### 142.2.4.4 Transmit Interleaving

~~For the purposes here: interleaver refers to the mapping from transmitted sequence to encoding/decoding sequence (including user and parity) and de-interleaver refers to the mapping from encoding/decoding sequence to transmitted sequence.~~

For the purposes here: “De-interleaver” refers to the mapping from transmitted sequence to encoding/decoding sequence (including user and parity). This is also referred to as “Reverse-Omega (R->L)” (i.e., right to left). “Interleaver” refers to the mapping from encoding/decoding sequence to transmitted sequence. This is also referred to as “Omega (L->R)” (i.e., left to right)

The information bit de-interleaver consists of 57 ~~local de~~independent Reverse-Omega (R-~~interleavers~~ >L) networks of size 256-by-~~256. As~~ 256 as illustrated in Figure 142–1 ~~these local interleavers are realized by 57 independent reverse-omega networks~~. The information bits after zero padding are divided into 57 data chunks, and each data chunk has 256 bits, which is sent to one of the 256-by-256 ~~omega~~ Reverse-Omega (R->L) networks.

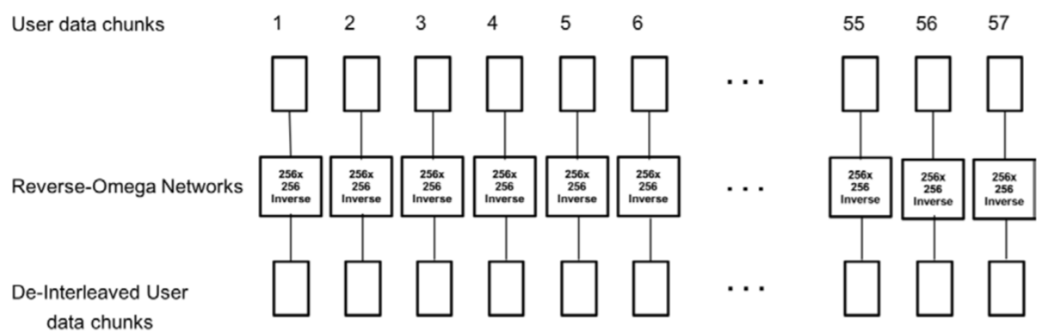


**Figure 142–1—Information Bit De-Interleaver**

The ~~first ten~~ parity bit interleaver consists of 10 independent Omega (L->R) networks (see Figure 142–4). Each 256-bit parity-check bit ~~segments are de~~segment is sent to one of the 256-by-~~interleaved~~ 256 Omega (~~see Figure 142–4~~L->R) ~~using an eight-stage 256x256 reversed omega network, where each segment has its own seed. These local interleavers are realized by 12 independent omega~~ networks. Because puncturing length is fixed (512) and 512 bits make up of two whole data chunks, the last two parity omega networks are by-passed. In implementation, the parity bit interleaver consists of 10 omega networks.

~~Note that the interleaver and de-interleaver are just reverse permutations of each other; the omega network and reverse-omega network are just reverse permutations of each other. With the omega network architecture, data is input from the left side and output from the right; while the reverse-omega network are obtained just by feeding the data to the right side and output from the left side.~~

~~Each omega network is made of an interconnection network with 8 stages of switches, each stage has 128 switches, and each switch has two inputs and two outputs as shown in Figure 142–5.~~

Note that the interleaver (Omega L->R) and de-interleaver (Reverse-Omega R->L) are just reverse permutations of each other. To clarify, with the Omega (L->R) network architecture data is input from the left side

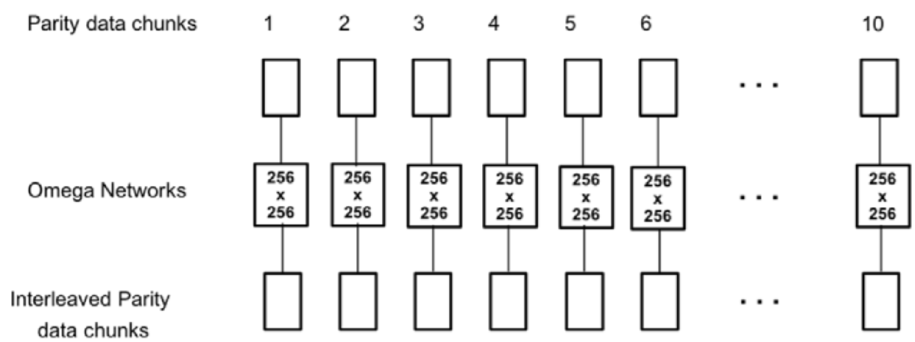


**Figure 142–2—Information Bit Interleaver**

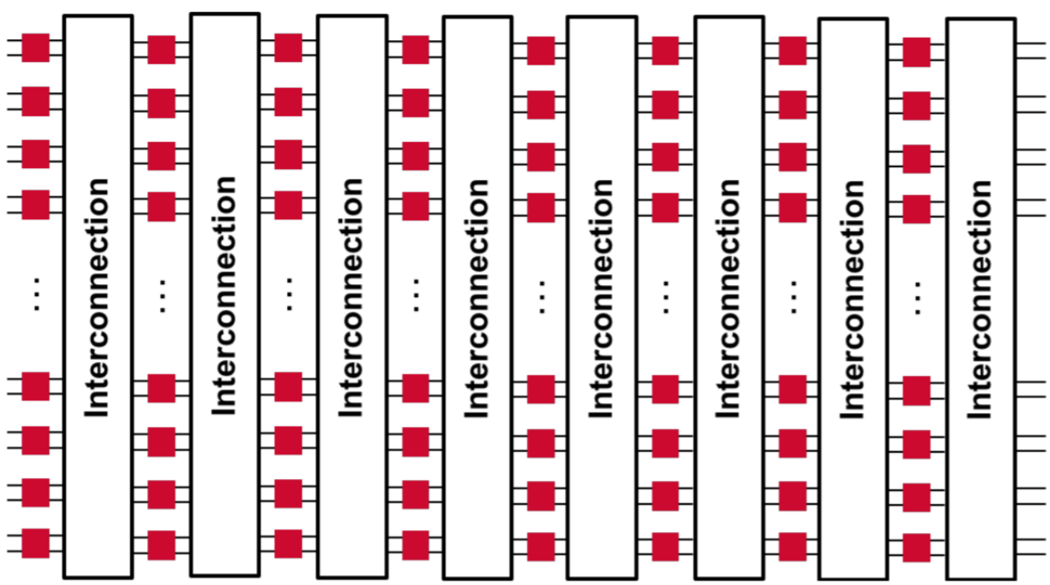


**Figure 142–3—Omega Network 256 Interconnection Network**

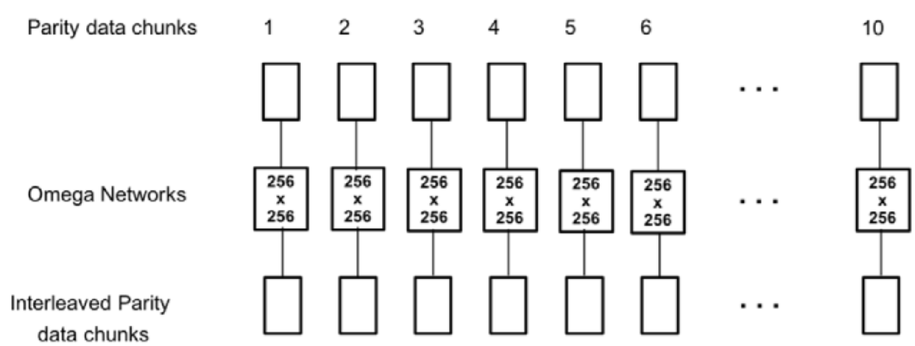


**Figure 142–4—Parity Bit Interleaver**

and output from the right; while the Reverse-Omega (R->L) network are obtained just by feeding the data to the right side and output from the left side. This is illustrated in Figure 142–5 where each omega network is made of an interconnection network with 8 stages of switches, each stage has 128 switches, and each switch has two inputs and two outputs as shown.

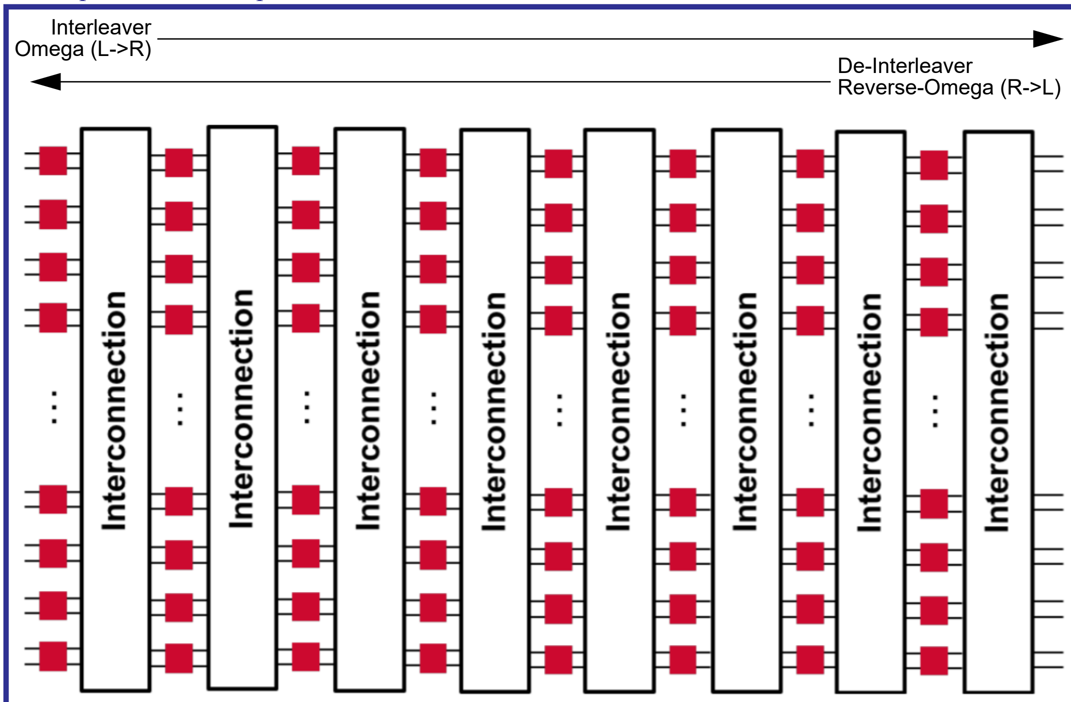


**Figure 142–5—Omega Network 256 Interconnection Network**

Each switch is individually programmed. If the switch is programmed to be 1, then this switch performs a swap of the input bits, otherwise, the input will be pass-through.

The interconnection between each stage of switches is deterministic and is described as follows. Denote the two output ports of switch $i$ in stage $k$ as $S^k_{i,0}$ and $S^k_{i,1}$, $k = 0, ..., 7$ and $i = 0, ..., 127$:

— Switch output port at stage $k$, $S^k_{i,0}$ is connected to switch input port at stage $k + 1$:

$$S^{k+1}_{\left\lfloor \frac{i}{2} \right\rfloor, \mathrm{mod}(i, 2)}$$

— Switch output port at stage $k$, $S^k_{i,1}$ is connected to switch input port at stage $k + 1$:

$$S^{k+1}_{\left\lfloor \frac{i}{2} \right\rfloor + 64, \mathrm{mod}(i, 2)}$$

~~As an example, Figure 142–6 illustrates an 8-by-8 omega network with interconnections of 3 stages of 4 switches; and for a given switch programming, how the inputs are mapped to the output.~~

**Editor's Note (to be removed prior to publication): Before entering WG ballot, content of individual seed tables will be published under http://standards.ieee.org/downloads/802.3/ in a machine readable format**

In implementation one 256-by-256 omega network of 8x128 switches is programmed based on a 128-bit control seed (see Table 142–2 and Table 142–3). The 128-bit switch programming sequence is derived by a circular bit shift of the control seed by x positions where x is given in Table 142–1 for each of the 8 stages.

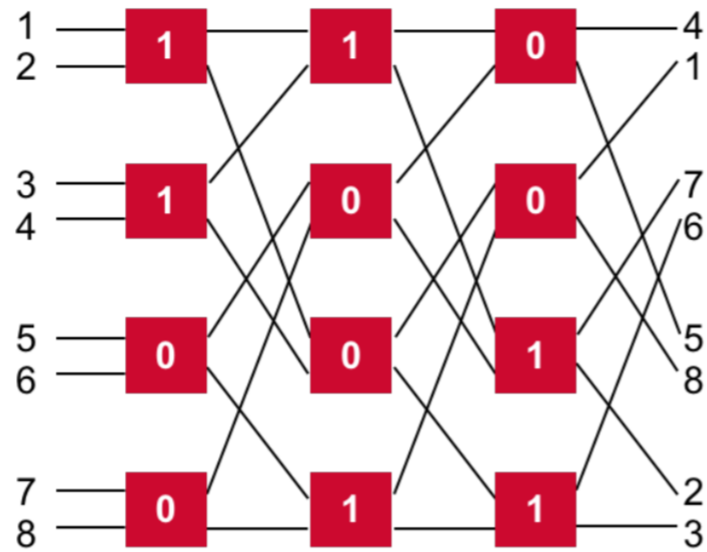


**Figure 142–6—Example 8x8 Omega Network with a given switch programming**

**Table 142–1—Control seed circular bit shift for stage 1 through 8**

| Stage | Circular shift x (bits) |
|---|---|
| 1 | 17 |
| 2 | 34 |
| 3 | 51 |
| 4 | 68 |
| 5 | 85 |
| 6 | 102 |
| 7 | 119 |
| 8 | 8 |

The control seeds for the 57 independent user interleavers are shown in Table 142–2 where each row is a 128-bit seed sequence.

The control seeds for the 10 independent parity interleavers are in Table 142–3 where each row is a 128-bit seed sequence.

**Table 142–2—User interleaver control seed values**

| User interleaver | 128-bit control seed sequence<br>(represented by a 32 character hex value) |
|---|---|
| 1 | 0xE3-88-B0-9A-74-F4-94-8E-5D-C0-CC-8A-18-9A-B9-B2 |
| 2 | 0xC3-0A-B4-F4-92-08-FF-EA-24-FF-17-5D-94-96-70-72 |
| 3 | 0x88-31-C5-46-D3-EC-8B-9F-FF-48-44-9F-A9-4E-8F-20 |
| 4 | 0x92-43-32-87-0C-22-37-A3-E1-06-6A-9F-F8-F2-CC-1E |
| 5 | 0x90-F6-C1-30-A0-3E-70-CF-60-81-79-53-6C-35-3F-7E |
| 6 | 0x03-77-AA-71-8A-AC-D3-6D-1B-30-CA-20-D1-56-31-A9 |
| 7 | 0x97-28-EB-4E-AE-3B-93-6C-32-EA-07-9D-F8-18-47-EF |
| 8 | 0xC1-E5-23-3A-D2-1A-92-00-B7-8B-34-65-90-E1-BD-40 |
| 9 | 0x8F-DC-FC-E6-E3-B0-EA-DF-96-42-7F-93-98-CE-3F-0C |
| 10 | 0x3F-C4-29-23-C9-01-DE-E0-0B-BB-DD-19-40-B4-13-DA |
| 11 | 0x42-95-0A-45-CF-AB-F1-6E-86-8D-96-F0-5E-F1-8F-7B |
| 12 | 0x87-36-32-E9-5D-0D-99-BB-1F-57-46-5C-55-5E-E9-D2 |
| 13 | 0x05-11-38-7F-A6-EB-93-A2-43-91-96-F1-9C-EE-67-3A |
| 14 | 0x4C-EF-11-A0-1D-FB-A0-5E-C0-01-9E-80-78-C1-B5-88 |
| 15 | 0x40-7C-C3-9F-D5-DE-6C-9A-C2-C0-1E-3B-45-FB-EE-B2 |
| 16 | 0xAE-FC-16-6F-9D-15-ED-E0-8C-7F-2B-14-74-85-36-14 |
| 17 | 0x8E-6D-B3-3B-C7-C8-9A-F9-08-AD-1D-C3-63-37-9B-43 |
| 18 | 0xE7-E0-B9-86-90-29-7B-7C-68-D8-6B-0E-52-79-8F-4F |
| 19 | 0xA1-F1-78-71-4B-B7-D3-6B-13-41-90-A4-68-1C-88-8A |
| 20 | 0x51-BD-15-AB-A9-88-5B-F8-11-C0-97-5C-FC-1B-65-E1 |
| 21 | 0xDA-5C-9A-8E-A2-F8-93-53-D9-F0-68-A5-F8-7F-2D-8E |
| 22 | 0x31-69-A5-9D-01-B3-CD-B1-27-0C-8C-B5-E8-F7-A2-D2 |
| 23 | 0x04-E2-36-BE-89-46-7E-08-D5-63-DA-41-67-A2-DC-A5 |
| 24 | 0x4E-BB-16-BF-E6-19-C8-E3-44-98-AF-C4-88-18-53-B0 |
| 25 | 0xEF-BB-12-28-66-47-EC-22-C7-1D-F6-49-6F-BE-A0-3A |
| 26 | 0x63-0F-7E-0F-AF-3C-47-15-2D-A7-20-E0-D2-EC-69-61 |
| 27 | 0x7C-3D-14-A5-BE-9E-E4-A4-71-64-BF-1B-71-C5-3E-D6 |
| 28 | 0xA4-66-0B-F8-27-EB-63-A4-C1-29-69-EC-81-D4-C0-89 |
| 29 | 0xF6-30-95-91-A5-F5-ED-B0-33-39-B6-72-75-CC-B1-93 |
| 30 | 0x13-93-BD-21-44-16-85-C3-5F-A1-A3-DE-89-A7-5B-A2 |
| 31 | 0xE2-32-7B-D2-31-11-CB-0E-D1-54-CC-59-E0-A4-55-4B |
| 32 | 0x54-AC-4C-7E-58-74-32-DF-CE-54-F6-AE-65-F7-54-F8 |
| 33 | 0x7E-D1-D3-B8-7D-3A-1D-EF-DF-13-70-FB-6D-AF-79-49 |

**Table 142–2—User interleaver control seed values**

| User interleaver | 128-bit control seed sequence (represented by a 32 character hex value) |
|---|---|
| 34 | 0x27-CC-FF-46-F2-C9-4A-45-A9-35-80-D2-44-69-A4-CE |
| 35 | 0x99-27-52-B8-96-3F-C0-90-98-9F-6D-A0-7C-FC-D3-B3 |
| 36 | 0x13-D3-9E-3C-5A-B4-AD-76-CF-8B-82-5F-E9-02-A5-EA |
| 37 | 0xB3-AD-1C-D1-ED-F5-17-4B-AF-4B-07-54-F6-30-5E-81 |
| 38 | 0x22-76-62-36-B9-92-4F-83-AB-04-E7-37-B6-4C-D2-7D |
| 39 | 0x5F-3C-DE-A1-05-AE-02-99-24-CC-A2-89-8D-57-C3-E7 |
| 40 | 0xAF-E4-7D-A0-B9-F6-CC-51-2D-B8-C9-FD-B6-8A-E9-B2 |
| 41 | 0x94-E7-58-DF-61-7B-DA-BF-C0-C4-72-15-C7-76-99-5C |
| 42 | 0x34-64-0A-89-2E-46-63-46-C0-A8-26-FD-46-60-F3-C7 |
| 43 | 0x89-54-48-83-50-C6-B4-72-35-F4-C8-47-6C-2B-D2-50 |
| 44 | 0xFB-68-B2-9B-CA-E6-F1-50-4B-ED-AA-C9-9F-DC-77-66 |
| 45 | 0x08-34-F8-F3-5F-4A-B4-E5-49-85-F1-C7-91-BF-A7-6A |
| 46 | 0x9D-C7-37-D5-C6-91-7C-D0-60-CC-66-3A-AF-A6-A7-91 |
| 47 | 0x01-89-6B-6C-8C-6E-35-B5-12-B4-BB-BC-41-AA-DF-EC |
| 48 | 0xF0-73-F8-02-02-9B-8B-38-1B-78-F2-70-51-96-2A-5C |
| 49 | 0x67-AE-64-C5-1B-B3-B0-CE-E6-89-B1-6F-B3-57-8C-80 |
| 50 | 0x84-C3-F1-40-85-82-DE-32-FB-43-EF-1C-A0-02-15-D4 |
| 51 | 0x6E-73-3D-34-85-62-EF-E1-F1-8F-C6-09-6D-19-B9-5A |
| 52 | 0x57-89-78-DB-42-D9-19-C5-11-2A-79-B4-77-F7-E4-28 |
| 53 | 0x87-03-83-E6-F6-C6-A0-F3-D5-65-84-63-83-07-42-4A |
| 54 | 0x4F-B7-69-FC-30-0E-5A-5B-0E-E8-D8-97-68-43-F0-74 |
| 55 | 0xCF-AF-92-E6-AA-BF-CE-5C-B3-F2-2E-03-02-F1-C8-EC |
| 56 | 0x43-29-FB-56-A6-57-01-9F-91-3F-BA-7A-B0-A5-7F-B3 |
| 57 | 0x1C-61-92-BE-C8-C3-FA-E3-B5-8B-B8-D0-7A-9B-B1-D7 |

**Table 142–3—Parity interleaver control seed values**

| ~~User~~ Parity interleaver | 128-bit control seed sequence (represented by a 32 character hex value) |
|---|---|
| 1 | 0x11-C7-DC-59-9A-61-76-D9-E3-44-BF-75-2E-AA-34-AF |
| 2 | 0x5F-5C-F0-20-9A-E9-B4-4B-CD-F9-52-C8-22-8D-F0-89 |
| 3 | 0x89-34-9C-4B-F1-90-13-0B-F8-BE-47-6B-29-BB-96-3C |
| 4 | 0xA2-6D-3B-8D-CC-B1-D9-C4-5E-FC-11-9F-AE-07-A6-C6 |
| 5 | 0xAC-45-29-CC-E5-2C-C7-D0-60-47-ED-32-76-4F-84-7B |
| 6 | 0x92-3A-DC-97-5B-23-62-9A-FB-81-BE-93-EC-AB-25-BF |
| 7 | 0x2C-4D-73-01-D3-01-D8-B8-9A-73-4A-3F-0A-E4-B6-F5 |
| 8 | 0xEF-CA-A9-2F-10-18-34-42-46-D4-BD-83-48-59-6A-BE |
| 9 | 0x72-18-53-70-16-E0-84-4B-8E-D7-96-F8-07-AA-A5-8D |
| 10 | 0x4D-F0-5D-35-75-9E-07-C9-56-6E-B1-4F-2B-22-43-90 |