SSY145 Wireless Networks

Question Bank

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Contents

1 For Exam

1.1 Article #02a & #02b – "Whitesides' Group: Writing a Paper" & "Analyzing the Past to Prepare for the Future: Writing a Literature Review"

1. Which of the following statement is(are) correct about sections of an academic paper according to George M. Whitesides?

   (a) The abstract should be done at the beginning of writing a paper.

   (b) The Conclusion section of an academic paper should be written as a list of short phrases or sentences.

   (c) The results and discussion are usually combined.

   (d) The main purpose of the Conclusion section is to shortly repeat what is in the Results section.

2. Which of the following statement is(are) correct about constructing an outline of a paper according to George M. Whitesides?

   (a) An outline should contain significant amount of text to be readable.

   (b) One should start to construct an outline after finishing a project.

   (c) The outline should be organized around text.

   (d) None of the above.

3. Which of the following statement is(are) correct about academic writing style?

   (a) Complete all comparisons.

   (b) Use the passive voice whenever possible to make long sentences.

   (c) The word "this" must always be followed by a noun, so that its reference is explicit.

   (d) Nouns can be used as adjectives, e.g. reaction product, ATP formation.

4. Which of the following statement is(are) false?

   (a) The objectives of a paper when it is finished are often the same as those used to justify starting the work, that's a reason why an outline is important.

   (b) A paper should be organized in chronological order so that the reader can follow how you arrive at your result.

   (c) A literature review is author-centric and should be a summary of the relevant articles.

   (d) A review should identify critical knowledge gaps and thus motivate research to close these gaps.

5. Which of the following statement is(are) correct about the tense in an academic paper?

   (a) When describing experimental results, use the present tense.

(b) When attributing a statement or idea to a person, use the past tense.

(c) When discussing concepts, use the present tense.

(d) None of the above.

6. Which of the following statement is(are) correct about the outline of a paper?

(a) Once the outline is finished after careful thinking, one should follow the outline and not do significant additional work.

(b) The outline should be organized in order of importance.

(c) The section headings should be as short as possible to be faster for readers to process.

(d) None of the above.

7. Which of the following elements should the Introduction of an article contain in general?

(a) Background

(b) The justification for the objectives of the work.

(c) Summary of what the reader should expect as conclusions of the paper.

(d) Guidance to the reader.

8. Which of the following statement for the theoretical development of an article is(are) false?

(a) In contrast to variance theories, process theories use events and states to help explain dynamic phenomena. Thus, in a review, the results of variance and process research are independent elements.

(b) Variance theories incorporate dependent variables that cause variation in independent variables.

(c) Models and propositions capture relationships between variables and represent theories.

(d) Extending current theories is a difficult task and is often the weakest part of a review, so it is the least important part of a review.

1.2 C1 – "Academic Technical Writing"

1. Which of the following is/are acceptable approach(es) to Referencing?

(a) Quote a paragraph by placing it in quotation marks and acknowledge the source.

(b) Take some short fixed phrases from several different sources and put them together with some of your own words.

(c) Copy a paragraph making only small changes. For example, replace some words with words with similar meanings.

(d) Paraphrase a paragraph: rewrite the paragraph but change the language, organisation and detail, and give your own examples.

2. Which of the following is/are the correct way(s) of using acronyms?
   (a) Include a table in the Results section.
   (b) Attach an appendix or index to the report.
   (c) Define them when their expansions first appear and use them after they have been displayed in full.
   (d) Use only very well known acronyms to avoid defining them.

3. Which of the following statements about graphics is/are true?
   (a) Figures and tables must be labeled.
   (b) A table is needed after every figure in order to explain it.
   (c) Tables do not need to be labeled.
   (d) Figures and tables must be referred to in the text.

4. Which of the following is/are correct way(s) of using "THAT"?
   (a) when you are adding helpful additional material, and use commas
   (b) when you are including essential material, and do not use commas
   (c) when you are including essential material, and use commas
   (d) when you are adding helpful additional material, and do not use commas

5. Which of the following is/are correct about adverbial?
   (a) Divide a dependent clause from an independent one.
   (b) Adverbials are dependent phrases or words that describe how, when, or where some action is done.
   (c) An adverbial generally won't change the subject-verb order in English.
   (d) All of the choices.

6. Which of the following statements about the use of references is(are) false?
   (a) Provide expert information/knowledge.
   (b) Keep you (and your readers) up to date on the latest developments in the field.
   (c) Give your readers high-quality information and thereby increase their trust in you.
   (d) None of the choices.

7. Which of the following statements is(are) correct about the IEEE reference list structure?
   (a) The references are arranged chronologically according to their publication date.
   (b) The references are arranged in the order of appearance of the text citations.
   (c) The references are arranged alphabetically with respect to the author's name.
   (d) None of the choices.

8. Which of the following is/are incorrect about text structure and grammar?
   (a) "Heavy" adverbials are often placed at the beginnings of sentences.
   (b) "That" is used when a sentence adds helpful additional material.
   (c) In academic writing, objective writing is recommended than first-person or second person pronouns.
   (d) In order to use formal expressions, it is required to avoid using contractions.

9. What information is compulsory to be given when commenting data?
   (a) Compare/assess data relative 'X'.
   (b) Highlight(s)
   (c) Location and summary
   (d) Unexpected results / reliability / validity

10. Which of the following is/are true about academic writing?
   (a) Writer should use more 1^{st} -person pronouns in order to make their statement straightforward.
   (b) Writer should indent the first line of each paragraph and leaves an empty line between each paragraph.
   (c) Contraction such as "you're" should be avoided in formal writing.
   (d) Every periods within the text could be replaced by semicolons.

11. Which of the following statement is(are) correct about figures and tables in a paper?
   (a) Figures and tables do not have to be labeled if they are referred to in text.
   (b) Figures and tables do not have to be referred to in text if they are labeled.
   (c) Figures and tables must be labeled and referred to in text.
   (d) A paper should only contain text and not figures or tables.

12. Which of the following use of "That" and "Which" is correct?
   (a) "That" should be used when you are adding helpful addition materials, and do not use commas.
   (b) "That" should be used when you are including essential material, and do not use commas.
   (c) "Which" should be used when you are adding helpful addition materials, and do not use commas.
   (d) "Which" should be used when you are adding helpful addition materials, and use commas.

13. According to Kathryn Strong Hansen, if someone asked the questions "Who founded Microsoft?" and "What is the company's name?", which of the following sentences is/are correct answers to these two questions?

(a) The company, which is called Microsoft, is founded by Bill Gates.

(b) The company that is called Microsoft is founded by Bill Gates.

(c) The company, which is founded by Bill Gates, is called Microsoft.

(d) The company that is founded by Bill Gates is called Microsoft.

14. What was said in the lecture Academic Technical Writing?

(a) Semicolon can be used in some cases but it is optional.

(b) As long as you mention the original writer's name, you can use this information as a source.

(c) "That" and "which" are used in the same way.

(d) The IMRaD structure should be used whenever writing a report.

15. According to Kathryn Strong Hansen, style and language are very important for academic writing. Considering formality, conciseness and objectivity, which of the following sentences is the best?

(a) It was noted that, after having been tested, the medicine was ineffective.

(b) We noted that, after testing, the medicine was ineffective.

(c) Tests showed that our medicine was really ineffective.

(d) Tests showed that the medicine was ineffective.

16. Which of the following statements is/are correct about reference?

(a) In the reference end list, references should be organized by the order in which they appear in the text.

(b) One of the reason for using references is providing expert information/knowledge.

(c) References can give your readers high-quality information and thereby increase their trust in you.

(d) Referencing has two parts: in the text and in the reference list.

17. Which of the following is/are correct in the academic technical writing?

(a) Writing papers from the Introduction section is the most efficient way.

(b) In an outline, the Conclusion section is just the summary of the paper.

(c) Tables and equations can be used to compress the information and make the paper shorter and more readable.

(d) A review succeeds when it helps other scholars to make sense of the accumulated knowledge on a topic.

1.3 Article #04 – "Evolution of LTE toward IMT-Advanced"

1. Which of the following statement(s) is(are) false about LTE-advanced?
   (a) Carrier aggregation capable terminals can receive only the primary component carrier, this increases the terminal's power consumption.
   (b) Transmission bandwidth can extended by means of carrier aggregation.
   (c) Discrete fourier transform spread OFDM is used in the uplink.
   (d) In cross-carrier scheduling, the scheduling decision is transmitted to the terminal on the same component carrier as for the corresponding data.

2. Which of the following statement(s) is(are) correct about LTE-advanced?
   (a) In inband relaying the donor-relay link operate on a different frequency.
   (b) In outband relaying the donor-relay link operate on the same frequency.
   (c) Network densification is one possible method to increase overall network capacity.
   (d) For better network performance, separate carrier should be used for closed subscriber group(CSG) cells.

3. Suppose you have a mobile device supporting LTE Release 10 and you are in a city with LTE Release 8 base stations. Which of the following scenarios are possible?
   (a) Mobile device will fail to connect to the base station.
   (b) Mobile device will connect to base station and operate normally.
   (c) Mobile device will connect to base station only if it is an Apple device.
   (d) The base station will update itself to LTE Release 10 since the mobile device is LTE Release 10.

4. Which of the following statement(s) is(are) true regarding heterogeneous deployments ?
   (a) Support for heterogeneous deployments includes carrier aggregation.
   (b) Heterogeneous deployment is possible with LTE Release 8.
   (c) In heterogeneous deployment the best cell for downlink is the one with lowest path loss.
   (d) Cell association strategy can lead to different uplink and downlink coverage area.

5. Which of the following statement(s) is(are) true regarding LTE Release 10 enhancements?
   (a) Carrier aggregation provides increased data rates by coalescing noncontiguous bandwidths.
   (b) Heterogeneous deployment provides increased data rates by allowing hierarchical cell structure.
   (c) In Heterogeneous deployment the pico cells are always wirelessly connected to macro cell basestation.

(d) Relaying increases coverage while Heterogeneous deployment increases data rate.

6. How does LTE Release 10 achieve backward compatibility with LTE Release 8 for carrier aggregation?

(a) Carrier aggregation in LTE Release 10 is not compatible with LTE Release 8.

(b) Each component carrier has LTE Release 8 structure, and hence, carrier aggregation is backward compatible.

(c) Carrier aggregation is already available in LTE Release 8. So there are no compatibility issues.

(d) A special software update is needed for LTE Release 8 terminals to support carrier aggregation capable LTE Release 10 devices.

7. Which of the following is an LTE Release 10 enhancement?

(a) Possibility to have control signals for different cell layers separated in frequency or time.

(b) Support for 4-layer spatially multiplexed downlink transmission using multiple antennas.

(c) Capability to have an aggregated transmission bandwidth of 200 MHz.

(d) None of these choices.

1.4 C2 – "Basic Principles of Wireless Networks"

1. In order to greatly reduce the effect of delay spread, which of the following is/are are being used at the receiver side?

(a) Power adaptation

(b) Spread spectrum

(c) Equalization at the receiver

(d) Multicarrier modulation

2. Which of the following is/are false about diversity?

(a) Independent signal paths have a high probability of experiencing deep fades simultaneously.

(b) The output SNR with Selection Combining improves linearly with the number of diversity branches.

(c) Independent fading paths can be achieved by separating the signal in time, frequency, space, and polarization, etc.

(d) To realize diversity, the same information should be sent over dependently fading radio.

3. Which property/properties can be used to modulate information on a signal?

(a) Amplitude

(b) Phase

(c) Frequency

(d) Amplitude and phase together

4. Which of the following is/are the issue(s) of multicarrier modulation (OFDM not included)?

(a) It requires reliable feedback channel and accurate channel estimation.

(b) Large bandwidth penalty.

(c) Expensive.

(d) Total data rate is changed for N subcarriers with rate R/N.

5. Which of the following statements is/are true about the Cyclic Prefix of an OFDM symbol?

(a) The length of the cyclic prefix should not be longer than the delay spread of the channel.

(b) A longer cyclic prefix length introduces losses in data rate.

(c) The cyclic prefix is a fixed set of symbols known by both the transmitter and reciever.

(d) The cyclic prefix tricks the reciever that the signal is periodic, thus providing a circular convolution.

6. Which of the following is/are false for modeling path loss?

(a) Maxwell's equations are complex and impractical.

(b) Free space path loss model is close to reality.

(c) Ray tracing models require site-specific information.

(d) Simplified power falloff models are good for high-level analysis.

7. A channel introduces a lot of amplitude noise but almost no phase noise. Which of the following constellations is(are) suitable for this channel?

(a) QPSK

(b) 32-QAM

(c) 16-PSK

(d) 8-QAM

8. Which of the following is/are true about flat fading countermeasures?

(a) Independent signal paths are likely to experience deep fades simultaneously, therefore the diversity combining techniques are ineffective.

(b) Channel coding techniques make a trade-off between improving bit error rate and maintaining data rate.

(c) The basic principle of interleaving in channel coding is to spread the burst errors over many codewords.

(d) Automatic Repeat Request (ARQ) is a power efficient technique.

9. Which of the following characteristics can be issues of multicarrier modulation (OFDM not included)?

(a) Large bandwidth penalty.

(b) Very high quality (expensive) low pass filters.

(c) More ISI when a large number of narrowband carriers are sent.

(d) None of the above.

10. Which of the following is/are true about the diversity combining technique Selection Combining?

(a) All branches are coherently combined with equal weights.

(b) All branches are coherently combined with weights which depend on the branch SNR.

(c) Picks the branch with the highest SNR.

(d) None of the above.

11. which one of the following factors does not affect small scale fading?

(a) Transmission bandwidth of the signal

(b) Multipath propagation

(c) Power density of the base station

(d) Speed of mobile

12. Which of the following belong(s) to large scale fading?

(a) Path loss

(b) Shadowing

(c) Multipath fading

(d) All of the above.

13. What is true regarding Orthogonal Frequency-Division Multiplexing (OFDM) and Multicarrier Modulation?

(a) The delay spread must be larger than the guard period to avoid ISI between symbols.

(b) OFDM divides a wideband signal into multiple smaller narrowband subcarriers to avoid frequency-selective fading.

(c) One downside with OFDM is that it is not very spectrum efficient.

(d) The cyclic prefix is used to eliminate the Inter Symbol Interference (ISI).

14. Which of the following statement is/are correct about adaptive techniques?

(a) Implementing adaptive modulation will increase transmitter and receiver complexity.

(b) Adaptive modulation can be utilized without good feedback channel.

(c) Adaptive modulation has potential for large increase in spectral efficiency, this improvement comes at the expense of increased signal bandwidth or a lower data rate.

(d) There are three types of Automatic Repeat Request, including Stop-and-Wait, Go-Back-N, and Selective-Repeat.

15. Which of the following is/are correct in Lecture 3?

(a) There is Doppler effects in fast fading, and it is a time variant system.

(b) The key point for MIMO to improve the performance is separating the signal in frequency dimension.

(c) Channel coding is a linear approach to reduce error probability.

(d) In OFDM, the delay spread should not be greater than guard band duration, otherwise, there will be ISI.

1.5 Review questions of Lecture #03 – "Basic Principles of Wireless Networks"

Part I:

1. Explain the difference between path loss and shadowing? What is the impact of shadowing on cell design?

2. What is flat fading and how is it different from AWGN? Why is Rayleigh good statistical model for flat fading?

3. How exactly does multi-path fading lead to frequency-selectivity and ISI in a broadband channel?

4. How exactly does mobility lead to time-selectivity in the channel?

5. What are the basic link performance measures? Explain each.

Part II:

1. Interleaving is one way to create diversity in fading channels. Explain briefly how interleaving helps to create diversity.

2. There are several sources of interference in wireless networks: inter-symbol interference (AWGN channels due to poor pulse-shaping; multi-path frequency-selective channels), inter-cell interference, intra-cell interference (CDMA), and inter-carrier interference (in OFDM). Briefly explain why each of these interference phenomena arise. How do techniques like pulse-shaping, spread spectrum/Rake, equalizers and OFDM deal with the ISI problem?

3. The cyclic prefix in multicarrier modulation serves as a time gap (a guard interval) between consecutive data blocks. Why is cyclic prefix used instead of a simpler guard interval?

4. Name two channel-related irreducible probability of error phenomena, and briefly describe the nature of each one. What is their relationship with the coherence bandwidth and Doppler spread of the channel?

1.6 Article #05 – "mmWave-5G"

1. Which of the following statements is/are NOT correct about 5G?
   (a) 5G promises twenty times peak data rates compared to LTE.
   (b) 5G is allocated the millimeter wave frequency band (6–100GHz).
   (c) 5G will have dense smaller cells compared to LTE.
   (d) All of the choices.

2. Which of the following statements is/are correct about millimeter wave communication?
   (a) Antenna arrays are possible using millimeter waves because of small size of each antenna element.
   (b) Penetration losses are higher for millimeter waves compared with waves with lower wavelength.
   (c) Fading channel matrices in millimeter wave communication are sparse.
   (d) Low resolution ADCs is used to improve energy efficiency in millimeter wave communication.

3. Which of the following statements is/are correct about millimeter wave communication?
   (a) Digital beamforming in millimeter wave communication is complex to implement if we require maximum performance.
   (b) Hybrid beamforming, which is proposed for millimeter wave communication, involves operations in analog domain as well as digital domain.
   (c) "Dirty RF" concept proposes to compensate for non-ideal hardware in digital baseband processing.
   (d) Noise in reference clocks can lead to phase noise.

1.7 C3 – "From 4G to 5G and Beyond, part 1"

1. When a UE is in the connected state, which of the following will happen?
   (a) The UE sends out paging information to the network about its channel characteristics.
   (b) The UE updates the Downlink control information (DCI) among other UEs.
   (c) The UE searches for candidate cells. If a stronger cell is detected, it then informs the network.

(d) The networks decides if a handover to a neighboring cell is needed or not.

2. Which of the following is/are false about spectrum in LTE?
   (a) Licensed spectrum allows for relatively high output power and long range.
   (b) Unpaired spectrum (TDD) uses only unlicensed bands.
   (c) LTE supports both FDD and TDD with a single radio-access technology.
   (d) There is a control of the interference situation on both licensed and unlicensed spectrum.

3. Which of the following statement(s) is/are true about carrier aggregation?
   (a) Inter-band aggregation means that frequencies of the same frequency band are aggregated.
   (b) The reasons to do carrier aggregation is to exploit fragmented spectrum and achieve higher data rates due to more bandwidth.
   (c) Intra-band aggregation only works if the frequencies are located next to each other.
   (d) It uses multiple carriers in parallel.

4. Which of the following is/are true about licensed spectrum ?
   (a) Exclusive right to a certain frequency range
   (b) Control of the interference situation
   (c) Typically associated with no license cost
   (d) Relatively low output power and short range of coverage

5. What information does a base station need to have in order to schedule uplink for a user?
   (a) A so called Buffer Status Report (BSR) which tells the base station how much data is in the buffers.
   (b) Channel-state information (CSI).
   (c) The UE's battery life.
   (d) Information that a user has data ready to transfer (scheduling request).

6. Which of the following is/are a correct sentence?
   (a) Round Robing scheduling is a way that assigns the channel to the user with the best absolute quality.
   (b) High reliability is one of the things that we require from a wireless system.
   (c) Proportional Fair (PF) is a scheduling that cyclically assigns the channel to users, not taking quality conditions into account
   (d) Max/CI provides high throughput and is fair as well.

7. Which of the following is/are true about license-assisted access (LAA)?

(a) Carrier aggregation is used to combine licensed and unlicensed spectrum.

(b) LAA use the 2.4 Ghz and 5 Ghz band.

(c) LTE does not use unlicensed spectrum.

(d) Listen-before-talk is required for unlicensed carriers.

8. Which of the following is/are true about error control in LTE?

(a) Hybrid-ARQ is slower than RLC retransmissions.

(b) Hybrid-ARQ indicates success/failure outband after reception of each 1 ms subframe of data.

(c) Because of the incremental redundancy supported by Hybrid-ARQ, the initial transmission could have two times the code rate as the first retransmission.

(d) RLC retransmissions handle most of the errors.

9. Which of the following is/are true about licensed spectrum?

(a) Anyone can use the given frequencies.

(b) Exclusive right to a certain frequency range

(c) Control of the interference situation

(d) Relatively low output power and short range

10. Which of the following is/are true about downlink control information (DCI) in scheduling and link adaptation?

(a) Downlink control information (DCI) informs the UE about MIMO layers.

(b) Downlink control information (DCI) informs the UE about time/frequency resources.

(c) Downlink control information (DCI) informs the UE about modulation scheme and code rate.

(d) None of the above

11. What is the largest bandwidth a UE is required to support in LTE?

(a) 5 MHz

(b) 1.4 MHz

(c) 20 MHz

(d) 15 MHz

12. Which of the following is/are the meaning of “global standard” ?

(a) merge of different standards

(b) faster network

(c) support larger user base

(d) lower latency

13. Which of the following statements is/are correct about uplink and downlink?

(a) For both uplink and downlink we have a scheduler that tells the UE what to do.

(b) Buffer status report is used to inform the UE of how much data the base station expects to receive.

(c) The UE sporadically reports the channel-state-information to the base station, containing information of the downlink channel quality.

(d) The power headroom report is used to inform a base station of the amount of available output power.

14. Which of the following statements is/are true regarding lecture 4?

(a) The main requirements for 4G performance can be visualized with "the spider diagram", with axes of mobility and peak data rate.

(b) Many of today's mobile subscription users are not human but e.g cars.

(c) One good scheduling technique is using dedicated channels for each device/user since it is very efficient.

(d) It is always best to choose scheduling type based on the full buffer traffic.

15. Among the following implementations in the LTE protocol stack, which is/are NOT in the radio link control (RLC) layer?

(a) Coding and Modulation

(b) RLC retransmissions

(c) Hybrid-ARQ retransmissions

(d) Header compression to reduce overhead

16. Which of the following is/are correct about scheduling?

(a) The max C/I scheduling scheme always has a higher system throughput compared with Proportional Fair.

(b) When rate adaptation is used in scheduling, the modulation scheme is determined as part of the scheduling.

(c) In order to adapt efficiently to dynamic data traffic conditions, a dedicated channel is the best choice.

(d) Round Robin considers channel quality conditions but has poor performance.

1.8 Article #06a – "NR: The New 5G Radio Access Technology" #06b – "5G NR evolution"

1. Which of the following is(are) true about 5G NR?

(a) NR is designed to co-exist with LTE through interworking

(b) NR is designed for forward compatibility

(c) NR is based on OFDM

(d) NR supports both TDD and FDD

2. Which of the following information is transmitted in physical uplink control channel?

(a) Hybrid ARQ acknowledgement

(b) Channel-state feedback for multi-antenna operation

(c) Number of mobile devices in the cell

(d) Scheduling request for downlink data awaiting transmission

3. Which of the following is true about channel codes in 5G NR?

(a) LDPC codes with no hybrid ARQ is used in smallest control payloads.

(b) Reed-Muller and polar codes are used in control channels.

(c) LDPC codes with hybrid ARQ is used for data transmissions.

(d) None of the above.

4. Which of the following statements is true?

(a) Measurement configuration and reporting does not take place until the UE enters the fully connected state in 5G NR release 16.

(b) The number of rate-matching patterns available in NR has been increased in 5G NR release 16.

(c) 5G NR release 16 enables NR operation in unlicensed spectrum, targeting the 5GHz and 6GHz unlicensed bands.

(d) 5G NR release 17 enhances many existing features and functionalities, such as paging collision avoidance and supporting NR from 52.6GHz to 71GHz.

1.9 C4 – "Challenges and Opportunities with mmWave Communications in 5G"

1. Based on specific used cases, which of the following is/are the advantage of mm-waves?

(a) They can be used for virtually any wireless communication, offering infinite bandwidth.

(b) It allows for dense frequency re-use, even with unfavourable propagation characteristics.

(c) It offers a possibility for contiguous bandwdith, leading to potentially high data rate and low latency.

(d) Due to high directionality of antennas used for mmWave communication, it offers less interference.

2. Why are relays useful?

(a) Because they help to increase the capacity inside the area of the base station.

(b) Because they extend the area covered by the base station.

(c) To make the capacity more uniform by putting the relays outside the coverage area of the base station.

(d) To make use of the multi-hop approach in a distributive way by donating time slots from the base station.

3. Which of the following is/are true about coordinated multipoint (CoMP) architectures?

(a) Each Base station has to do the scheduling on its own.

(b) Different CoMP architectures can have base stations, remote radio units and relay stations.

(c) Every CoMP architecture is meant to work without a central unit for transmission control.

(d) Coordinated mulit-cell transmission and reception has the potential to improve the outage capacity and to smoothen the capacity over the cell areas.

4. Which of the following is/are true about coordinated scheduling and/or beamforming?

(a) Data to a single user is instantaneously transmitted from one of the transmission points.

(b) Data to a single user is simultaneously transmitted from multiple transmission points

(c) Scheduling decisions are coordinated to control e.g. the interference generated in a set of coordinated cells.

(d) It can improve the outage capacity and to smoothen the capacity over the cell areas.

5. What differences are there between the CoMP approaches of coordinated scheduling and/or beamforming vs coordinated joint processing/transmission?

(a) Data is transmitted from one transmission point for the scheduling/beamforming approach and from multiple points for the joint processing/transmission approach.

(b) The scheduling/beamforming approach requires only exchange of control data beween nodes and the joint processing/transmission approach requires only exchange of user data between nodes.

(c) The joint processing/transmission approach is more advanced and complex than the scheduling/beamforming approach.

(d) The scheduling/beamforming approach can be seen as a point-to-point-like network and the joint processing/transmission approach can be seen as a star-like network with a central unit.

6. Which of the following statements is/are incorrect?

(a) Intercell interference is a major challenge in wide area deployments for the WINNER system concept.

(b) IMT-Advanced is the 3G systems family.

(c) For 5G, the ITU-R system family is called IMT-2020.

(d) Coordinated scheduling/beamforming over multiple cells has the potential to lower the interference levels in a frequency reuse one system.

7. When using beamforming, which of the following describe(s) the genetic algorithm (GA)-based search?

(a) First find the queen then adjust the queen by making small changes and replacing a few columns in the beamforming codebook.

(b) First find the queen then adjust the queen by changing columns to their neighbors in the beamforming codebook.

(c) Successively beamform to each user taking interference from previous users into account.

(d) Find the queen roughly with wide beams in the first-level codebook then steer to narrow beams by the second level codebook.

8. Which of the following is/are true about Coordinated Multi-Point (CoMP) schemes?

(a) In coordinated joint processing, data to a single user is transmitted from single transmission point.

(b) In coordinated scheduling, only the exchange of control data is required between nodes.

(c) CoMP intends to solve the problem that cell edge users obtain only fraction of the average throughput in conventional LTE system.

(d) Feedback links and backhaul links introduce latency to the transmission loop of central unit (CU).

9. Which of the following is/are use case(s) in mmMAGIC?

(a) Dense urban society with distributed crowds

(b) Immerse 5G early experience (hot spots)

(c) Moving hot spots

(d) Media on demand

10. What is true about the CoMP approaches?

(a) Coordinated scheduling and/or beamforming requires exchange of control data only between nodes.

(b) Coordinated joint processing/transmission doesn't require exchange of user data.

(c) Coordinated scheduling and/or beamforming have data transmitted to a single user from one transmission point.

(d) Coordinated joint processing/transmission transmitts data to a single user from multiple transmission points.

11. Which of the following is/are true regarding standards and different technologies mentioned in lecture 5?

(a) The IMT-Advanced defines capabilities that go beyond 4G systems.

(b) One important concept for the WINNER system was cooperation between different standards.

(c) Relaying is important since it enables extended coverage but also for its possibility to get more uniform capacity in cells.

(d) It is best to streamline different standards once the technology is widespread since it is easiest to make them compatible and minimize complexity once they're developed.

12. Which of the following statements is/are correct?

(a) One of the advantages of mm-waves for selected use cases is that the high directionality of antennas needed for mmWave transmissions causes less interference to other systems.

(b) MmMAGIC aims to collaborate with other 5G PPP projects, towards achieving a common set of 5G PPP KPIs.

(c) There are several use cases in mmMAGIC, including cloud services, moving hot spots, smart offices, etc.

(d) None of the above

13. Which of the following is/are false about Coordinated Multi-Point(CoMP)?

(a) The data can be transmitted to one user from multiple transmission nodes in beam forming.

(b) Coordinated joint processing only demands interchange of the user data.

(c) The characteristic of cellular structure with CoMp is: the capacity has fixed coordinates.

(d) All of the choices.

1.10 Article #07 – "5G technologies for the connected car"

1. Which of the following create unique challenges for V2X communications compared to other communication systems?

(a) High antenna heights.

(b) High speed of the vehicles.

(c) Dynamic surroundings.

(d) All of the above.

2. Which of the following statements is/are the key open research topics about integrated moving networks?

(a) Track a large set of mobile channels at a high speed to enable advanced spectrally efficient and robust closed loop MIMO schemes in the moving backhaul links.

(b) Design close-loop and cooperative interference coordination techniques in ultradence heterogeneous networks. communication are sparse.

(c) Resource allocation and resource slicing for versatile quality of services to meet key performance targets on outage, throughput, latency, and energy efficiency.

(d) Enable efficient mobility protocols in such integrated moving networks.

1.11 Article #08 – "Spectrum management"

1. Which of the following statement(s) is(are) true about spectrum management?

(a) Avoiding interference is one of the probable reasons for spectrum utilization agreement in 1903.

(b) The ITU is in charge of deciding between administrative model, trading model or free model for spectrum management.

(c) In trading model, the rights for spectrum usage can be sold and bought.

(d) WLAN is an example of a success story for spectrum commons.

2. Which of the following is(are) true?

(a) Fragmented spectrum will require devices to handle more interference scenarios.

(b) Fragmented spectrum calls for aggregation of narrow frequency bands.

(c) The downside of spectrum commons approach is imminent congestion due to increasing number of users.

(d) There is a general trend towards more frequency bands being allocated to spectrum commons.

1.12 C5 – "From 4G to 5G and Beyond, part 2"

1. Which of the following is/are correct about network slicing ?

(a) It involves deployment of different access gNB for different services

(b) It involves the telecom operator which logically re-planning its frequency spectrum for various services.

(c) It involves the control, or signaling data, riding on the 4G LTE network.

(d) It involves the logical separation of services at the core network into multiple virtual networks that operate on the same gNB.

2. Which of the following is/are advantage(s) of not restricting transmission to slot boundaries?

(a) Transmission efficiency for unlicensed spectrum.

(b) Low latency.

(c) Beams scheduled at the beginning of each slot.

(d) None of the above.

3. Which of the following is/are true about beamforming?

(a) The combination of analog and digital beamforming is supported by NR.

(b) Analog beamforming gives unlimited degrees of freedom.

(c) In digital beamforming every antenna has its own digital to analog converter and amplifier.

(d) Only digital beamforming is supported by NR.

4. Which of the following is/are true about 5G bandwidth?

(a) carrier bandwidth in NR up to 400MHz.

(b) Up to 16 component carriers

(c) The subcarrier spacing is up to 120KHz

(d) A UE can't support less than the carrier bandwidth

5. Which of the following choice(s) is/are NR characteristics?

(a) Ultra-lean design

(b) Backward compatibility

(c) LTE and NR cannot coexist together

(d) Low latency

6. Which of the following is/are true about high-frequency spectrum in cities?

(a) It is needed to satisfy the traffic demands and possibly future demands as well.

(b) It improves the coverage area like buildings that lower frequencies couldn't penetrate in.

(c) It is a replacement for the previous low-frequency operations

(d) It is optimized when used in joint operations with lower frequencies.

7. Which of the following statements is/are incorrect?

(a) In non-standalone NR, LTE handles initial access and mobility.

(b) The first 5G release is NR Release 16.

(c) In stand-alone NR, NR handles initial access and mobility.

(d) One of the NR characteristics is that it provides multi-antenna support.

8. Which of the following is(are) true regarding bandwidth in 5G NR?

(a) A UE needs to support 400 MHz carrier bandwith to work properly.

(b) Bandwidth adaptation is useful to reserve power.

(c) Switch of active bandwidth parts is slow.

(d) None of the above.

9. Which of the following is/are true about multi-antenna transmission in NR?

(a) Analogue beamforming can transmit multiple directions at the same time.

(b) In higher frequency such as millimeter waves, there could be up to several hundreds antenna elements.

(c) Digital beamforming requires own DAC and amplifier for each antenna element, hence making the implementation more challenging than analogue beamforming.

(d) Both analogue beamforming and digital beamforming (as well as hybrid) are supported by NR.

10. Which of the following is/are examples of NR characteristics?

(a) High latency

(b) Multi-antenna support

(c) Forward compability

(d) Narrow spectrum range

11. What/which of the following is true about analog and digital beamforming?

(a) Analog beamforming has limited degrees of freedom.

(b) Digital beamforming has highest degree of freedom.

(c) Both analog and digital beamforming are supported by NR.

(d) Digital beamforming is easy to implement at high frequency.

12. Which of the following is/are correct about analog and digital beamforming?

(a) From the practical perspective, it is more preferable to use digital beamforming than analog beamforming due to the simplicity of its implementation.

(b) Digital beamforming allows to transmit multiple data streams with a separate directivity at the same time.

(c) Hybrid analog and digital beamforming is not supported by NR.

(d) Analog beamforming refers to the formation of a single beam in a particular angular direction.

13. Which of the following is/are a major cost for upgrading to a 5G network?

(a) Building Base Station

(b) Electricity

(c) Adapting network slicing by hosting virtual machines

(d) Running 4G system in parallel

14. Which of the following statements is/are true about 5G NR?

(a) The use of network slicing provides a more flexible way of running networks.

(b) The reason that the non-standalone NR was released early was to fulfill the need of data.

(c) TDD is often used for the whole range of 5G spectrum.

(d) Compared to LTE, NR uses a higher frequency spectrum.

15. Regarding NR technologies and its possibilities, what/which of the following is/are true?

(a) Beamforming scheme must be decided beforehand since analog and digital beamforming cannot be both be supported by NR.

(b) By virtually dividing a physical network into network slices, different slices can serve different users' requirements.

(c) NR and LTE systems can coexist by sharing the spectrum.

(d) Increased connectivity applied in industry may be a driving force both for 5G and for new technologies and applications.

16. Which of the following description is/are correct about the challenges of mm-wave?

(a) Due to the higher frequency, there is propagation challenge for wave from outdoor-to-indoor.

(b) Signal with larger wavelength has lower propagation attenuation in the environment compared with that of smaller wavelength.

(c) The implementation challenges include: efficiency, deterministic range, output power...

(d) Above 6 GHz, there is extra limitation of transmitted power.

1.13 Article #09 – "Wireless backhaul"

1. Which of the following statements is/are correct about MIMO for microwave?

(a) A MIMO channel can be decomposed into multiple SISO sub-channels over different time and frequency band.

(b) Optimal antenna separation gives 90 degrees phase shift between the cross-channels relative to the direct channels

(c) 2x2 MIMO and 100 percent of optimal antenna separation gives over 3x SISO capacity.

(d) There is a trade-off between MIMO spectral efficiency and optimal antenna separation percentage for sub-optimal antenna arrangements.

2. Which of the following statements is/are correct?

(a) The E-band and is becoming an essential backhaul band of high global alignment.

(b) In order to use spectrum more efficiently, backhaul bands should be used in one smart universal way in all locations.

(c) The US takes the lead in high band 5G.

(d) Fiber is a complementary technology for fronthaul, when microwave is not a viable solution.

1.14 Article #10 – "Space communications"

1. Which of the following statements is/are correct?

   (a) Diluting the antenna with air can improve the performance in terms of tolerances and losses for ground-based and airborne arrays.

   (b) Satellite-based cellular systems require a multitude of independent beams that cover separate areas to provide multiple access through frequency re-use.

   (c) Multiple fixed beams can be produced by an array antenna with a suitable beam-forming network (BFN), e.g. a Butler matrix.

   (d) The main disadvantage of slotted waveguide antennas is the rather complicated mechanical build-up, especially if dual polarization is needed.

2. Which of the following is/are feature(s) of the S-DMB element?

   (a) One circular polarization

   (b) Small aperture: 0.8λ ($\approx$ 110mm)

   (c) S-DMB band (2170 – 2200 MHz)

   (d) Integrated with a low-pass filter

1.15 C6 – "C6 Cellular-V2X and Integrated moving networks"

1. Which of the following is/are the challenge(s) of building integrated moving networks?

   (a) The backhaul design for the moving base stations, relays and cells.

   (b) Interference coordination within the network

   (c) The Handover process between the sites to ensure quality of service (QoS)

   (d) Deployment of SDN and NFV to support network slicing for managing the network

2. What is/are true about integrated moving networks?

   (a) The performance of outdoor UEs can be significantly degraded when the experience of VUES is improved using MNs with advanced interference coordination (ICIC).

   (b) In low interference scenarios, it is very useful to consider moving relays/base stations.

   (c) The key to further boost the performance of MNs are advanced backhaul links.

   (d) There is no need of interference Management when using MNs in ultra-dense urban scenarios.

3. Which of the following statement(s) is/are true about 5G V2X communication?
   (a) The communication between vehicles is done via base stations only.
   (b) Radio interfaces should provide low latency and high reliability V2X communication.
   (c) Sidelink communication means that the vehicles are communicating to the network infrastructure via a relay.
   (d) URLLC stands for ultra robust little lag communication.

4. Which of the following is/are true about vulnerable road user protection?
   (a) Pedestrian-UEs and CAR V-UE send out specific waveforms to infrastructure.
   (b) Base stations receive it, and the location server triangulates the positions.
   (c) Potentially triggering warnings via Alert message to Car.
   (d) Connected vehicles make room for an entering vehicle.

5. What types of communication does a V2X vehicular communication systems incorporate?
   (a) V2V, which means vehicle-to-vehicle.
   (b) V2G, which means vehicle-to-grid.
   (c) V2T, which means vehicle-to-traffic.
   (d) V2H, which means vehicle-to-human.

6. Which of the following is(are) true regarding the predictor antenna concept?
   (a) Can be used to improve beamforming accuracy in downlink.
   (b) Non-equal scattering environment around the antennas might introduce decorrelation.
   (c) Can not be combined with conventional prediction based on past data.
   (d) Experiments show that it is 10x better than the Kalman based approach.

7. Which of the following is/are true about a vehicle moving in high velocity?
   (a) There is no effects on the standing wave pattern
   (b) Larger prediction is required
   (c) Higher SNR is required
   (d) Predictor antenna concept was proposed to solve the issue

8. Which of the following may be the cause of decorrelation in predictor antennas?
   (a) Effects of the moving vehicle on the standing wave pattern
   (b) Non-equal scattering environment around the antennas
   (c) Mutual electromagnetic coupling of antennas
   (d) All of the above

9. Which of the following statement(s) is/are true from lecture 7?

(a) Interference management is very important for the use of MNs in ultra-dense urban scenarios

(b) Moving relays/base stations are not that useful in low interference scenarios

(c) Advanced backhaul links are the key to further boost the performance of MNs.

(d) With advanced interference coordination (ICIC) schemes, the usage of MNs can improve the experience of VUEs.

10. Which of the following is/are use case class(es) of the 5GCAR project?

(a) Cooperative perception

(b) Cooperative safety

(c) Remote driving

(d) None of the above

11. Which of the following statements is/are true according to the lecture on cellular-V2X?

(a) URLLC should be robust and have low latency, long range and high capacity among else.

(b) According to the video about ITS shown during the lecture, traffic would be more efficient if all cars are autonomous and able to communicate with each other.

(c) Remote drivers can be one of the steps towards a fully autonomous vehicle.

(d) The main motivations for V2X are safety and energy savings.

12. What is true regarding 5G car systems technology?

(a) Moving networks can be used to increase capacity during traffic jams.

(b) By sharing local awareness and exchanging data from different sources, vehicles can perform cooperative manouvers and make other vehicles "see-through".

(c) One use case of 5GCAR is the employment of remote operators, used in complicated and rare situations.

(d) One test case of moving networks is traffic efficiency and can be used to improve speed and congestions.

13. Which of the following is/are test case(s) related to moving networks?

(a) Massive deployment of sensors and actuators

(b) Traffic efficiency and safety

(c) Blind spots

(d) Real-time remote computing for mobile terminals

14. Which of the following descriptions is/are correct about moving cells/networks?

(a) Since vehicles are natural hot spots, they can be used to generate MNs which serve the users both inside and outside the vehicles.

(b) Interference is one of the challenges of using MNs in congested area.

(c) Energy loss happens when the wave propagates into the vehicles.

(d) The users in the same vehicle share the same resources.

1.16 C6' – "Spectrum management concepts for mobile and wireless communications"

1. In the process of spectrum refarming, which of the following is/are stipulated requirements?

(a) The RF emission report for the equipment currently using the frequency bands

(b) Operators have a minimum amount of spectrum each

(c) Often, spectrum holding is contiguous

(d) Licenses are technology neutral

2. Which of the following is/are true about network sharing among operators?

(a) They share the workers and save money on payments.

(b) They share resources such as sites, RAN, core, spectrum.

(c) They share the subscribers. This is called users pooling.

(d) All of the above.

3. Which of the following is/are organizations for regional spectrum managment?

(a) APT-Asia Pacific Telecommunity.

(b) ATU-African Telecommunications Union.

(c) 3GPP-3rd Generation Partnership.

(d) CITEL-Inter American Telecommunication Commision.

4. What is/are the requirements for refarming of spectrum?

(a) Spectrum sharing can be a part of network sharing, if the national regulator allows

(b) Licenses are technology neutral

(c) Operators have a minimum amount of spectrum each

(d) Affects the system efficiency.

5. Which of the following is(are) true about network and spectrum sharing?

(a) Network sharing between operators seldom occurs.

(b) Spectrum sharing is not allowed due to how the spectrum is regulated.

(c) Network sharing is also known as spectrum pooling.

(d) None of the above.

6. Which of the following is(are) true about cognitive radio?
   (a) Can be used to utilize the spectrum more efficiently in an opportunistic way.
   (b) It obtains knowledge of its geographical and operational environment.
   (c) It's only an adaptive system.
   (d) None of the above

7. Which of the following is/are true about the safety guideline regarding to EMF exposure?
   (a) Individual country cannot set its own national standard for exposure to EMF
   (b) Exposure at very high field intensity is not common
   (c) The only health effect of EMF is related to increase in body temperature
   (d) Surveys have shown that the RF exposures from base stations range from 0.002% to 2% of the levels of international exposure guidelines

8. Which organisation is managing the spectrum on the national level in Sweden?
   (a) International Telecommunications Union Radio Sector
   (b) European Communications Committee
   (c) The Swedish Post and Telecom Authority
   (d) None of the above

9. Which of the following is/are true from the 'Spectrum Management' lecture?
   (a) 2.4-2.5 GHz Wi-Fi is considered to be apart of "Unlicensed spectrum".
   (b) FR1 is considered to be in the range of 24.25 GHz - 52.6 GHz.
   (c) FR2 is considered to be in the range of 24.25 GHz - 52.6 GHz.
   (d) Auctions is a common method to assign spectrum to mobile operators.

10. Which of the following statements is/are true about spectrum?
   (a) It is the foundation of any wireless system and enables us to use our mobile devices.
   (b) The spectrum is regulated between 10^{-3} Hz and 10^{22} Hz.
   (c) Refarming a certain spectrum prevents deployment of new technologies as it only allows for shift to the same technology.
   (d) Utilizing different parts of the spectrum results in different exposure and the typical indoor values can be harmful according to scientific proofs.

11. Regarding spectrum management mentioned in lecture 8, which of the following statements is/are NOT correct?
   (a) The birth of spectrum management came with the maritime radio telegraphy in 1927. The agreements on global usage created an environment for business and economy of scale.

(b) Refarming will sometimes be necessary in order to allow new technologies to be deployed and improve spectrum utilization. One of the requirements of refarming is that the operators have a minimum amount of spectrum each.

(c) After safe exposure limits to EMF decided by countries or ICNIRP, there is a precise line between safety and hazard.

(d) National regulatory authorities manage spectrum following three different models: administrative model, trading model and free mode.

12. Which of the following is/are incorrect about spectrum refarming?

(a) The technology changed from one to another should be located in the adjacent frequency band.

(b) Refarming improves the spectrum utilization.

(c) The spectrum should be reshuffled in order to have contiguous spectrum.

(d) Refarming can help deploy new technologies.

1.17 Article #11 – "-Slicing in 5G Transport Networks"

1. Which of the following statements is/are correct about optical network security?

(a) Existing models of physical layer impairments are too naive to identify the complex effects of a range of attacks.

(b) Machine learning techniques are found useful because they are able to jointly analyze multiple monitoring parameters to identify security breaches.

(c) Machine learning techniques still need a deeper scalability analysis.

(d) The artificial neural network is always capable of detecting all the attacks correctly.

2. Which of the following statements is/are true about transport network slicing?

(a) Space Division Multiplexing (SDM) techniques can help increase the capacity of fronthaul traffic.

(b) Time-Sensitive Networking (TSN) working group intends to devise solution for carrying high and low priority traffic together, with no need for time synchronization.

(c) The latency requirements can be different according to split options.

(d) There is still lack of studies on efficient traffic scheduling.

1.18 C7 – "Wireless backhaul –introduction and evolution"

1. In wireless backhaul link deployments, which of the following factors does the optimal antenna placement depend on?

(a) The hop length

(b) The frequency in use

(c) The antenna arrangement style selected

(d) The length of the power and IF cable to the base station

2. What is/are the difference(s) between multipath and line-of-sight (LOS) propagation?

(a) The wavelengths in antenna separation.

(b) The Signal-to-Noise Ratio (SNR).

(c) The path loss.

(d) Both are good for MIMO.

3. What are dependencies for the optimal separation of antennas in MIMO systems?

(a) Wavelength.

(b) Hop length.

(c) Number of antennas.

(d) None of the choices.

4. What is/are the possibilities that knowledge of the MIMO channel matrix provides?

(a) Signal reconstruction at Rx

(b) Precoding at Tx

(c) Analysis of MIMO channel (performance)

(d) All of the choices

5. Which of the following is/are true about W- and D-band?

(a) It takes approximately 1 year for D-band to mature

(b) There is 5 times more spectrum for W- and D-band than for E-band

(c) W-band will have a shorter journey to reach maturity than D-band

(d) W- and D-band won't have significant use until 2025

6. Which of the following is(are) true about hop lengths in backhauling?

(a) The most common hop lengths are distributed between around 0-5 km.

(b) Longhaul at 10-200 km can support up to less than 10 Gbps.

(c) The most common hoplengths are around 10-20 km.

(d) Shorthaul uses the frequencies of 6-15 GHz.

7. Which of the following is/are true about integrated access and backhaul (IAB)?

(a) Typical effective distance is several kilometers

(b) The standardization is ongoing

(c) The main idea is to enable access and backhaul to share the same band in radio access network

(d) One benefit would be extending coverage for 5G NR mmWave

8. Which of the following can be used to improve spectral efficiency?

(a) Higher-order modulation

(b) Dual Polarization & XPIC

(c) MIMO

(d) High performance antennas

9. Which of the following is/are true according to the "Wireless backhaul" lecture?

(a) The "optimal" antenna placement in MIMO only depends on frequency.

(b) Precoding in suboptimal antenna separations results in improved availability and capacity.

(c) The total amount of spectrum for W- and D-band is roughly 20 GHz.

(d) Backhaul spectrum is mostly point-to-point licensed.

10. Which of the following statements is/are true about antenna arrangement ?

(a) Planar arrays is a possible antenna arrangement

(b) The "optimal" antenna placement depends on frequency

(c) Sub-optimal antenna separation is a trade-off between MIMO capacity and availability.

(d) None of the choices

11. Which of the following statements is/are true according to the lecture "wireless backhaul"?

(a) One factor that might affect the availability is the amount of rain in an area.

(b) With long haul you receive lower data rates than short haul. Long haul is more suitable for rural areas or even remote rural areas.

(c) Some of the frequency bands are transitioned to 5G NR.

(d) Microwave is the fastest backhaul distribution medium.

12. What is/are true regarding backhaul and antenna placement?

(a) The future majority of backhaul media distribution will consist of microwave in all countries and regions.

(b) Sub-optimal antenna placement results in a trade off between capacity and availability.

(c) Larger separation between antennas handle larger hop length compared to more compact installations.

(d) All backhaul capacity demands are predicted to at least double to year 2025 in suburban, urban and rural areas.

13. Regarding wireless backhaul mentioned in lecture 9, which of the following statements is/are correct?

(a) Backhaul spectrum is mostly point-to-point licensed

(b) For suboptimal antenna spacings, the SNR loss, which depends on implementation, may be the same or different for all data streams.

(c) Optimal antenna separation depends on wavelength, hop length and number of antennas.

(d) None of the choices

14. Which of the following descriptions is/are true about backhaul spectrum licensing schemes?

(a) Mostly, backhaul spectrum is individually used between 2 geographic regions.

(b) Backhaul spectrum is block licensed.

(c) There is a licensing scheme which follows the principle: "first come, first served".

(d) Interference analysis is in regulator's database for individual licensing.

1.19 C7' – "Space Communications"

1. Which of The following is/are the consideration(s) for designing space satellite antennas?

(a) Presence of dust and debris in space

(b) Radiation

(c) The temperature range in outer space

(d) The outer space is a vacuum

2. Which of the following is/are requirements for "Earth observation satellites in low earth orbit"?

(a) Low angular rate for ground station.

(b) Small coverage area / short connection time.

(c) Large ground station antennas.

(d) Medium data quantities/low data rate.

3. Which of the following statement(s) about frequency is/are true?

(a) Higher frequencies means larger antennas.

(b) Lower frequencies have less attenuation.

(c) It is easy to generate high power for high frequencies.

(d) Low frequencies have wide bands.

4. Which of the following is/are true about low earth orbit?

(a) Medium data quantities / low data rate

(b) Large data quantities / high data rate

(c) Small coverage area / short connection time

(d) Large coverage area / long connection time

5. Which of the following is/are true about atmospheric attenuation?

(a) The frequency range up to 20 GHz has low attenuation

(b) The resonance for water vapor is around 50GHz

(c) The oxygen line is around 60 GHz

(d) For frequencies below 10 GHz, oxygen attenuation is higher than water attenuation

6. Which of the following is(are) true about direct broadcast satellites?

(a) They have a geostationary orbit which means they follow the movement of the earth and always stay over the same spot.

(b) They have a lifetime of about 10-15 years.

(c) You need about 30 of these satellites to get global coverage, not including the south and north pole.

(d) These satellites are very large and expensive.

7. Which of the following is/are true about frequency usage in space communication?

(a) Frequency at 60GHz is well suited for communication between the ground stations and the satellite

(b) Frequency at 60GHz is a good choice for inter-satellite communication

(c) There is no frequency allocation for space communication

(d) Multiple access is not easy through frequency re-use

8. Which of the following is/are requirements for earth observation satellites in low earth orbit?

(a) Large data quantities / high data rate

(b) High angular rate for ground station

(c) Small coverage area / short connection time

(d) Large ground station antennas

9. Which of the following is/are true from the "Space Communications" lecture?

(a) TV Satellites can have a specific shaped beam to transmit to a specific country.

(b) Frequency up to 20 GHz is considered to have a low atmospheric attenuation.

(c) Satellites for Earth observation often have an orbit that passes over the poles.

(d) None of the above is true.

10. Which of the following is/are a difficulty(ies) to overpass when designing space antennas?

(a) Abrasion caused by micrometeoroids and debris

(b) Thermo-Mechanical fatigue due to solar radiation

(c) Outgassing due to the vacuum

(d) None of the above

11. Which of the following statements is/are true about atmospheric attenuation?

(a) The 60 GHz band is suitable for communication between satellites.

(b) The frequency range up to 20 GHz has low attenuation and is suitable for communication between ground station and satellite.

(c) The attenuation in oxygen is the worst at around 60 GHz.

(d) None of the above.

12. Which of the following is/are true regarding space communication?

(a) The James Webb Space Telescope will not have as long lifetime as its predecessor, Hubble, since repairs is not possible.

(b) Space communication is difficult to realize due to costs and reliability.

(c) There are different kinds of beam types for satellite communication, eg. linguistic and "spot" for TV satellites.

(d) When designing space antennas, you need to consider electromagnetics, microwave engineering and computational electromagnetics among others.

13. What is/are the difference(s) between space based communications and ground based communications?

(a) Cost

(b) Distances

(c) Frequency allocation

(d) Reliability

14. Which of the following description is/are correct about space communication?

(a) 'K-band' is required to apply in 'deep space' communication for data downlink.

(b) 'Deep space' requires low angular rate for ground station due to the long distance.

(c) Communication at high frequencies is sensitive to the weather, such like the rain.

(d) Due to the long distances, there is high 'free space loss' in the space communication.

1.20 Article #12 – "Wireless Security"

1. Which of the following are the current security concerns regarding 5G?

(a) User identity and confidentiality

(b) New trust models

(c) Evolved threat landscape

(d) Cloud security and virtualization

2. Which of the following statement(s) is(are) true?

(a) 5G will be using clouds computing and virtualization in order to optimize the service, thereby rising a new level of security concerns

(b) In 2G, none of the security algorithms used by GSM is available to the public.

(c) In 3G, there is an attack type in which the attacker causes an interruption of operation by destroying resources.

(d) In LTE, the Media Access Layer (MAC) Layer Issues include location tracking, bandwidth stealing, DoS attacks and security issues due to open architecture.

1.21 C8 – "Slicing in 5G Transport Networks"

1. In the SDN/NFV deployment, which of the following is/are correct about the function(s) of the Orchestrator?

(a) It is in charge of coordinating the provisioning of virtual networks into the physical network.

(b) It is only used in 5G and beyond 5G deployments.

(c) It can manage only three controllers at a time.

(d) It harmonizes radio, cloud, and transport resources managed by different controllers.

2. Which is/are the main challenge(s) from 5G to B5G?

(a) Introduction of new services should be faster, and adapted to user needs.

(b) Lower monitoring cycle time and more parameters. Thus, higher accuracy and coverage is needed.

(c) Tailored for each service.

(d) None of the choices.

3. Which of the following is/are the benefits of slicing networks?

(a) Develop open APIs

(b) Scalability

(c) Agility

(d) Flexibility

4. What can generally be noted about dynamic slicing?

(a) Dynamic Slicing is a scheme to adapt resources assigned to a slice in order to match the time varying requirements.

(b) Dynamic Slicing can make it more profitable for infrastructure providers.

(c) When using Dynamic Slicing you risk degrading some services.

(d) Dynamic Slicing accepts all slices but makes sure to reduce the amount of resources to worse slices.

5. Which of the following is(are) true about Dynamic slicing?

(a) Slice acceptance ratio can be greatly improved but as a trade-off there will be a very large service degradation.

(b) Crucial to have a intelligent policy that only accept slices which are not likely to create performance degradation.

(c) Dynamic slicing is expensive for network infrastructure providers.

(d) To meet the needs of the tenants' services the network and cloud services should be provisioned on the fly.

6. Which of the following is/are true about dynamic slicing?

(a) MILP method achieves both high execution time and optimality.

(b) The dynamic slicing provisioning problem comprises of mapping and reconfiguration.

(c) The objective of MILP_{map} is to minimize the (possible) degradation of each virtual link, the number of reconfigured lightpaths, and the wavelength resource usage in the network.

(d) VN degradation is the reduction in the amount of service time.

7. Which of the following is/are benefits of slicing?

(a) Scalability

(b) Resource Efficiency

(c) Multi-tenancy

(d) Complexity

8. What is true regarding network slicing?

(a) One challenge of 5G and is to provide high capacity for on-demand users.

(b) The main objective of network slicing is to ensure performance by assigning resources for multiple services.

(c) Dynamic slicing utilize the same amount of resources but more efficiently than static slicing.

(d) All of the above.

9. What is/are the main challenge(s) from 5G to B5G?

(a) Network service interfaces.

(b) Automation

(c) Manageability

(d) Security

10. Which of the following description is/are false about dynamic slicing?

(a) The network slicing should consider that the requirements from tenants can come/leave at any time.

(b) Slices can be dynamically modified by configuring the virtual network, so that they can meet different traffic scenarios in day and night.

(c) Dynamic slicing brings the benefits of flexibility and resource efficiency to 5G networks.

(d) None of the choices.

1.22 Article #13a & #13b – "Reverberation Chamber"

1. Which of the following is true?

(a) Anechoic chambers are unsuitable for MIMO measurements due to lack of reflections.

(b) Reverberation chambers provide a controllable Rayleigh environment.

(c) Antenna patterns plays near zero role in design and evaluation of small antenna MIMO systems.

(d) Reverberation chambers can be made much smaller than anechoic chambers.

2. Which of the following statement(s) are true about reverberation chambers?

(a) Reverberation chambers can be used to simulate handover.

(b) The rich scattering environment inside the reverberation chamber makes it suitable to simulate keyhole channels

(c) The reverberation chamber provides rich scattering environment that is repeatable as well as isolated from outside interference that may affect the measurements

(d) The reverberation chamber can be used to measure TRP (Total Radiated Power) and TIS (Total Isotropic Sensitivity)

3. Which of the following are active types of measurements that are automated using Bluetest Flow?

(a) Total Radiated Power.

(b) Antenna diversity.

(c) MIMO capacity

(d) Total Isotropic Sensitivity.

1.23 C9 – "Wireless Security"

1. In wireless security, why WPA3 is much better than the previous standards?
   (a) It offers a more robust password-based authentication, even when users choose weak passwords.
   (b) DiffieHellman will be used for each station.
   (c) It offers an optional 192-bit maximum-strength keys to better protect sensitive data
   (d) It offers forward secrecy, by protecting data traffic even if a password is compromised

2. What are the main features of WPA2?
   (a) Radius is used for authentication in Enterprise mode.
   (b) Uses 802.1x, TKIP, MIC.
   (c) Hash is 4096 iterations of HMAC-SHA-1.
   (d) Insecure due to RC4.

3. What is/are true about integrity check in WEP?
   (a) It is impossible to know or guess IP addresses.
   (b) WEP should have used a non-linear checksum.
   (c) It is possible to alter the content and change the checksum so that they can match.
   (d) Encryption goes end to end.

4. Apart from CIA, which of the following security attributes do some standards and publications add?
   (a) Privacy
   (b) Accountability and Traceability
   (c) Authenticity (or Non-repudiation)
   (d) All of the choices.

5. What is true about 802.11i?
   (a) The temporal key is never changed
   (b) Each packet has a unique sequence number
   (c) 256-bit Pre-shared keys are used in home environments
   (d) 802.11i is used in WPA

6. What does the letters in the acronym CIA stand for in wireless security?
   (a) C stands for Consistency.
   (b) C stands for Confidentiality.
   (c) I stands for Integrity.

(d) A stands for Authenticity.

7. Which of the following statements is/are incorrect?
   (a) WEP uses shared key authentication
   (b) If hash function is used, when one bit in plaintext is modified, we know exactly what bits to change directly.
   (c) In WEP, APs use MD5 to generate a key from a user's password
   (d) WPA2 requires one table per SSID name

8. Which of the following is(are) the major security flaw(s) in WEP?
   (a) No unique session key.
   (b) CRC allows modification.
   (c) Flaws in MIC (message integrity check).
   (d) IVs are reused.

9. Which of the following is/are true about issues in WEP?
   (a) Devices that start sessions with IV of incremental sequence (e.g. 0, 1, 2...) is prone to IV duplication.
   (b) The use of CRC enables modification in the checksum to match input even if it is encrypted.
   (c) The XOR operation will secure the messages if two plaintexts are encrypted with the same stream.
   (d) The short IV space is vulnerable to collision.

10. Which of the following is/are steps of shared key authentication (WEP)?
   (a) Client sends authentication request to AP
   (b) AP sends frame with 128-byte challenge text to client
   (c) Challenge is encrypted with RC4 using a shared secret and a newly selected IV by the client
   (d) AP decrypts response and verifies it

11. Which of the following 802.11 standards have rates that goes above 100 Mbps?
   (a) Wi-Fi: 802.11n
   (b) Wi-Fi: 802.11b
   (c) Wi-Fi: 802.11ac
   (d) Wi-Fi: 802.11g

12. Which of the following is/are true about security in GSM?
   (a) GSM ensure the identity of the holder thanks to the SIM card

(b) GSM encrypt the communication for confidentiality

(c) The security of GSM was based on the confidentiality of its design.

(d) GSM is still a secure network today.

13. According to IEEE 802.11 standard, which of the following is/are the main security requirements?

(a) Protection against unauthorized packet/data modification, removal, forgery, ...

(b) Provisioning of availability, so that the system is able to serve its authorized users.

(c) Protection against eavesdropping.

(d) All of the above.

14. What is true about security according to Tomas Olovsson?

(a) The availability aspect of security refers to if the system is able to serve its authorized users or not.

(b) Integrity means that the protocol can protect against eavesdroppers.

(c) When designing a system the CIA is the standard to use, while the other attributes like maintainability, accountability, traceability and so on is not too important.

(d) The accountability and traceability aspect is important when an eavesdropper resends an old message from a third party.

15. Which of the following statements is/are true regarding wireless security?

(a) Most WLAN systems are encrypted today but not all use the best standards.

(b) Using Hash instead of CRC is better since the avalanche effect makes it not easy to know what has been changed.

(c) Good examples of AP names are: WLAN, eduroam and AndriodAP, since there are dictionaries developed for them.

(d) A good security system makes it hard to impersonate and eavesdrop on communication between users.

16. Which of the following statements is/are true about 802.11 sub-standards?

(a) The most popular 802.11 sub-standard today is 802.11ac appeared in 2009.

(b) 802.11n utilizes multiple antennas for simultaneous data stream transmission.

(c) 802.11ax has been adopted by most new equipment.

(d) 802.11a is very old and rare in Sweden.

17. Which of the following is/are correct about Wired Equivalent Privacy?

(a) In WEP, the key is only known by user own and it is unique for different device.

(b) WEP uses CRC to check which and whether the bits are modified.

(c) CRC with stream cipher can be modified. This feature is one of the weakness in WEP.

(d) The same as WEP, the linear CRC is also implemented in TKIP.

1.24 Article #17a & #17b – "Mobile Positioning"& "5G mmWave Positioning for Vehicular Networks"

1. Which of the following statements is(are) true?
   (a) Angel of arrival based positioning relies on directional measurements
   (b) Time of arrival based positioning relies on time synchronization.
   (c) Typical position measurements include momentum and acceleration measurements.
   (d) The variance of uncertainty in the Okumura-Hata model is chosen depending on the environment in which the mobile device is.

2. Which of the following statement(s) is(are) true about Network centric positioning techniques?
   (a) In network centric positioning the position of the mobile device is provided to it by the network
   (b) Network centric positioning uses motion models to enhance positioning accuracy.
   (c) Cell-identification is a network centric positioning mechanism.
   (d) In network centric positioning the calculation of the position happens at mobile device.

3. Which of the following statement(s) is(are) true about TOA and TDOA positioning methods?
   (a) They are exactly the same, it is just that researchers from US called it TDOA while researchers from Europe called in TOA.
   (b) TOA takes time difference of two TDOA measurements to avoid clock bias.
   (c) TDOA accuracy is determined solely by synchronization accuracy while for TOA accuracy is independent of synchronization accuracy
   (d) TDOA takes time difference of two TOA measurements to avoid clock bias.

4. Which of the following is(are) used as a reference point for mobile centric positioning technique?
   (a) Position of satellites
   (b) Royal observatory at Greenwich, London
   (c) Centre of earth
   (d) Position Radio base stations

5. Which of the following statements is(are) true?
   (a) Positioning measurement accuracy is measured using Shannon-information matrix.
   (b) The positioning problem always boils down to solving linear equations using matrices.
   (c) Monte-carlo gradient algorithms are used to solve dynamic positioning problem.
   (d) None of the other options are true.

6. What is(are) the challenge(s) related to positioning in GPS receiver equipped mobile devices?

(a) GPS is not supported well in urban and indoor scenarios

(b) Mobile device requires to communicate with the GPS satellite which takes a lot of energy.

(c) GPS fails in outdoors

(d) There are no challenges, the device will position accurately everywhere and always.

7. What does a digital map used in positioning contain?

(a) RSS measurements (predicted or provided from dedicated measurement scans)

(b) TOA measurements (from satellites)

(c) AoA measurements (from base stations or from satellites)

(d) Information from Google maps

1.25 C10 – "Testing of Wireless Devices –the Past, the Present, and the Future"

1. Which of the following tests in transmitter conformance is/are suitable for the reverberation chamber (RC)?

(a) Total gain and EIRP

(b) Adjacent Channel Leakage Ratio (ACLR)

(c) Spurious emission

(d) Total power (TRP)

2. Which of the following is/are properties of a channel model?

(a) The angle of departure for each RF path.

(b) The throughput.

(c) The delay spread.

(d) The Angle of arrival.

3. Which statement(s) is/are true about farfield patterns?

(a) Small antennas have a long farfield distance.

(b) The farfield distance depends on the antenna size and the wavelength.

(c) The radiation pattern doesn't change with increasing distance at long distances.

(d) Large antennas have a short farfield.

4. Which of the following is/are true about farfield measurement ranges?

(a) Vector Network Analyzer often used as validation instrument

(b) A planar wave is created by simply placing DUT far from measurement antenna

(c) DUT antenna is rotated to sample pattern in different directions of sphere

(d) For wireless devices mainly performed in an reverberation chamber

5. What is true about farfield patterns?

(a) The farfield distance depends both on the size of the antenna and the wavelength

(b) Small antennas have a long farfield distance

(c) Large antennas have a short farfield distance

(d) The radiated pattern of an antenna has a shape that never change with increasing distance

6. What are the requirements that need to be checked when performing tests?

(a) Marketing requirements, to see if it can sell.

(b) Costumer requirements, which are set by the operator companies or civilians.

(c) Conformance requirements, to see if the product is safe and legal.

(d) Internal product requirements, to meet the design specifications.

7. Which of the following is/are small antennas for short farfield distance?

(a) Dipoles

(b) Patch antennas

(c) Cell phone antennas

(d) Base station antennas

8. Which of the following statements is(are) true?

(a) The reverberation chamber have higher uncertainty at lower frequencies.

(b) VNA measures cable loss and chamber loss.

(c) The characteristics of the reference antenna is unknown, so a lot of samples are needed for characterization.

(d) The standard deviation for the mean received power is $1/\sqrt{N_{\text{indep}}}$, where N_{indep} is the number of sampled independent field distributions.

9. Which of the following is/are true about channel models?

(a) Velocity of device is the major factor of delay spread

(b) The UMi usually has higher base station antenna correlation than UMa

(c) Angles of departure/arrival of all RF paths are the same at a given location in real life

(d) Channel emulator adds many characteristics to help recreating different channel scenarios

10. Which of the following is true about the isotropic field environment?
    (a) Any angle of arrival equally probable
    (b) Any polarization equally probable
    (c) Average power equal in each direction and polarization
    (d) All of the above

11. Which of the following is/are true from the "Testing of Wireless Device" lecture?
    (a) Frequency bands below 6 GHz provides good coverage.
    (b) Dual connectivity is needed to provide connection stability.
    (c) Frequency bands above 6 GHz provides both good coverage and good capacity.
    (d) None of the above.

12. Which of the following is/are true about the reverberation chamber?
    (a) The reverberation chamber creates scattering environment
    (b) The average transmission level in a reverberation chamber is proportional to the total radiated power.
    (c) Each independent field sample creates an isotropic field environment.
    (d) Rayleigh faded signals transmission is one of the useful properties of the reverberation chamber.

13. Which of the following statements is/are false about the reverberation chamber?
    (a) Reverberation chamber creates scattering environment.
    (b) Transmission samples in chamber are Rayleigh distributed.
    (c) The simulation in reverberation chamber is a multipath fading simulation.
    (d) None of the choices.

14. Which of the following is/are true when testing wireless devices?
    (a) A good testing environment can be e.g. a domestic house in the city, so that the equipment can be tested in real life environment.
    (b) Testing is performed to make sure that internal product, conformance and customer requirements, are fulfilled.
    (c) Conducted and Over the air testing are both equally good testing schemes and measure the same performance.
    (d) Reverberation chambers have been looked the same since they were first invented in the 1960's.

15. Which of the following is/are the reason(s) to test wireless devices?
    (a) To fulfill internal product requirements

(b) To fulfill conformance requirements

(c) To fulfill customer requirements

(d) None of the above.

16. Which of the following is/are correct about test results?

(a) The test in the lab has an ideal environment, therefore, the result will be better than that in a real life environment.

(b) If we do the same test in another place, different results are what we desired.

(c) Instead of taking the best result, the data that can represent most of the experimental results is what we want.

(d) All of above.

17. What is/are true about the properties of the reverberation chamber?

(a) With the reverberation chamber you can simulate multipath fading.

(b) With the isotropic field environment from the reverberation chamber we can extract things like total radiation power and reflection coefficient.

(c) The average transmission level in the chamber is proportional to only the total radiated power.

(d) A reverberation chamber creates a scattering environment.

1.26 C10' – "Presentation skills"

1. Which of the following is/are the criteria for an excellent presentation?

(a) Excellent eye contact and openness to the audience

(b) Professional, well-prepared and excellent command of content

(c) Use visual aids to clearly illustrate and reinforce content

(d) Brief introduction and conclusion

2. Which of the following is/are necessary item(s) to know before you start creating a presentation?

(a) The audience.

(b) The style.

(c) The time limit.

(d) The purpose.

3. What is/are true when doing presentations as a group?

(a) It is not necessary to define the tasks clearly. In the end everything can be merged together.

(b) All team members should know the plan.

(c) Everyone should introduce himself.

(d) The final speaker will conclude the entire presentation.

4. Which of the following is/are true about working in groups?
   (a) Make sure that at lest one of your team members know the plan
   (b) Each group member should have clearly defined tasks
   (c) Aim for each person to speak for similar spans of time
   (d) The first speaker should introduce only himself
5. Which of the following are presentation building blocks?
   (a) Opening
   (b) Background
   (c) Main Body
   (d) Quiz
6. What should be included in the building blocks of a presentation?
   (a) You should make it clear for the listeners what they need to know in order to understand your talk in the opening block.
   (b) You should clearly state in the end when you are finished either via a slide or say that "I'm done", in order to not make the audience uncertain when you are actually finished.
   (c) The main body of the presentation may be divided into many subsections, if so then these must be linked together clearly.
   (d) The opening should always start with your introduction about yourself and the title of the project.
7. Which of the following statements is/are incorrect?
   (a) Different contexts require different presentations
   (b) Considering audiences is not important
   (c) One of the things that you need to know before you start creating your presentation is the subject
   (d) One of the things that you need to know before you start creating your presentation is the purpose
8. Which of the following statements is(are) true regarding presenting in an online setting?
   (a) It is not recommended for gourp members to present back and forth, e.g. present each slide individually.
   (b) Vocal inflection is especially important.
   (c) Transition words are less important than in-person presentations.

(d) Eye contact still matters, so look at the camera when presenting.

9. Which of the following is/are true about the rhetorical foundations of a presentation?

(a) A good presentation has a goal it aims to achieve

(b) Adapt your presentation to the context

(c) The "Kairos" is related to the style of presentation

(d) It is important to know what your audience expect

10. Which of the following is/are important to keep in mind when doing a virtual presentation?

(a) Just reading your notes will be enough for a good presentation

(b) Instead of writing out every word, use notes that only have the main keywords (and possibly a few phrases you want to remember)

(c) Transition words to show how ideas/slides connect are even more important than in-person presentations

(d) Simply read each bullet point on each slide

11. Which of the following is/are true about the "Presentation skills" lecture?

(a) Ethos, Pathos and Logos are rhetorical appeals that are good to use.

(b) Logos is associated with "establishing the speaker"

(c) Pathos is associated with "appeal to reason".

(d) Choices with visuals can play a huge role in your presentation

12. Which of the following is/are good reason(s) to use visuals in your presentation?

(a) Fill your slide.

(b) To introduce yourself and topic

(c) To creates interest.

(d) To remind audience of points.

13. Which of the following is/are true about presentation visuals?

(a) A combination of verbal and visual presentation of your project is more likely to be remembered by an audience for a longer period of time.

(b) The more visuals you have for each minute of your speech, the better your presentation will be comprehended by an audience.

(c) When making a presentation it's better to include a title for every slide to help audience understand the purpose of your visuals.

(d) It is much easier to read the text in uppercase letters.

14. What is true about visuals?

(a) When using visuals in a presentation, studies show that the audience remembers the content longer.

(b) All visuals are good.

(c) People learn from hearing best and the second most effective is seeing.

(d) It's generally a bad idea to use color or shapes in a presentation.

15. What is/are true regarding presentation visuals and techniques?

(a) It is always good to illustrate things by using diagrams, colours and tables. The more the better.

(b) Signposting guides the listener through the talk and helps them relate and understand different parts of the speech.

(c) When audiences view visuals, they may have difficulty focusing on what you are saying. It is important to think of how you talk.

(d) It is good to let your audience know you are done by saying "I am done".

16. Which of the following is/are necessary items in a presentation?

(a) Subject

(b) Purpose

(c) Organization

(d) None of the above.

17. Which of the following is/are correct about presentation delivery techniques?

(a) Using the contractions such as "can't" and "I'll" will be regarded as informality.

(b) Repeat the previous information to start a new section is one of the recommended way in signposting

(c) Notes within Powerpoint will help the lecturer in virtual presentations.

(d) None of the above.

1.27 C11 – "Basics of Positioning in Wireless Networks"

1. What are the advantage(s) of using high-band frequencies for positioning?

(a) The possibility of having resolution of approximately 1 metre

(b) TDOA, AOA, and AOD measurements are possible with even 1 base station slid 43

(c) The multipath can be better resolved

(d) They are very efficient for high mobility scenarios very bad for traking

2. Which of the following statements is/are correct when comparing 5G positioning with automotive radar?

(a) Automotive radar uses full-band ADCs.

(b) 5G is mainly used for communication. slid 53

(c) 5G uses uncoordinated transmission.

(d) Automotive radar is mainly used for communication.

3. Which of the following is/are the right steps for TDOA protocol?

(a) Agent transmits at known time t_0

(b) Anchor i receives at time $t_i = t_0 + d_i/c$

(c) Collect information from all anchors to remove t_0

(d) None of the above

4. Which of the following statements is/are incorrect about 5G positioning?

(a) It uses carrier above 28 GHz.

(b) It uses very large bandwidth (0.5 - 4 GHz). Large bandwidth (100+ MHz), slid 53

(c) It uses Large antenna arrays (100+).

(d) It uses coordinated transmission.

5. Which of the following statements is(are) true regarding UWB tracking/positioning? slid 39

(a) When tracking each position is iteratively computed with information from the previous position and the new measurements.

(b) Process models describe how the user is moving.

(c) Process models describe how the measurement relate to the position at time t.

(d) The maximum likelihood estimator takes the uncertainty of the measurement into consideration.

6. Which of the following is/are true about UWB ranging?

(a) The relative permittivity of materials causes positive bias to the received signal. slid 22

(b) TDOA requires only one anchor to work. wrong 3 anchor slid 25

(c) TTW-TOA requires synchronization between agent and anchor. no synchronization requierment

(d) TDOA is faster than TTW-TOA.

7. Which of the following is/are true about high carrier frequencies in 5G?

(a) No diffraction, limited scattering and little reflection compared to lower carrier frequencies

(b) Communication channel is dominated by LOS and a few location-dependent clusters slid 46

(c) The received power depends on path loss, shadowing and multipath fading

(d) Low penetration loss compared to lower carrier frequencies

8. Which of the following is/are true from the "Basics of Positioning in Wireless Networks" lecture?

(a) Location information needs high resolution in delay or angle. slid 54

(b) 5G exploits good delay resolution, but not good angle resolution.

(c) For 5G positioning, we need large antenna arrays (100+).

(d) None of the above.

9. What is/are true about ultra wideband (UWB)?

(a) UWB has the challenges of synchronization and equalization while receiving signal. slid 16

(b) It has a bandwidth of less than 500 MHz. greter than slid 12

(c) In the lecture there were three localization algorithm classes mentioned. two localization algorithm

(d) USA have had spectrum allocated for UWB since 2002. slid 12

10. What is/are true regarding Henk Wymeersch's lecture about localization?

(a) Depending on the obstacle, the bias/mean for calculating the propagation performance differs.

(b) Radio-based positioning has increased in accuracy with every generation of wireless mobile telecommunications technology.

(c) Devices need to know its distance from at lest three satellites to now its position.

(d) TDOA and TW-TOA require the same kind of synchronization.

11. Which of the following is/are the selling point for 5G SLAM?

(a) High carrier frequencies

(b) Shaping the environment slid 45

(c) D2D communication

(d) Large number of antennas

12. Which of the following is/are true about UWB?

(a) In the non-LOS propagation, the SNR is reduced compared to the same environment but with LOS propagation.

(b) Compare to TDOA, TW-TOA requires near real-time latency.

(c) To approach UWB tracking, the procedures are: predict, correct and update.

(d) Point estimators can be used in UWB positioning, and it is appropriate for mobile agents.

1.28 Review Questions from the Final Reports

5G network slicing: applications and benefits within industry:

1. Give two main functions/requirements of a virtual network in 5G network slicing.

2. Explain in your own words what a network slice is.

3. What are the main benefits of network slicing and why?

4. Within the automotive sector many areas benefit from network slicing. Give some examples and explain why.

5. AR/VR requests high capacity networks to achieve high density computing. What are the main technologies to realize this feature?

5G New Radio: Next Generation Radio Access Network:

6. Re-farming of 4G LTE bands, in order to improve the coverage of 5G NR is not considered as a good solution. Please briefly explain why.

7. Give two key categories of services that 5G NR supports and briefly explain them.

Energy efficiency and sustainability solutions for mobile networks:

8. Give two technical solutions and explain in your own words why they make mobile networks more energy efficient or energy sustainable.

Localisation strategies in ultra-dense networks:

9. Briefly describe one location information which could be used for improving the performance of a communication system.

Energy efficiency challenges in home capillary M2M networks:

10. Name two approaches and briefly describe how they can improve the energy efficiency of a M2M network mentioned in the report "Energy efficiency challenges in home capillary M2M networks".

Future challenges with Massive MIMO, Reconfigurable Intelligent Surfaces and Teraherz Communication:

11. What is a key implementation challenge with reconfigurable intelligent surfaces (RIS)?

High Altitude Platform Concepts andImplementations:

12. Mention at least one advantage and one disadvantage of High Altitude Platforms (HAPs) in comparison with terrestrial systems, and briefly explain them.

13. Explain the advantages and disadvantages of High Altitude Platforms (HAPs) in comparison with the satellite system.

C-V2X Assisted Automated Driving:

14. How is an individual user equipment (UE) able to know that resources are occupied or available in PC5?

15. In regard to what aspect is PC5 better than DSRC?