* XMPP :

(Extensible Messaging & Presence Protocol)

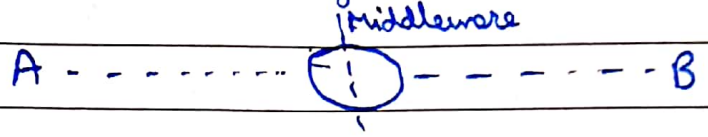
→ It is an open std. protocol.

→ Client A can send to B without any verifications.

A ⊘ ⟶ ⊘ B (Bit - Bit Comm^n.)

→ It is based on real time ~~data~~ exchange structure data phenomena.

→ Based on message oriented middleware.



⇒ Highlights -

1. It is de-centralised i.e. no central server, so anyone can run their own XMPP server.
2. No Royalty req., as it is open std.
3. Highly secured than MQTT & CoAP.

⇒ Technology -

→ Core :

Based on XML language.

Jingle is used for MMS (Multimedia signalling) i.e. voice, video, file transfer.

→ Supports multi-party Comm^n.

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→ BOSH
↳ HTTP binding with XMPP.

→ Pub Sub – Publication subscriber.
It is used for notifications, for data syndication.

⇒ Disadvantage:
1. Doesn't support QOS i.e. channel capacity & data rate support is not good.
2. Best suited only for text Commⁿ. i.e. Overhead may appear in XMPP.
3. Binary data is first encoded, then transmitted, hence causes delay.

⇒ Applications:
1. Publish - Subscribe (open)
2. Signalling for VoIP
3. FTP
4. Gaming
5. IOT → Social Networking Services (SNS), Smart Grid.

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* AMQP :

(Advanced Message Queueing Protocol)

→ To cover the disadvantage of delay given by XMPP, this was introduced.

→ Open Protocol, developed for Business applications.

→ Works on Queueing Algorithm to overcome overhead.

→ So, we communicate based on Frame-Frame comm^{n}.

→ It is binary application layer Protocol.

→ Std: ISO-19464.

→ Assures better QOS, QOE.

⇒ ~~Basic Architecture~~

→ Assured QOS & QOE :-

(a) At ~~least~~ most once — each msg is delivered once, or not (50% QOS) msg never be deliv.

(b) At least once — each msg is certain to be delivered, but maybe in the form of multiple times.

(c) exactly one — each msg. is delivered certainly exactly one time. (100% QOS)

⇒ Instead of Router, we use Open-Flow switches now a days. They are intelligent devices based on AMQP that divert the message signal to an empty port, to avoid congestion & assure the connection. Works on- 1. Control Plane 2. Data Plane 3. User Plane.

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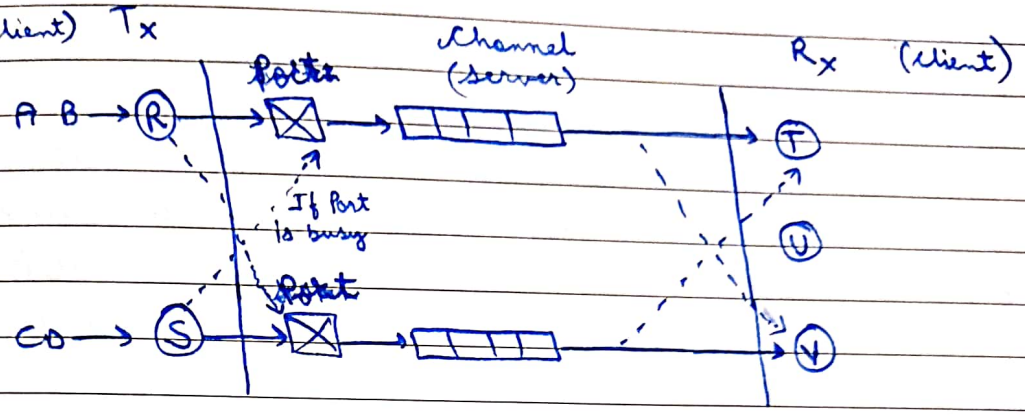
⇒ Basic Architecture -



Provides Adaptive Port selection.
Cross connect possibility at both ends.

⇒ Features of AMQP:

1. Designed on basis of different organisations, ex. medical, educational, military.
2. It depends on time & space.
3. It is based on technology.

⇒ Frame Structure of AMQP:

1. Open (connection established)
2. Begin (session start)
3. Attach (Begin new link)
4. Transfer (send info)
5. Flow Table (enters queue)
6. Disposition (cross connection may happen)
7. Retract
8. Detach
9. In the session.

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* Wireless Sensing Networks:

⇒ Wired vs Wireless.-

i) Channel co-efficient is constant in Wired N/W, while it keeps changing in Wireless N/W.

ii) Wired N/W have high data speeds (upto 200 Gbps), while wireless N/W have lower speeds (upto 200 Mbps)

iii) Wireless → Infra-based – Wifi, Cellular
→ Infra-less – AdHoc
MANET, FLYNET, VANET

- In Infra-less N/W, reconfiguration is possible.
Lifetime of the N/W can be enhanced
Multi-hop N/W can be possible in infra-less N/W.
Peer-Peer N/W (peer nodes) behave as relays.
Relays can → Amplify & Forward
Decode & Amplify
B.E.R. should be less than 10^{-7}. (ex. 10^{-100}, 10^{-200}).

⇒ Relays vs Repeaters:
Relays are used in Wireless N/W, while repeaters are used in wired N/W.
Repeaters work in layered structure & only amplify (to enhance BER values & hence Quality factor)
Relays can decode and amplify, provide platform for uniform distribution of signals, hence enhancing S/N.

⇒ Wireless Networks:
1. Homogenous – same devices forming a N/W.
2. Heterogenous – Diff. devices/capabilities forming a N/W.

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TDD, FDD

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⇒ History of Wireless N/W:

i) DARPA (1972)
ii) ALOHA (Hawaii)
iii) PRNET (Mobile, Relay, Host)

⇒ Ad-Hoc Networks –

1. They are distributed networks.
2. It operates in TDD (Time Div. Duplex)
3. Nodes commⁿ. to each other by single hop wireless tech., as it req. less power.
4. If dist. b/w 2 nodes is too much, then they may use some intermediate node (which behaves as relay & F/W node).

⇒ Wireless Ad-Hoc Commⁿ Tech. –

1. ZigBee (802.15.4) → Short rang Commⁿ. (<100 m)
   Not so high Data Rate (<250 kbps)

2. Bluetooth (802.15.1) → Used for PAN.
   A- <100 m
   B- 40-50 m
   C- ~10 m

3. 802.11 – AdHoc Mode (Infra-less)

4. WiMAX – 802.16 d → Fixed Mobile (Infra-based)
   802.16 e → Mobile (Used in Ad-Hoc)

★ 802.11 is not designed for Ad-Hoc N/W bcoz it suffers with following performance issues –

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LOS, Interference, Infra-based.
To remove this, we use MIMO, OFDM
MIMO → Inc. Channel Cap., Inc. Spatial Diversity
OFDM → Removes ISI.

* Comparison in Ad-Hoc Tech. :-

Technology	Applⁿ.	Data-Rate	Range	Config.	Other Features
1. Zigbee. (802.15.4)	Home Auto., Smart Grid, Dis. Management	250 Kbps	10-100m	256 peer devices	High Battery
2. Bluetooth	Alternative of RS-232	1 Mbps	100m.	8 active Peer-Peer devices	OTP authent.
3. 802.11	Single Hop Commⁿ.	54 Mbps ~~100-200m~~	100-200m Pract. - 60m		Inexpensive

⇒ Functions of Ad-Hoc N/W →

1. Routing – Identifying the ~~shortest~~ ~~weighted~~ path from sender to receiver.
2. Forwarding – It's a big challenge for researchers to identify the forwarding path because routing path & forwarding path may not be the same.
   It depends on Queue size & latency. (delays)

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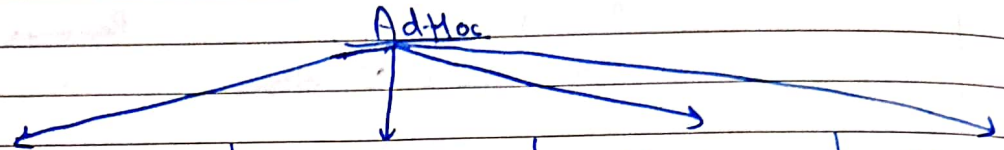
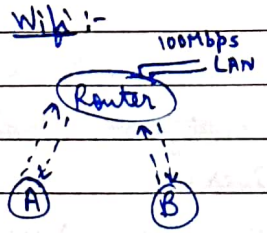
* Types of Ad-Hoc Networks -

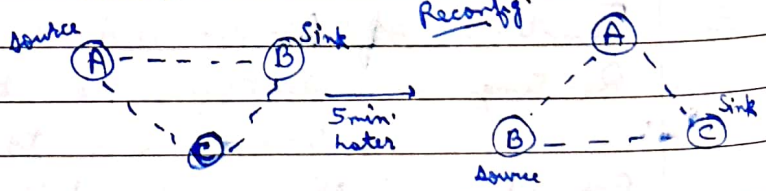


WMN	MANET	WSN	VANET
Self Config. Self Heal Self Optimise Self Protect i.e. Self CHOP → It supports highly dynamic config. → Nodes act as routers & these help for routing & forward.	→ Enables a spatial Spectrum reuse. i.e. reusable spectrum band. Due to limited bandwidth.	→ Can support multi-hop N/W. → Some nodes are stationary & some are mobile.	→ WAVE technology.

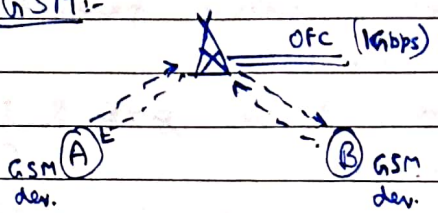
⇒ Wifi :-



⇒ Ad-Hoc :-



⇒ GSM :-



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* NFC -

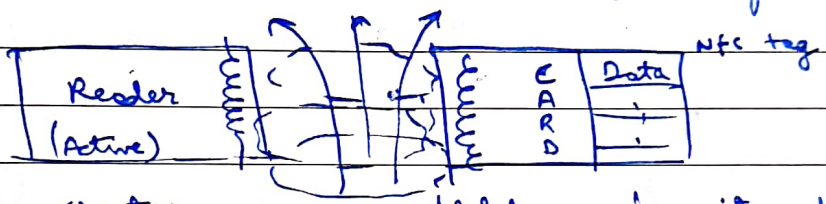
Near Field Comm^{n}, part of RFID, design for close proximity. All types of NFC's are same, but appl^{n} are diff. ex. Felica.
May be Passive or Active.

→ Passive device cont. info. which is readable by other devices. However, it can't read the info. itself. ex. ATM Card

→ Active devices are able to collect & Transmit info. ex. Phones.

⇒ Working Principle -

Works on 13.56 MHz. Works on Magnetic induction.



→ Reader creates a mag. field, using its battery source.

→ This mag. field converts into bridge b/w card & reader.

→ The gen. Mag. field comm. with card (client) & produces elect. impulses in card by mutual induction.

→ Data may be — ID no., sec. info. or any other info.

→ Active / peer-peer tags have their own power.

⇒ Specifications -

Freq. of Op. — 13.56 MHz ; Data rate — 106 kbps, 212, 424 kbps.
Mem. of Tag — 96 to 512 bytes

⇒ Modes of operation -

1. Peer to Peer → 2 sim. nature device comm. to each other.
2. Read-Write → Read from Passive & Written by Active.
3. Card emulation → NFC can be used like contactless Credit Card.

⇒ Appl^{n}. — Phone based payment, parcel tracking, Low Power home auto.; Computer Crome synch.

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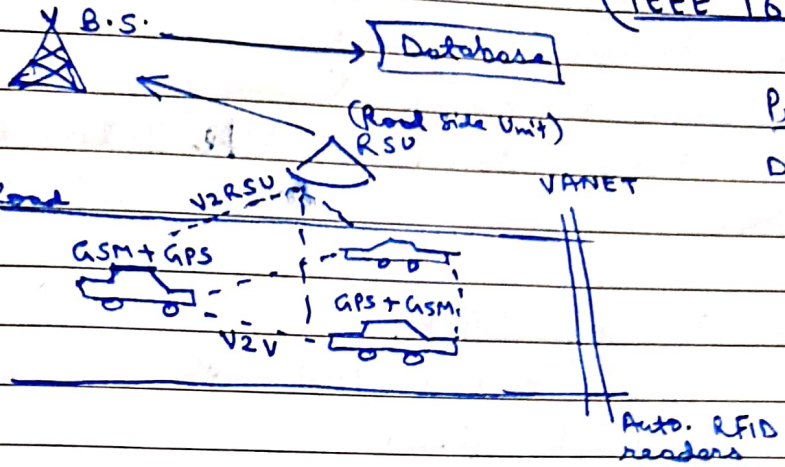
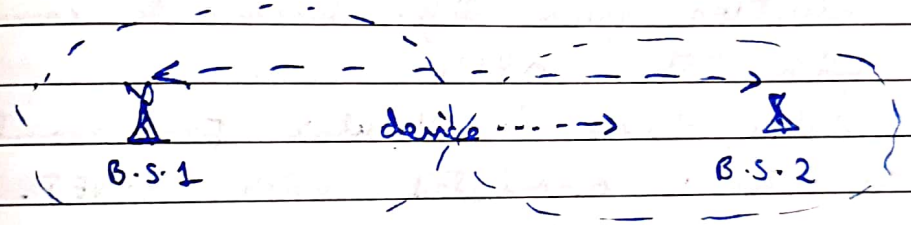
* VANET :

Also, DSRC 802.11P
(IEEE 1609.2)



Protocols used -
DSR, TORA, AODV

⇒ Hand Over Management -



As the device moves out of the range of B.S.1, the B.S.1 comm^n. with B.S.2 for handover initiation.

Conditions -

$-3dB < V_{th} < -1dB \rightarrow$

$-1dB < V_{th} < 0\ dB \rightarrow$

$0\ dB < V_{th} < 3\ dB \rightarrow$

The entire system is based on ITS.
(Intelligent Transport System)

Tech. used → GSM, Wifi, WiMAX.

⇒ 2 types of Comm^n. -

1. Vehicle to Vehicle
2. Vehicle to Infra.

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⇒ Advantages:-

1. Due to co-operative driving, we are able to predict traffic on road.
2. Info. sharing & media streaming
3. Value Added Service, like Internet access & navigation.

⇒ Components of VANET -

1. RSU → Infra. based N/W which enables the comm^n. through B.S.
2. OBU → On Board Unit is enabled with GSM, wifi module, responsible for data collection from diff. sensors & comm. with other OBU.
3. WAVE → Wireless Access in Vacular Environment is the tech. associated with VANET. Provides multi-hop comm^n.

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* Comparison b/w MANET & VANET :-

Parameters	MANET	VANET
Cost of dep.	Less Costly.	Expensive.
Mobility	Less	High mobility.
Freq.	2.4 GHz	5.9 GHz (≈ 6 GHz)
Range	100 m.	2 Km.
Modes of Op.	Infra. – Less	Infra-Based
Movement Pattern	Random movement	Constrained by Roads

* Sensor Networks -

→ To process the real time data, like temp., pressure, sound, vib. etc. to the cloud.
→ It will sense & measure the data, & transfer in dig. data form.
→ It will work in short as well as long range comm^n. (Multi Hop N/W.)
→ The sensor N/W can simulate on basis of embedded OS, like Tiny OS.
→ The entire operation is based on Low Power Phenomenon. (LEACH protocol provides platform for low power (energy efficient) WSN)

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⇒ Mesh N/W:-

1. Provides multiple paths at a time for comm^{n}.
2. Enhances range of comm^{n}
3. Switches path on basis of best SNR.

⇒ Components of Sensors:-

GPS	Sensing Unit
Tx/Rx Antenna	ADC
Processor	
Storage	
Power I/P	

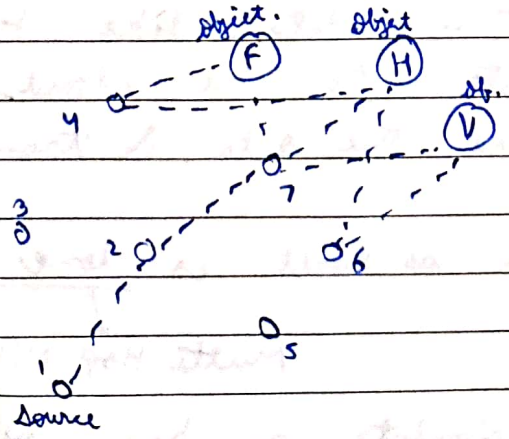
Challenges -

1. Accuracy
2. Power Optimisation
3. Short range Comm^{n}.

↓ we can use multi-hop N/W

⇒ Real Time Appl^{n} for Sensor N/W:-

1. Single source — single Object detection
2. Single source — multi Object "
3. Multi source — Single Object "
4. Multi source — Multi Object "



SS.S.O.	S.S.M.O.	M.S.S.O.	M.S.M.O.
7 - H	7 - H	4 - H	4 - F
	7 - F	6 - H	7 - H
	7 - V	7 - H	6 - V

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ISM- Industrial Scientific Medicine

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* HART : [Highway Addressable Remote Transducer] [802.15.4]

→ Based on Master - Slave operations.
→ Supports max. 15 slaves per master. (allocated 15 diff. channels)
→ Slaves req. only 4mA for operation.
→ Developed as a daughter of ZigBee.
→ Developed for network smart field device.
→ Implementation of HART is cheaper & easier.
→

⇒ Application -

1. Reaction Tank's Top.
2. Inside gas / water pipes to detect leakage.
3. Different Warehouse at diff. loc. can communicate.

⇒ Layers -

1. Physical layer - Tx-Rx (Antenna) at ISM (2.4GHz)
2. Data Link -
3. Network -
4. Transport -
5. Application -

⇒ Diff. in Wired & Un-Wired version of HART -
Wired HART lacks Network layer.
In Wireless ; it has all 5 layers.

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★ Physical Layer → 1. 802.15.4
2. Tx/Rx (Antenna)
3. 2.4 GHz
4. 15 devices with 15 diff. channels.

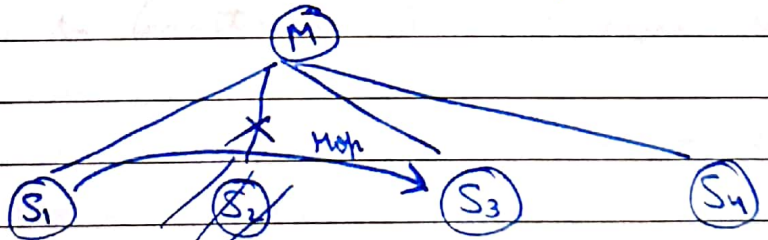
★ Data Link → 1. Collision free & deterministic comm.
2. Collision free due to intro. of Super-Frame (consists of grouped 10ms Time Slots)
3. Based on TDMA.

⇒ Super Frames provide idea/control timing of diff. slave devices. i.e. provides diff. time intervals so that no slaves have overlapping time.

ex. (S1) (S2) (S3) (S4) - - - - .. (S15)
1.2 sec. 1.2005 sec 1.2010 sec 1.2015 sec.

Also,
Incorporates channel blacklisting & channel hoping.

ex.



Blacklisted due to channel noise/collisions

The channel ② is blacklisted & ① directly hops to ③.

⇒ The channel to be blacklisted is identified on threshold value i.e. if operation time is higher than defined time & in such case, master will blacklist that channel.
So, by this, we can increase the security & reliability.

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If, channel co-eff. = h then gain = h^2.

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★ Network layer → 1. Routing
2. Creates session (for 15 diff. slaves)
↓
Hence provides security & is collision free.
3. In Wireless HART, comm^{n} is based on Forward Packets Phenomena.
4. Mesh network is used.

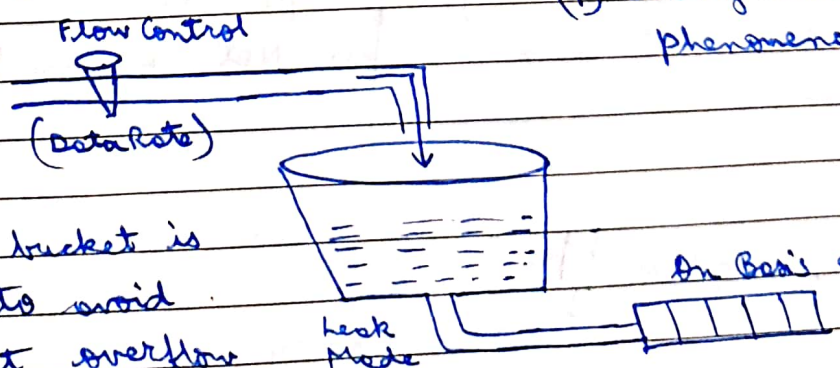
⇒ This layer is a combination of N/W layer + Transport layer + Session layer, with ref. to OSI model.

★ Application layer → 1. Comm^{n} through Gateway to diff. field devices. (slaves)
2. Based on Req.- Response phenomena.

⇒ This layer is based on Seemless phenomena.
- unable to diff. b/w Wired & Wireless

⇒ Congestion Control in HART :

(i) Leaky Bucket phenomena.



Leaky bucket is used to avoid bucket overflow & wastage of data.

★
1. Transmission synchronisation b/w diff. devices is req.

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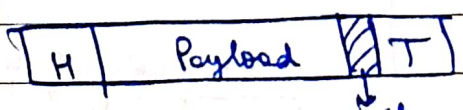
by using 10ms time slot.
2. Max. no. of devices controlled can be 15.
3. The entire phenomena is supervised by manager, which decides — priority, dist. b/w master & slave, when & where slave can Trans. & Rec. packets.
4. On basis of Resource allocation, manager database is updated.
5. In these operations, freq. of Operations & Time slot is registered.
6. Through Coding & Decoding then. (RSA, AES), we get security in HART.

⇒ **Diff in HART & Zigbee -**

HART	Zigbee
1. Provides collision info at each hop.	1. Collision info only after complete hop counts.
2. Based on TDMA	2. Based on CSMA/CD
3. Works on both Forward & Backward packet info.	3. Only in forward packet then.
4. Power Optimised	4. Not so low power Consumption

★



Channel Modelling
Provides info for prev. channel mode

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DSR, AODV, TORA

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* UAV : (Unmanned Aerial Vehicle)

→ FLYNET protocol is used for communication between diff. UAV's.

→ Based on star/mesh N/W. Prefers stars.

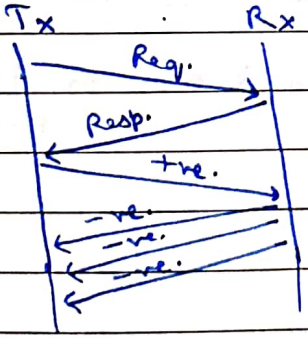
→ SDN - Software Defined N/W.
Testing is based on SDN, under 3 planes - Controller Plane, Data Plane, USER plane

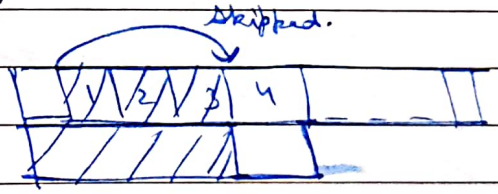
→ The database management in UAV is done by SDN.

→ The routing protocols in UAV are adaptive in nature. ex. DSR, AODV, TORA.
Routing Protocols depend on routing tables. (formed acc. to depth of nodes or anything)

RREQ - Route Req. Packet
RRESP -

⇒ Sliding Window Phen.





After 3 -ve. ack., the 3 -ve. are slided.

→ UAV can cover large distance comm^n. by using multiple UAV's in "Horizontal" & "Vertical" alignments.

⇒ Issues :
1. Dynamic network config.
2. Less Secure
3. Lack of Protocols

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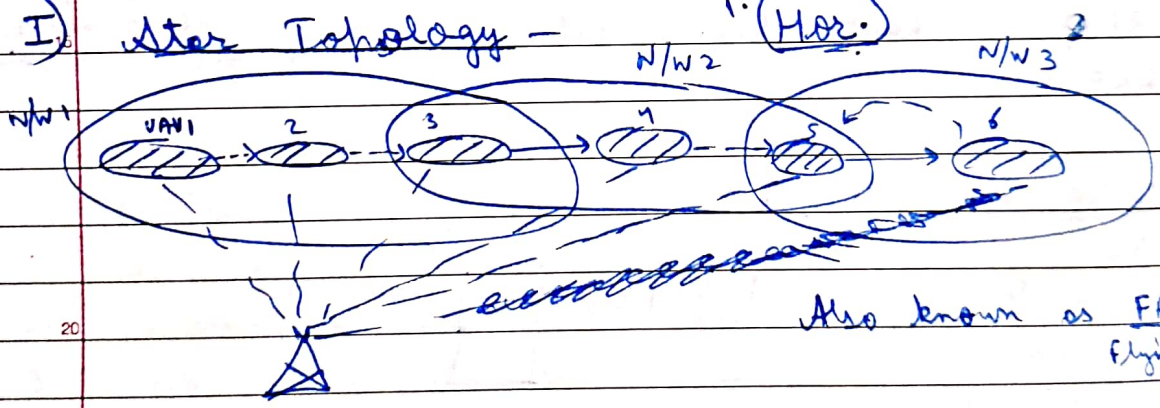
⇒ Types of UAV systems –

	Features	Single UAV system	Multi UAV system
1.	Failure chance	High	Low
2.	B.W. req.	Low	High
3.	Antenna used	Omni-directional	Directional
4.	Altitude	Very low	low
5.	N/W lifetime	Low	Very low

⇒ Architecture :

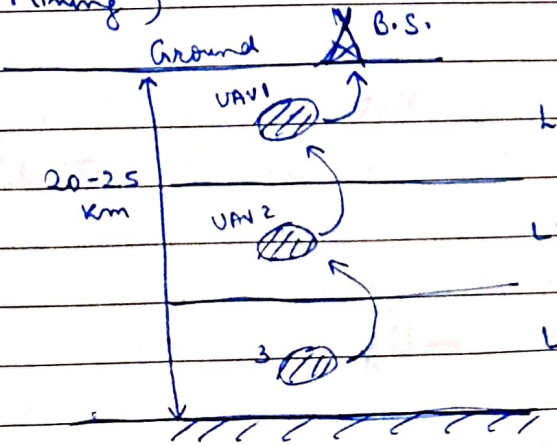
I) Star Topology –



Also known as FANET
Flying Ad hoc N/W.

2. Vertical

(ex. For Mining)



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