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**FACULTY OF SCIENCE AND TECHNOLOGY**

**COURSEWORK FOR THE BSC (HONS) INFORMATION TECHNOLOGY; BSC (HONS) COMPUTER SCIENCE; YEAR 2**

**ACADEMIC SESSION 2017; SEMESTER 3**

**NET3204: Distributed System**

**Project DEADLINE: Week 12**

**INSTRUCTIONS TO CANDIDATES**

* This assignment will contribute 30% to your final grade.
* This is a Group assignment of 5 members.

**IMPORTANT**

The University requires students to adhere to submission deadlines for any form of assessment. Penalties are applied in relation to unauthorized late submission of work.

- Coursework submitted after the deadline but within 1 week will be accepted for a maximum mark of 40%.

- Work handed in following the extension of 1 week after the original deadline will be regarded as a non-submission and marked zero.

**Lecturer’s Remark** (Use additional sheet if required)

**15053648**

**Choong Kai Wern**

****

I.............................. (Name) ...................std. ID received the assignment and read the comments....................................... (Signature/date)

**19/11/17**

**Academic Honesty Acknowledgement**

**Choong Kai Wern**

****“I .........................................(student name). verify that this paper contains entirely my own work. I have not consulted with any outside person or materials other than what was specified (an interviewee, for example) in the assignment or the syllabus requirements. Further, I have not copied or inadvertently copied ideas, sentences, or paragraphs from another student. I realize the penalties *(refer to page 16, 5.5, Appendix 2, page 44 of the student handbook diploma and undergraduate programme)* for any kind of copying or collaboration on any assignment.”

**19/11/17**

….................................. (Student’s signature / Date)



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**15075153**

**Lim Shi Hern**



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**16080111**

**Mah Qi Hao**

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**13079272**

**Mu Chun Khang**

****

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**Ong Li Sheng**

**15071863**

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….................................. (Student’s signature / Date)

**DISTRIBUTED CHAT SYSTEM**

**NET 3204**

Distributed System

**Choong Kai Wern** (100%)

15053648

**Lim Shi Hern** (100%)

15075153

**Mah Qi Hao** (100%)

16080111

**Mu Chun Khang** (100%)

13079272

**Ong Li Sheng** (100%)

15071863

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# Introduction

The project involves the building of a distributed chat system called Mittere. The chat system allows users to send messages to each other, either in the form of personal messages or group messages. The novelty of Mittere lies in the utilisation of the peer-to-peer system architecture. Unlike applications that employ the client-server architecture, Mittere operates on the premise of intercommunicating nodes instead of a traditional server to handle all requests from clients. Herein, the chat system is comprised of nodes distributed across the same network that can freely communicate with one another, all managed by an assigned supernode. The supernode acts as the entry point for new nodes trying to join the system, introducing them to all existing nodes. In terms of technologies, the project employs Scala as the high-level programming language, ScalaFX as the user interface (UI) domain-specific language (DSL), and Akka as the concurrency and distributed framework.

# Physical and Interactive Models

## Physical Model

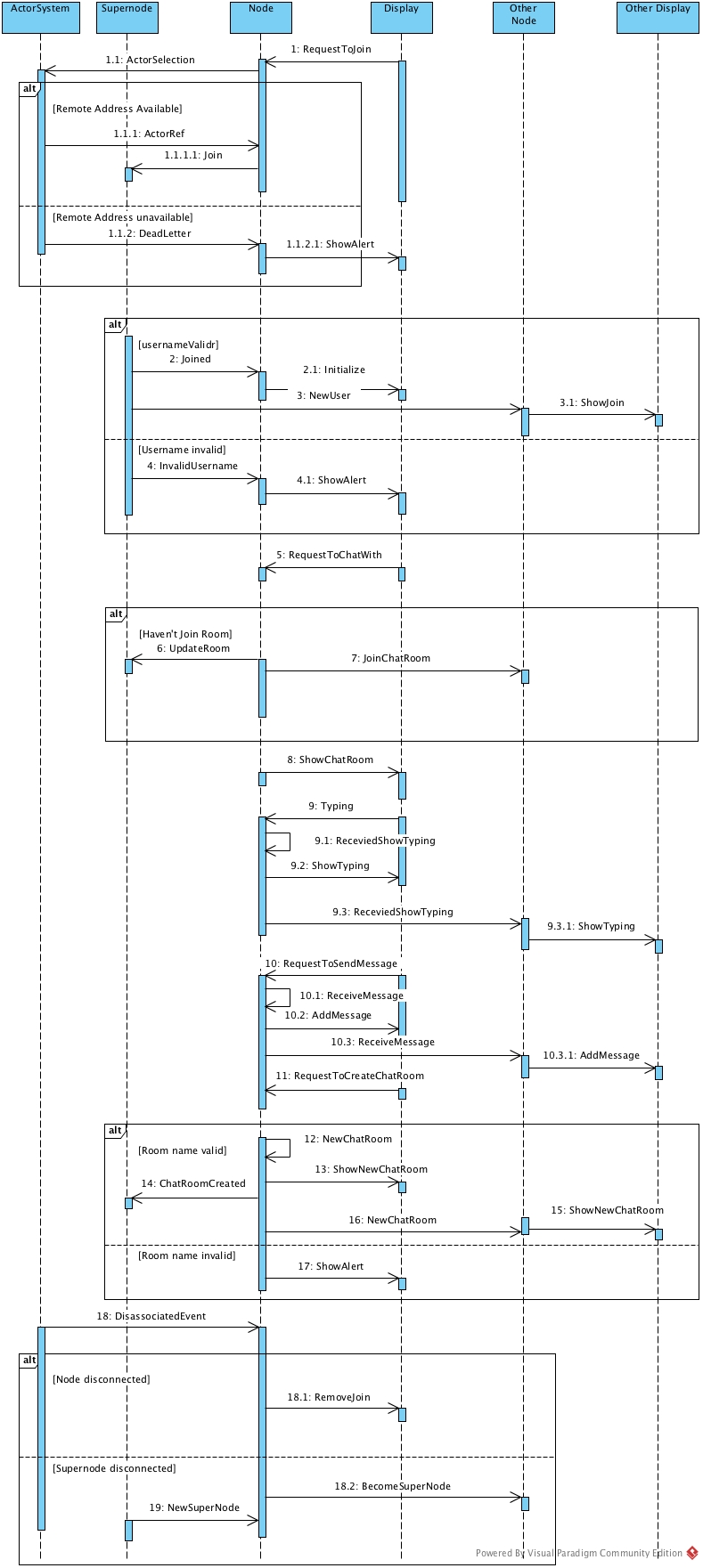
The physical model of Mittere is based on the peer-to-peer system architecture. Specifically, it comprises of a system of nodes where each node can directly communicate with other nodes. Among all the nodes in the system, there will always be one supernode. To start a chat system, a node must first join itself to become a supernode. Then, new nodes must join the supernode to be in the same system. Figure 1 shows the system architecture diagram.

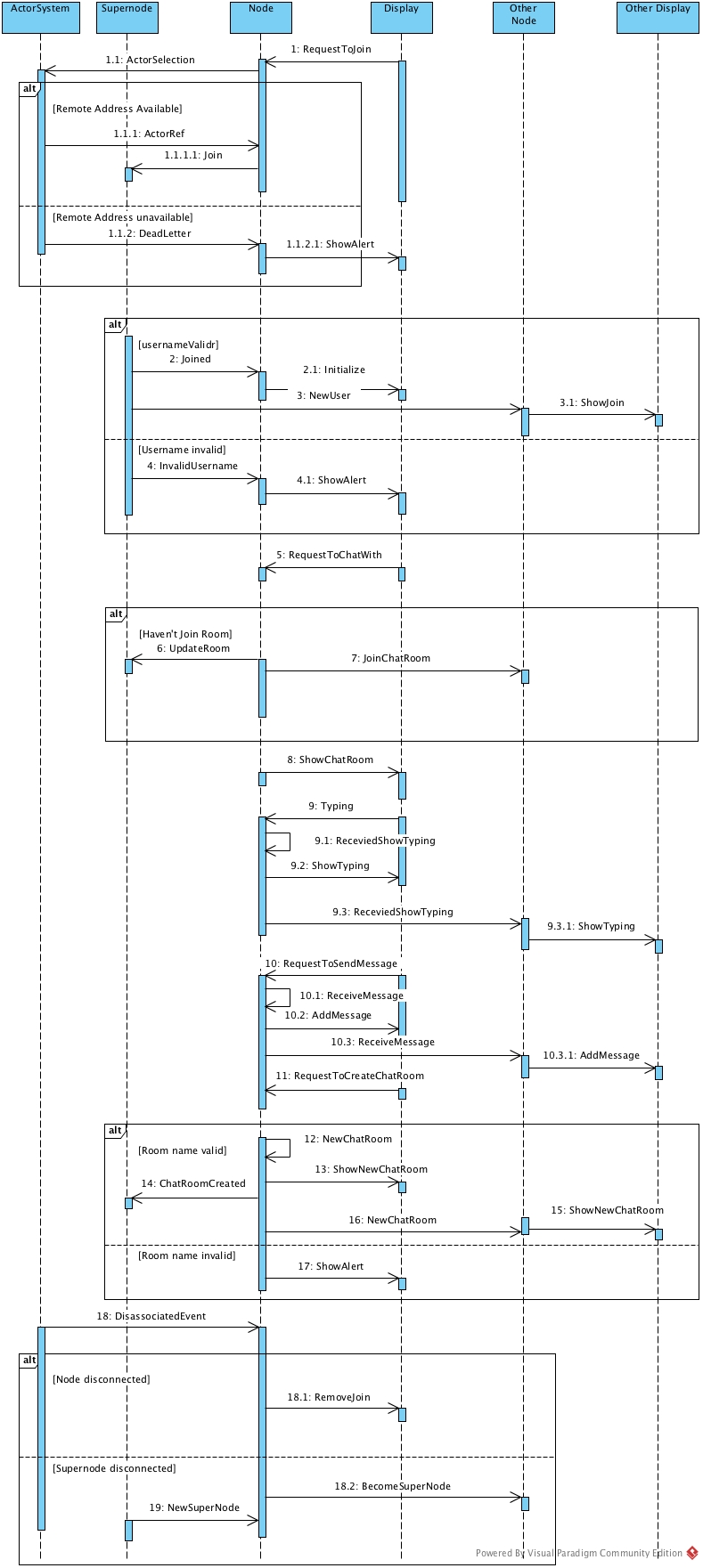
**parts/system_diagram.pdf**

**Figure 1**: System architecture diagram for Mittere

## Interactive Model

Mittere is comprised of four components, namely ActorSystem, Supernode, Node and Display. At this juncture, ActorSystem is responsible for handling the remote networking aspect of the system. It is subscribed to remote events such as DisassociatedEvent and DeadLetters to inform the node about the status of remote nodes. On the other hand, Supernode passes information regarding the chat system environment such as list of users and rooms. Meanwhile, Node handles all the core functionalities of the chat system which include keeping track of users, rooms and messages. Display is responsible for managing the graphical user interface (GUI) of the system. The interactive model of Mittere is based on an asynchronous distributed system. It has no assumed bounds on process execution speed, message transmission delay and clock drift rates. Figure 2 shows the communication protocol sequence diagram of Mittere. It should be noted that the diagram also shows how the nodes check to see whether they should be the new supernode when the current supernode disconnects or crashes.





**Figure 2**: Communication protocol sequence diagram for Mittere

# Scalability and Reliability

## Scalability

Scalability is important in a distributed system, especially a communication system with many users. A system is scalable if it remains effective with significant increases in resources and users. At this juncture, the peer-to-peer system architecture is adopted because it promotes scalability. In Mittere, each node is only concerned with fulfilling its own responsibilities of sending and receiving messages. In other words, a node will never handle a message that it does not intend to send or receive. Hence, the system can be scaled up to accommodate more nodes because no single node is responsible for everything. In Mittere, the nodes each need to store a local copy of all nodes in the system to communicate with one another. Nevertheless, storing the ActorRef for all other nodes only consumes a small amount of memory. For instance, if there are 100,000 users connected in the system, each node will store 100,000 references locally; this is no problem as the list still occupies little memory and can be iterated with ease. This means that the chat system can scale up with many users without significantly affecting the core functionalities.

## Reliability

On the other hand, reliability is also essential in distributed systems. In Mittere, there will always be a supernode assigned. Herein, the supernode oversees the handling new nodes that just joined the system. Specifically, it keeps track of all the available rooms and nodes in the system. When a new node enters the system through the supernode, its reference is broadcasted to all existing nodes in the system. The new node is also provided with the references to all other nodes in the system. To ensure reliability in this context, the supernode's role is passed on to another node in the system if the current supernode disconnects or crashes. Herein, the new supernode is always chosen based on alphabetical order. It will then broadcast itself to other nodes in the system to inform them. This way, a new node can always join the system even when the original supernode has disconnected or crashed. After joining the system, a node no longer relies on the supernode to communicate with other nodes. Since a node has a copy of all current nodes that will always be updated by the supernode, it can start chatting with other nodes without further assistance. Even if the supernode disconnects or crashes, the node can still communicate with the rest of the nodes.

# Test Case

Test case that you have proposed to test your distributed system and result of the test case

# Reflections

## Choong Kai Wern

Blab la bla

## Lim Shi Hern

Blab la bla

## Mah Qi Hao

Blab la bla

## Mu Chun Khang

Distributed system is defined as hardware or software components located at networked computers that communicate and coordinate their actions by passing messages. Herein, the system’s core functionalities are provided entirely through message passing. One of the most important distributed system concepts applied in the project is independent failures. Basically, each component of the system can fail independently without affecting the whole system. Besides that, failure handling is also another concept applied. Specifically, the system needs to be able to both detect and recover from failures.

In terms of how the distributed concepts are applied in the project, Mittere employs Akka, a framework that relies on the concept of actors and message passing to build a concurrent, distributed system. Meanwhile, independent failures are ensured since Mittere is composed of a system of independent nodes. Each node can disconnect or crash independently without affecting the other nodes in the chat system. On the other hand, failure handling is implemented with the notion of disassociation and supernodes. Herein, the Akka actor system will send the DisassociatedEvent message to all remaining nodes when a node fails. Nonetheless, the failed node can still rejoin the system by joining the supernode.

The implementation of Mittere was faced with several problems. Namely, I faced a huge problem when dealing with fault tolerance. During the initial implementation, whenever the host node disconnected, the remaining nodes could still communicate with each other because they still retain a local copy of node references each. However, no new nodes can join the system since the entry point is lost. To rectify this problem, I proposed the concept of supernode whereby one of the nodes in the system will always be the entry point. The supernode is responsible in getting new nodes up to date with the chat environment and informing existing nodes about the arrival of new nodes. Herein, when the supernode fails, all remaining nodes will be notified. Subsequently, they will reassign a new supernode among themselves by selecting the node with the smallest name alphabetically to ensure consistency. With that, the nodes will send a message to the new supernode to acknowledge it. Meanwhile, the new supernode will also send messages to the other nodes to inform them of its role.

Of course, Mittere has its strengths and weaknesses. One of the strengths of the chat system is heterogeneity. Mittere works equally on different operating systems due to the underlying Java Virtual Machine (JVM). Besides that, Mittere is also decentralised. This is because it employs a peer-to-peer system architecture whereby there is no single point of failure. On the other hand, one weakness of Mittere is the lack of data persistency. Since the messages received by each node are not stored in local databases or logs, chat history is effectively lost when the node disconnects or crashes before joining the same system again. Also, Mittere offers poor security. In this context, the chat messages are not encrypted in any way, and therefore can be easily intercepted and read by any malicious party.

|  |  |
| --- | --- |
| **Group Member** | **Contribution (%)** |
| Choong Kai Wern | 100 |
| Lim Shi Hern | 100 |
| Mah Qi Hao | 100 |
| Mu Chun Khang | 100 |
| Ong Li Sheng | 100 |

## Ong Li Sheng

Blab la bla