**DISTRIBUTED SYSTEMS**

# Question 1a

Fundamentally RMI simplifies the construction of distributed systems due to the higher level of abstraction it provides, so the developer needs to consider less aspects of how the system works. In the most basic level a system based on RMI may not even need to concern itself with how the components are connected (e.g. which protocol is used). At the very most the developer only needs to instruct the RMI middleware which protocols to use but does not have to deal with the specific implementation. This is further extended to the transfer of data between components. When using sockets, we need to specify exactly what data we are transferring, as well as validating it on the receiving end. Again, a system based on RMI can abstract nearly all of this out, so that the developer only needs to handle when components disconnect or cause some sort of exception (which would normally result in disconnecting/restarting the component). While it may be possible to create a system based on socket programming fairly easily, handling errors/edge cases quickly makes the task much greater, even more so when dealing with multiple components that could fail at any time.

Systems based on RMI also simplify the construction by providing a registry. This provides a standardised way to connect/disconnect components, so that the developer does not have to concern themselves with the details. While they still must obtain the stubs to each object and handle when objects are disconnected or become available again, the registry greatly simplifies and streamlines the process.

Systems based on RMI could potentially vastly simplify cross language communication if the languages support it. This could allow one set of components that has already been written in one language to be seamlessly integrated with another language. However, in practice each implementation of RMI (e.g. Java RMI, Pyro) only works in their own language. This is a worthwhile trade-off though, since systems will normally be written in the same language. Furthermore, this allows RMI to operate without any limitations on what objects/data structures can be transferred across, allowing for complex serialisation to occur without any effort on the developer’s part.

# Question 1b

A front-end in a distributed system facilitates access transparency to data by hiding how each component is represented and accessed. Different replica components may use different data structures/models to store/transfer their data. The front end needs to be aware of these differences between components, but it can hide this from the client either by converting the data before giving it to the client, or by instructing the components to output data in specific formats. This goes the other way as well; the front end may need to convert the data received from the client or instruct the components to process the data in a specific way. In all scenarios the front end makes sure the client does not need to know the specifics of each replica. The way in which a component is accessed not just depends on the type/format of data, but also the underlying protocols. If components use different protocols, then the front end can facilitate transparency by handling the specific implementation for each component silently without the client’s knowledge.

If components are replicated to store data, then the front end can facilitate access to this by giving the appearance that the components are one single homogenous component. That way it doesn’t matter which components store the required data, if the front end can collate the full data set and give it to a client.

# Question 2

Front End

File Servers (1 – 3)

**File Server registers object with registry**

Delete

Download

List

Upload

Client retrieves front end stub from registry

**Front End registers object with registry**

Delete

Download

List

Upload

Front end retrieves file server stubs from registry

Client

Registry