Token Bus Protocol Number 1

Patent Application

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Token Bus Protocol Number 1

Abstract

The Token Bus Protocol Number 1 is a simple but sophisticated protocol that uses a numerical token that is passed retrospectively by the network hardware from one unit to another thus providing high speed data transfer through the resulting low data link overhead . The protocol operates on a bussed topology and as such has the inherent high reliability of this topology . In addition the protocol has an arbitrary unit number assignment system providing greatly increased ease of connectability of units . The protocol also has provision for the connection of intra and inter network gateways . The protocol can be implemented easily and cheaply .

Patent Application Mr Kim Lyon

The Token Bus Protocol Number 1

The Token Bus Protocol Number 1 , henceforth also refered to in this patent application as The Token Bus Protocol , has been designed to provide a simple but sophisticated solution to many of the problems found within current local area networking systems .

The Token Bus Protocol uses a numerical token that is passed by the network hardware from one unit to another thus providing high speed data transfer through the resulting low data link overhead . The data link overhead is approximately the same as the data link overhead with a token loop \ ring network - around 3 % . This is as opposed to the data link overhead for Carrier Sense Multiple Access \ Collision Detection protocols of 25 % to 50 % . CSMA \ CD protocols are commonly used on bussed topologies . The data link overhead of CSMA \ CD protocols is high due to both the communication response time and the collisions and their associated random retry times . The data link overhead increases exponentially in proportion to the number of units trying to gain access to the network at any one time due to the effect of the collisions .

The Token Bus Protocol operates on a bussed topology and as such has the inherrent high reliability of this topology . If one unit breaks down the operation of the network as a whole is not effected . This is as opposed to the inherrent unreliability of the loop \ ring network where the reliability of the network is dependent on the reliability of each of the individual units on the network . If one unit breaks down the whole network breaks down . As such the Mean Time Before Failure of the loop \ ring network is equal to the MTBF of the individual units divided by the number of units on the network .

The Bussed Topology

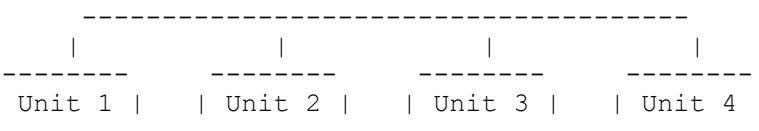

Figure 1

The Loop \ Ring Topology

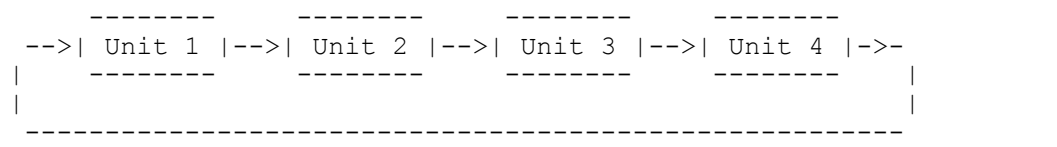

Figure 2

In addition the Token Bus Protocol has an arbitrary unit number assignment system providing greatly increased ease of connectability of units . Units can be plugged into the network without setting up their addresses .

The Token Bus Protocol also has provision for the connection of intra and inter network gateways . This allows traffic to be easily managed on the network and allows for porting into other networks .

Conventions

The Following conventions are used :-

1) The most significant bit (the left most bit) shown is shifted out first .

2) All bit patterns are shown in binary except those shown with an H suffix which are shown in hexadecimal .

The Token Bus Protocol on a Basic Level

The Token Bus protocol uses the following basic format :-

1) All characters \ data have a basic length of 8 bits .

2) There are 3 unique characters :-

the Flag character with a bit pattern of 01111110 ,
the Poll character with a bit pattern of 01111111 ,
and the Terminate character with a bit pattern of 11111111 .

3) All non unique characters (ie. data) are checked on a bit by bit basis for the occurence of consecutive 1's .

At the transmitter if 5 consecutive 1's occur then a 0 is inserted .

IE. the bit pattern 11111111 becomes 111110111

Similarly at the receiver if 5 consecutive 1's followed by a 0 occur then the 0 will be removed .

IE. the bit pattern 11111000 becomes 1111100

As such the uniqueness of the unique characters is preserved .

4) Addresses are encoded as non unique characters and consist of gateway numbers and unit numbers . The bit pattern or number group of the gateway numbers is uniquely different than the unit numbers . The gateway address path within a destination address preceedes the unit number . As such the unit number delimits the destination address .
IE. if the gateway addresses are defined by the upper nibble being set to 1111 then the following example shows the use of gateway addresses within a destination address .

```
1111 0001     first gateway address
1111 0010     second gateway address
1111 0001     third gateway address
0001 0101     final destination unit address
```

Source addresses are encoded in the same way and show the path taken to take from the destination to the source .

5) The error check syndrome is encoded as a non unique set of characters and may use any technique such as Hamming codes or Cyclic Redundantcy Check codes .

The Token Bus Protocol on a Message Level

The Token Bus protocol consists of two types of messages encoded in the following basic format :-

```
The first consists of  :- FLAG
                          SOURCE ADDRESS
                          SOURCE ADDRESS
                          POLL
```

and is used to indicate that no data is to be transfered .

The second consists of :- FLAG
DESTINATION ADDRESS
SOURCE ADDRESS
DATA
ERROR CHECK SYNDROME
POLL

and is used to transfer data .

Access to the network is passed onto a subsequent unit at the transmission of the poll .

The token position is tracked by the use of the source address .

If a consecutive numbered unit is not on the network an inactive byte is inserted in between the poll and the subsequent flag . This becomes a free slot for a subsequent unit to occupy in the token passing sequence .

If a unit is switched on it will monitor the network for a specified time (eg. 65536 bytes time) for any activity . If there is no activity it will assign itself the lowest number (eg. 01H) and transmit a " no data to be transfered " message and then monitor again for any activity . If the network is active it will monitor for an inactive byte and will assign the number corresponding to that inactive byte to itself .

If a unit is removed from an active network it will be replaced by a number of inactive bytes corresponding to the number of units between the previous unit and the subsequent unit for one cycle and then the subsequent unit will place just one inactive byte between the previous unit and itself .

IE. if units 1 , 2 and 4 are present on the network and the subsequent cycle mode is being used there will be an inactive byte between units 2 and 4 . If unit 2 is taken off the network there will be an initial 2 inactive bytes between units 1 and 4 (corresponding to units 2 and 3) and then on the subsequent cycle a single inactive byte between units 1 and 4 .

The inactive byte is used for the subsequent entering of other units into the token passing sequence .

The Terminate character is used to indicate the end of a transmission when an error condition occurs .

Addresses

The following address types are used :-

1) A unique number is reserved as a local network general broadcast number . This allows all units within a network to be simultaneously addressed .

2) A range of unique numbers are reserved for the unit numbers .

3) A range of unique numbers are reserved for global broadcast numbers . These allow party conversations to occur .

4) A range of unique numbers are reserved for gateway unit numbers . These allow communication with the gateways to occur .

5) A unique gateway general broadcast number . This allows all gateways to be simultaneously addressed .

6) A range of unique numbers are reserved for the gateway numbers . These allow the data to be transfered through the gateway .

7) A unique number is used as a wide area network general broadcast number . This allows broadcasts to all units on the network to occur .

Please Note :- implementations of the protocol may assign a zero range of numbers to any of the above addresses . IE. there may be no numbers assigned to a specific address type .

The destination address for units transfering data through gateways consists of path information specifying the path to be taken from the source unit to the destination unit .

The source address for units transfering data through gateways consists of path information specifying the path that was taken from the source unit to the destination unit .

Each gateway strips off the destination address corresponding to itself and adds the source address to itself as it passes the message from its' network receiver on one network to its' network transmitter on the other network .

Examples of the Operation of the Token Bus Protocol

The convention used is that the arrow points to what occurs next in time .

A Single Unit is Present On the Network

Figure 3

A Second Unit is Plugged into the Network

The second unit hears the first unit during its' inactive time . It then assigns itself the next free number -> 2 and places itself into the cycle .

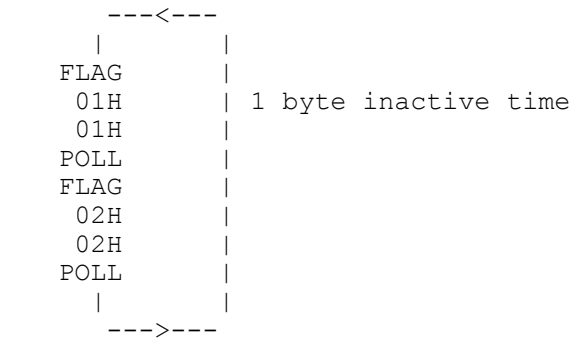

Figure 4

A Third Unit is Plugged into the Network

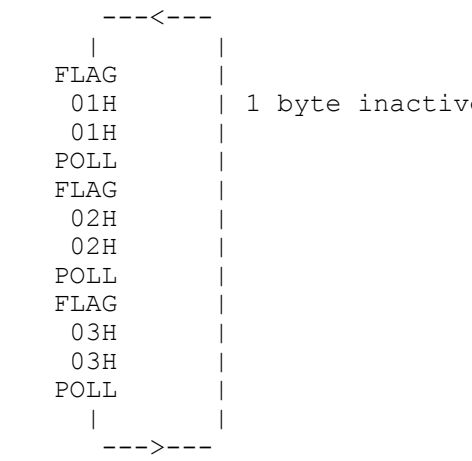

Figure 5

The First Unit is Unplugged from the Network

Initial Cycle

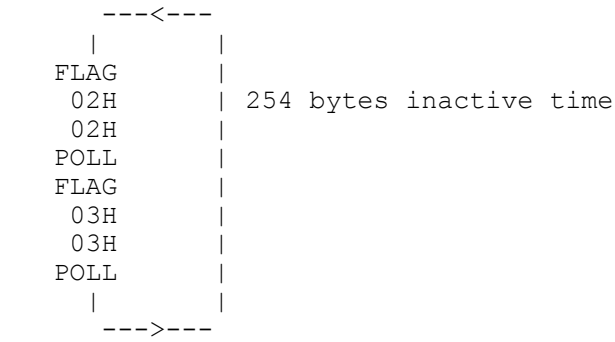

Figure 6

Subsequent Cycles

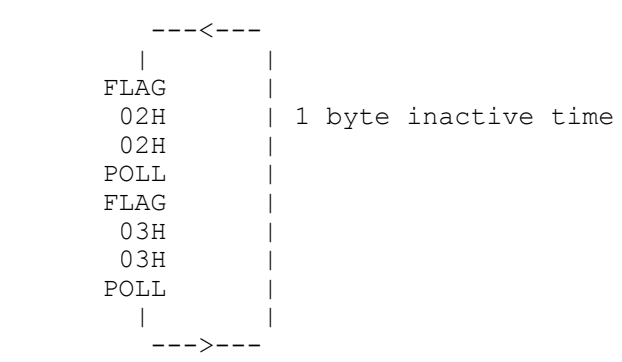

Figure 7

Communication

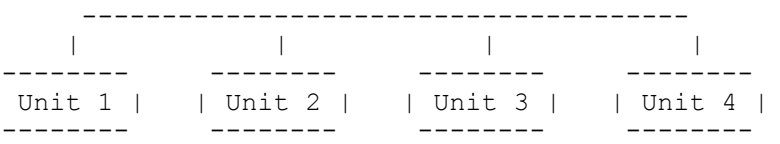

Figure 8

If unit no. 1 wishes to transfer data to unit no. 3 it transmitts the sequence :-

FLAG	start of packet
03H	destination address
01H	source address
DATA	data
ERROR CHECK SYNDROME	error check syndrome
POLL	end of packet

Usage of Gateways

Figure 9

If unit no. 1 in the left hand network wishes to transfer data to unit no. 2 in the right hand network it transmitts the sequence :-

FLAG	start of packet
0F0H	gateway address
02H	destination unit
01H	source address
DATA	data
ERROR CHECK SYNDROME	error check syndrome
POLL	end of packet

After passing through the gateway the packet becomes :-

FLAG	start of packet
02H	destination address
0FEH	gateway address
01H	source unit
DATA	data
ERROR CHECK SYNDROME	error check syndrome
POLL	end of packet

0FEH,01H being the complete source address .

0FEH being the address of the unit (in this example a gateway) that last transmitted the message . This address also being the one that is used to signify the current token position and hence to provide a link to the next unit in the numerical order .

Claims
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1) A token bus protocol that uses

i) a bussed network topology . The bussed network topology being by definition a single communication medium onto which all the network units are connected .

and

ii) a retrospective token passing method where each unit monitors the prior transmission sequence using this to identify the transmission of the previous unit and the number (address) of the previous unit and hence determining the starting position of it's transmission .

The retrospectivity being where the current unit does not know the number (address) of the subsequent unit but where the current unit does know the number (address) of the previous unit . Thus knowledge is not maintained as to where the token is going to but is retained as to where the token has come from .

The unit that holds the numerical token by definition has sole access to the network bus . The unit releases it's sole access to the network bus thus allowing the next unit to access the network by completing it's transmission and indicating this fact . The next unit not having a specific number or consecutive number but being the next numerically numbered unit currently connected to the network bus . The current unit indicates that it has the token by transmitting it's source address and releases it's sole access to the network bus by transmitting the poll (message end) character .

The unit's transmission occurs immediately after it's previous unit has finished transmission and with or without inactive bytes inserted between the previous unit's transmission and the unit's transmission as required .

2) A token bus protocol as defined in claim 1 that provides for arbitrary unit number (address) assignment .

   The arbitrary unit number (address) assignment by definition being that the unit does not have a predefined number (address) but assigns itself an available number (address) on connection to the network bus .

   The arbitrary unit number (address) assignment being accomplished by the use of the retrospective token passing in conjunction with the inactive bytes such that the unit comming onto the network assigns the number (address) corresponding to the source address plus 1 of the first received message that is immediately followed by an inactive byte . This being the first available address .

3) A token bus protocol as defined in claim 1 that provides for the connection to and communication via intra and inter network gateways .

   The gateways being by definition a method of connecting the network to other networks of the same or differing types .

   This being accomplished by the token bus protocol via destination and source address paths that have defined characteristics and defined positions and hence both the paths and their component addresses have identifyable positions .