Q.1 How much time it will take to propagate all these messages (i.e., from M1 to M4) including all the computation and communication cost?

**Ans:**

Transaction 🡪 Vehicle to Block server communication

**Provided Values**

|  |  |  |
| --- | --- | --- |
| **Cryptographic function** | **Keyword** | **Execution Time (in**  **milliseconds)** |
| AES encryption  (Enc(Sk(x)) | ENC | 1.534 |
| AES encryption  (Drc(Sk(x)) | DRC | 1.834 |
| SHA256 | SHA | 0.0083 |
| XOR | X0 | 0.00012 |
| Concatenation | CO | 0.00015 |

**Channel Size**: 2Mbps or 250 bytes/millsec

|  |  |  |  |
| --- | --- | --- | --- |
| **Types of messages** | **Keyword** | **Size**  **(in bytes)** | **Time in millisec**  **(T)** |
| Accident | M1 | 2 | 0.008 |
| Traffic Jam | M2 | 5 | 0.02 |
| Bad Road | M3 | 10 | 0.04 |
| Construction site | M4 | 18 | 0.072 |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Computational Cost(CC) | Operations | | | Operation Time  (O) | Total Operation Time  (X) | Total Communication Cost  (In milliseconds) |
| Name | Count  (C) | Value  (V) | (C \* V) | Sum of [C \* V] | T \* X |
| VCC (Vehicular Computational Cost) | CO | 2 | 0 | 1.5423 | 9.8372 | 9.8452 |
| ENC | 1 | 1.534 |
| SHA | 1 | 0.0083 |
| X0 | 2 | 0 |
| RSU Computation Cost | DRC | 1 | 1.834 | 3.3763 | 9.8572 |
| SHA | 1 | 0.0083 |
| CO | 2 | 0 |
| ENC | 1 | 1.534 |
| Controller Computational Cost | CO | 4 | 0 | 1.5506 | 9.8972 |
| SHA | 2 | 0.0083 |
| ENC | 1 | 1.534 |
| Blockchain Server Computational Cost | ENC | 1 | 1.534 | 3.368 | 9.9092 |
| DRC | 1 | 1.834 |

Q.2 What will be the storage requirement to store complete one transaction (including everything required to propagate the information in the network for each type of message?

**Ans:** Assuming that storage cost is not used for the channel used in message communication.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  |  | **Operations** | | **Total**  **(bytes)** |
| Name | Keyword | Count |
| Vehicle | Variable | P | 1 | 3 |
| Encryption | X | 1 |
| Hashing | Q | 1 |
| RSU | Hashing | Q’ | 1 | 3 |
| Variable | Y | 1 |
| Encryption | Z | 1 |
| Controller | Variable | MInfo | 1 | 5 |
| Hashing | TH | 1 |
| Hashing | PH | 1 |
| Variable | BI | 1 |
| Encryption | W | 1 |
| Blockchain Server | Encryption | S | 1 | 1 |
| **Total** |  | | | **12** |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Types of messages** | **Keyword** | **Size**  **(S)**  **(in bytes)** | **Total**  **(T)**  **[From above table]** | **Total Cost**  **(Bytes)** |
| **S + T** |
| Accident | M1 | 2 | 12 | 14 |
| Traffic Jam | M2 | 5 | 12 | 17 |
| Bad Road | M3 | 10 | 12 | 22 |
| Construction site | M4 | 18 | 12 | 30 |

Q.3 If an accident happened at the bad conditioned construction road.

(a) How many messages are required to be communicated and what time it

will take to transmit from vehicle to controller?

**Ans:** Based on the information provided in the question we would need 3 messages. M1, M3 and M4

(b) Also, explain which type of message will be transmitted first and why?

**Ans:** Delivery of messaged will be in order of M1 🡪 M3 🡪M4, while the priority is M1 < M3 < M4.