**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)

+++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++

**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

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

Analog Signal

Digital

Analog

Source

TX

Receive

RX

Analog Signal

Analog

Digital

3 Volts

2 Volts

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

|  |  |
| --- | --- |
| 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**

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

Frequency F1

Freq Frequency F1

Frequency F1

120o

120o

120o

**Sectorized Antenna**

**Mobile Communication**

**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

**T1-**Time Slots 1 2 3 4 8 12 16 20 24

6 12 18 24 24

8 bits 64 Kbps

Bits 0 7

A B C D

Robbed Bits

ABCD Comment 0011 ADD 0001 Time slot No 1 0011 Delete 0001 Time slot No 1

**Chip Sequence C**

**Chip Sequence B**

**Chip Sequence A**

Payload

Payload

Payload

**Frequency**

**CDMA (Code Division Multiple Access)**

Base Station

Downlink F1

Uplink F2

F3

Base Station