



SCSI

IT Essentials Chapter 1

SCSI

- The Small Computer Systems Interface (SCSI) is based on an older, proprietary bus interface called Shugart Associates System Interface (SASI).
- SASI was originally developed in 1981 by Shugart Associates in conjunction with NCR Corporation.
- In 1986, a modified version of SASI that provided a beefier, open system was ratified by the American National Standards Institute (ANSI) as SCSI.

SCSI

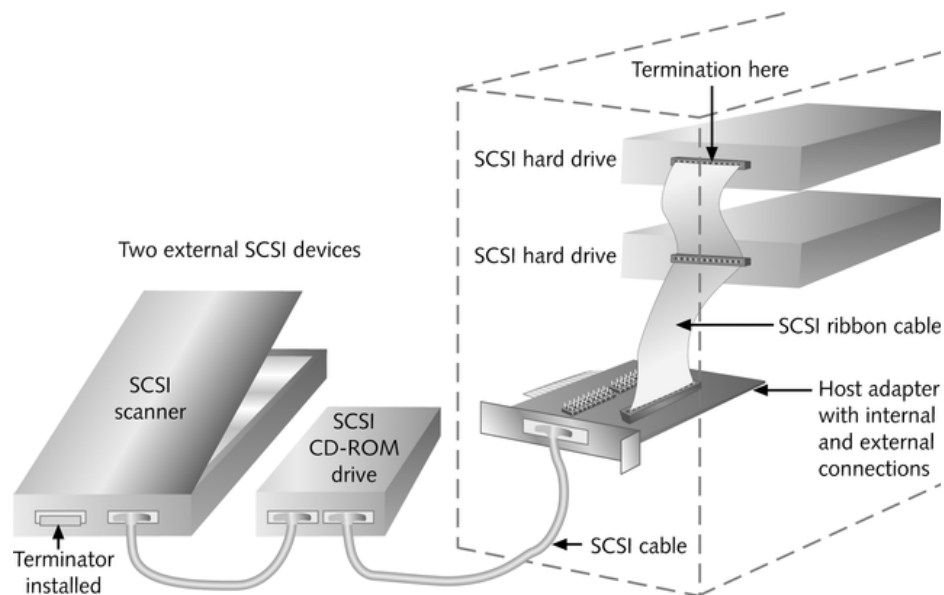
- There are several benefits of SCSI:
 - It's fast -- up to 160 megabytes per second (MBps).
 - It's reliable.
 - It allows you to put multiple devices on one bus.
 - It works on most computer systems.
- Mixing disk drives from the different versions of SCSI can seriously impact performance of the SCSI channel.

SCSI

- A SCSI interface will allow up to **7** or **15** devices to be connected to one SCSI adapter or controller. If the SCSI card is counted, it makes 8 SCSI devices.
- Such devices may include hard drives, CD-ROM drives, taped drives, scanners, and removable drives.
- Each SCSI device in the chain, including the SCSI controller card is given a SCSI ID number from 0 to 15;
 - #0 for the primary boot device (hard drive)
 - #7 for the SCSI controller card
- Each end of the SCSI chain has a terminating resistor
- Each device on the bus is assigned a SCSI ID

Host Adapter

- Gateway from the SCSI bus to the system bus
- Manages all devices on SCSI bus
- Supports internal and external SCSI devices
- Forms a single daisy chain with devices



BIOS

- Look for a host adapter that is PnP compatible and has a configuration utility built into its ROM
- SCAM = SCSI Configuration AutoMatically
 - Method by which SCSI devices and the host adapter can be PnP compliant
- Check for software that configures termination and assigns system resources
- See how many devices the BIOS supports (up to 15 is best)

Expansion Slot

- Host adapter must fit the expansion slot you plan to use:
 - PCI bus
 - ISA or EISA
 - VL-bus

Bus Mastering

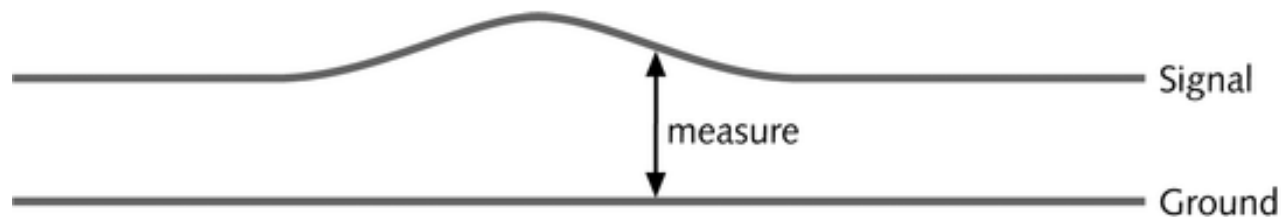
- Two devices on SCSI bus can pass data between them without going through CPU; convenient for back up
- Choose a host adapter that supports bus mastering, if your system bus supports it

SCSI Device Drivers

- Enable OS to communicate with a host adapter
- Two popular driver types
 - ASPI (Advanced SCSI Programming Interface) – more popular of the two
 - CAM (Common Access Method)

Single-Ended Signaling

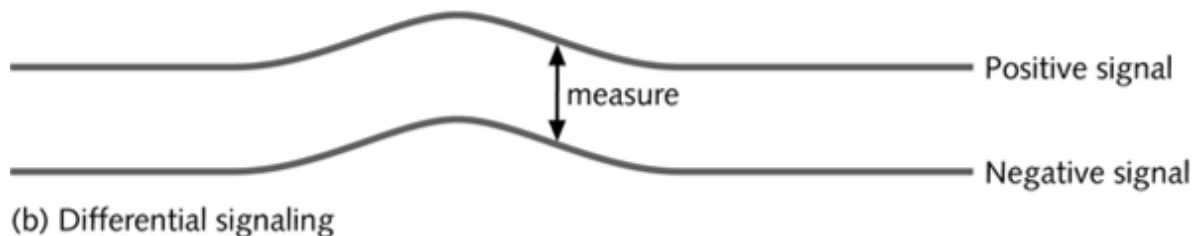
- Send a signal on a pair of twisted wires; one carries voltage, the other is a ground
- Less expensive, but maximum cable length cannot be as long because data integrity is not as great



(a) Single-ended signaling

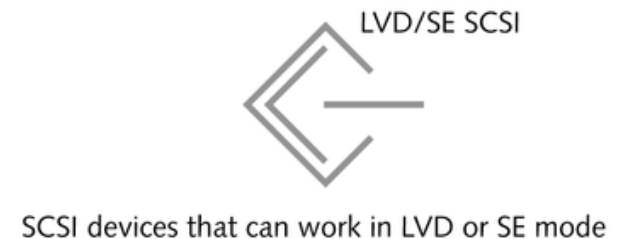
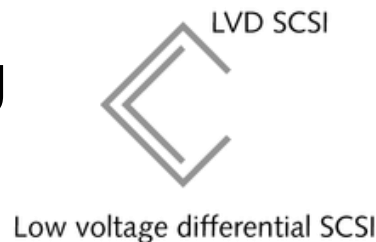
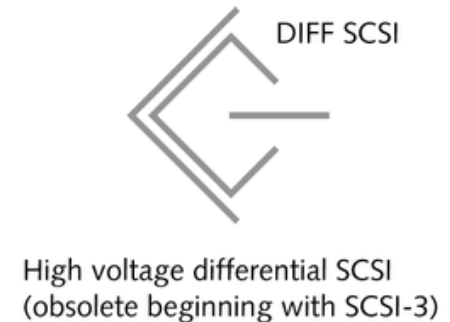
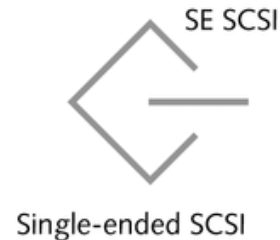
Differential Signaling

- Send a signal on a pair of twisted wires; both carry voltage, and the signal is calculated to be the difference between the two voltages
- Better signal accuracy
- Greater reliability and reduction in chance of data errors
- High Voltage Differential (HVD)
- Low Voltage Differential (LVD)



Signaling Symbols

- To help identify the signaling system used by SCSI devices (controllers and drives), a system of symbols has been devised to identify the different signaling systems.

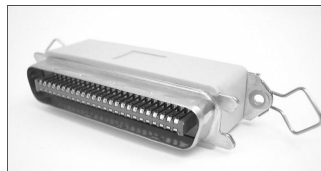


SCSI Versions

- Three major versions of the SCSI standard are currently on the market. They are SCSI-1, SCSI-2, and SCSI-3.
- Installation of SCSI devices among the three different SCSI standards is very similar.
- The differences are mainly in the size of the SCSI connector that is used to connect the SCSI disk drive to the SCSI cable.
- There are also three signaling systems that can be used by SCSI devices. The three signaling systems are
 - single-ended (SE)
 - high-voltage differential (HVD)
 - low-voltage differential (LVD)
- There is no difference in the connectors used among the three different signaling systems.

Ways to Terminate a SCSI Chain

- Termination provides an echo effect from electrical noise and reflected data at the end of the SCSI daisy chain
- Three way to terminate:
 - Host adapter can have a switch setting that activates or deactivates a terminating resistor on the card
 - Device can have either a single SCSI connection or two connections (external terminator)
 - Device at end of the chain can be terminated by a resistor physically mounted on that device



Types of Terminators

- Passive terminators - only regulate the impedance of the line.
- Active terminators - a type of single ended SCSI terminator with a built-in voltage regulator to compensate for variations in terminator power.



Bus Width

- Narrow SCSI (8 bits)
- Wide SCSI (16 bits)

SCSI or SCSI-1

- SCSI-1 (Narrow only), originally just known as SCSI, was used by many Apple computers in the early 1980s. By today's standards it was rather slow.
- The SCSI bus ran at 5 MHz using an 8-bit data path. This allowed a data transfer rate of 5 MBps.
- SCSI-1 generally supported a single channel per SCSI controller.
- The SCSI-1 internal cable was a ribbon cable that was attached to the disk controller by a 50-pin connector.
- Many early SCSI controllers used a DB-25, 25-pin connector, for external SCSI devices.
- Maximum cable length of SCSI-1 is 6 meters.

SCSI-2

- SCSI-2 uses two different signaling systems, known as single-ended interface and differential interface.
- The two signaling systems are incompatible and cannot be mixed on the same SCSI bus.
 - Make sure that all devices, including the SCSI-2 controller, are all using either single-ended interface or all using the differential interface.
 - The differential interface allows for longer cable lengths and is generally found connecting the server to an external SCSI device.
- Narrow SCSI-2 uses the same 50-pin connector on the internal SCSI cable that is used by SCSI-1 devices.

SCSI-2

- SCSI-2 also has a variant called Wide SCSI-2, which can transfer 16 bits at a time as opposed to the 8 bits at a time used by normal SCSI-1 and normal SCSI-2.
- This Wide bus width requires the use of a 68-pin connector.
- Wide SCSI-2 allows for 16 devices on the SCSI-2 channel, whereas normal SCSI-2 (also called narrow SCSI-2) and SCSI-1 only allow 8 devices on the SCSI channel.
- Another variant of SCSI-2 is Fast SCSI-2, which doubles the bus speed from 5 MHz to 10 MHz. Fast SCSI-2 requires an active termination technique.
- Due to the increased speed, the bus length is reduced from 6 meters to 3 meters.

SCSI-2

- There also is a Fast-Wide SCSI-2 implementation. It requires 68-pin cables, active termination, and short cable length (3 meters), but it can transfer data at 20 MBps.
- SCSI-2 (Narrow SCSI-2) uses 50-pin connectors on the internal SCSI-2 devices.
- Wide SCSI-2 uses 68-pin connectors on the internal SCSI-2 devices.
- The Fast SCSI-2 and Fast-Wide SCSI-2 variants require active termination.
- Regular SCSI-2 and Wide SCSI-2 can use passive termination, although active termination is preferred.

SCSI-3

- SCSI-3 is the latest standard of the SCSI family. It combines all the best features of the previous SCSI standards.
- It uses LVD differential signaling and supports up to 15 devices on a single cable.
- The cable can be up to 12 meters long.
- SCSI-3 supports three different bus speeds:
 - Ultra (20 MHz)
 - Ultra2 (40 MHz)
 - Ultra3 (80 MHz).
- There are both narrow (8-bit) and wide (16-bit) implementations of the three SCSI-3 bus speeds.
- Ultra SCSI-3 and Ultra2 SCSI-3 both use 50-pin connectors. The wide variants (Wide Ultra SCSI-3 and Wide Ultra2 SCSI-3) as well as Ultra3 (also known as Ultra160 SCSI-3) use 68-pin connectors. All versions of SCSI-3 require active termination.

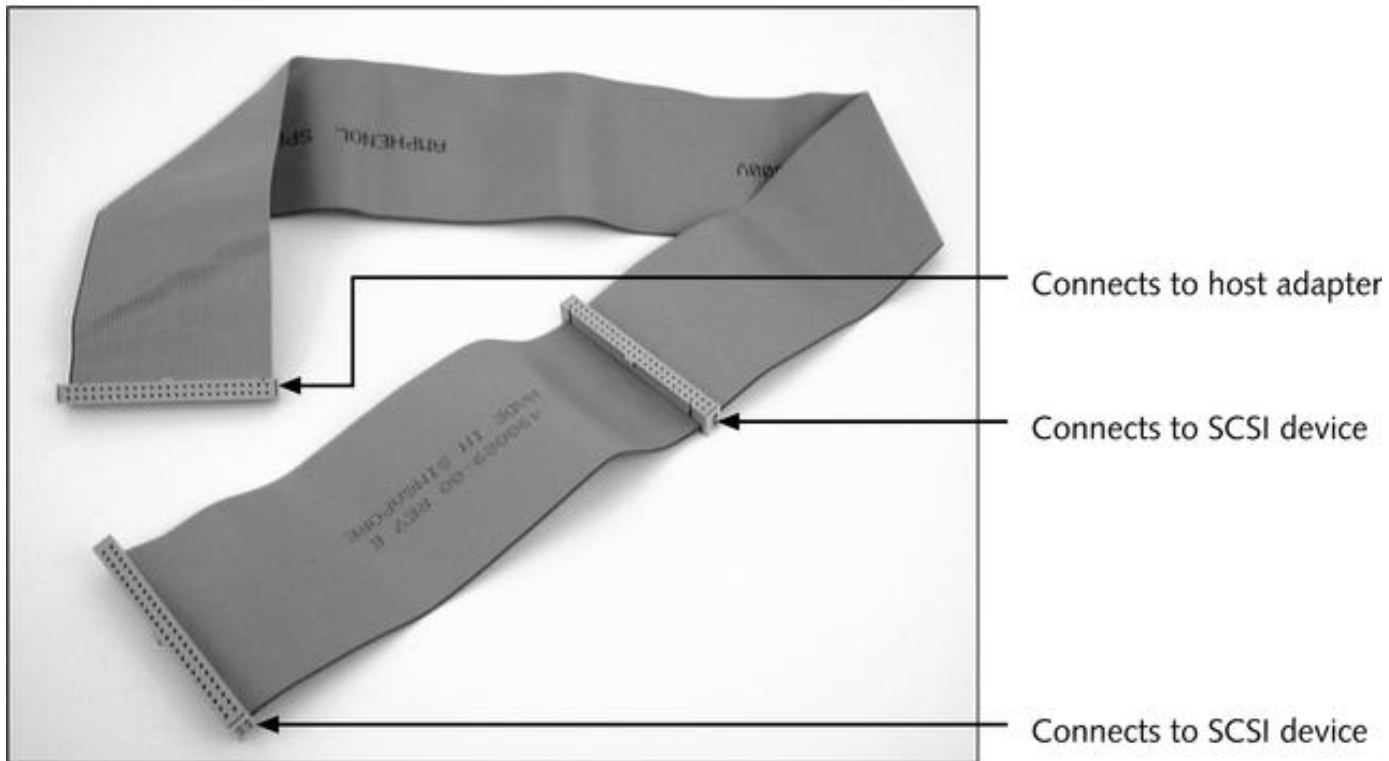
SCSI Standards

Standard Name	Standard Number	Bus Width	Transfer Rate	Max Devices	Single Ended	Differential	Cable Connector
SCSI	SCSI-1	Narrow	5 MB	8	6 m	25 m	50-pin
Fast SCSI or Fast Narrow	SCSI-2	Narrow	10 MB	8	3 m	25 m	50-pin
Wide SCSI or Fast Wide SCSI	SCSI-2	Wide	20 MB	16	3 m	25 m	68-pin
Ultra SCSI or Ultra Narrow	SCSI-3	Narrow	20 MB	8	1.5 m	25 m	50-pin
Wide Ultra SCSI or Fast Wide SCSI	SCSI-3	Wide	40 MB	16	1.5 m	25 m	68-pin
Ultra2 SCSI or SPI-2	SCSI-3	Narrow	40 MB	8		12 m LVD	50-pin
Wide Ultra2 SCSI	SCSI-3	Wide	80 MB	16		12 m LVD	68-pin

SCSI Standards

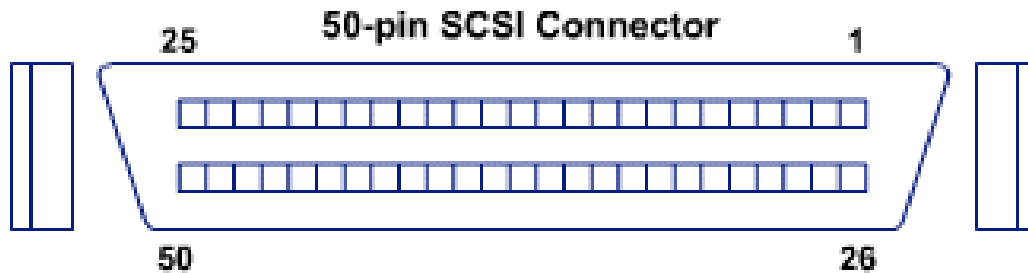
Standard Name	Standard Number	Bus Width	Transfer Rate	Max Devices	Single Ended	Differential	Cable Connector
Ultra3 SCSI or SPI-3	SCSI-3	Narrow	80 MB	8		12 m LVD	50-pin
Wide Ultra3 SCSI or Ultra 160 SCSI	SCSI-3	Wide	160 MB	16		12 m LVD	68-pin
Ultra4 SCSI or Ultra 320 SCSI or SPI-4	SCSI-3	Wide	320 MB	16		12 m LVD	68-pin
Ultra5 SCSI or SPI-5	SCSI-3	Wide	640 MB	16		12 m LVD	68-pin
Ultra6 SCSI or SPI-6 (NR)	SCSI-3	Wide	1,280 MB	16		12 m LVD	68-pin

SCSI Cable Connectors

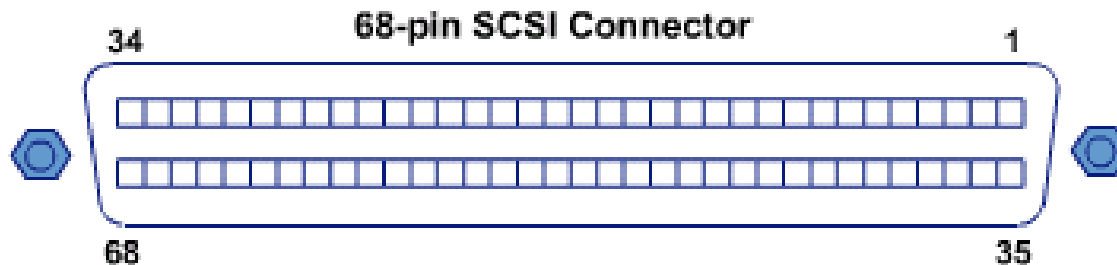


- This is a 50-pin SCSI ribbon cable used to connect two narrow SCSI devices. 68-pin for wide variants.

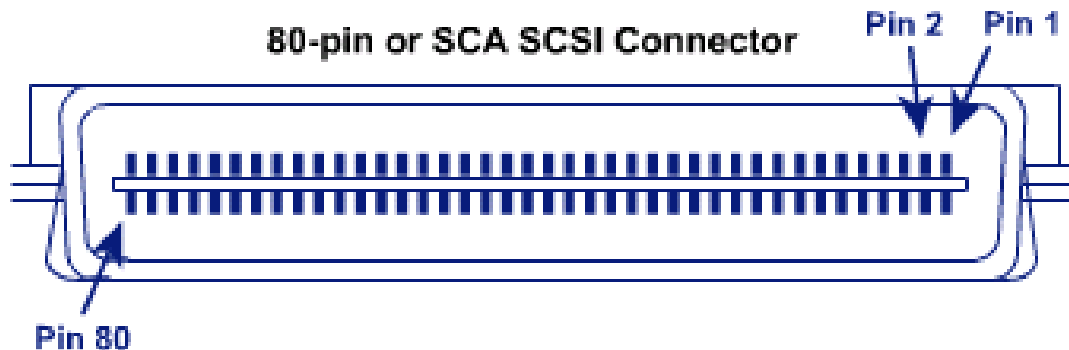
SCSI Connectors



Used by:
 SCSI-1
 Narrow SCSI-2
 Ultra SCSI-3



Wide SCSI-2
 Fast Wide SCSI-2
 Ultra Wide SCSI-3



Used internally for
 hot swappable
 drive.

SCSI Cabling

- **Traditional (Parallel) SCSI**
 - Internal SCSI cables are usually ribbon cables that have two or more 50-pin or 68-pin connectors.
 - External cables are typically shielded (but can be unshielded) and only have connectors on the ends with either 50-pin or 68-pin connectors.
- **Serial SCSI**
 - Uses the same connectors and cables as Serial ATA.
- **iSCSI**
 - Usually uses Ethernet connectors and cables as its physical transport but actually it's not restricted to any physical interface.

Setting Device IDs During Installation

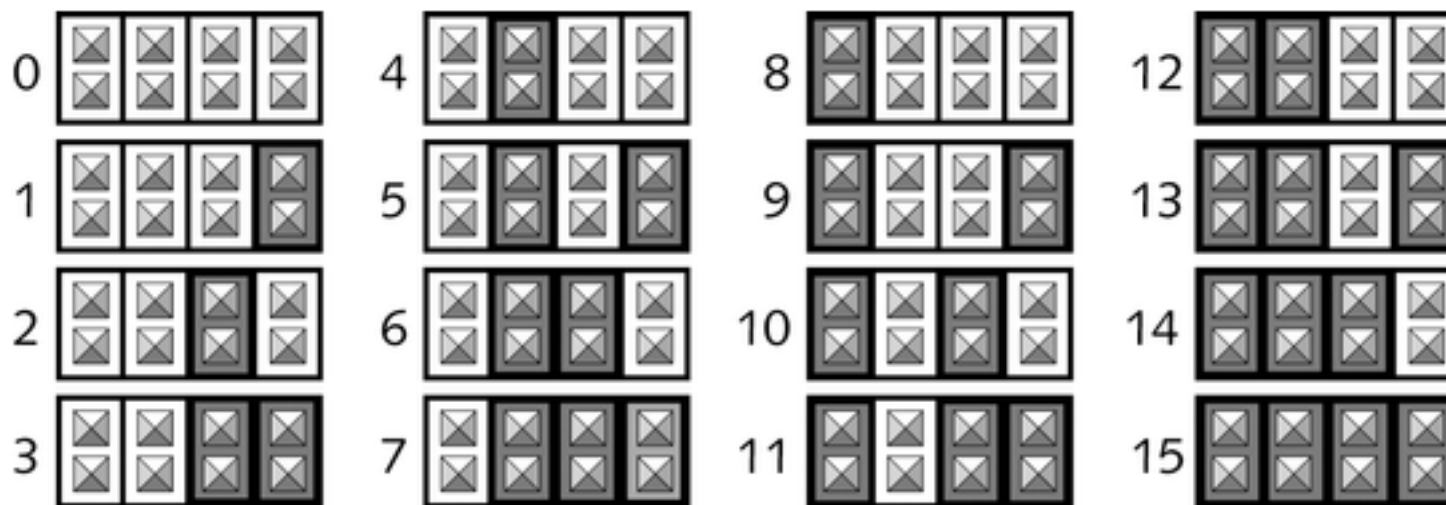
- With SCAM-compliance, SCSI IDs are assigned automatically
- Without SCAM compliance, set device SCSI IDs manually
 - Each ID must be unique; no two devices on same SCSI channel can have same ID number
 - For narrow SCSI, use IDs 0-7
 - For wide SCSI, use IDs 0-15
 - Host adapter gets ID 7
 - Boot device get ID 0

Setting External Device IDs



- This rotary dial on the rear of a SCSI scanner is used to set the SCSI ID, which is now set to 6

Setting Internal Device IDs



- Wide SCSI ID binary jumper setting for internal devices.
- A 3 jumper block will allow up to 7 device IDs.

ID Priority

- Controller #1 gets the highest priority
- Highest ID gets the highest priority

- In a SCSI installation that supports 16 devices, what is the ID Priority order?

7, 6, 5, 4, 3, 2, 1, 0, 15, 14, 13, 12, 11, 10, 9, 8