M-134 Προηγμένες Δικτυακές Τεχνολογίες – 2024

Review Questions

A. Ad-Hoc Routing Scalability

1. Why ad hoc nets? Advantages
2. Flat vs cluster-based/hierarchical topologies
3. Single- vs multi-hop transmissions. Pros and cons.
4. Energy consumption and savings approaches for mobile nodes.
5. Connectivity vs capacity tradeoff through power control (transmission range). Explain, understand, justify.
6. MANET vs DTN: basic difference?
7. Proactive vs reactive routing approaches: basic operation/characteristics, advantages, disadvantages. Understand under which conditions / environments you would select one or the other approach.
8. Why Hybrid routing schemes? How is ZRP implementing both philosophies?
9. Control overhead: definition and description in proactive and reactive routing protocols
10. Understand suboptimal routing overhead. How it appears.
11. Understand tradeoff between reactive/proactive overhead and suboptimal routing overhead.
12. Understand the Achievable Region of routing protocols. Why convex, how it changes as key network parameters change (increase) and how it can be seen that hybrid routing protocols are to be preferred to sought scalability under critical network parameter increases. (power of 2 vs less than 2 region displacement).
13. Understand the concept/metric of "minimum traffic load" (MTL) experienced by a specific network.
14. Understand the concept/metric of "Network Rate" (NR) and think of a way (i.e., change in some network parameter) it could increase/decrease.
15. Get to know the definition of network's scalability, especially by relating MTL and NR.
16. Prove why our networks (under assumptions a.1-a.8) are not scalable with respect to (wrt) N (network size), exploiting results from the paper by Gupta and Kumar.
17. Which kind of networks scale wrt network size. Exploit basic/intuitive result from the paper of Groossglauser and Tse.
18. Explain why fully connected networks are scalable wrt network size.
19. Show that our networks (under assumptions a.1-a.8) – which have scalability factors 0, 1, 1.5 wrt mobility, traffic load and size, respectively- are scalable wrt mobility but not wrt traffic load.
20. Explain/show that ad hoc networks are not scalable wrt transmission range.
21. Routing protocol scalability by comparing total routing protocol overhead and MTL, or comparing the routing protocol and network scalability factors.
22. Understand how key/critical network parameters can be depended.

23. Read the 8 assumptions made for our networks (under assumptions a.1-a.8). Especially, (a) understand the linear/square dependence appearing in assumptions 3 and 4, (b) understand how traffic destination assumptions can point to the best protocol to use, and (c) understand the resulting displacement for a mobile user under a random mobility model vs the correlated movement model shown under assumption 8.
24. Learn how to calculate the asymptotic results for the overheads (proactive, reactive, suboptimal routing) as done for the protocols: Plain flooding, Standard Link State, Dynamic Source Routing (DSR) without route cache.
25. Give an insightful explanation as to why hierarchies can yield scalability wrt size?
26. Understand how the virtual abstraction node approach builds hierarchies.
27. Explain how these hierarchies can simplify routing in large size networks.
28. Understand how Location Management 2 works.
29. Basic ways to limit the BW consumption: efficient flooding, limiting info generation rate and depth of info propagation. Various ways to do the previous.
30. Explain why nodes do not need necessarily to learn about a remote link change in order to make a correct next-hop routing decision.
31. Fussy Sighted Link State (FSLS) algorithms: basic design philosophy for reducing total overhead – key idea.
32. Basic algorithmic description of FSLS and understanding a plot showing the depth of propagation of a link state (S) over discrete-time.
33. Understand what is the maximum refreshing time of a node located at a certain distance away from the link change. Special cases for near Discretized Link State (DLS) and Sighted Link State (NSLS)
34. Understand how the operation of Fisheye and DREAM protocols relates to FSLS.
35. How is Hazy Sighted Link State (HSLS) defined?
36. Explain what we mean by "fixed angular uncertainly" and why this is important in hop-by-hop routing. Notice that this a property of the Hazy Sighted Link State (HSLS).
37. From the various asymptotic scalability expressions shown, learn how to read them and be in a position to compare relative behaviors of protocols wrt certain network parameters.
38. Understand the comparative behavior of Hierarchical Link State (HierLS) and HSLS, wrt complexity and performance wrt network parameters.

B - Resource Competition in a Highly Networked World of Humans and Things

1. Under what conditions can a Non-Assisted Parking Search (NAPS) be worse than an Opportunistically-Assisted Parking Search (OAPS) one? Explain why this can happen and why this is a case of "Less is More".
2. Describe a case of competition in a classical communication system for a common resource by a number of uncoordinated (non-communicating) distributed users.
3. Familiarize yourselves with the key parameters β, γ, δ. Understand what they capture.
4. Understand the plots showing the cost of competing when the total number of competitors is k; See the impact of the key parameters.
5. Understand the assumption on what information is available under the strategic game formulation.

6. Understand the Nash Equilibrium (NE) of a strategic game. What is the key condition met at NE and how it is used to determine it (as a principle)?
7. Become familiar with the threshold $N_0 = R(\gamma-1)/\delta$ and its relation to the NE.
8. What is the Price of Anarchy (PoA)? Distinguish between the optimal social cost and the cost under NE. Understand the plot – example showing a price paid for lack of coordination equal to 500 and a PoA value of 1.11. Think of how β and δ might affect the PoA.
9. Why do we consider a mixed-action game in lieu of a pure-action game? What is the symmetric mixed action NE for our competition game?
10. What are the assumptions (number of competitors) made under the Bayesian model of the resource competition game? What is for the pre-Bayesian.
11. How is the symmetric mixed-action safety-level equilibrium defined (under an upper bound of players equal to N) and how is it related to the symmetric mixed-action equilibrium game involving N players.
12. Explain how "less-is-more" phenomena can arise under strictly incomplete (upper bound on N) information, by exploiting the plots of social cost vs competing probability and the plot of competing probability vs N.
13. Does the Nash EQ maximize the expected utility of a player under a given decision of the other players, or it maximizes the Expected utility over all players?
14. Understand Allais' paradox: people's choices do not necessarily maximize their expected utilities as full rationality (Expected Utility Theory) would indicate.
15. Understand the four-fold pattern of risk attitude: risk seeking or aversion for extreme-value probabilities (low or high) for the outcomes.
16. Basic idea behind the framework of Prospect Theory and Cumulative Prospect Theory.
17. Understand the concepts of "diminishing sensitivity" and "loss aversion".
18. How is an equilibrium state defined under the Cumulative Prospect Theory?
19. Apply the CPT approach to find the CPT equilibrium for our competition problem and learn how to plot and read a CPT value vs competing probability plot.
20. Alternative human-driven (binary) decision models - Quantal Response and Rosenthal: rational, definition, rationality parameter (interpretation) and equilibrium probabilities (how are they derived).
21. Comparison of goodness of decisions under the alternative models and under fully rational behavior.
22. Heuristics: rational, confidence heuristic.

C - Coordinated Resource Allocation through Auction-based Systems

1. If the bids in an auction-based system allocating resources to competitors are in the range of (min, max), where min is the price under successfully acquiring a limited resource and max is the price paid for an always available alternative resource in the symmetric mixed-action competition game (uncoordinated case), then will the players always pay on the average a higher price under resource auctioning? Justify the answer.

D - Coordinated Resource Allocation through Social Applications

1. Describe how would you assess the quality of an ICT-based social application for the decentralized allocation of common resources, assuming that only a portion of the potential users would subscribe to the application? Discuss issues and quantities to consider.

E – Delay Tolerant Networks

1. Κατανοήστε την δυνατότητα κλιμάκωσης τους ως προς τον αριθμό των κόμβων. Θεωρητική και διαισθητική εξήγηση.
2. Routing / forwarding: Utility-based versus flooding versus randomized versus hybrid.
3. 2-hop relaying and optimal Spray and Wait. Πλεονεκτήματα / μειονεκτήματα.
4. Κατανοήστε πως maximum-copy cdf και zero-spreadtime cdf φράσουν την απόδοση του 2-hop relaying και πως μπορεί να συνθέσουν μία προσεγγιστική καμπύλη της cdf.

F - Distributed and Scalable Content/Service Placement

1. Κατανοήστε τα κοινά χαρακτηριστικά των 3 προσεγγίσεων για την επίλυση του Facility Location προβλήματος.
2. Κατανοήστε τα διαφορετικά χαρακτηριστικά των 3 προσεγγίσεων για την επίλυση του Facility Location προβλήματος.
3. Ορισμός betweeness centrality και conditional betweeness centrality.