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**FACULTY OF ENGINEERING AND TECHNOLOGY**

Distributed Systems (BCS-701)

LECTURE -11

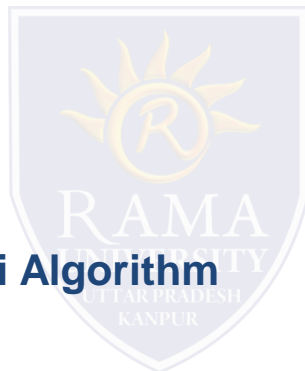
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# OUTLINE

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# TOKEN BASED MUTUAL EXCLUSION

## Token Based Algorithm

### 1. Suzuki–Kasami Algorithm for Mutual Exclusion in Distributed System

**Suzuki–Kasami algorithm** is a token-based algorithm for achieving mutual exclusion in distributed systems.

This is modification of Ricart–Agrawala algorithm, a permission based (Non-token based) algorithm which uses **REQUEST** and **REPLY** messages to ensure mutual exclusion.

In token-based algorithms, A site is allowed to enter its critical section if it possesses the unique token. Non-token based algorithms uses timestamp to order requests for the critical section where as sequence number is used in token based algorithms.

Each requests for critical section contains a sequence number. This sequence number is used to distinguish old and current requests.

# TOKEN BASED MUTUAL EXCLUSION

## Data structure and Notations

- An array of integers **RN[1...N]**

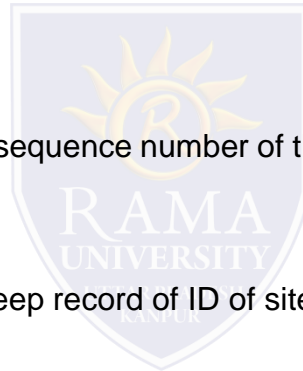
A site  $S_i$  keeps **RN<sub>i</sub>[1...N]**, where **RN<sub>i</sub>[j]** is the largest sequence number received so far through **REQUEST** message from site  $S_j$ .

- An array of integer **LN[1...N]**

This array is used by the token. **LN[j]** is the sequence number of the request that is recently executed by site  $S_j$ .

- A queue **Q**

This data structure is used by the token to keep record of ID of sites waiting for the token



# TOKEN BASED MUTUAL EXCLUSION

## Algorithm

### ➤ To enter Critical section

➤ When a site  $S_i$  wants to enter the critical section and it does not have the token then it increments its sequence number  $RN_i[i]$  and sends a request message  $REQUEST(i, sn)$  to all other sites in order to request the token.

Here  $sn$  is update value of  $RN_i[i]$

➤ When a site  $S_j$  receives the request message  $REQUEST(i, sn)$  from site  $S_i$ , it sets  $RN_j[i]$  to maximum of  $RN_j[i]$  and  $sn$  i.e  $RN_j[i] = \max(RN_j[i], sn)$ .

➤ After updating  $RN_j[i]$ , Site  $S_j$  sends the token to site  $S_i$  if it has token and  $RN_j[i] = LN[i] + 1$

### ➤ To execute the critical section

➤ Site  $S_i$  executes the critical section if it has acquired the token.

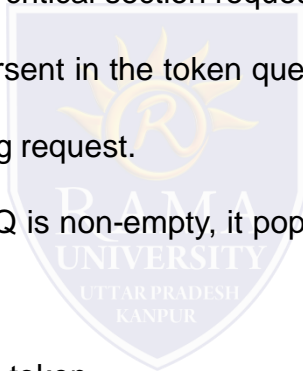
# TOKEN BASED MUTUAL EXCLUSION

## Algorithm

### ➤ To release the critical section

After finishing the execution Site  $S_i$  exits the critical section and does following:

- sets  $LN[i] = RNi[i]$  to indicate that its critical section request  $RNi[i]$  has been executed
- For every site  $S_j$ , whose ID is not present in the token queue  $Q$ , it appends its ID to  $Q$  if  $RNi[j] = LN[j] + 1$  to indicate that site  $S_j$  has an outstanding request.
- After above updation, if the Queue  $Q$  is non-empty, it pops a site ID from the  $Q$  and sends the token to site indicated by popped ID.
- If the queue  $Q$  is empty, it keeps the token



# TOKEN BASED MUTUAL EXCLUSION

## Message Complexity

The algorithm requires 0 message invocation if the site already holds the idle token at the time of critical section request or maximum of N message per critical section execution. This N messages involves

1.  $(N - 1)$  request messages
2. 1 reply message

## Drawbacks of Suzuki–Kasami Algorithm

### Non-symmetric Algorithm:

A site retains the token even if it does not have requested for critical section. According to definition of symmetric Algorithm “No site possesses the right to access its critical section when it has not been requested.”

## Performance

- ❑ Synchronization delay is 0 and no message is needed if the site holds the idle token at the time of its request.
- ❑ In case site does not holds the idle token, the maximum synchronization delay is equal to maximum message
- ❑ transmission time and a maximum of N message is required per critical section invocation.



# MCQ

1. What is the access point (AP) in a wireless LAN?

- a) device that allows wireless devices to connect to a wired network
- b) wireless devices itself
- c) both device that allows wireless devices to connect to a wired network and wireless devices itself
- d) all the nodes in the network

2. In wireless ad-hoc network \_\_\_\_\_

- a) access point is not required
- b) access point is must
- c) nodes are not required
- d) all nodes are access points

3. Which multiple access technique is used by IEEE 802.11 standard for wireless LAN?

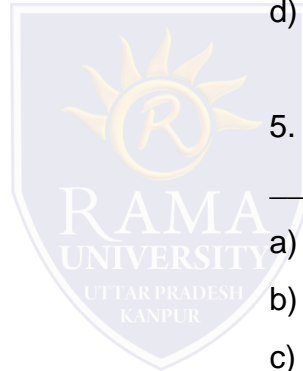
- a) CDMA
- b) CSMA/CA
- c) ALOHA
- d) CSMA/CD

4. In wireless distribution system \_\_\_\_\_

- a) multiple access point are inter-connected with each other
- b) there is no access point
- c) only one access point exists
- d) access points are not required

5. A wireless network interface controller can work in \_\_\_\_\_

- a) infrastructure mode
- b) ad-hoc mode
- c) both infrastructure mode and ad-hoc mode
- d) WDS mode





# REFERENCES

- ❑ <http://cs-www.cs.yale.edu/homes/aspnes/classes/465/notes.pdf>
- ❑ <https://www.geeksforgeeks.org/mutual-exclusion-in-distributed-system/>
- ❑ <https://www.vidyarthiplus.com/vp/attachment.php?aid=43022>
- ❑ <http://www.cs.fsu.edu/~xyuan/cop5611/lecture8.html>

