BUS Arbitration in Computer Organization

Bus Arbitration refers to the process by which the current bus master accesses and then leaves the control of the bus and passes it to the another bus requesting processor unit. The controller that has access to a bus at an instance is known as **Bus master**.
A conflict may arise if the number of DMA controllers or other controllers or processors try to access the common bus at the same time, but access can be given to only one of those. Only one processor or controller can be Bus master at the same point of time. To resolve these conflicts, Bus Arbitration procedure is implemented
to coordinate the activities of all devices requesting memory transfers. The selection of the bus master must take into account the needs of various devices by establishing a priority system for gaining access to the bus. The **Bus Arbiter** decides who would become current bus master.
There are two approaches to bus arbitration:

1. **Centralized bus arbitration –**
   A single bus arbiter performs the required arbitration.

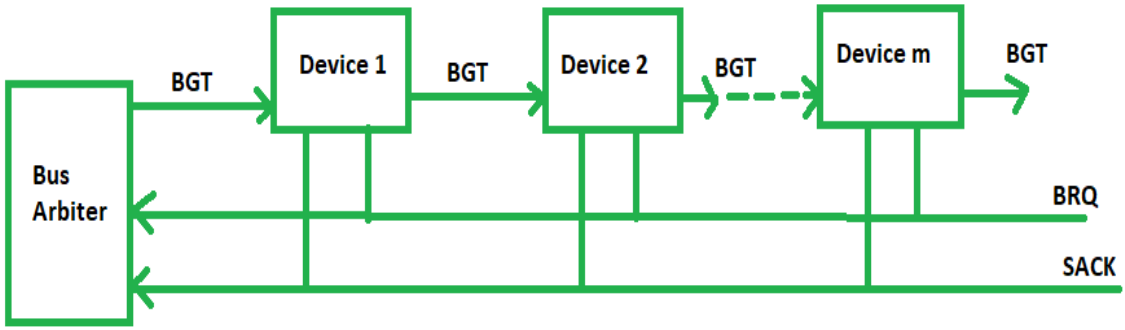
2. **Distributed bus arbitration –**
   ll devices participate in the selection of the next bus master.

Methods of Centralized BUS Arbitration –
There are three bus arbitration methods:

(i) Daisy Chaining method –

It is a simple and cheaper method where all the bus masters use the same line for making bus requests. The bus grant signal serially propagates through each master until it encounters the first one that is requesting access to the bus. This master blocks the propagation of the bus grant signal, therefore any other requesting module will not receive the grant signal and hence cannot access the bus.

During any bus cycle, the bus master may be any device – the processor or any DMA controller unit, connected to the bus.



Daisy chained bus arbitration

Advantages –

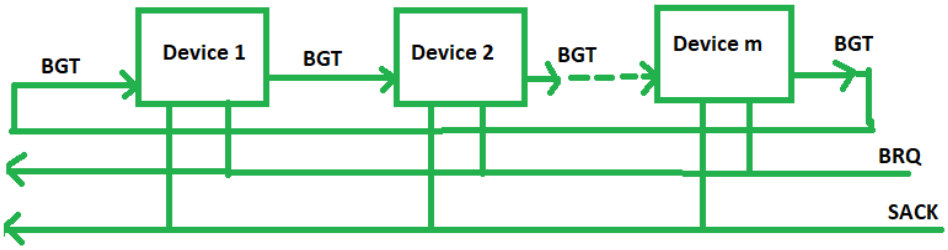
- Simplicity and Scalability.
- The user can add more devices anywhere along the chain, up to a certain maximum value.

Disadvantages –

- The value of priority assigned to a device depends on the position of master bus.
- Propagation delay arises in this method.
- If one device fails then entire system will stop working.

(ii) Polling or Rotating Priority method –

In this, the controller is used to generate the address for the master(unique priority), the number of address lines required depends on the number of masters connected in the system. The controller generates a sequence of master address. When the requesting master recognizes its address, it activates the busy line and begins to use the bus.



Rotating priority bus arbitration

Advantages –

- This method does not favor any particular device and processor.
- The method is also quite simple.
- If one device fails then entire system will not stop working.

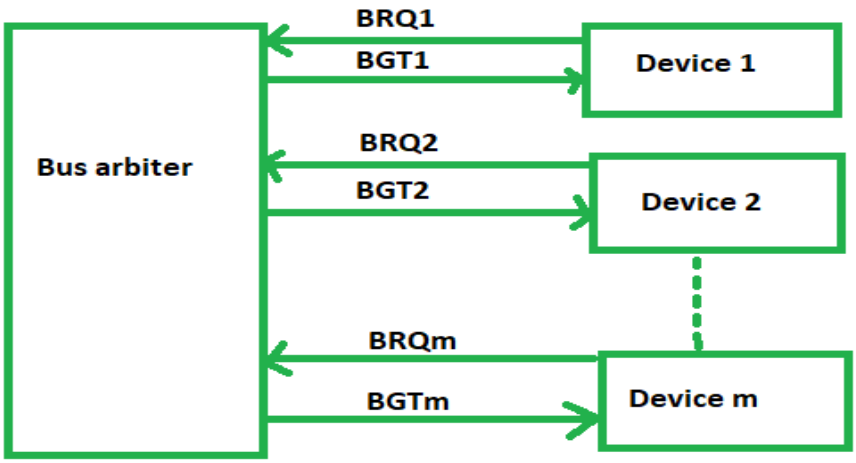
Disadvantages –

Adding bus masters is difficult as increases the number of address lines of the circuit.

(iii) Fixed priority or Independent Request method –

In this, each master has a separate pair of bus request and bus grant lines and each pair has a priority assigned to it.

The built-in priority decoder within the controller selects the highest priority request and asserts the corresponding bus grant signal.



Fixed priority bus arbitration method

Advantages –

- This method generates fast response.

Disadvantages –

- Hardware cost is high as large no. of control lines are required.

Distributed BUS Arbitration :

In this, all devices participate in the selection of the next bus master. Each device on the bus is assigned a 4bit identification number. The priority of the device will be determined by the generated ID.