
→ Power management
→ Security management

can't sure all collisions in any case : hidden terminal

→ goal : avoid collisions : CSMA/CA -

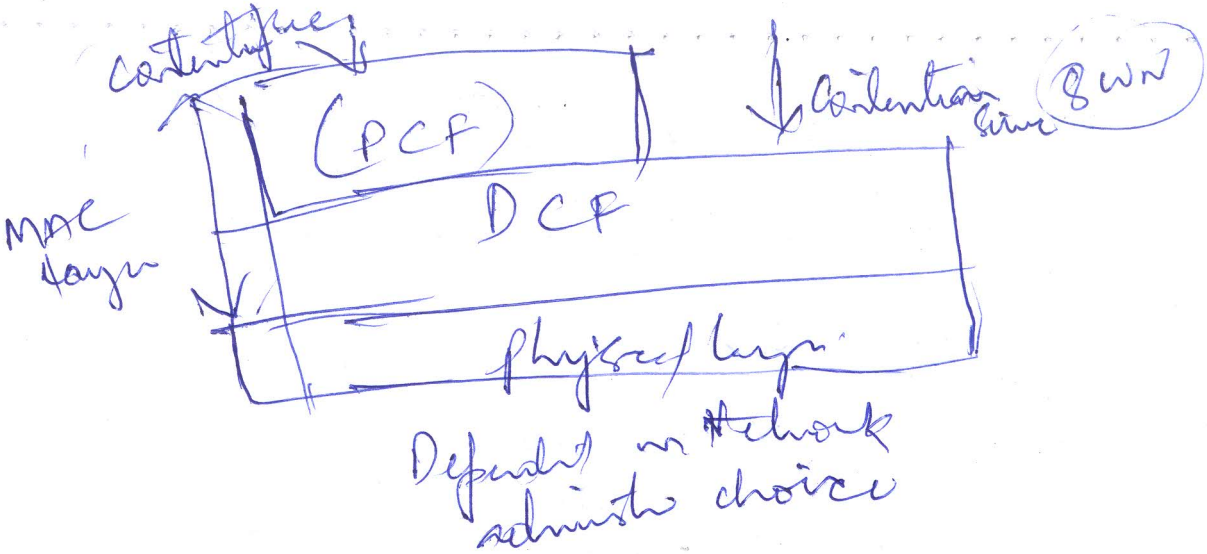
802.11 Protocol Architecture

The standard provides two modes of operation which are

(a) DCF (mandatory) 802.11 every system must.
- best effort service
- uses CSMA with CA

(b) PCF (optional) - base station controls access to the medium - uses a polling mechanism with high priority access to the medium (guaranteed service)

(judging) Plus three types of frames:
- data, control, management.



802.11 works

802.11 Sender

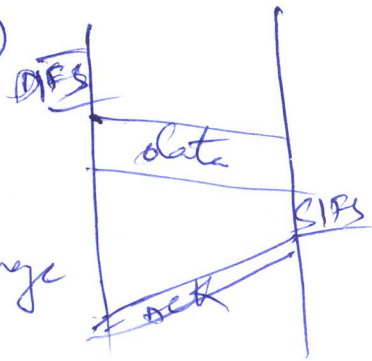
1. If sense channel idle for (DIFS) then transmit entire frame (NO CD) atleast

2. If sense channel busy then start random backoff time time counts down while channel idle transmit when time expires if no Ack increase random backoff interval repeat 2

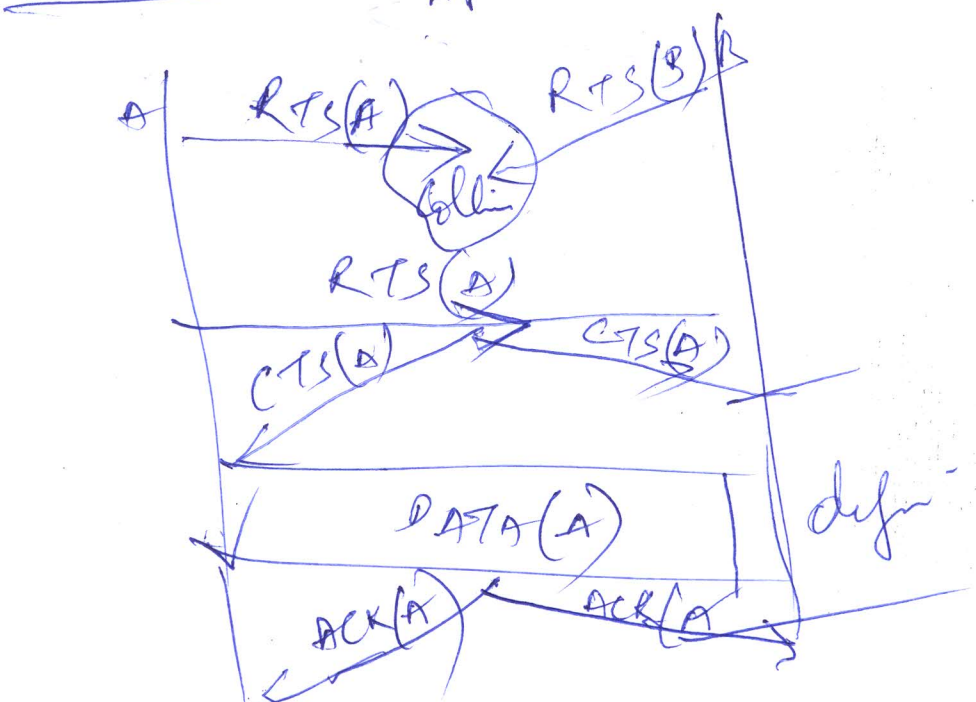
(9WN)

802.11 Recap

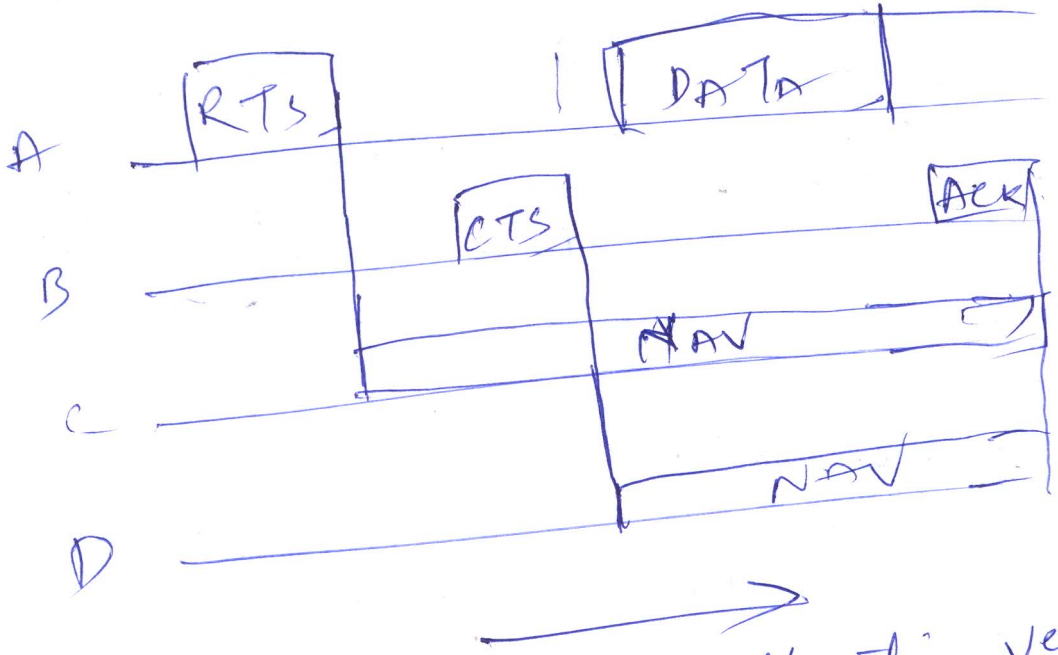
- If frame received ok
  then ack after SIFS
  (ack needed due to
  hidden terminal
  problem)



Collision Avoidance: RTS-CTS exchange



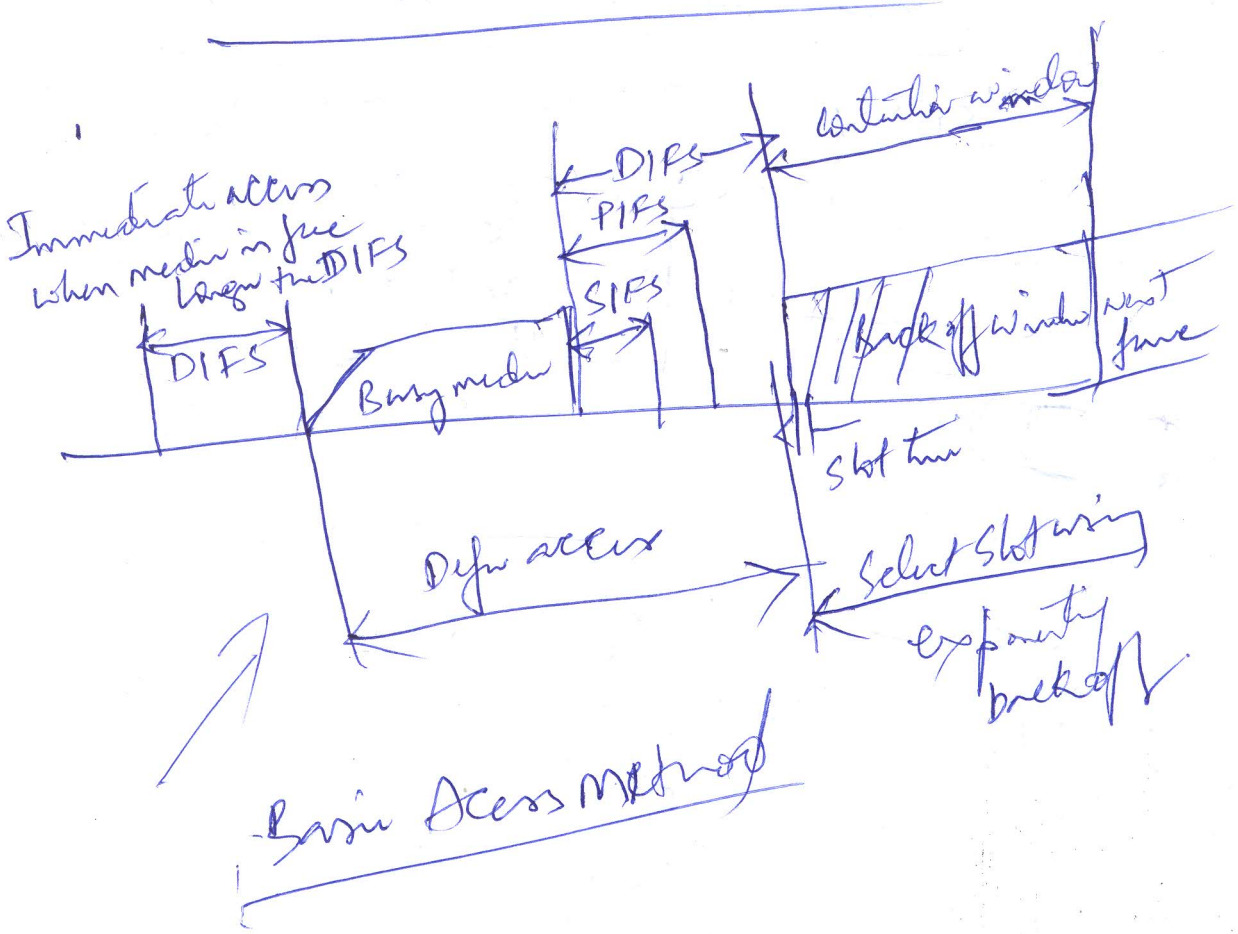
The use of Virtual channel sensing using CSMA/CA



NAV (Network Allocation Vector)

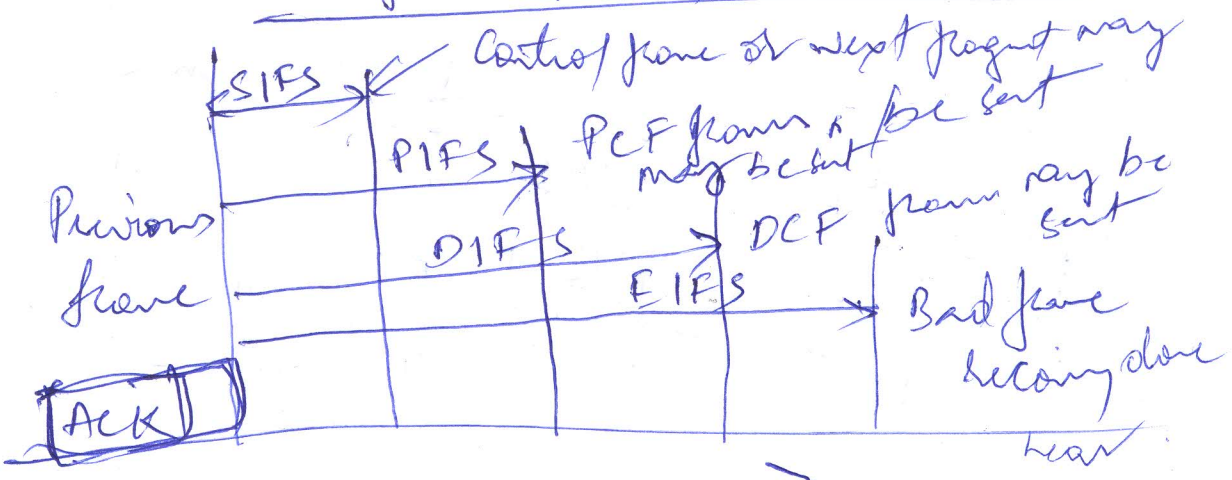
Blocked

802.11 Frame transmission



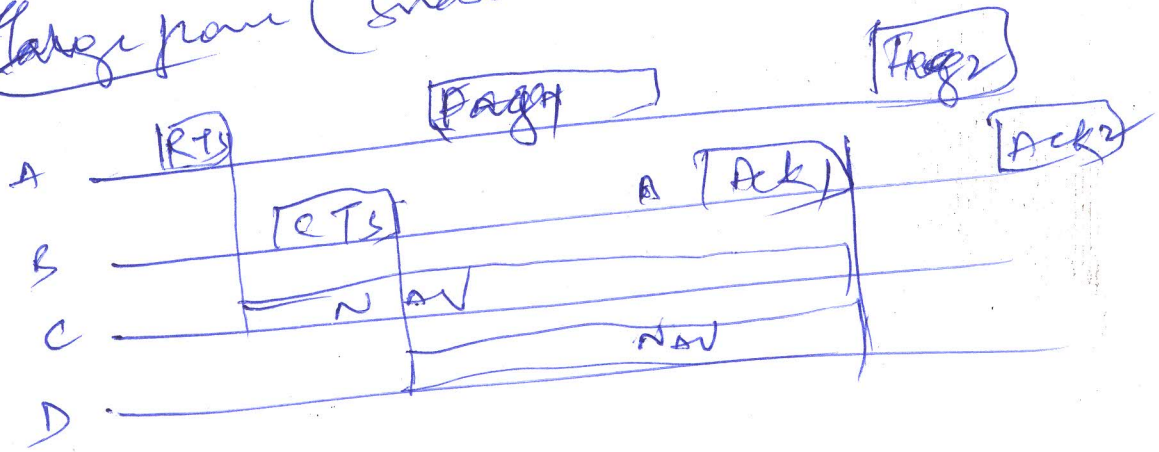
Basic Access Method

Interframe Spacing in 802.11



SIFS – Short Inframe spacing
PIFS – PCF IFS
DIFS – DCF IFS
EIFS – Extended IFS

Large frame (Smaller fragments)



802.11 mac frame format

0-2312

2	2	6	6	6	2	6	payload	4
FC	D/I	Add1	Add2	Add3	SC	Add4	Frame body	CRC

FC frame control

Add1: mac address of wireless host/AP to receive this frame

Add2: mac address of wireless host/AP transmitting this frame

Add3: mac address of router interface to which AP is attached

Add4: used only in adhoc mode.

D/I: Duration/connection ID

SC sequence control

duration of reserved transmission (RTS/CTS)

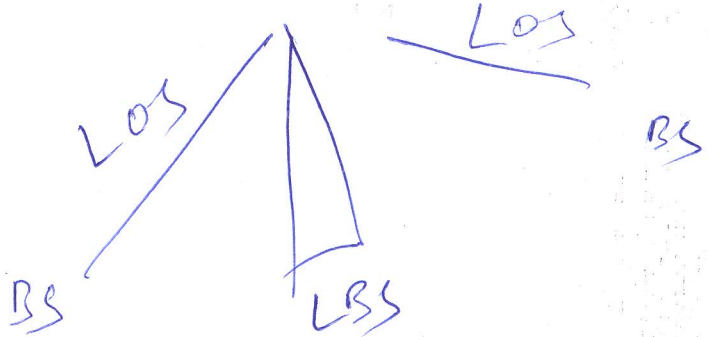
frame seq (Sequence control) for reliable ARQ

---

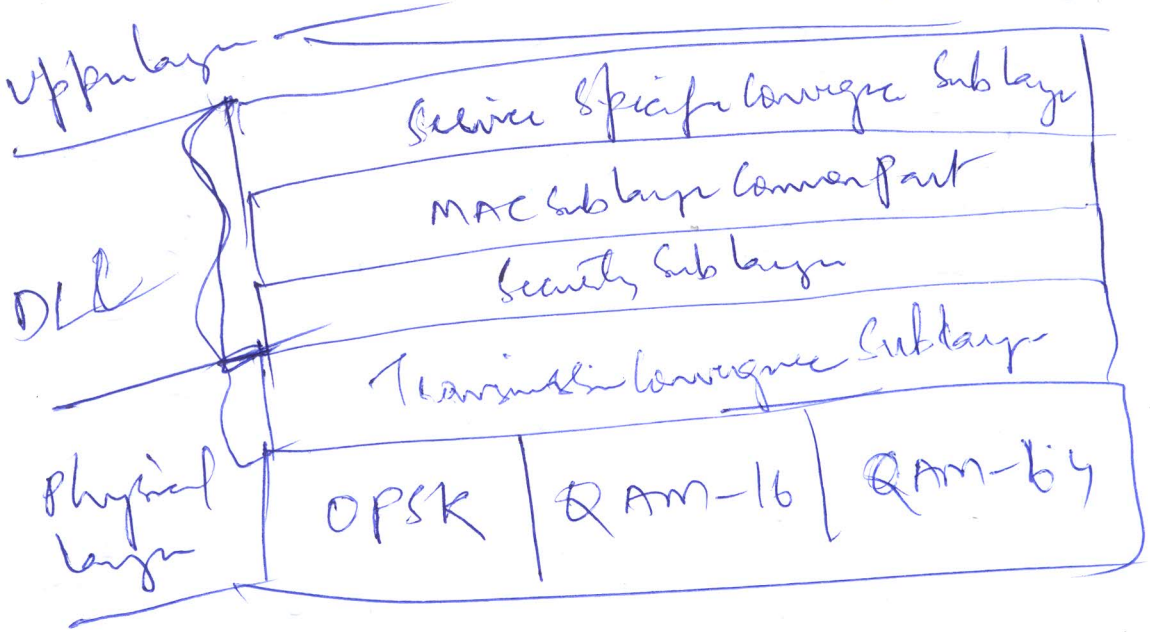
wireless MAN

802.16

LOS — BS



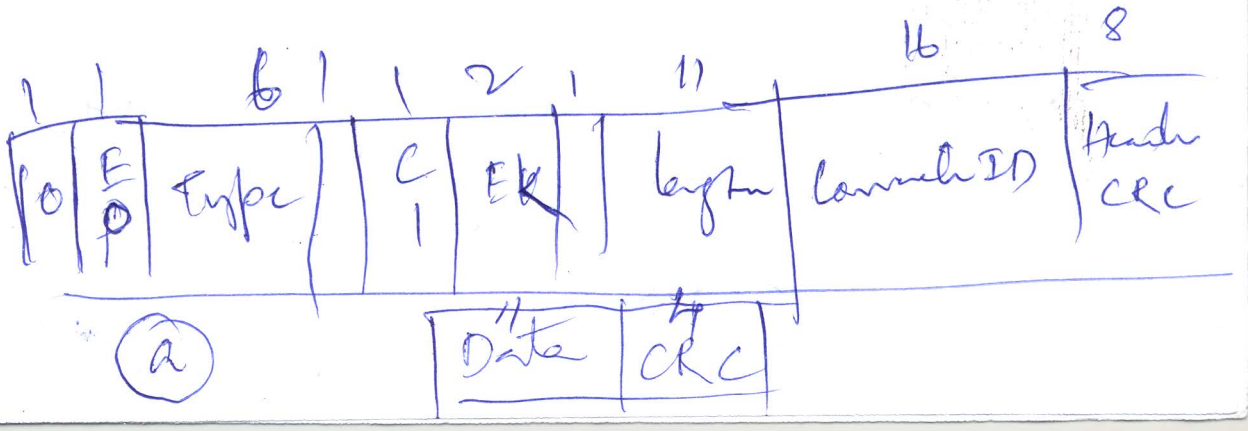
802.16 Protocol Stack



frame formatt

(a) Data frame

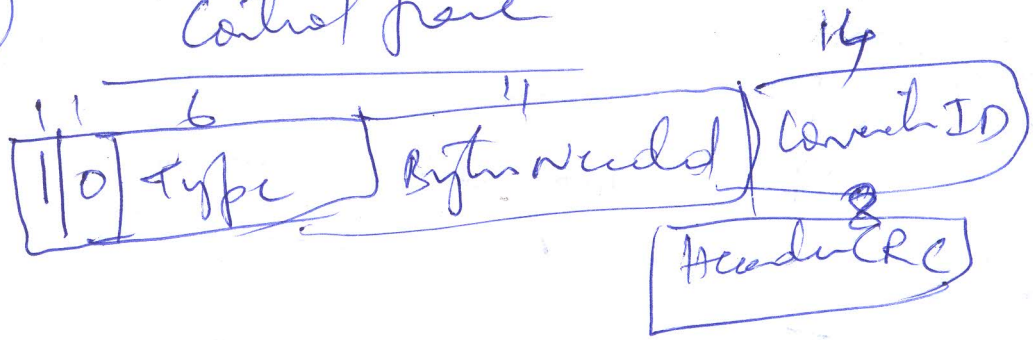
(b) Control reg: bandwidth request frame



(16) WN

(b)

Control frame



Connection ID: - binds the end points through the system.

Bits: first bit defining it is a data or control frame.

Ep: Encrypted payload

CI: Checking Indicating keys used

length - includes ~~length~~ header.

type - type of frame

EK - which of 4 encryption.

Header CRC:

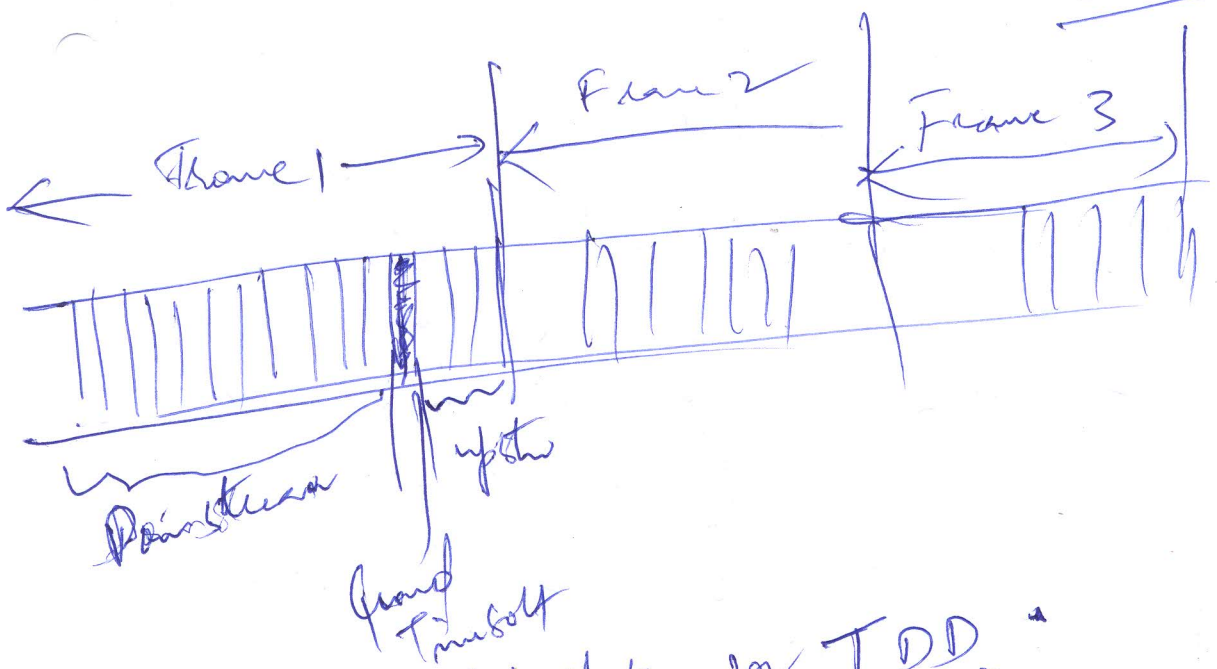
17 WN

Service classes

- Constant bit rate service (voice)
- Real-time variable bit rate service (Video)
- non-real-time variable bit rate service (high quality data)
- Best efforts service (data - email, http etc.).

- The key architectural principle is Traffic control by the base station
  - Creates frames of time slots
  - Allocates time slots to connections
- Time slots are allocated by service class.

(18) WiMAX

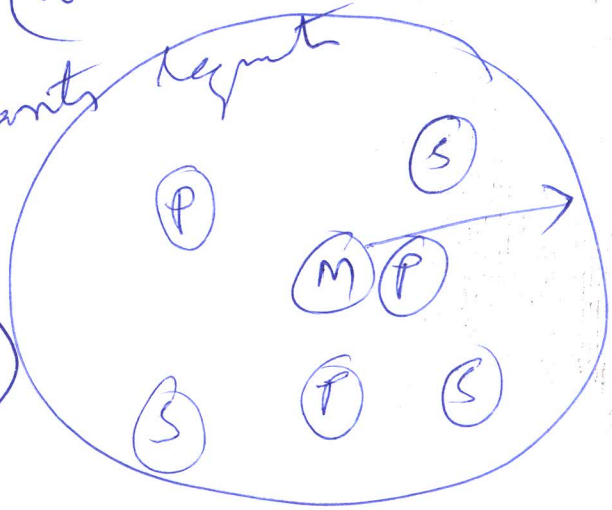


- Frames and time slots for TDD.
  Base station allocate time slots in frame to connections:
- CBR (Constant Bit Rate) Service - highest Priority (a certain No. of slots per frame)
- rt-VBR next highest Priority (variable number of slots per frame)
- nrt-VBR third highest Priority data (can be delayed)

(d) Anything remaining = best effort
Contention based access of unallocated
time slots by other traffic

802.15 Personal area network

- less than 10 m diameter
- replacement for cables (mouse, keyboard, headphones)
- ad hoc: NO infrastructure
- master/slaves:
  - slaves request permission to send (to master)
  - master grants request



P - Parked devices (inactive)

Bluetooth characteristics

- Operates in the 2.4 GHz ISM band.
- Packet Switched
  - 1 milliwatt (Power)
  - 500 mW (cell phone)
  - Low Cost.
- 10m to 100m range.
- Uses Frequency Hop SS

During connection, devices hop from one channel to another 1600 times per second.

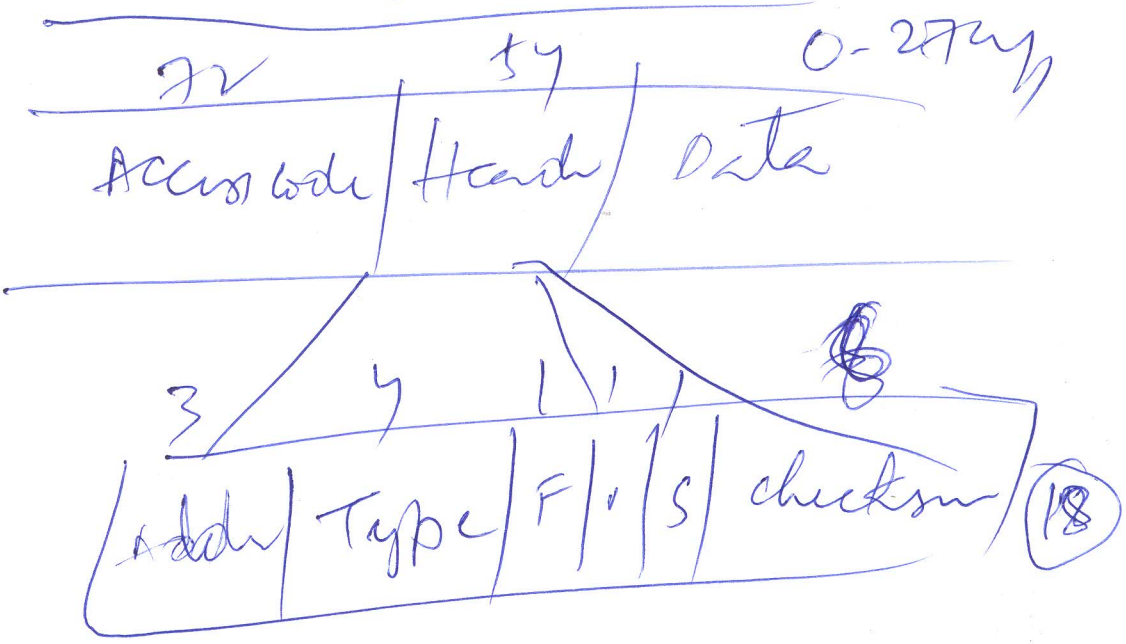
- Bandwidth 1-2 megabits/second
- Supports up to 8 devices in a piconet (two or more Bluetooth units sharing a channel)

- Built in Security
- non line of sight transmission through walls and brief gaps
- Easy integration of TCP/IP for networks

Piconets

- Small area network
- Adhoc network: No fixed structure
- Based on available nodes and their location
- formed (and changed) in real time

Bluetooth frame structure



Bluetooth System Block