Router Partitioning and Offsetting Tutorial

Introduction

The flexible architecture of NK Series routers allows users to configure a router with multiple partitions, effectively making two or more smaller routers from the one frame. Router inputs and outputs can also be offset allowing multiple routers to be addressed on the same level. This tutorial describes the mechanics of router partitioning and offsetting and provides practical applications.

Partitioning

A router's crosspoint matrix can be represented using a conceptual diagram consisting of a number of inputs which can be routed to any one or more of a number of outputs as shown below in Figure 1.

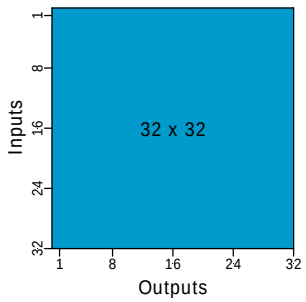

Figure 1 – 32 x 32 Router Crosspoint Conceptual Diagram

When a router is partitioned, its crosspoint matrix is divided into multiple partitions which are always square in size. Figure 2 below shows a 32 x 32 router with two 16 x 16 partitions.

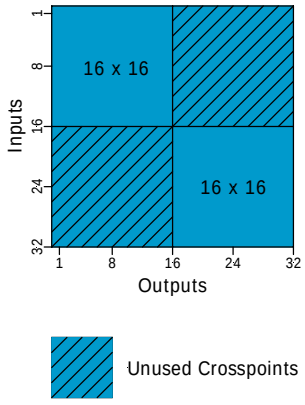

Figure 2 – 32 x 32 Router with two 16 x16 Partitions

The number of partitions is set in the router's configuration, by the **Num Partitions** parameter, shown in Figure 3.

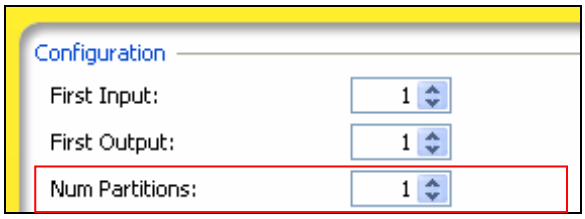

Figure 3 – Router Num Partitions Configuration Option

The partition sizes which result from setting the **Num Partitions** parameter are shown in Table 1 below. A router can have a maximum of 8 partitions, with some partitioning configurations leaving unused inputs and outputs which become inaccessible.

	16 x 16 Router		32 x 32 Router		34 x 34 Router		64 x 64 Router		72 x 72 Router	
Partitions	**Size**	**Unused**	**Size**	**Unused**	**Size**	**Unused**	**Size**	**Unused**	**Size**	**Unused**
1	16 x 16		32 x 32		34 x 34		64 x 64		72 x 72	
2	8 x 8		16 x 16		17 x 17		32 x 32		36 x 36	
3	5 x 5	1	10 x 10	2	11 x 11	1	21 x 21	1	24 x 24	
4	4 x 4		8 x 8		8 x 8	2	16 x 16		18 x 18	
5	3 x 3	1	6 x 6	2	6 x 6	4	12 x 12	4	14 x 14	2
6	2 x 2	4	5 x 5	2	5 x 5	4	10 x 10	4	12 x 12	
7	2 x 2	2	4 x 4	4	4 x 4	6	9 x 9	1	10 x 10	2
8	2 x 2		4 x 4		4 x 4	2	8 x 8		9 x 9	

Table 1 - Router Partition Sizes

The default router configuration has one partition which we describe as an unpartitioned router. When the number of partitions is two or greater, the router is said to be partitioned and the resulting partitions function as independent crosspoint matrices, where inputs of one partition cannot be routed to outputs of a different partition without external cabling. This is the point of partitioning; inputs and outputs of a router can be partitioned into different functional blocks, preventing inadvertent switching between blocks.

Once a router is partitioned, each partition must be assigned a level. Levels are assigned in the Router Partition Table in the router's configuration, shown in Figure 4. A partition can be assigned more than one level, in which case a switch command on any of the assigned levels will result in a switch. (Levels can be assigned to unused partitions, however they will be ignored).

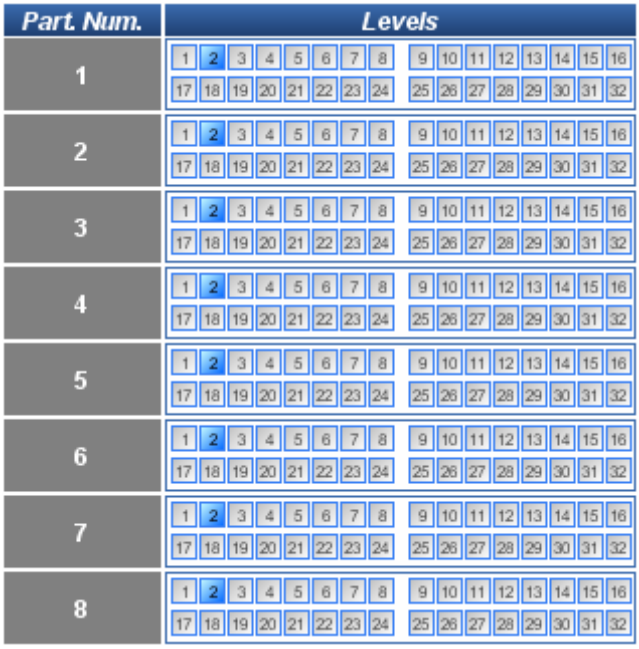

Figure 4 - Router Partition Table

Example 1 - NK-V32 Router Partitioned for RGB Switching

Figure 5 shows an NK-V32 32 x 32 Analogue Video router partitioned into three 10 x 10 partitions for the purpose of routing RGB component video signals. Partitioning ensures that the R, G and B signals are routed independently, while assigning all three partitions to the same level ensures that they switch synchronously to maintain the integrity of the video image. This partitioning scheme will result in 2 unused inputs and outputs. Figure 6 shows the configuration settings for the router.

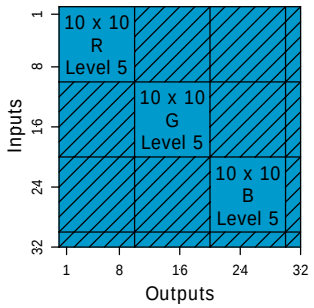

Figure 5 - NK-V32 Router Crosspoint Partitioned for RGB Switching

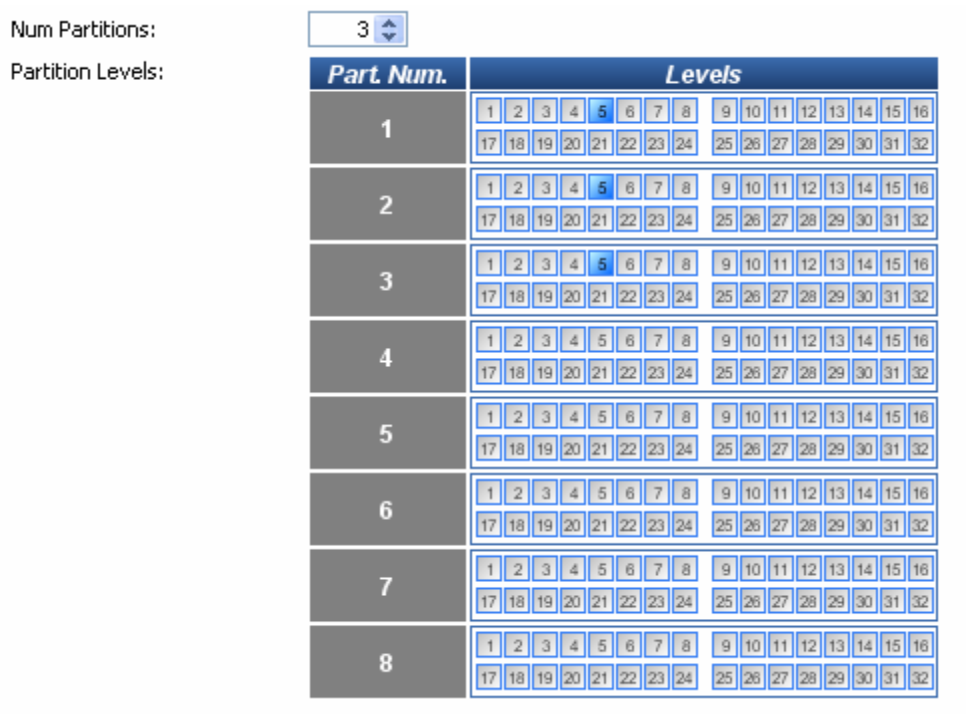

Figure 6 - NK-V32 Configuration for RGB Switching on Same Level

Switching a Partitioned Router

When a router is partitioned, each partition uses different physical input and output connectors, but the partitions are addressed using the input and output range of the first partition. Partitions set to the same level will then automatically switch together.

As an example, consider the NK-V32 router of Figure 5 partitioned for routing RGB component video. A control panel for switching this router would require 10 source and 10 destination keys, as shown in Figure 7, with each source key selecting an RGB source to be routed to an RGB destination.

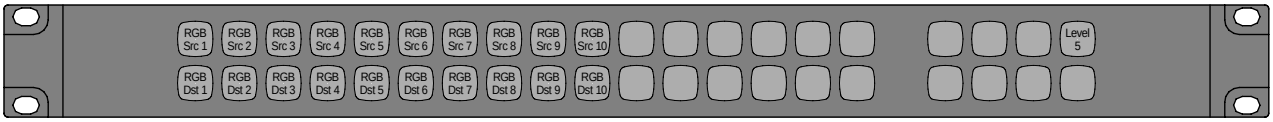

Figure 7 – RCP-NK1 Control Panel for Switching RGB with an NK-V32 Router

Table 2 shows the relationship between the physical inputs and outputs and the inputs and outputs addressed by the control panel keys. In this example the control panel key assigned as Source 1 (**RGB Src 1**) will select physical Inputs 1, 11 and 21. The **Level 5** key on the control panel selects all three partitions for a switch (this may not be required if this is the only router being controlled by the control panel).

Partition	Level	Physical Inputs	Addressed as Input/Source #	Physical Outputs	Addressed as Output/Dest #
1 (R)	5	1 – 10	1 - 10	1 – 10	1 - 10
2 (G)	5	11 – 20	1 - 10	11 – 20	1 - 10
3 (B)	5	21 – 30	1 - 10	21 – 30	1 - 10

Table 2 – Partitioned NK-V32 Switching Map

The Phoenix NK Switchboard displays the NK-V32 crosspoint status for R,G and B partitions as shown in Figure 8.

Figure 8 –Phoenix NK Switchboard for NK-V32 Router Partitioned for RGB

Example 2 - NK-MD34 Partitioned with HD and SD on Different Levels

Figure 9 shows an NK-MD34 34 x 34 Multi-definition SDI router with two 17 x 17 partitions – one for HD and one for SD. This partitioning scheme utilizes all of the router inputs and outputs. Figure 10 shows the configuration settings for the router.

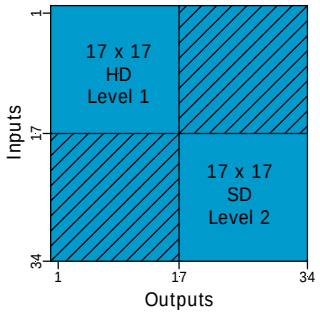

Figure 9 - NK-MD34 Partitioned with HD and SD on Different Levels

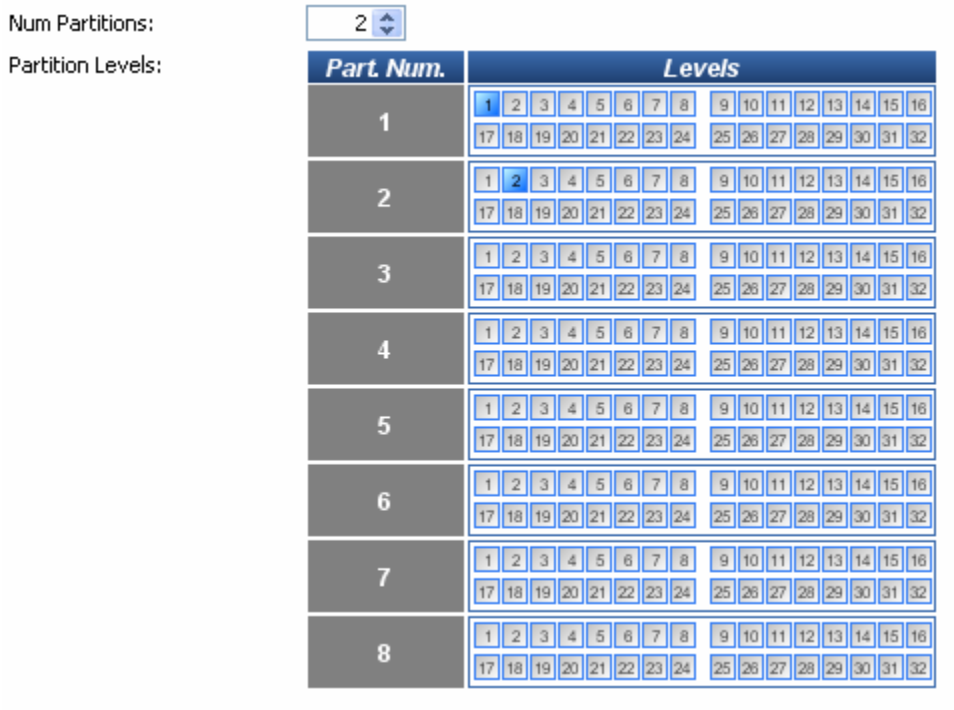

Figure 10 - NK-MD34 Configuration for Switching HD and SD on Different Levels

Assigning the SD and HD partitions to different levels allows them to be switched separately or together. Partitions assigned to different levels will only switch together if both their levels are included in the currently selected level mask for a switch. The levels to be switched would typically be selected using level keys or breakaway keys on a control panel as shown in Figure 11. In this example the **Level 1** key selects the HD partition and the **Level 2** key selects the SD partition. When both level keys are selected, SD and HD partitions are switched together in a tied switch. (A tied switch can also be made by assigning Level 1 and Level 2 in the first breakaway, and deselecting both Level keys, so the panel defaults to the first breakaway). The control panel uses 17 source and 17 destination keys to select the inputs and outputs for each partition.

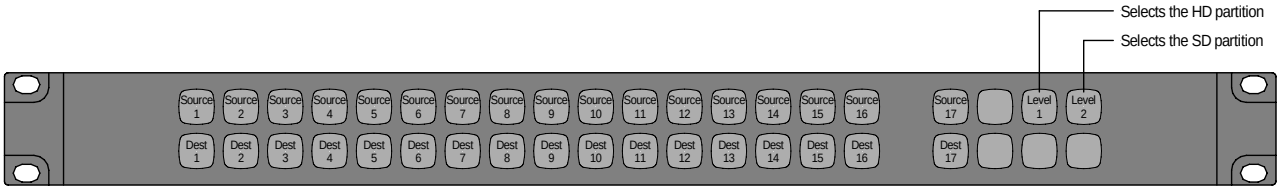

Figure 11 – RCP-NK1 Control Panel for Switching an NK-MD34 with HD and SD Partitions

Table 3 shows the relationship between the physical inputs and outputs and the inputs and outputs addressed by the control panel keys. In this example the SD partition of the NK-MD34 uses physical input connectors 18 to 34, which are addressed using the input range 1 to 17.

Partition	Level	Physical Inputs	Addressed as Input/Source #	Physical Outputs	Addressed as Output/Dest #
1 (HD)	1	1 – 17	1 – 17	1 – 17	1 – 17
2 (SD)	2	18 – 34	1 – 17	18 – 34	1 - 17

Table 3 – Partitioned NK-MD34 Switching Map

The Phoenix NK Switchboard displays the NK-MD-34 crosspoint status for HD and SD partitions as shown in Figure 12.

Figure 12 –Phoenix NK Switchboard Display for NK-MD34 with HD and SD Partitions

Router Offsetting

It is useful to conceptualise a router as existing in an I/O address space with a theoretical limit of 65,536 inputs and 65,536 outputs as shown in Figure 13. A switch command string received by a router (via its T-Bus connection) specifies a 4 byte **level mask**, a 2 byte **input** value and a 2 byte **output** value:

<level mask > <input> <output>

The **input** and **output** values specify which inputs and outputs in the I/O address space are to be switched by all routers whose levels are included in the **level mask**. Since the largest router crosspoint size is much smaller than the maximum I/O space, much more efficient use can be made of the I/O address space available by allowing the router's input and output range to be shifted anywhere within the I/O address space by applying an input or output offset value. This allows multiple routers assigned to the same level to be switched independently or routers with overlapping I/O ranges to switch simultaneously if desired.

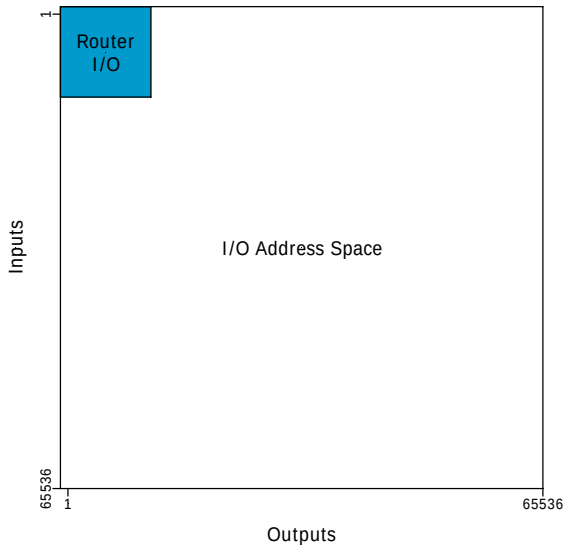

Figure 13 - Router I/O Address Space

A router's input and output offset are set in the router's configuration by the **First Input** and **First Output** parameters as shown below in Figure 14.

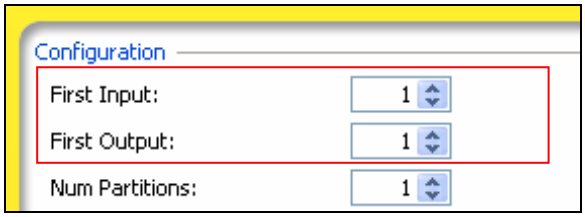

Figure 14 – Router Input and Output Offset Configuration Option

Although it is possible to offset router inputs and outputs anywhere in the range 1 to 65,536, the I/O range which can be addressed depends on the control device used to switch the router. For example, an RCP-NK1 control panel can control up to 255 inputs and outputs in the range 1 to 65,536, while the RCP-NKM and RCP-NKQ control panels can control up to 2000 inputs and outputs, but only in the range 1 to 2000.

The RCP-NK1, NK-GPI and NK-SCP/A control devices use an input and output offset (First Input and First Output) option identical to the router offset option shown in Figure 14, allowing them to control routers anywhere in the I/O space from 1 to 65,536.

The RCP-NKM and RCP-NKQ do not have an input and output offset option, which limits them to using I/O in the range 1 to 2000, however this is more than adequate for any real world application. Since the I/O address space exists across multiple levels (up to 32), and multiple levels can be included in a switch, there is no practical limitation to the I/O which can be addressed in a switch with the partitioning and offsetting capabilities of the NK Series. Table 4 below shows the addressable I/O range for the different NK Series control options.

Control Device	Levels	Inputs/Outputs	I/O Range
RCP-NK1 Control Panel	8	255	1 – 65,536
RCP-NKM Control Panel	32	2000	1 - 2000
RCP-NKQ Control Panel	32	2000	1 - 2000
NK-GPI General Purpose Interface	8	255	1 – 65,536
NK-SCP/A Serial Control Interface	8	255	1 – 65,536
Phoenix NK Switchboard	32	1000	1 – 65,536

Table 4 – Addressable I/O Range of NK Series Control Devices

Figure 15 shows the First Input, First Output and Level Position configuration options for the RCP-NK1, NK-GPI, and NK-SCP/A. The Level Position configuration option allows the 8 levels which can be controlled by these devices to be offset anywhere (at 8 level boundaries) within the 32 levels available for the NK Series control system.

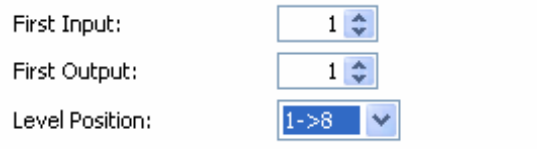

Figure 15 – Offset Options for RCP-NK1, NK-GPI and NK-SCP/A

Example 1 – Two 32 x 32 routers with independent I/O

When two routers are offset so that they occupy different I/O ranges, they can switched on the same level and operate independently. Figure 16 below shows two 32 x 32 routers offset with independent I/O.

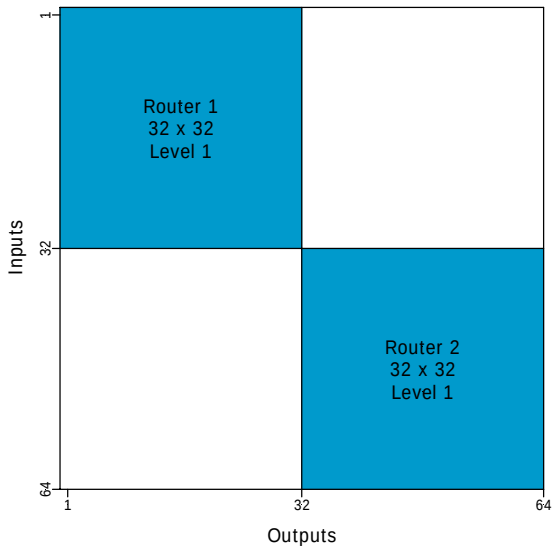

Figure 16 – I/O Space for 32 x 32 Routers with Independent I/O

Table 5 below shows the offset configuration for each router.

	Router 1	Router 2
First Input	1	33
First Output	1	33

Table 5 – Offsetting for 32 x 32 Routers with Independent I/O

In the above example, Router 1 makes a switch when the input is in the range 1 to 32 and the output is in the range 1 to 32, while Router 2 makes a switch when the input is in the range 33 to 64 and the output is in the range 33 to 64.

When a switch command is received by a router (whose level assignment is specified in level mask), the router first determines if the specified output is within its range, taking into account the offset. If it is not within range, the router ignores the command. If the output is within range, the router then determines if the input is within range, in which case a switch is made from the specified input to the specified output. If the input is out of range, the router turns off the crosspoint switched to the specified output. (An alternative router response occurs when the "Ignore Out Of Range Inputs" option in the router's configuration is enabled – refer to Codan Broadcast application note AN-003 for more information). Table 6 shows the different router responses to the input output ranges in a switch command.

Output	Input	Router Response
Out Of Range	Don't Care	Command Ignored
Within Range	Within Range	Switch Input to Output
Within Range	Out Of Range	Crosspoint to Output Switched Off

Table 6 – Router Responses to Switch Command I/O ranges

Table 7 describes some possible switching scenarios for the routers in Example 1.

Switch made from Control Panel (Level 1)	Router 1 Physical Switch	Router 2 Physical Switch
Input 1 to Output 1	Input 1 to Output 1	No Switch (Output Out of Range)
Input 33 to Output 1	Switch Off Crosspoint to Output 1 (Input Out of Range)	No Switch (Output Out of Range)
Input 1 to Output 33	No Switch (Output Out of Range)	Switch Off Crosspoint to Output 1 (Input Out of Range)
Input 33 to Output 33	No Switch (Output Out of Range)	Input 1 to Output 1
Input 65 to Output 65	No Switch (Output Out of Range)	No Switch (Output Out of Range)

Table 7 – Example Switches for 32 x 32 Routers with Independent I/O

Example 2 – Two 32 x 32 routers with overlapping I/O

When two routers assigned to the same level are offset so that part of the I/O range overlaps, switch commands in the shared I/O space will result in both routers making a switch. Figure 17 below shows two 32 x 32 routers with Router 2 offset with overlapping I/O. In this example, a switch command on Level 1 in the range of Inputs 25 – 32 to Outputs 21 – 32 will switch both routers.

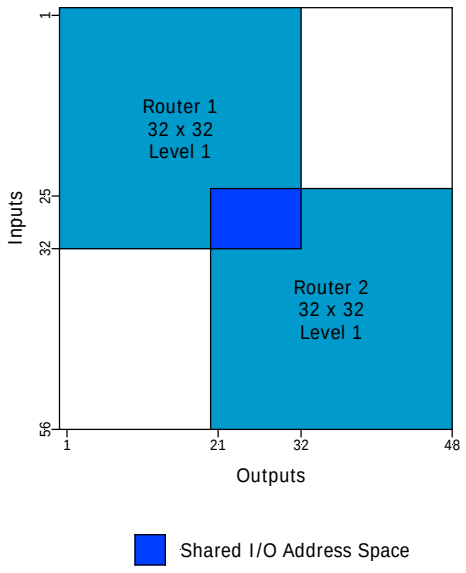

Figure 17 – I/O Space for 32 x 32 Routers with Overlapping I/O

Table 8 below shows the offset configuration for each router.

	Router 1	Router 2
First Input	1	25
First Output	1	21

Table 8 – Offsetting for 32 x 32 Routers with Overlapping I/O

Table 9 below describes some possible switching scenarios for Example 2.

Switch made from Control Panel (Level 1)	Router 1 Physical Switch	Router 2 Physical Switch
Input 25 to Output 1	Input 25 to Output 1	No Switch (Output Out of Range)
Input 33 to Output 1	Switch Off Crosspoint to Output 1 (Input Out of Range)	No Switch (Output Out of Range)
Input 1 to Output 21	Input 1 to Output 21	Switch Off Crosspoint to Output 1 (Input Out of Range)
Input 25 to Output 21	Input 25 to Output 21	Input 1 to Output 1
Input 1 to Output 33	No Switch (Output Out of Range)	Switch Off Crosspoint to Output 13 (Input Out of Range)
Input 25 to Output 33	No Switch (Output Out of Range)	Input 1 to Output 13
Input 33 to Output 33	Switch Off Crosspoint to Output 21 (Input Out of Range)	Input 9 to Output 1

Table 9 – Example Switches for 32 x 32 Routers with Overlapping I/O

Example 3 – Combining two 32 x 32 routers into a 32 x 64 router

In the following example, the inputs of two 32 x 32 routers are fed from the same 32 sources (from distribution amplifiers for example), while the outputs of the two routers provide 64 independent outputs as shown below in Figure 18. With both routers assigned to the same level, any one of the 32 inputs can be routed to any one or more of the 64 outputs, so that only one router makes a switch at a time. Inputs 1 to 32 of both routers share the same input range, while the output of Router 2 has an offset of 32 to provide the 64 independent outputs. If Router 2 was not offset, both routers would make an identical switch, and the 32 outputs of both routers would be duplicated.

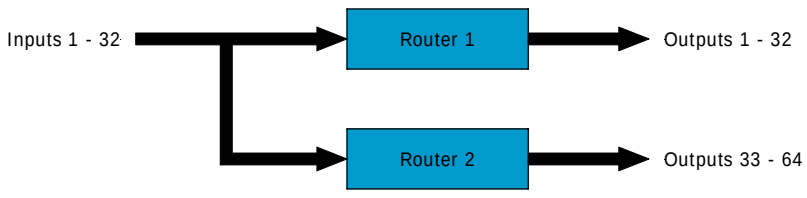

Figure 18 –Block Diagram of two Routers with Parallel Inputs

Figure 19 below shows the two 32 x 32 routers with outputs of Router 2 offset.

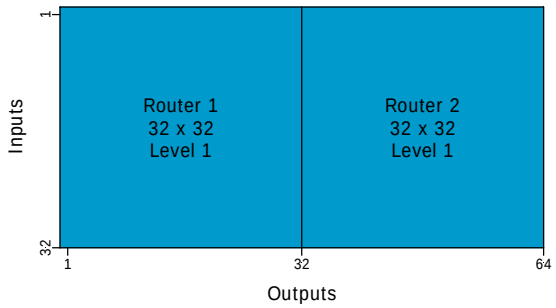

Figure 19 – I/O Space for 32 x 32 Routers with Parallel Inputs

Table 10 below shows the offset configuration for each router.

	Router 1	Router 2
First Input	1	1
First Output	1	33

Table 10 – Offsetting for 32 x 32 Routers with Parallel Inputs

Table 11 below describes some possible switching scenarios for Example 3.

Switch made from Control Panel (Level 1)	Router 1 Physical Switch	Router 2 Physical Switch
Input 1 to Output 1	Input 1 to Output 1	No Switch (Output Out of Range)
Input 33 to Output 1	No Switch (Output Out of Range)	No Switch (Output Out of Range)
Input 1 to Output 33	No Switch (Output Out of Range)	Input 1 to Output 1
Input 33 to Output 33	No Switch (Output Out of Range)	Switch Off Crosspoint to Output 1 (Input Out of Range)

Table 11 – Example Switches for 32 x 32 Routers with Overlapping I/O

Router Partitioning and Offsetting Rules and Guidelines

- A router can have up to 8 partitions
- Each partition can be assigned to a one or more unique or common switching levels
- Some partitioning configurations will leave unused inputs and outputs which become inaccessible
- Where there are unused inputs and outputs due to partitioning, they will be the last inputs and outputs
- Partitions are configured using Phoenix or web browser via the NK-IPS and are stored in the router's flash memory.