**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

Start Flag Payload Header End Flag FCS

Start Flag Header Payload End Flag FCS

0011111

1100111

**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 (requests)

**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

8 bits 64 Kbps

8 bits 64 Kbps

Bits 0 7

**T1-**Time Slots 1 2 3 4 24

**E1-**Time Slots 1 32

Time slot 6, 12, 18, 24

A, B, C, D

1 1 1 0 Added time slot

0 0 0 1 Time slot No. 1

1 1 0 0 Deleted time slot

0 0 0 1 Time slot No. 1

S**ynchronous Protocol Transmission**

Request from A

Response from B

**Asynchronous Protocol Transmission**

Request from A

Request from B

Response from B

Response from A

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

**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 |

**Signaling Methods in the Networking**

1. **Out-of-Band Signaling**

Signaling

Information

Information + Signaling

1. **In-Band Signaling**

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

**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)**

Frequency F1

Freq Frequency F1

Frequency F1

120o

120o

120o

**Sectorized Antenna**

**ESCAPE Characters 7F** AB567321

End Flag 7F

Start Flag **7F**

**Escape Character**

Frame 1

ACK-1

Frame 2

NACK-2

Frame 3

ACK-3

Fram2 Retranssmit