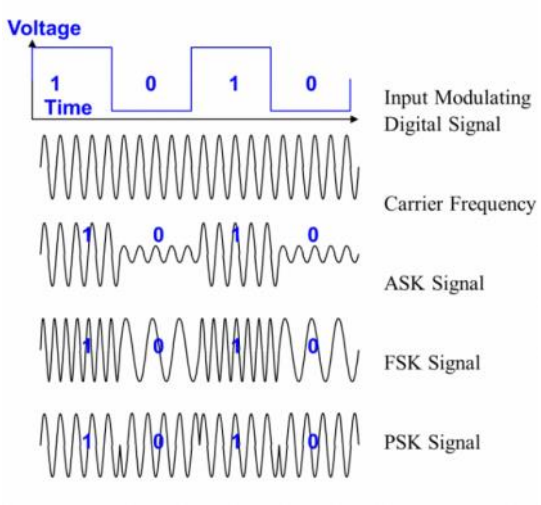
UE 2020

Tuesday, September 13, 2022 10:31 AM

QUESTION 1 - a



https://www.ni.com/en-za/innovations/white-papers/08/amplitude-shift-keying--frequency-shift-keying--and-phase-shift-.html

ASK
- Amplitude Shift Keying
- When the input modulation signal is high then the amplitude of the waveform is also high
- When the input modulation signal is low then the amplitude of the waveform is low
- Poor noise immunity
- Less bandwidth compared to PSK and FSK
- More power use

FSK
- Frequency Shift Keying
- When the input modulation signal is high then the frequency increases causing the waveform to be closely packed . The waveform travels fast but over a short distance
- When the input modulation signal is low then the frequency is low and the waveform is loosely packed
- Better noise immunity
- More bandwidth

PSK
- Phase Shift Keying
- When the input modulation signal changes from high to low then the waveform changes direction
- Better noise immunity
- The phase changes by 90 degrees
- Less to moderate bandwidth
- This is the best as it stands out but it has a complex implementation which is a drawback

ASK	FSK	PSK
1] Information is in amplitude variations.	Information is in frequency variations.	Information is in phase variations.
2] Less Bandwidth as compared.	More Bandwidth as compared.	Less to moderate Bandwidth.
3] Poor Noise immunity.	Better Noise immunity.	Better Noise immunity.
4] Synchronization is not required.	Synchronization is not required.	Synchronization is essential.
5] Effect of DC is more.	Effect of DC component is less.	Effect of DC component is less.
6] More power required.	Moderate power required.	Less-moderate power required.
7] Low bit rate application	Moderate bit rate application.	High bit rate application.
8] Simple Implementation.	Moderately complex Implementation.	Very complex Implementation.

QUESTION 1 - b

QAM (quadrature amplitude modulation) is a method of combining two amplitude modulation (AM) signals into a single channel.

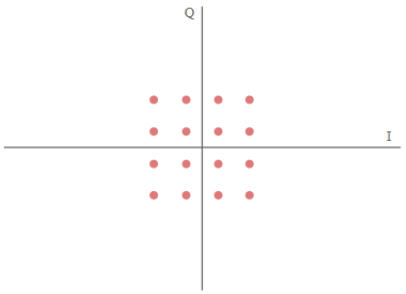
From <https://www.techtarget.com/searchnetworking/definition/QAM>

This approach helps double its effective bandwidth.

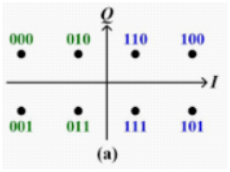
QAM is also used with pulse AM (PAM) in digital systems, like wireless applications. A QAM modulator works like a translator, helping to translate digital packets into an analog signal to transfer data seamlessly. QAM is used to achieve high levels of spectrum usage efficiency.

16 QAM and 64 QAM are currently used for digital terrestrial television using DVB - Digital Video Broadcasting

From <https://www.electronics-notes.com/articles/radio/modulation/quadrature-amplitude-modulation-types-8qam-16qam-32qam-64qam-128qam-256qam.php>



16QAM constellation



MODULATION	BITS PER SYMBOL	SYMBOL RATE
BPSK	1	1 x bit rate
QPSK	2	1/2 bit rate
8PSK	3	1/3 bit rate
16QAM	4	1/4 bit rate
32QAM	5	1/5 bit rate
64QAM	6	1/6 bit rate

Apart from ASK, PSK, FSK IN QAM it modulates more than one bit
QAM modulates 2 bits at a time
Keep in mind the 2^n where this is the max number of users

QUESTION 1 - c

FDMA	TDMA	CDMA
FDMA stands for Frequency Division Multiple Access.	TDMA stands for Time Division Multiple Access.	CDMA stands for Code Division Multiple Access.
In this, sharing of bandwidth among different stations takes place.	In this, only the sharing of time of satellite transponder takes place.	In this, there is sharing of both i.e. bandwidth and time among different stations takes place.
There is no need of any codeword.	There is no need of any codeword.	Codeword is necessary.
In this, there is only need of guard bands between the adjacent channels are necessary.	In this, guard time of the adjacent slots are necessary.	In this, both guard bands and guard time are necessary.
Synchronization is not required.	Synchronization is required.	Synchronization is not required.
The rate of data is low.	The rate of data is medium.	The rate of data is high.
Mode of data transfer is continuous signal.	Mode of data transfer is signal in burts.	Mode of data transfer is digital signal.
It is little flexible.	It is moderate flexible.	It is highly flexible.

QUESTION 1 - d
FDD

- Uses large guard bands hence uses a lot of frequency spectrum to minimize interference
- Provides two distinct bands of frequencies for every user, one for downlink and one for uplink.

TDD

- Example : WIFI, WiMAX, Bluetooth, Zigbee
- Same channel, difference timeslot

Parameter	FDD	TDD
Spectrum requirements	Requires paired spectrum	Only one channel required
Traffic asymmetry	Depends on available spectrum	Dynamically adjustable
Duplex separation	Guard band in frequency domain required	Guard Period in time domain required
Intra-system Interference	Unlikely to occur	Time synchronization between eNodeBs is required
Cell size	Suit for small and large cells	Suits for smaller distances because of Guard Period
Hardware costs	Higher costs caused by complicate diplexer	No major cost affects

QUESTION 1 - e

https://www.electronics-notes.com/articles/connectivity/3g-umts/td-cdma-umts-tdd.php

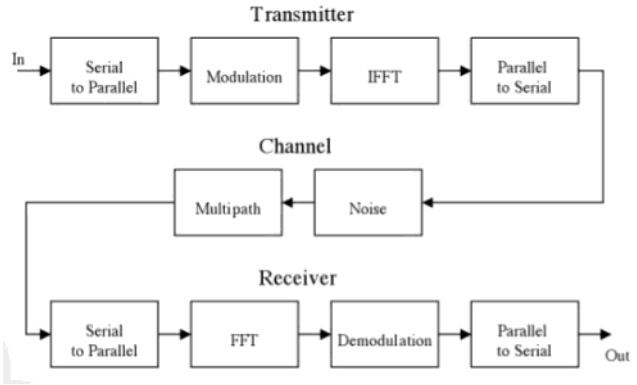
https://www.everythingrf.com/community/tdd-vs-ldd#:~:text=Time%2Ddivision%20duplexing%20(TDD),for%20transmit%20and%20receive%20operations

QUESTION 2 -a
Refer to the paper Japhet sent

OFDM - a multiple carrier transmission technique where a single set of data is transmitted over a number of sub-carriers
Uses multipath - propagation and reduces the fading effect

Ofdm makes transmission faster by dividing a single carrier into many (multipath) - normally the transmission over a long path will reach with a weak signal

This will help in using lower bandwidth and lower power is used and reduces inter-symbol inteference



In OFDM we have transmitter, channel and receiver
For a signal to be modulated or demodulated and transmitted it has to be in parallel form
Multipath - same frequency but different path, info is multi reflected and sent several times through different paths
The channel assist in noise elimination and multipath

QUESTION 2 - B
In OFDM the signal itself is first split into independent channels,
modulated by data and
then re-multiplexed to create the OFDM carrier.

QUESTION 2 - C
Telephony encoding - 4G
Wireless networks
DSL (Digital subscriber line) internet access
Digital television - digital video broadcasting
Digital radio - digital audio broadcasting
Video conferencing

In all of the above it has an advantage of higher data rates, low bandwidth

QUESTION 2 - D
Uplink is sending data
Downlink is getting data

- To overcome effect of multipath fading
- it presents a high Peak-to-average Power Ratio it is not possible to use it on the uplink
- Has a good ability to resist inter symbol interference

Uplink uses more power consumption so OFDM is not used in uplink

So LTE uses SC-FDMA for uplink

QUESTION 3 - A

QUESTION 3 - B

- Hard Handover : Used in GSM
  Break before Make
- Soft Handover : Used in 3G
  Make before Make

Hard because of circuit switching
FDMA and TDMA is supporting hard handover
UMTS supports soft handover - more seamless

For 2G you break the old connection before you make the new connection
For 3G you make a new connection before you break the old connection

Hard Handover
Old Connection is broken before new connection is activated.
Fdma & Tdma is supporting hard handover.
Minimize Interference and Different frequency ranges.

One Mobile station and one Base Station.
Break Before Make.

Soft Handover
New Connection is activated before old is broken.
UMTS is supporting it.
More Seamless handover.
Up-link and down-link more costly.
One Mobile Station and two Base Station.
Make Before Break.

QUESTION 3 - C
Seamless connectivity - you can't feel the disconnectivity
Higher bandwidth and higher data rates
Lower latency 1ms
100 times more efficient than 4G
Faster because it uses millimeter waves
Different frequencies for uplink and downlink
Can be used in various frequency bands include higher and lower frequencies
Suitable for real time services
Enabled by new radio technology
It is data only - voice over IP
It is the latest technology
Lower cost per bit
5G is meant to connect massive number of embedded sensors - low cost, higher data rate

Application - IOT, virtual reality, self-driving cars, Realtime services

QUESTION 3 - D
Eg Amazon Go

By capturing the difference in the picture background

b-frame - this is the first
i-frame -
p-frame

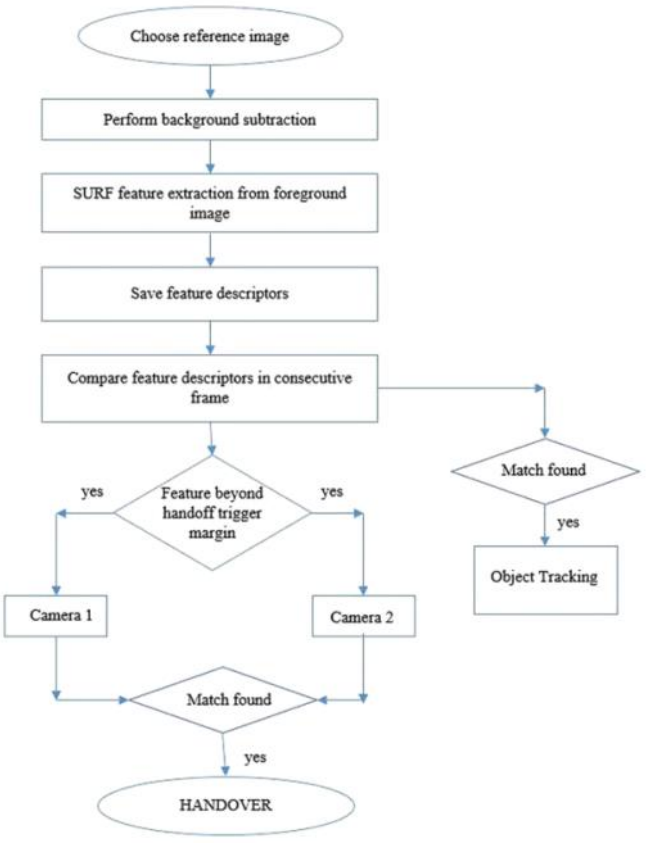


Fig. 2 Algorithm for Camera Handoff and Object Tracking

QUESTION 4 - A
Channel coding - Is the addition of information to remove corruption
It is important to reduce corruption level in data

Disadvantage is that the redundancy of information increases, complexity of coding operation

Source coding - compression - removal of some part of information when sending file eg in file compression

It's best to use in wireless communication systems since signal loss is greater in wireless than wired for improved error performance

Add parity bits to get the output t

QUESTION 4 - B
Block codes - the bits are taken in block after block at a time for encoding independent of all other blocks
There is linear and nonlinear - Hamming code
They are memory less / no memory
Information bits are followed by parity bits

Convolution codes - one bit at a time, they encode much longer inputs at once
There is linear and non linear
They have memory
Information bits are spread along the sequence
Uses small code weights but achieve same quality as block codes

QUESTION 4- C

QUESTION 5 - A

How antennas work

Suppose you're the boss of a radio station and you want to transmit your programs to the wider world. How do you go about it? You use microphones to capture the sounds of people's voices and turn them into electrical energy. You take that electricity and, loosely speaking, make it flow along a tall metal antenna (boosting it in power many times so it will travel just as far as you need into the world). As the electrons (tiny particles inside atoms) in the electric current wiggle back and forth along the antenna, they create invisible electromagnetic radiation in the form of radio waves. These waves travel out at the speed of light, taking your radio program with them. What happens when I turn on my radio in my home a few miles away? The radio waves you sent flow through the metal antenna and cause electrons to wiggle back and forth. That generates an electric current—a signal that the electronic components inside my radio turn back into sound I can hear.

QUESTION 5 - B

OMNI	BI
360	45-90
All directions	2- directions
Has noise since it cannot filter interference	Has no noise since it filters inteference
Has a large coverage	Has a small coverage
Uses more power	Uses less power

QUESTION 5-C

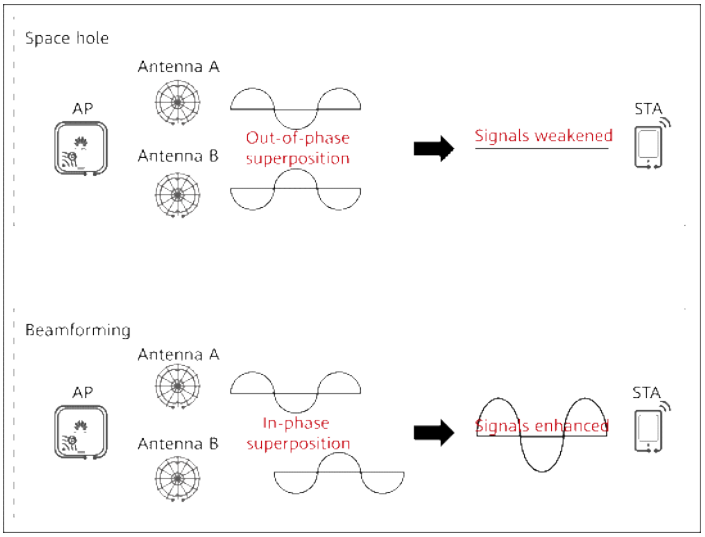
How Do Smart Antennas Work?

Smart antennas are implemented using beamforming and antenna array technologies. Both technologies leverage combinations of multiple antennas to improve the beams of the transmit signals, thereby improving wireless user experience. By combining the advantages of the two technologies, smart antennas achieve better benefits.

Beamforming Technology

Beamforming, also called transmit Beamforming (TxBF), is a technology that transmits signals to STAs in an energy-focused and directional fashion. It comprehensively improves the quality of signals received by STAs and increases the throughput. Beamforming has been supported since Wi-Fi 4 (802.11n). It can be implemented using multiple common antennas.

In a multi-antenna system, when signals transmitted by different antennas arrive at a location, zero-energy signals may occur if two beams have equal attenuation but opposite phases. Beamforming technology enables two beams to be superimposed with the best effect by pre-compensating the phases of transmit antennas. This approach improves the strength of signals received by STAs, thereby improving user experience.



How beamforming improves the strength of signals received by users

Antenna Array Technology

An antenna array is a beam switching technology, and it consists of a plurality of small antennas. Each small antenna has several antenna elements. Each antenna element can be independently enabled or disabled. In this way, each small antenna can be used as an omnidirectional antenna or a directional antenna. How small antennas are combined is closely related to their gain, polarization, pattern, and the like. Therefore, the numbers of small antennas and their antenna elements directly determine the number of ultimately formed beams. For example, there are four antennas on the 2.4 GHz frequency band, and each antenna has four elements, meaning 16 antenna elements in total. Given that each antenna element can be enabled or disabled, 2^{16} antenna combinations are available in this instance.

From <https://info.support.huawei.com/info-finder/encyclopedia/en/Smart+Antenna.html>

QUESTION 5 - D
The one with high power will be heard more and over power the other signal. An interference will occur and since you are unlicensed you can't get any help

QUESTION 5 - E

Why MIMO is used in 5G?

Benefits of massive MIMO

Massive MIMO **contributes to increased capacity first by enabling 5G NR deployment in the higher frequency range in Sub-6 GHz** (e.g., 3.5 GHz); and second by employing MU-MIMO where multiple users are served with the same time and frequency resources.

19 Jun 2019

Why MIMO is used in 4G?

Multiple-input-multiple-output (MIMO) technology will be used by fourth generation mobile networks (also called Long Term Evolution-LTE) **to achieve very high data rates in both the uplink and downlink channels**. MIMO is based on the use of multiple antenna systems within the mobile terminal as well as the base station.

Used in beamforming so it needs multiple inputs and multiple outputs

QUESTION 6 -A

NFC - Near Field Communication - NFC enables short-range communication between two compatible devices—typically an NFC tag and a smartphone or tablet. Allows users to make transactions

RFID - RFID is the method of uniquely identifying items using radio waves.
It is a wireless, contactless data transfer technology that uses tags or cards to store data, that do not need to be powered.

An RFID system comprises a tag, a reader, and an antenna.

From <https://wlius.com/blog/rfid-vs-nfc-whats-the-difference/>

QUESTION 6 - B

RFID For Asset Tracking
Fleet managers who manage a variety of assets, equipment and tools can increase productivity across operations by using RFID technology. Tracking equipment can be overwhelming if you don't have a way to easily view equipment inventory.

RFID technology helps fleets maximize efficiency. Let's go over a few key benefits of RFID technology:

Does Not Require Action & Can Read More Tags- RFID is used in production, logistics, retail, tracking and asset management because the RFID scanner can read a large number of tags at the same time and due to the range which can reach hundreds of feet. It also does not require action by the user, making it a better fit for asset and inventory tracking.
Requires No Additional Hardware –
RFID technology is easy to implement because it doesn't require purchasing additional hardware. Fleet managers can purchase fairly inexpensive RFID tags to tag their assets and start receiving visibility on their whereabouts. With Wireless Links RFID asset tracking system, fleets can also leverage a mobile app to gain visibility anywhere.

Receive Real-Time Notifications – when an asset is removed from a vehicle at a job site, and when an asset is forgotten, fleet managers and drivers receive immediate notification on location and time of drop off or if a tool is forgotten once the vehicle starts moving. This key insight can improve the way you manage operations and ensure you have real-time visibility into every aspect of your fleet.

Visibility- If tags are placed on shipments, fleet managers can ensure their shipments get to where they need to be. It also makes sure that shipments arrive on time without any damage. No matter what assets tags are placed on, they provide a visual complete with location & time, providing insight into inventory and building accountability .

- Openning the door
- To trace a stolen object

QUESTION 6 - C

https://www.techtarget.com/iotagenda/definition/RFID-radio-frequency-identification
How does RFID work?

Every RFID system consists of three components: a scanning antenna, a transceiver and a transponder. When the scanning antenna and transceiver are combined, they are referred to as an RFID reader or interrogator. There are two types of RFID readers -- fixed readers and mobile readers. The RFID reader is a network-connected device that can be portable or permanently attached. It uses radio waves to transmit signals that activate the tag. Once activated, the tag sends a wave back to the antenna, where it is translated into data.
The transponder is in the RFID tag itself. The read range for RFID tags varies based on factors including the type of tag, type of reader, RFID frequency and interference in the surrounding environment or from other RFID tags and readers. Tags that have a stronger power source also have a longer read range.

QUESTION 6 - D
RFID SYSTEM
- Antenna
- Transceiver
- Transponders

NFC SYSTEM
- NFC chip
- Antenna
- Something to keep it together (inlay)

QUESTION 6 - E
- Can be read without your knowledge
- RFID systems can be easily disrupted since made using electromagnetic spectrum so they jam easily at any frequency
- RFID reader collision - when the signals from two or more readers overlaps
- RFID tag collision - when many tags are present in small area
- Security, privacy and ethics - a high gain antenna can read the tag even in a greater distance
- The tags are difficult to remove - the consumer can't remove the tags
- RFID tags with unique serial numbers could be linked to an individual credit card numbers

QUESTION 7 - A
Similarities
- They allow multilanguage support
- Allow email, web services and remote login
- They support alternate keyboards
- They interface the applications and the hardware
- They manage the CPU
- They manage the memory
- They both help the hardware to manage the drivers

- They manage the storage capabilities
- They helped security of the phone or laptop
- They support multitasking and multithreading and multiuser
- Both provide a beautiful GUI
- Both have updates in their OS
- They both manage power saving modes
- Both allow the user to save files to a backup store
- Both allow resetting to default settings
- They both organize processing time and scheduling
- Both have either open source or proprietary on both

Differences

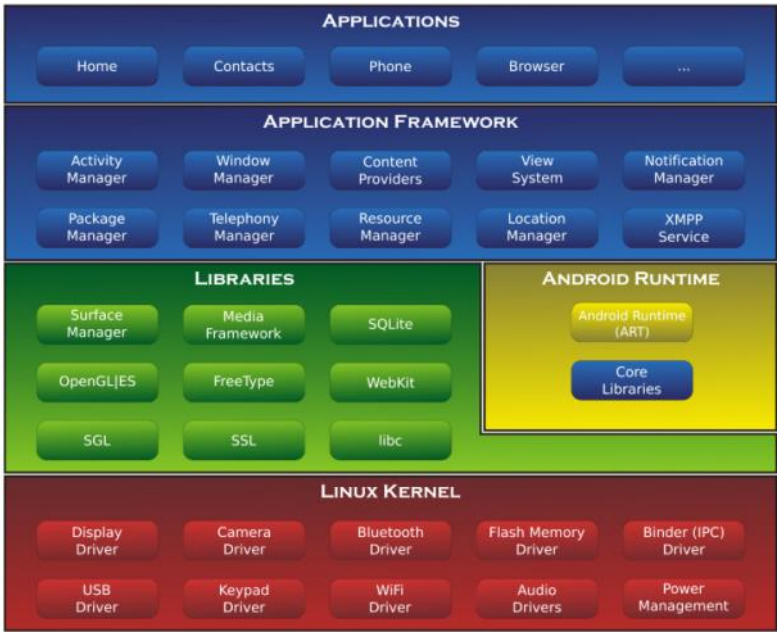
Features	Mobile Operating System	Desktop Operating System
Definition	It is a type of operating system that allows application software to operate on mobile devices.	It is the environment in which a user handles a personal computer.
Memory Requirement	It needs minimum RAM to optimize.	It needs huge memory to operate.
Storage	It uses a flash drive to store the data.	It uses hard drives and flash drives to store data.
Boot Time	It takes less time to boot.	It takes much time to boot.
Purpose	It handles cellular and wireless connectivity and device access.	It handles the software and hardware resources of the system.
Power	It is optimized to work under minimal power needs and has a feature to prevent energy loss.	It is not readily optimized for energy loss.
Interface	It runs on touchscreen or touchpad devices.	It runs through many input devices, including a mouse, keyboard, etc.
Example	Some examples of the Mobile OS are Apple iOS, Google Android, Bada, Palm OS, Symbian OS, Windows Mobile OS, Blackberry OS, iPhone, Harmony OS, WebOS, etc.	Some examples of the desktop OS are Windows 10, MacOS, Windows Vista, etc.

From <https://www.javatpoint.com/mobile-operating-system-vs-desktop-operating-system>

QUESTION 7 - B

- Widget API
- Game mode API
- Rounded corner API
- OS
- Camera
- Authentication
- Security

QUESTION 7 - C



QUESTION 7 - D

1. Foreground Services:

Services that notify the user about its ongoing operations are termed as Foreground Services. Users can interact with the service by the notifications provided about the ongoing task. Such as in downloading a file, the user can keep track of the progress in downloading and can also pause and resume the process.

2. Background Services:

Background services do not require any user intervention. These services do not notify the user about ongoing background tasks and users also cannot access them. The process like schedule syncing of data or storing of data fall under this service.

3. Bound Services:

This type of android service allows the components of the application like activity to bound themselves with it. Bound services perform their task as long as any application component is bound to it. More than one component is allowed to bind themselves with a service at a time. In order to bind an application component with a service **bindService()** method is used. Example music playing while interacting with the music player

QUESTION 7 - E

How Mobile IP Works

This section explains how Mobile IP works. The Mobile IP process has three main phases, which are discussed in the following sections.

- Agent Discovery
  A Mobile Node discovers its Foreign and Home Agents during agent discovery.
- Registration
  The Mobile Node registers its current location with the Foreign Agent and Home Agent during registration.
- Tunneling
  A reciprocal tunnel is set up by the Home Agent to the care-of address (current location of the Mobile Node on the foreign network) to route packets to the Mobile Node as it roams.