

Assessment Rubric

Assignment (which architecture): traffic control system

To everyone: All groups did very well on the Traffic Control System assignment. We are very pleased with the questions you wrote.

All groups receive a rating of **Excellent**.

Congratulations!

We offer each group some feedback below. These are things for you to think about and learn from. You are not required to submit any response.

T21

One of your five questions is, “What level of redundancy or failover capability is required for the system?” This is an interesting question, but there are more important questions that precede it. First, we ask what would happen if the (new) system goes down. Then we ask if that behavior is all right. For example, the traffic light might have a default of changing every minute, and that could be the backup. Later, you will ask this question, but will also want to understand how much a redundant system costs. You can see with this question that some questions are quite involved, and may be parts of larger questions. And they may have sub-questions.

T22

One of your five questions is, “How should the systems communicate with each other?” First, what do you mean by “systems”? Are these the traffic control systems that we are going to develop, or does it include older legacy systems that the new systems might communicate with? Or is there a system that is a central control system, that all the new traffic controllers communicate with? The point is that the word “systems” in the question is unclear. We must be very clear with our terms when we write architecture documents. What may be obvious to you might not be obvious to others.

Consider also the word “How” in this question. “How” almost always is about implementation. This question is implementation. It doesn’t mean that the question isn’t important, but it does indicate that the question is firmly in the solution space. That is good information to know. Also, “how” questions generally will be answered later in development, not during early analysis.

T23

One of the five questions is, “What are the constraints and regulations we need to consider when optimizing traffic flow?” This is an interesting question, and is certainly important; I would consider it a candidate for the top five. But it is tricky. For example, some regulations such as speed limits might be independent of the traffic signal. We might not care what the speed limit is. On the other hand, emergency vehicle handling must be handled in the architecture – somehow. It might push you towards a particular architecture pattern, “Event-Driven System”.

T24

One of your five questions is, “What are the data privacy and security measures for the collected traffic data?” Then you point out that the system will likely handle large amounts of data. Really? While it is true that if you use machine learning to define the behavior of the traffic signals, that machine learning will happen elsewhere, not on the traffic signals themselves. I do not see much data transmitted from one signal to another. The main threat to the signals will be to either disable them or to take over control. So the key question to ask first is how such attacks could occur. During early architecture, one might consider whether to use dedicated hardware communication links. But there is an even more important question that comes first: “Is it necessary for a traffic signal to communicate with other traffic signals, and/or with a central server? If so, why?” Then ask about communication security.

Looking forward, though, one might consider whether traffic signals will communicate with cars. For example, it could communicate with autonomous vehicles and command them to stop. If so, security becomes much more interesting, and important. But there are many questions to answer before a question about autonomous cars and security becomes important.

T25

One of the five questions is, “What data and what data types are we dealing with?” While it is necessary to understand the data a system deals with, this system is clearly a control system; its main focus is not data processing. Traffic signal controls are unlikely to need data management as sophisticated as a database. If there is a central server that collects data from all the traffic signals, it will have a database, but we do not know if a central server is even required. So before going to this question, we should understand the functions of the desired system. Then we can decide whether we even need anything beyond very simple data storage.

It is natural to consider a new system in terms of the architectures of other systems we are familiar with. But that might not be the appropriate architecture, as we saw from the in-class exercise. Instead, it is useful to know several different architecture patterns, and we can use the patterns that fit best. We will begin learning about architecture patterns next week.

T31

One of the five questions is, “Are there any plans for future expansion or integration with emerging technologies like connected vehicles or smart infrastructure?” This is a very pertinent question, and the answer could influence the architecture of the system in terms of maintainability, compatibility, portability, and security, at least. However, the answer seems to be obvious: a yes. If the answer is a no, how would that change the architecture and design of the solution? Shouldn’t we always design for the expected and unexpected future? How to balance effort, overengineering, simplicity, and timelessness? These are a few points to consider.

T32

One of the five questions is, "What metrics will we use to define 'optimized traffic flow'? (e.g., minimize wait times, maximize throughput, prioritize specific vehicle types)" While a traffic control system uses data and optimization strategies to tune the flow, possible one or many, the overall system structure should be able accommodate different sources of data, different criteria, different strategies, in a specific time, local, or situation. This said, this question seems important to answer in part early, so that the data acquisition mechanisms can be ensured to exhibit the expected qualities (security, reliability, etc.); but at the same time, it can be answered very late, since it is only needed when implementing the optimization strategies, considering the necessary data is available somehow. Why is this? What type of concern is underlying this question? Is it a one-time question? Is it recurrent? Does it have an end?

T33

One of the five questions is, "How will emergency vehicles affect traffic signal prioritization?" This question addresses a very important feature of the system, maybe even a critical feature in some contexts (cities, occasions, etc.). This seems to be an easy feature, easy to add whenever decided, but the fact is that many non-functional requirements (timeliness, area impacted, reliability, etc.) associated with this feature may be affected and even blocked by previous architectural and design decisions. May you point some decisions to avoid to keep many scenarios open to implement this feature?

T34

One of the five questions is, "Is the traffic system for single intersections or should it work across multiple traffic lights?" I think this question has an obvious answer (multiple) but it makes sense to ask it anyway, to be sure of what we are talking about, as the impact of different answers can differ in many orders of magnitude. Do you have in mind something else that triggers the importance of having this question answered in a top 5? If yes, it would be good to detail more on those details.

T35

One of the five questions is, "How should the system address potential privacy issues related to data collection and processing?" This question seems to be related with a crosscutting concern, i.e., a concern that is scattered across all the system, which when addressed might need changes in many components, if not all. To have this concern explicit and detailed and "under watch" is important, to avoid surprises. Conformance to existing laws and rules will help to answer this right away, but there might be other details to be taken care of. By the way, this is a mandatory question in the current state of the IT industry.

T37

One of the five questions is, "Is the system going to integrate with existing traffic signals or can he design of the traffic signals themselves be changed?" This question is about the future, and we all know that "It's tough to make predictions, especially about the future." Therefore, to be prepared to cope with future unknowns, we should decide in a way that is future proof, at least in most concerning aspects of the system. The answer might be "maybe" or "who knows" or "yes". Which other possible answers do you foresee and why are they worthy to consider to better inform previous decisions? Would they constrain or relax more the architecture and design of the overall system?