RapidIO™ Interconnect Specification Part 12: Virtual Output Queueing Extensions Specification

4.1, 6/2017

Revision History

Revision	Description	Date
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2.1	No technical changes	07/09/2009
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Chapter 1 Introduction

1.1 Problem Illustration

In the basic switch model shown below, head-of-line blocking occurs when a packet for port 3 cannot be transmitted on the link because of congestion in port 2. The link effectively stalls causing the congestion in port 2 to spread to traffic on other ports. The backpressure method described here helps alleviate congestion spreading caused by transient blockages of queueing structures.

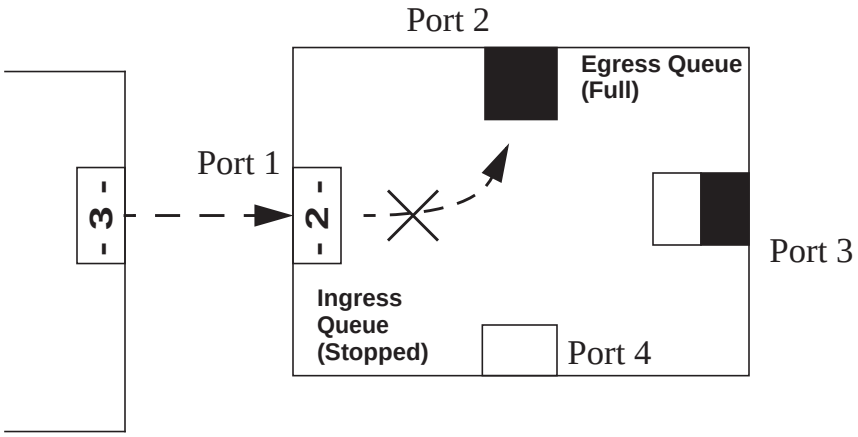

Figure 1-1. Basic Head-of-Line Blocking

The example is simplistic, but any queueing mechanism can become congested, head-of-line block, and stall the link to the upstream device. The VoQ Backpressure Process defines a *congestion message* that informs the upstream port about the congestion, allowing traffic to be sidelined (in a virtual output queue) in favor of traffic with a clear path ahead.

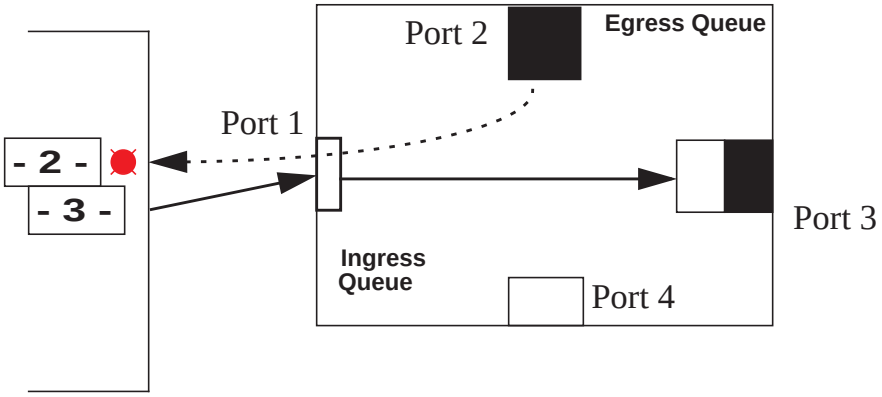

Figure 1-2. Effective Backpressure

Effective backpressure is achieved when the following elements exist:

a) The congested device can communicate congestion information to upstream devices.

b) The upstream device can segregate traffic and allow traffic to re-order based on that congestion information.

These two properties are essential. To keep the operation at the physical layer, the method described uses port identification for both the staging of traffic and the congestion status. Implementation of this specification is optional.

1.2 Terminology

Upstream Device - A device ahead of another device in the traffic flow. The upstream device is the recipient of the backpressure messages.

Downstream Device - The device later in the traffic flow. The downstream device is the originator of backpressure messages.

Port - a port is a local value associated with a specific physical interface. Every device with more than 1 port is responsible for mapping the destination ID to a local port.

Congestion Message - A bit, or group of bits indicating the congestion status of one or more ports.

Backpressure Symbol - A specific field in a RapidIO control symbol that contains the congestion message.

1.3 Conventions

All fields and message formats are described using big endian format.

|| Concatenation, used to indicate that two fields are physically associated as consecutive bits

italics	Book titles in text are set in italics.
REG[FIELD]	Abbreviations or acronyms for registers are shown in uppercase text. Specific bits, fields, or ranges appear in brackets.
TRANSACTION	Transaction types are expressed in all caps.
operation	Device operation types are expressed in plain text.
n	A decimal value.
[*n*-*m*]	Used to express a numerical range from *n* to *m.*
0b*nn*	A binary value, the number of bits is determined by the number of digits.
0x*nn*	A hexadecimal value, the number of bits is determined by the number of digits or from the surrounding context; for example, 0x*nn* may be a 5, 6, 7, or 8 bit value.
x	This value is a don’t care.
<variable>	Identifies a logical variable that may be a specific field of a register or packet or data structure.

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Chapter 2 Overview

The purpose of this backpressure method is to maintain system performance during temporary congestion caused when statistical peaks in traffic flow oversubscribe the ability of a port and its associated buffering to handle the peak load. The backpressure avoids blocking of crossing traffic that competes for common resources. As such, the scope of the message is limited to a device and its immediately adjacent upstream devices. The system may be designed such that sustained congestion will cause a cascade of backpressure messages, but the ability to avoid degradation of performance drops as the radius of affected devices increases. RapidIO has other flow control methods to manage more systemic traffic impediments. Implementation of this specification is optional.

2.1 Congestion Message

Two key considerations for the message format described here are the efficiency and latency of the message, and independence for the two devices involved in the exchange from implementation differences. The congestion message uses a packed format to convey the status of multiple ports in a single message. The contents of the congestion message are shown in Figure 2-1.

Figure 2-1. Congestion Message Information

The VC_IND indicates the virtual channel (VC0–8) that the congestion message applies to. Port Status is a bit vector that indicates the congestion status of ports, where a port is congested if its status is 1 and uncongested if its status is 0. The Port Group field identifies the subset of ports whose port status is found in this congestion message. The size of the Port Group field is programmable to support sending more or less Port Status in each message, and to support fewer or more ports on a device. The first port in the Port Status vector is the Port Group value multiplied by the port group size. The lowest numbered port in the Port Status vector occupies the least significant bit in the Port Status field. Smaller devices may be able to communicate port status in one or two messages. A congestion message is typically transmitted when at least one of the ports' status changes. The congestion message is embedded in a field in the RapidIO control symbol. The symbol containing this

message is defined as the backpressure symbol.

2.2 Traffic Staging

For the congestion message to be useful, the upstream device must segregate or stage traffic prior to committing it to the RapidIO link to the downstream device, or any critical resource (like a buffer) that could block other traffic. To stage the packets, the upstream device must have knowledge about the routing configuration of the downstream device. A typical RapidIO switch will lookup incoming traffic and switch it to a port based on its destination ID. To support this backpressure method, that lookup must produce the egress port for the current device as well as the egress port for the next device. It is straightforward to align the routing tables, but it does require additional entries.

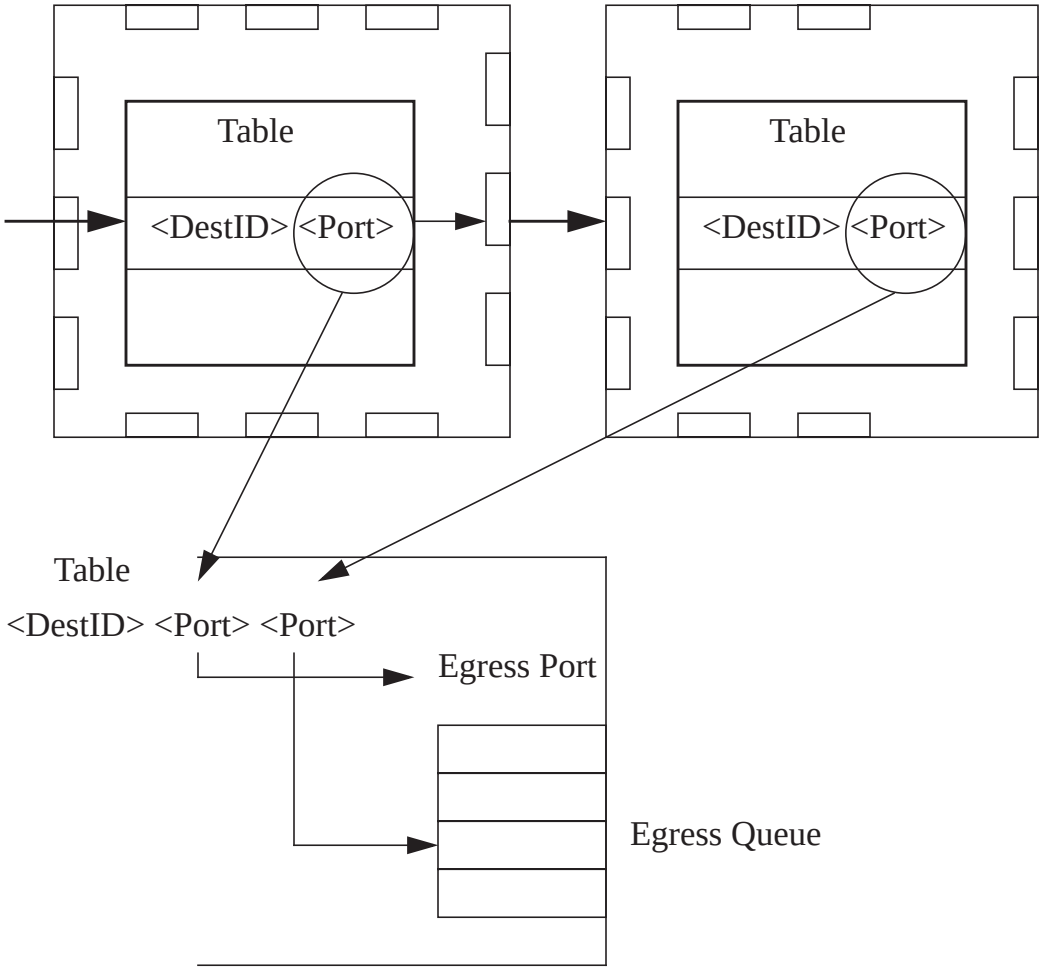


Figure 2-2. Adding Egress Staging

In the figure above, output staging is created by adding a second parameter to the routing table for the next hop port value. That value is the same value that has to be put in the downstream device's routing table. In the upstream device it is used to identify what queue to stage the traffic in, and what queue to act on when a

congestion message is received. The value is specified in an implementation-dependant fashion.

For end points, there is normally no routing table. To use this form of backpressure, the end point would need a method to associate a destination ID with the downstream egress port.

2.3 Adding Device Independence

In the basic structure above, the traffic is staged in a queue that corresponds to a port in the downstream device. A difficulty arises to match the number of queues to the number of possible ports that might exist in the next device. It is inconsistent with RapidIO's goal of allowing devices to implement cost and complexity as needed by their market to require every device to have hundreds of queues to support a maximum sized device, so an additional abstraction is required.

A device may combine traffic into fewer queues by reverse mapping the incoming port congestion message. In the figure below, the egress port supports 4 staging queues. The downstream device has 16 ports. So traffic for several ports are staged in a common queue. When a port specific message is received it is reverse mapped to the same queue that the forward lookup used to stage the data.

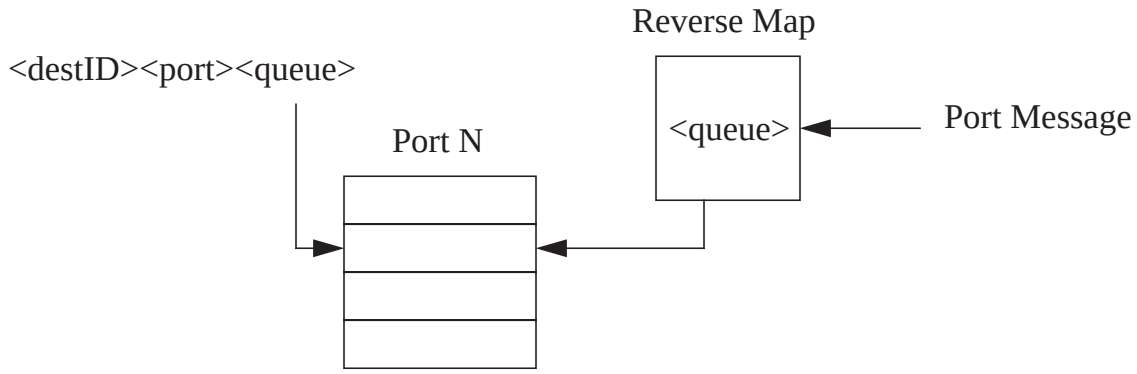


Figure 2-3. Mapping Staging Queues

In this example, as long as the forward/reverse mapping corresponds to the right downstream device's egress port, any implementation can be used, as it is all internal to a single device. This mapping requires that only enough bits for the number of queues be added to the forward table, which can be very large. In the reverse direction, the mapping can be RAM based for maximum flexibility (in the above example requiring a 256 x 2 bit RAM), or a straight decoder. This specification does not prescribe a specific method.

The only other requirement, when mapping multiple ports to a single queue, is that the queue must be shut down when any of those ports are congested. This will reduce the benefits of this backpressure method, but a significant amount of benefit is achieved with just a few queues.

2.4 Relationship With Virtual Channels

The staging method illustrated above uses queues in the output stage of the upstream device. Devices implementing multiple Virtual Channels will have additional queueing structures for the VCs. The staging queues may be before the traffic is sorted into its VC, or each VC may have a set of staging queues. When the output queueing is not tied to the implementation of VCs, the congestion message is not associated with VC operation, and the backpressure symbol can be combined with any valid combinations of RapidIO symbols.

If the output queueing is embedded within the VC structure, the VoQ congestion message can be associated with VC operation. Both message formats are described in the next section. The congestion message may be associated with a specific VC. A CSR bit is provided to enable or disable transmission of VoQ backpressure per VC.

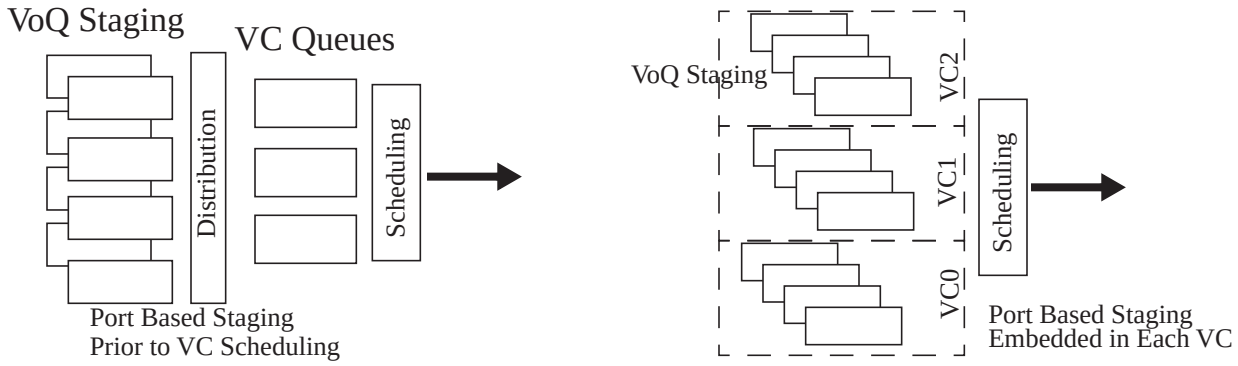


Figure 2-4. Associating a VC with VoQ Backpressure

2.5 Additional Queueing Considerations

If the downstream (originating) device is using queues in its output stage to determine congestion, then congestion messages will have to be sent to all ports that might be sources of incoming traffic.

If the downstream device is using virtual output queues, presorting traffic by egress port at the input, then it has the ability to reflect congestion status on only those ports that are receiving traffic for the congested output. Input queued switches do require N^2 queues (where N is the number of ports).

Devices using some combination of input and output queueing, or shared memory architectures, may make congestion decisions based on whatever resource allocation algorithm is being employed. It is important to consider some of the following boundary conditions:

- If the congestion message is issued with too little room in the port's egress to account for packets that might be in flight, head-of-line blocking can still occur.

- If very small queueing structures are used, a lot of on/off chatter can occur. This is not necessarily bad as long as the additional utilization of link bandwidth is accounted for.

The generation and application of the congestion message defined in this specification will be highly dependent on the queueing and switch design of the device, and as such, is left to the implementer.

Chapter 3 Control Symbol Format

The VoQ congestion message adds a control symbol to the *RapidIO Interconnect Specification Part 6: LP-Serial Physical Layer Specification*. Refer to that specification for the definitions of control symbols, packet delimiting, and the definitions of the fields not defined here. The VoQ backpressure symbol uses the Control Symbol 48 defined for use on Baud Rate Class 2 links, and the Control Symbol 64 format defined for use on Baud Rate Class 3 links. Baud Rate Class 1 links can be designed to support the Control Symbol 64. For more information, see *RapidIO Interconnect Specification Part 6: LP-Serial Physical Layer Specification*.

3.1 Stype2 Control Symbol 48

The Control Symbol 48 is defined as follows in the *RapidIO Interconnect Specification Part 6: LP-Serial Physical Layer Specification*:

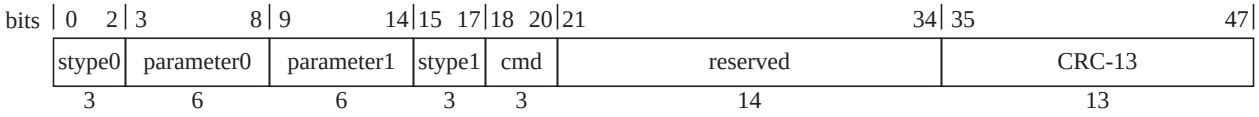


Figure 3-1. Control Symbol 48 Format

The stype2 field uses the 14 reserved bits in Control Symbol 48, and has an operation code (CMD) field and a parameter field. The VoQ backpressure symbol defines the following usage for the Stype2 field:

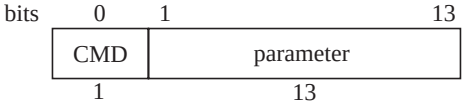


Figure 3-2. Stype2 Field Format

Table 3-1 shows the Stype2 field format definitions.

Table 3-1. Stype2 Field Format

Function	CMD (Bit 0)	Parameter (Bits 1–13)	
Reserved	0b0	Reserved	
VoQ Backpressure	0b1	Port Status Bits	Port Group

The combined size of the Port Group and Port Status Bits is 13 bits. The size of the

The Port Group field is determined by the Port n VoQ Control Status Register's TX Port Group Size and RX Port Group Size fields. For example, suppose that the RX Port Group Size field value is 0b001, indicating that the Port Group field size is 1 bit. The Port Status bits would be assigned as shown in Table 3-2.

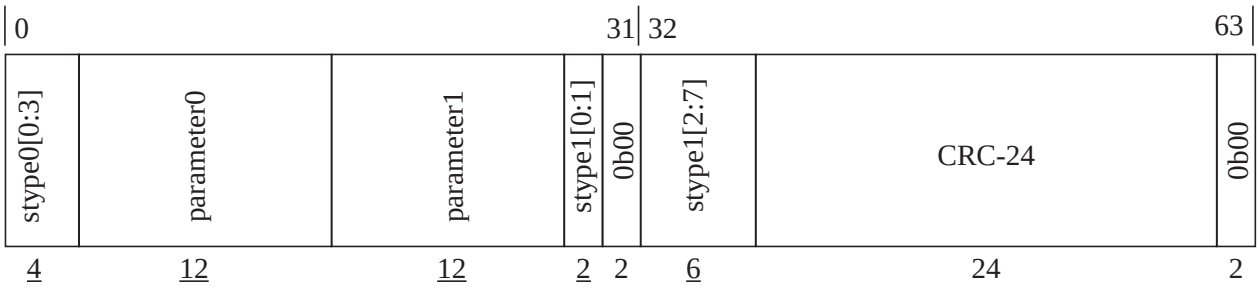
Table 3-2. Control Symbol 48 Example Port Status Bit Assignment

Port Group Value	Port Number for Port Status Bit											
	0	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
0x0	11	10	9	8	7	6	5	4	3	2	1	0
0x1	23	22	21	20	19	18	17	16	15	14	13	12

3.2 Control Symbol 64 VoQ Backpressure

The Control Symbol 64 is defined as follows in the *RapidIO Interconnect Specification Part 6: LP-Serial Physical Layer Specification*:

Figure 3-3. Control Symbol 64 Format



VoQ Backpressure messages are encoded as Control Symbol 64 Stype 0 control symbols using an stype0[0:3] field value of 0b1101. The parameter0 and parameter1 fields are combined into one contiguous format that includes the VC_IND, Port Status, and Port Group fields, as shown in Figure 3-4.

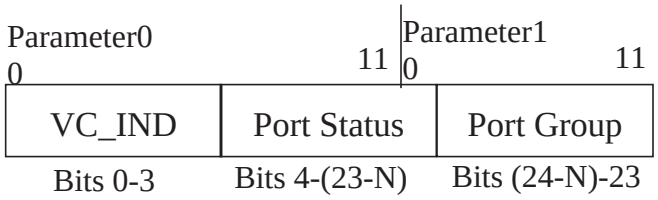


Figure 3-4. Control Symbol 64 VoQ Backpressure Parameter 0 and 1 Usage

The VC_IND value is defined as shown in Table 3-3. Reception of a reserved value in the VC_IND field shall cause the receiving endpoint to ignore the VoQ Backpressure control symbol without error.

Table 3-3. VoQ Backpressure Control Symbol VC_IND Field Definition

VC_IND Value	VC	Comments
0b0000	VC1	This encoding scheme was chosen to allow the Control Symbol 64 VC_IND value to be an extension of the Control Symbol 48 VC_Status control symbol VCID encoding.
0b0001	VC2	
0b0010	VC3	
0b0011	VC4	
0b0100	VC5	
0b0101	VC6	
0b0110	VC7	
0b0111	VC8	
0b1000	VC0	
0b1001–0b1110	Reserved	
0b11111	All VCs	This value shall be used when VoQ backpressure per VC is disabled.

The combined size of the Port Group and Port Status Bits is 20 bits. The size of the Port Group field is determined by the Port n VoQ Control Status Register's TX Port Group Size and RX Port Group Size fields. For example, suppose that the RX Port Group Size field value is 0b100, indicating that the Port Group field size is 4 bits. The Port Status field is 16 bits long. In this case, the Port Status bits shall be assigned to ports as shown in Table 3-4.

Table 3-4. Control Symbol 64 Example Port Status Bit Assignment

Port Group Value	Port Number for Port Status Bit															
	0	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
0	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
1	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
2	47	46	45	44	43	42	41	40	39	38	37	36	35	34	33	32
3	63	62	61	60	59	58	57	56	55	54	53	52	51	50	49	48
4	79	78	77	76	75	74	73	72	71	70	69	68	67	66	65	64
5	95	94	93	92	91	90	89	88	87	86	85	84	83	82	81	80
6	111	110	109	108	107	106	105	104	103	102	101	100	99	98	97	96
7	127	126	125	124	123	122	121	120	119	118	117	116	115	114	113	112
8	143	142	141	140	139	138	137	136	135	134	133	132	131	130	129	128
9	159	158	157	156	155	154	153	152	151	150	149	148	147	146	145	144
10	175	174	173	172	171	170	169	168	167	166	165	164	163	162	161	160
11	191	190	189	188	187	186	185	184	183	182	181	180	179	178	177	176
12	207	206	205	204	203	202	201	200	199	198	197	196	195	194	193	192
13	223	222	221	220	219	218	217	216	215	214	213	212	211	210	209	208

Table 3-4. Control Symbol 64 Example Port Status Bit Assignment

Port Group Value	Port Number for Port Status Bit															
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
14	239	238	237	236	235	234	233	232	231	230	229	228	227	226	225	224
15	255	254	253	252	251	250	249	248	247	246	245	244	243	242	241	240

3.3 VoQ Backpressure per VC

Note that the VC_IND field discussed in Section 2.1 is not defined in the Control Symbol 48 VoQ backpressure message. By default, VoQ backpressure Port Status applies to all VCs on a port.

The association of VoQ backpressure with a specific port within a VC is known as VoQ Backpressure per VC. When Control Symbol 48 is used, VoQ Backpressure per VC is accomplished by transmitting a VC_Status symbol or Status symbol with every VoQ backpressure symbol. The VC_Status VCID, or VC0 for the Status symbol, identifies the specific VC that is congested for that port.

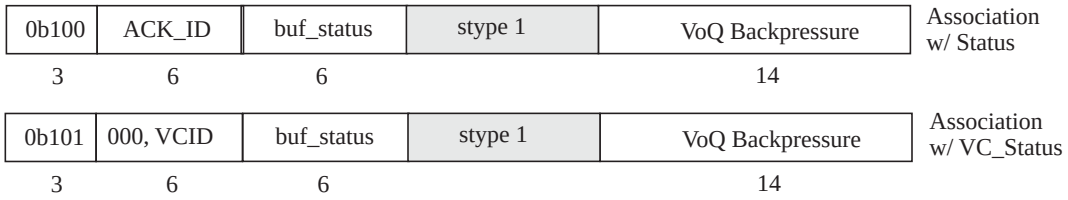


Figure 3-5. Control Symbol 48 Associating a VC with VoQ Backpressure

When Control Symbol 64 is used, VoQ Backpressure per VC is accomplished by using VC_IND field values other than 0b11111 (all VCs).

VoQ Backpressure per VC only works if both upstream and downstream devices use port staging within VC structures. If either device does not have a corresponding capability, VoQ Backpressure per VC Transmission shall be disabled in the CSR. A device with queueing within VCs shall flow control corresponding port queues in all VCs when VoQ Backpressure per VC Transmission is disabled.

When VoQ Backpressure per VC Transmission is set in the Port n VoQ Control Status Register and the stype2 field contains a VoQ Backpressure Symbol, the upstream device shall flow control just the per-port queue within the corresponding VC. When VoQ Backpressure per VC is enabled, the VoQ backpressure symbol shall be combined with a VC_Status or Status symbol.

When the VoQ Backpressure per VC Transmission field is clear, the VoQ backpressure symbol shall apply to all VCs, even if the VoQ backpressure message is combined with a VC_Status or Status control symbol.

Chapter 4 Rules

4.1 Implementation Rules

a) Implementation of VoQ backpressure is entirely optional.

b) Devices may implement VoQ backpressure on a port by port basis.

c) Devices may support only the generation of backpressure messages without the ability to honor messages, or vice versa.

d) Devices using VoQ backpressure shall support Control Symbol 48 and/or Control Symbol 64.

4.2 Rules for Generating Backpressure Control Symbols

a) The VoQ backpressure symbol shall only be transmitted to an upstream device if generation is enabled for a given port. If a congested port requests a symbol be sent to all upstream devices, only ports enabled for this feature shall actually transmit the symbol.

b) VoQ backpressure symbols may indicate congestion on any VC when VoQ Backpressure per VC is disabled.

c) VoQ backpressure symbols shall indicate congestion on a specific VC when VoQ Backpressure per VC is enabled.

d) Ports shall be grouped in order. Ports numbered 0 through N-1 shall occupy Port Group 0 in the backpressure message, ports numbered N to 2N-1 shall occupy port group 1, and so on, where N is controlled by the Port n VoQ Control Status Register's TX Port Group Size field and the number of bits available in the control symbol format.

e) The backpressure symbol shall be generated any time the status of at least one of the ports in the group changes. It is up to the implementer to define what constitutes a status change.

f) The backpressure symbol may be generated at arbitrary intervals, based on a timer. The timer may be the same timer used for VC_status, or it may be a separate timer. Use of a timer is implementation specific.

g) The backpressure symbol may be generated after link recovery to avoid orphaned congestion states.

4.3 Rules for Interpreting Backpressure Control Symbols

a) Devices shall have a mechanism to associate traffic with the downstream device's egress port.

b) Devices shall have a mechanism to associate the incoming congestion message with traffic destined for the indicated port. All traffic identified for that port shall not be committed to a critical resource when that port is identified as congested, allowing other traffic to pass. A critical resource is any resource that can block other traffic like a link or a buffer in a VC.

c) Traffic that is still eligible for transmission is still subject to existing RapidIO ordering rules.

d) Traffic that has been segregated shall be re-introduced to the data stream with the same ordering requirements that existed when it was segregated.

e) Devices may deliberately co-mingle traffic (traffic destined to different ports) to simplify implementations. When such co-mingling loses the ability to further discriminate among the ports, any congestion for any of the ports associated with the co-mingled traffic results in all that traffic being stopped. Co-mingled traffic may only be committed to the link if all ports represented by the traffic are not congested.

Chapter 5 Register Definitions

5.1 VoQ Backpressure Extended Features Block

This section describes the registers for all RapidIO LP-Serial devices supporting virtual channels. This Extended Features register block is assigned Extended Features block ID=0x000B.

5.1.1 Register Map

Table 5-1 shows the VoQ backpressure register map for all RapidIO LP-Serial devices. The Block Offset is the offset relative to the 16-bit Extended Features Pointer (EF_PTR) that points to the beginning of the block.

The address of a byte in the block is calculated by adding the block byte offset to EF_PTR that points to the beginning of the block. This is denoted as [EF_PTR+xx] where xx is the block byte offset in hexadecimal.

Table 5-1. VoQ Register Block

Block Byte Offset	Register Name
0x0	LP-Serial Port - VoQ Backpressure Register Block Header
0x4–0x1C	Reserved
0x20	Port 0 VoQ Control Register
0x24	Port 1 VoQ Control Register
0x28	Port 2 VoQ Control Register
0x2C	Port 3 VoQ Control Register
0x30–0x418	Port *n* VoQ Control Registers
0x41C	Port 255 VoQ Control Register

5.1.2 VoQ Backpressure Control Block Registers

Multiport devices implementing VoQ backpressure shall implement one register per port, even if the port does not support backpressure. Single port end points implement the port 0 register only

5.1.2.1 LP-Serial VC Register Block Header (Block Offset 0x0)

The LP-Serial VC register block header register contains the EF_PTR to the next extended features block, and the EF_ID that identifies this as the LP-Serial virtual channel register block header.

Table 5-2. Bit Settings for LP-Serial Register Block Header

Bit	Name	Reset Value	Description
0-15	EF_PTR		Hard wired pointer to the next block in the data structure, if one exists
16-31	EF_ID	0x000B	Hard wired Extended Features ID

5.1.2.2 Port *n* VoQ Control Status Register (Block Offset - 0x20 + (4* n))

This register is used by each port to configure VoQ backpressure operation.

Table 5-3. Port n VoQ Backpressure CSR

Bit	Name	Reset Value	Description
0	VoQ Backpressure Symbol Generation Supported	see footnote[1]	0b0 = generation of VoQ backpressure is not supported by this port 0b1 = generation of VoQ backpressure supported (read-only)
1	VoQ Backpressure Symbol Reception Supported	see footnote[1]	0b0 = reception of VoQ backpressure is not supported by this port 0b1 = reception of VoQ backpressure supported (read-only)
2	VoQ Backpressure Per VC Supported	see footnote[1]	0b0 = VoQ backpressure messages shall indicate, and be interpreted to mean, that all VCs on a port are congested. 0b1 = VoQ backpressure messages shall indicate, and shall be interpreted to mean, that a specific VC on a port is congested. (read-only)
3-7	reserved	0b0	
8	Enable VoQ Symbol Generation	0b0	0b0 = No VoQ backpressure symbols will be transmitted 0b1 = VoQ backpressure symbol generation is enabled
9	Enable VoQ Participation	0b0	0b0 = this port's status will not be included in any VoQ symbols transmitted, nor cause symbols to be generated (the port's status will always be reflected as enabled). 0b1 = this port's status shall be reflected in VoQ backpressure symbols and will cause symbols to be generated
10	Port XOFF	0b0	0b0 = Port status will reflect current state of the port. 0b1 = Port status will always reflect congested (= 0b1) This field should be set to 1 if the Port n Status and Control CSR Port Unavailable bit is set for this port.
11	Enable VoQ Backpressure Per VC Transmission	0b0	0b0 = The Port Status in VoQ backpressure messages shall aggregate the congestion status of all VCs 0b1 = The Port Status in VoQ backpressure messages shall communicate the congestion status of individual VCs This field shall be reserved when VoQ Backpressure per VC Supported is 0. When this bit is set for links using Control Symbol 48, VoQ backpressure messages shall only be transmitted with VC_Status and Status control symbols.
12	Port Group Size 0 Supported	0b1	0b0 = A port group size of zero bits is not supported 0b1 = A port group size of zero bits is supported for both transmission and reception
13	Port Group Size 1 Supported	see footnote[1]	0b0 = A port group size of one bit is not supported 0b1 = A port group size of one bit is supported for both transmission and reception
14	Port Group Size 2 Supported	see footnote[1]	0b0 = A port group size of two bits is not supported 0b1 = A port group size of two bits is supported for both transmission and reception

Table 5-3. Port n VoQ Backpressure CSR

Bit	Name	Reset Value	Description
15	Port Group Size 3 Supported	see footnote[1]	0b0 = A port group size of three bits is not supported 0b1 = A port group size of three bits is supported for both transmission and reception
16	Port Group Size 4 Supported	0b1	0b0 = A port group size of four bits is not supported 0b1 = A port group size of four bits is supported for both transmission and reception
17	Port Group Size 5 Supported	see footnote[1]	0b0 = A port group size of five bits is not supported 0b1 = A port group size of five bits is supported for both transmission and reception
18	Port Group Size 6 Supported	see footnote[1]	0b0 = A port group size of six bits is not supported 0b1 = A port group size of six bits is supported for both transmission and reception
19-25	reserved	0x00	
26-28	TX Port Group Size	0x0	Current number of bits devoted to port group for transmitted VoQ Status control symbols, encoded as follows: 0x0 = No bits for port_group, all bits are port status 0x1 = One bit for port_group, remaining bits are port status 0x2 = Two bits for port_group, remaining bits are port_status ... 0x6 = Six bits for port_group, remaining bits are port_status 0x7 = Reserved This field shall be changed only when Enable VoQ Symbol Generation is cleared.
29-31	RX Port Group Size	0x0	Current number of bits devoted to port group for received VoQ Status control symbols, encoded as follows: 0x0 = No bits for port_group, all bits are port status 0x1 = One bit for port_group, remaining bits are port status 0x2 = Two bits for port_group, remaining bits are port_status ... 0x6 = Six bits for port_group, remaining bits are port_status 0x7 = Reserved This field shall be changed only when the link partner's Enable VoQ Symbol Generation field is cleared.

[1]The reset value is implementation dependent

Symbol Generation by a port must be enabled only when the device at the other end of the link supports reception.

VoQ Backpressure per VC should be enabled only if it is supported by both connected devices. Support is defined as being able to generate and receive VoQ Backpressure per VC messages. Generating and receiving per VC VoQ Backpressure messages requires an underlying queueing structure that can segregate traffic by both VC and port.

Bits 9 and 10 combine as shown in Table 5-4.

Table 5-4. Port Status Control

Bit 9	Bit 10	Status Reflected in VoQ Backpressure Messages
0	0	Port Status is always 0b0 (will not cause symbol to be generated)
0	1	Port Status is always 0b1 (will not cause symbol to be generated)
1	0	Normal operation, state transitions cause symbols to be generated and the status is reflected in the symbol
1	1	Port Status is always 0b1 (will cause a symbol to be generated if changing from normal operation causes a state change).

With bit 9 = 0b0, toggling bit 10 will change the port's reported state, but will not trigger any new symbols. With bit 9 = 0b1, changing from normal operation to congested or congested to normal operation will cause a symbol to be transmitted only if the state of the port changed.

Note that changing the status of the port does not necessarily imply traffic will change. That depends on the configuration of the upstream device.