**Data Link Layer Data Link Layer**

Router 1

Router 2

1

2

3

Access Point

**Routing Table of Router 1**

Destination IP Address Out Port

B 2

Date segmentation

**Van Allan Belt (Electro Magnetic Field surrounding Earth**

**Bit Timing**

Bit Timing

Bit Timing

**Modulation**

**Modem = Modulation + DeModulation**

**Base Band Base Band**

Base Band + Carrier Base Band + Carrier

Network

De-Modulator

Modulator

Modulator

De-Modulator

Carrier Frequency Carrier Frequency

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**San Jose San Francisco**

**Using multiple sub-carriers**

**Modulation (Packing) Demodulation (Unpacking)**

Base Band

Boxes Truck-1 (Carrier-1) Truck-1 (Carrier-1) Boxes

Truck-2 (Carrier-2) Truck-2 (Carrier-2)

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**OFDM (Orthogonal Frequency Division Multiplexing)**

Guard Band

Max MaxMax

F1 F2 F3 Frequency

**Bit Timing**

Signal

Bit Timing

Bit Timing

**Non Self Clocking Code**

Information

Clock

**Information**

**Clock**

**++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++**

**Self Clocking Code**

Information + Clock

**Clock Pulses**

**TX**

**RX**

**++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++**

**bps (Bit Per Second) =** **100 symbols rate per sec \* 8 (No. of bits per character) =800**

**Baud = 100 symbol rate per sec**

**++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++**

**QAM (Quadrature Amplitude Modulation)**

1000

Amplitude

Phase

UDP

Payload of UDP carries the protocol messages (requests)

**Programing Assignment**

UDP

Payload of UDP carries the protocol messages (resposes)

**Normal Procedure**

Start timer= 5 Sec

The Ack-1 could be received from start of timer until the timer becomes zero

Wait for 5 sec.

The timer=0

Start timer= 5 Sec

Start timer= 5 Sec

The Ack-1 could be received from start of timer until the timer becomes zero

Wait for 5 sec.

The timer=0

Data-1

Ack-1

Data-2

Ack-2

**Server doesn’t send ACK**

Data-1

Timer Counter =2 Start timer= 5 Sec

Wait for 5 sec.

The timer=0

No Ack-1 received

Send the Data-1 packet again

Start timer= 5 Sec

The timer=0

No Ack-1 received

Send the Data-1 packet again

Start timer= 5 Sec

Wait for 5 sec.

The timer=0

**No Ack-1 received**

**Generate Error message on the screen**

Data-1

Data-1

Server

First Mile

Last Mile

Middle Mile

IXC

**Codec (Analog-to-Digital and Digital-to-Digital Conversion)**

Source

TX

Receive

RX

Analog Signal

Analog

Digital

3 Volts

2 Volts

Analog Signal

Digital

Analog

|  |  |
| --- | --- |
| Digital | Analog |
| 0010 | 2 Volts |
| 0011 | 3 Volts |

|  |  |
| --- | --- |
| Analog | Digital |
| 2 Volts | 0010 |
| 3 Volts | 0011 |

**+++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++**

**λ = c/f C speed of light 300.000 KM/sec**

**f frequency**

**++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++**

**Mobile Communication**

Base Station

Downlink F1

Uplink F2

F3

Base Station

**RFID operation**

Electromagnetics

Object

CPU

Memory

ROM

Antenna

RFID Reader

**Digital Bandwidth**

Bit Per Second = bps

**Metal, Fiber Optics, Radio Frequency**

**Analog Bandwidth**

Frequency

[Hz]

Time [Sec]

FMax

FMin

**Analog Bandwidth = F Max – F** Min

**Simplex**

**Half Duplex**

**(WalkiTalki)**

**Full Diplex**

From A to B or From B to A

From A to B and From B to

At the same time A

AnalogSignal

Digital Signal

50 Ohm prevents reflection of analog signal

50 Ohm

Resistor

Reflection

75 Ohm

Resistor

75 Ohm prevents reflection of analog signal

Reflection

**Chip Sequence C**

**Chip Sequence B**

**Chip Sequence A**

Payload

Payload

Payload

**Frequency**

**CDMA (Code Division Multiple Access)**