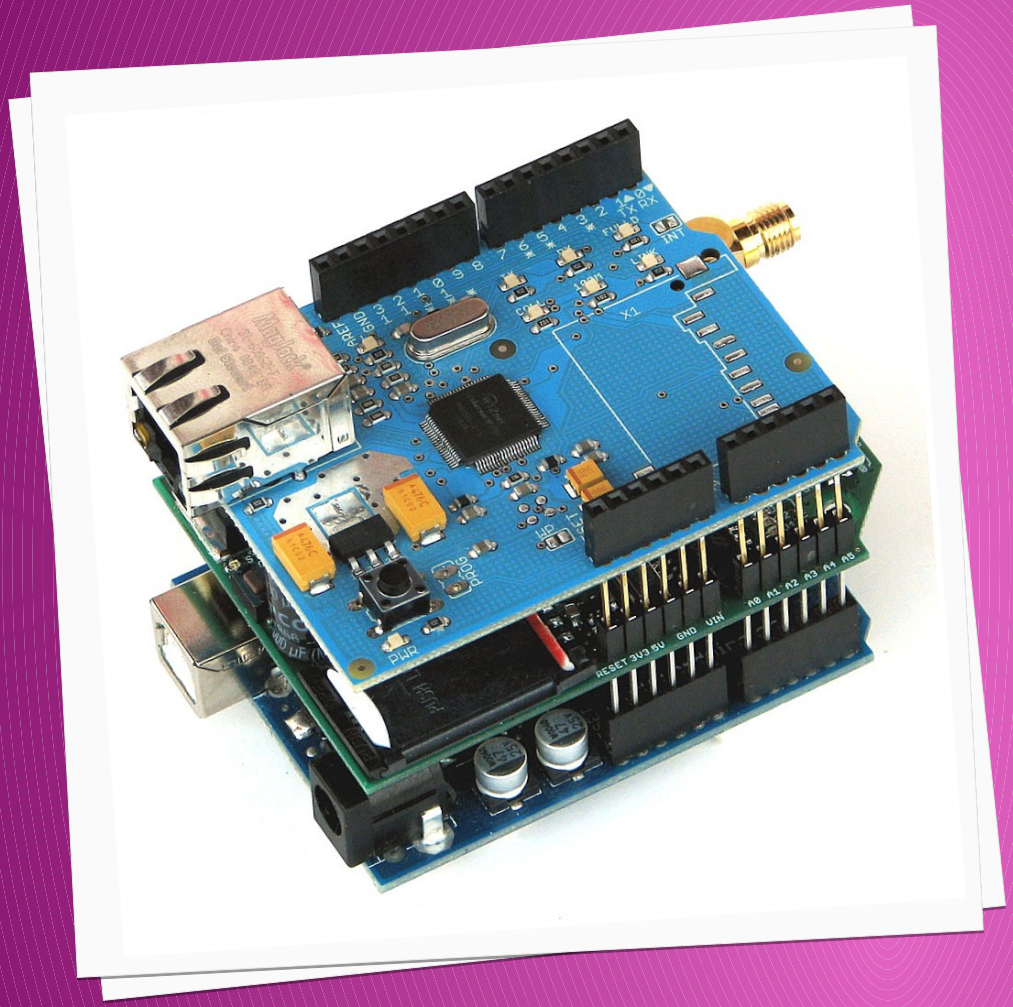
DIGITAL COMMUNICATION

SWAPNIL UPADHYAY

SCOPE OF DIGITAL COMMUNICATION

- Internet
- Mobile Networks
- Wireless Networks

OUR INTEREST

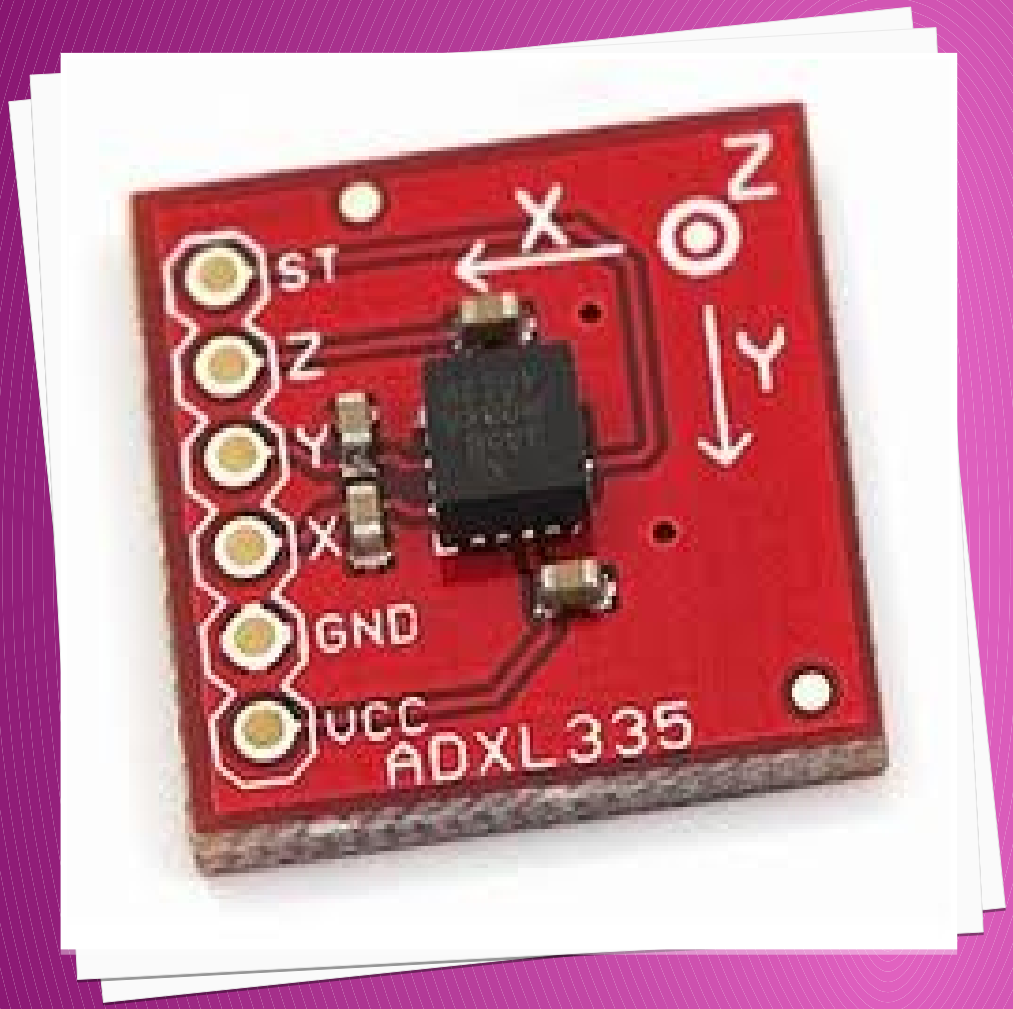


ARDUINO SHIELDS

- Use SPI or UART to communicate with arduino boards

JPG COLOR CAMERA

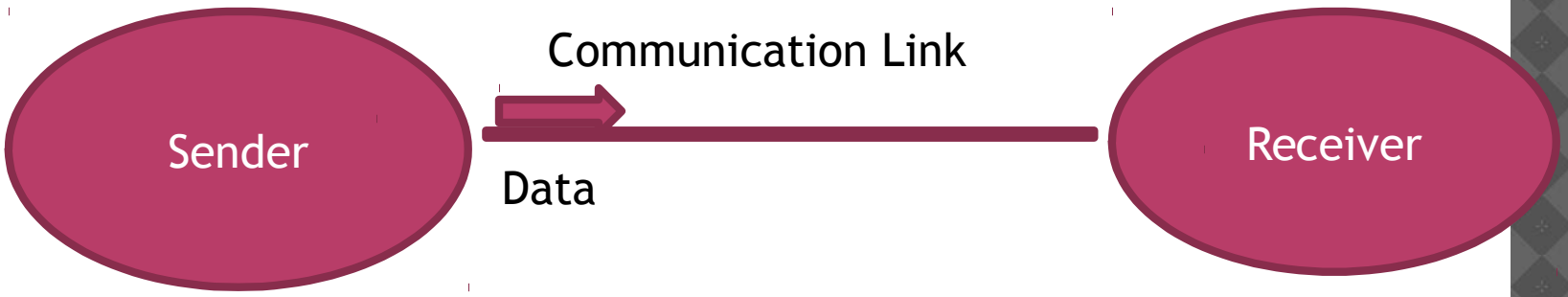
Uses UART to communicate with Master board



ACCELEROMETERS

Communication through SPI

ESSENTIALS OF COMMUNICATION



But this simple model requires many guarantees.

GUARANTEES IN COMMUNICATIONS

- The communication link exists.
- The communication link is sound.
- The sender and receiver are the correct nodes.
- The sender is sending the correct data.
- The receiver is able to correctly interpret the incoming data.

PROTOCOLS IN COMMUNICATION

- In order to have robust communication, the guarantees needs to be realized.
- To do so, we need an elaborate and standardized mechanism.
- These standard rules that defines the parameters of communications and ensures these guarantees are called protocol.

ADVANTAGES OF PROTOCOLS

- Standardized, so interoperability is ensured.
- Usually include error-detection and error-correction mechanisms.
- Are available as implemented chips that can be directly used.

TYPES OF PROTOCOLS

- There are different ways of categorizing protocols
- First Categorization :

Serial Mode Transfer

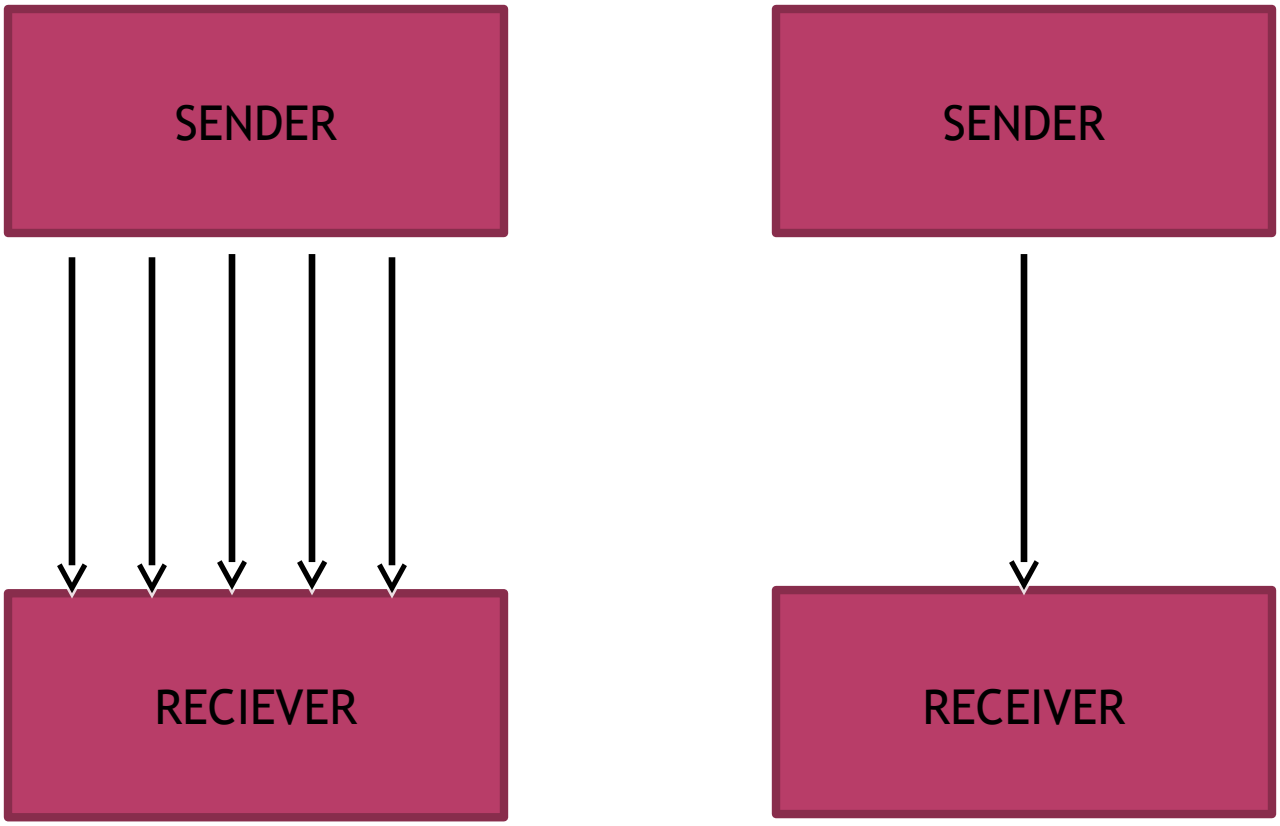
Parallel Mode Transfer

- Second Categorization :

Synchronous Mode Transfer

Asynchronous Mode Transfer

SERIAL AND PARALLEL MODE



PARALLEL MODE

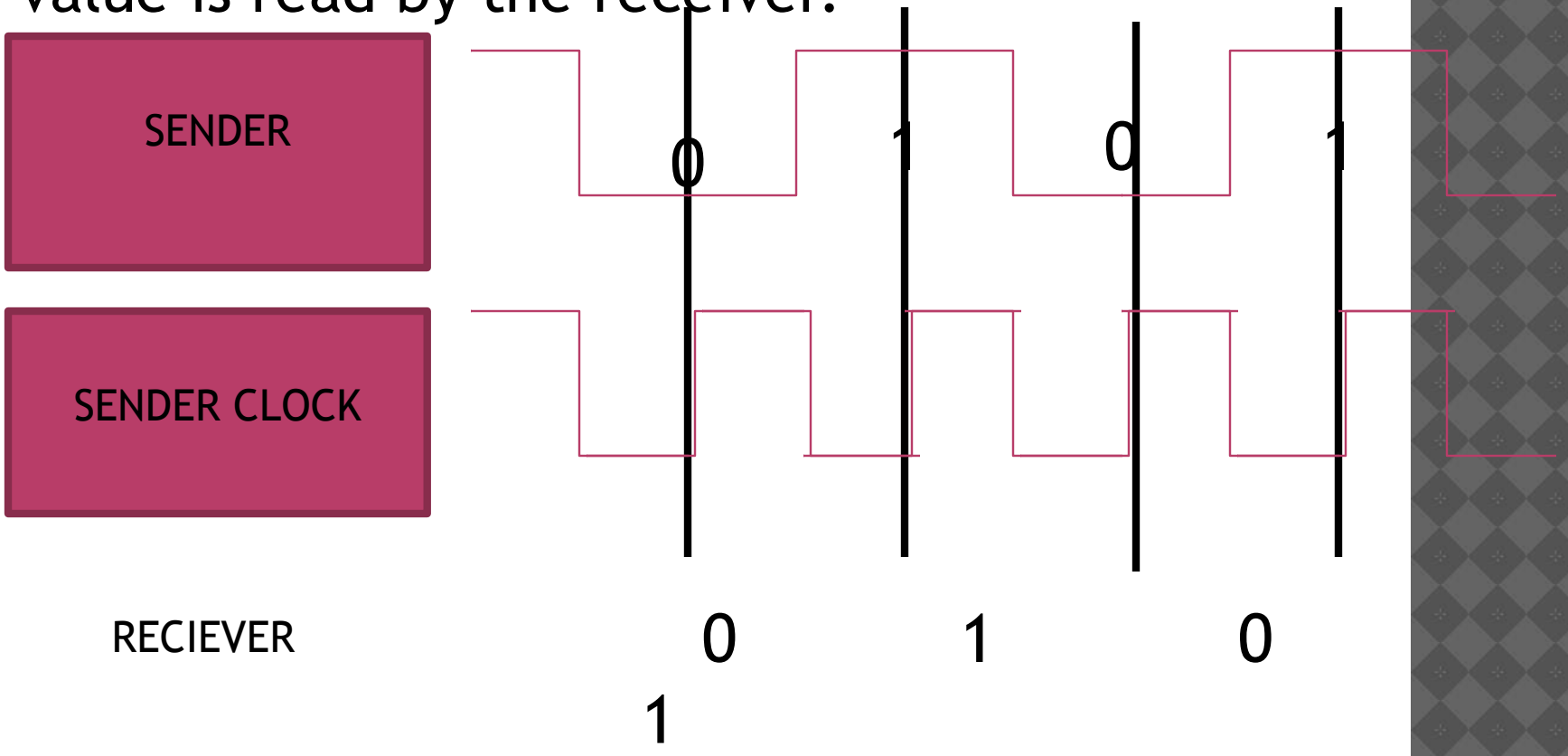
SERIAL MODE

SERIAL VS PARALLEL MODE

Parameter	Serial Mode	Parallel Mode
Reliability	Reliable	Unreliable
Speed	Slow	Fast
Power	Low	High
Cost	Low	High
Complexity	High	Low
Range	Long	Short

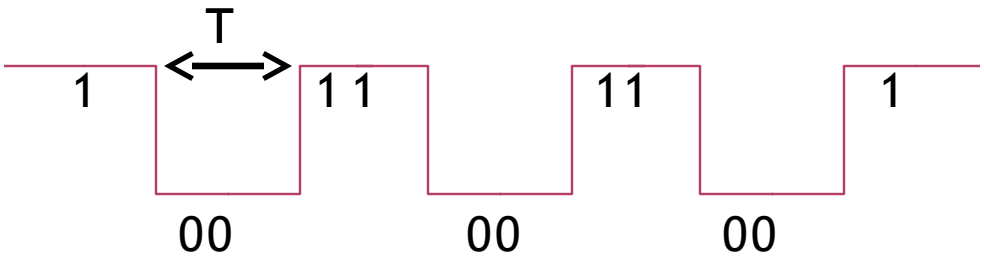
SYNCHRONOUS TRANSMISSION

- Sender sends a clock signal along with data at every rising / falling edge of the clock, the data value is read by the receiver.



NEED OF SYNCHRONIZATION

SENDER



Suppose Sender sends data with a Time Period of T

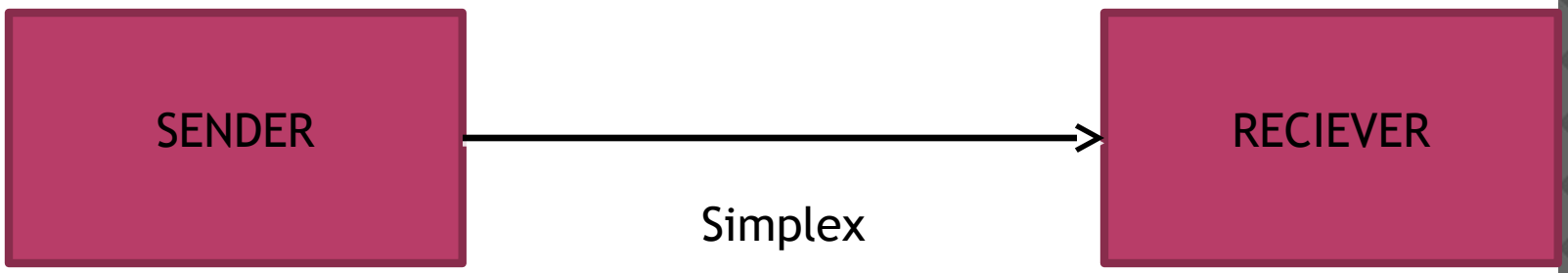
What if Receiver doesn't know the speed and assume it to be say T/2

The Data received will be

ASYNCHRONOUS MODE

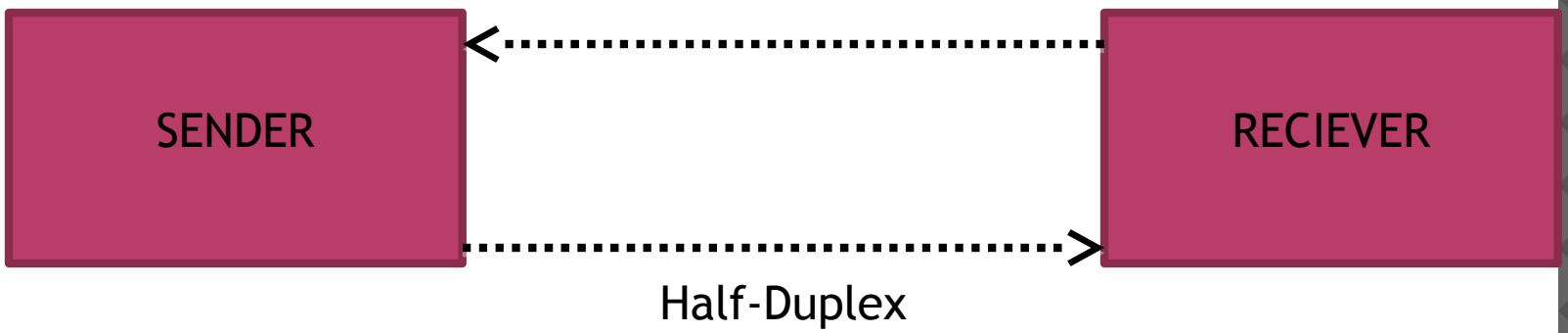
- There is no clock signal.
- The receiver and the sender communicate at a predetermined speed (bauds or bits per second).
- Baud Rate : Baud Rate is a measurement of transmission speed in asynchronous communication. The devices that allows communication must all agree on a single speed of information - 'bits per second'.

TRANSMISSION MODES



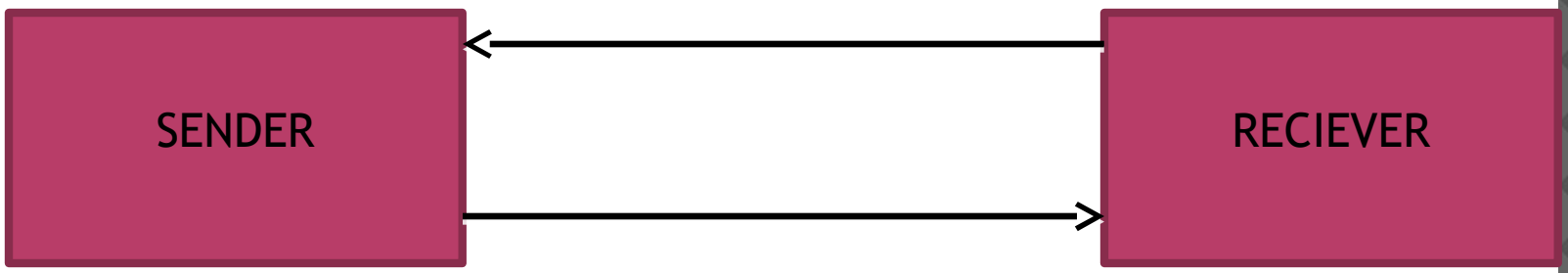
Only one way transmission takes place

TRANSMISSION MODES



Two way transmission takes place but only one end can communicate at a time

TRANSMISSION MODES



Full-Duplex

Two way transmission takes place and both end can communicate simultaneously

UART – UNIVERSAL ASYNCHRONOUS RECEIVER TRANSMITTER

UART

- UART is a simple half-duplex, asynchronous, serial protocol.
- Simple communication between two equivalent nodes.
- Any node can initiate communication.
- Since connection is half-duplex, the two lanes of communication are completely independent.

FORMAT OF UART PACKET

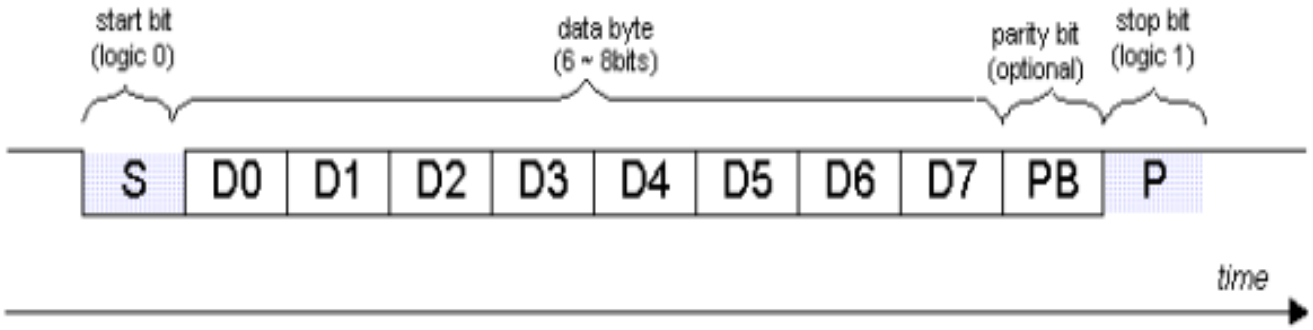
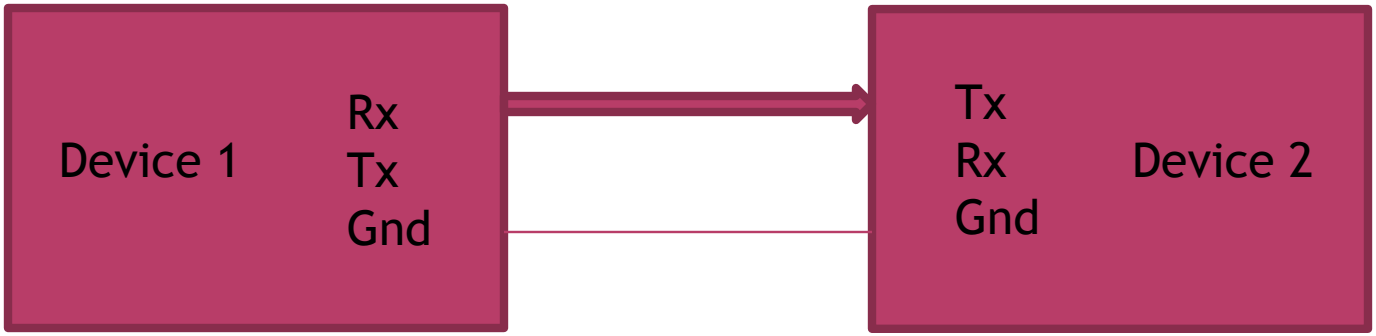


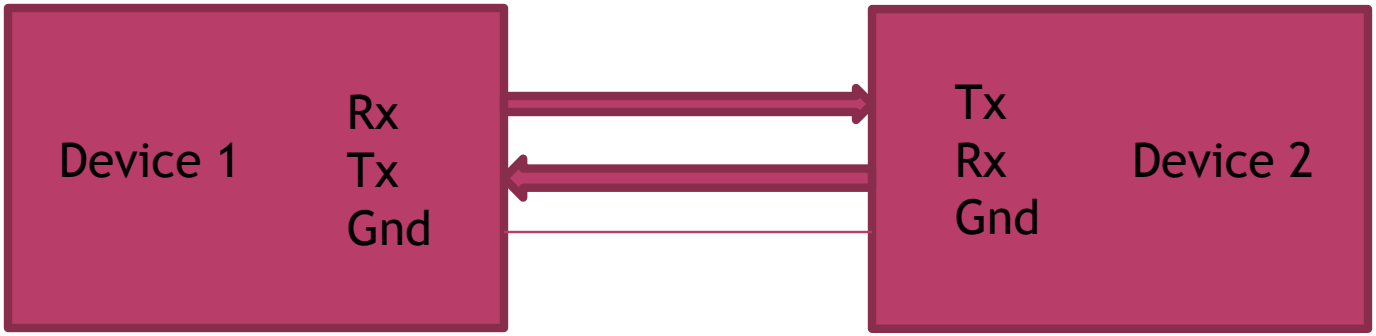
Figure 17: Basic UART packet format: 1 start bit, 8 data bits, 1 parity bit, 1 stop bit.

CONNECTIONS FOR UART

CONNECTIONS FOR UART



CONNECTIONS FOR UART

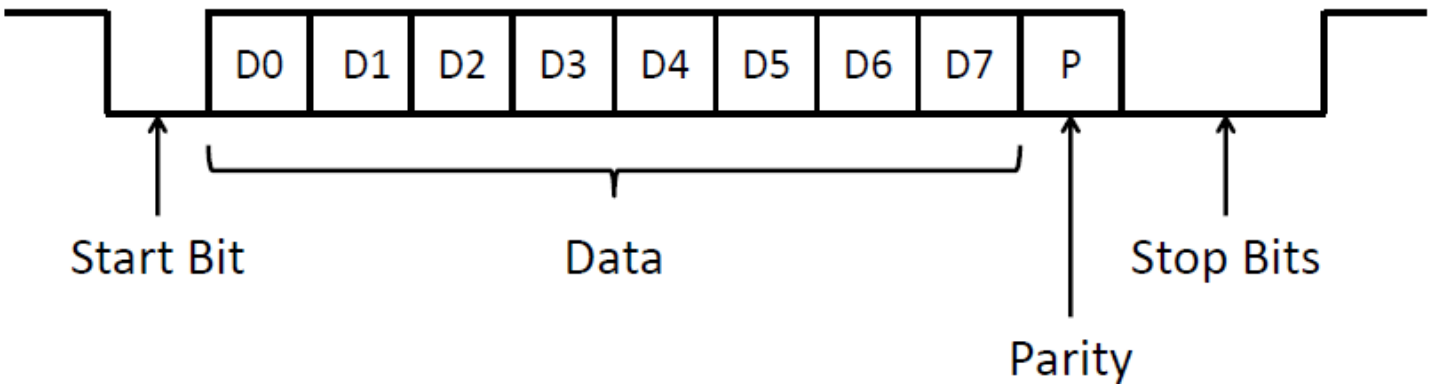


UART CHARACTERISTICS

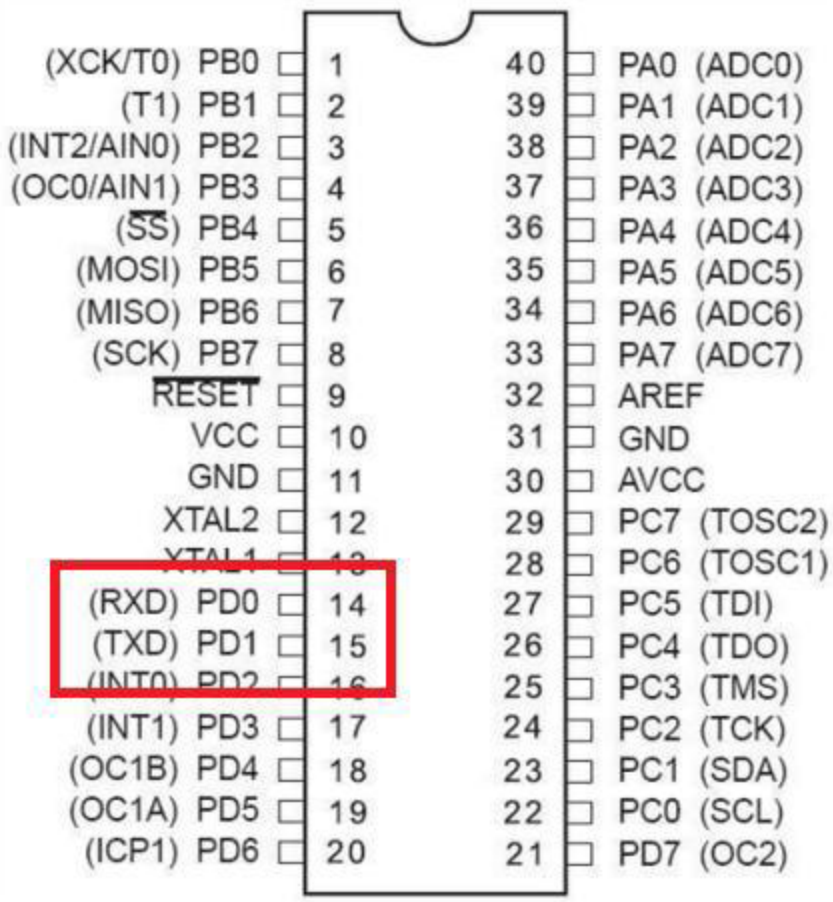
- ⁼ The speed of communication (measured in bauds) is predetermined on both ends.
- ⁼ A general rule of thumb is to use 9600 bauds for wired communication.
- ⁼ UART implements error-detection in the form of parity bit.

PARITY BIT

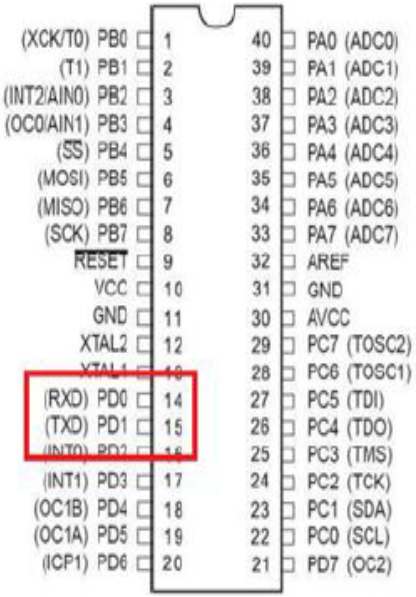
- Parity bit is HIGH when number of 1's in the Data is odd (if bit parity is even).
- Respectively, it is LOW when number of 1's in the Data is even (if parity is even).



UART IN ATMEGA16



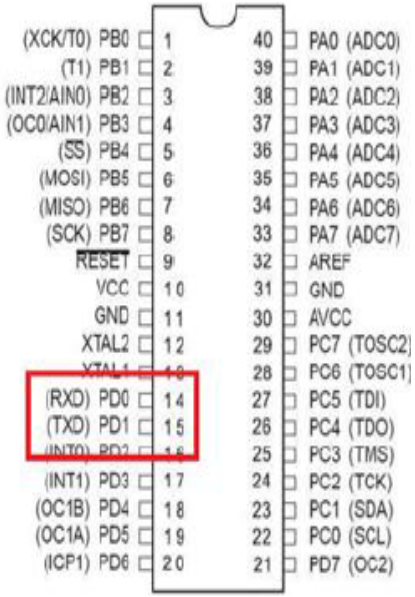
CONNECTING ATMEGA16'S WITH UART



Rx ? Tx

Tx ? Rx

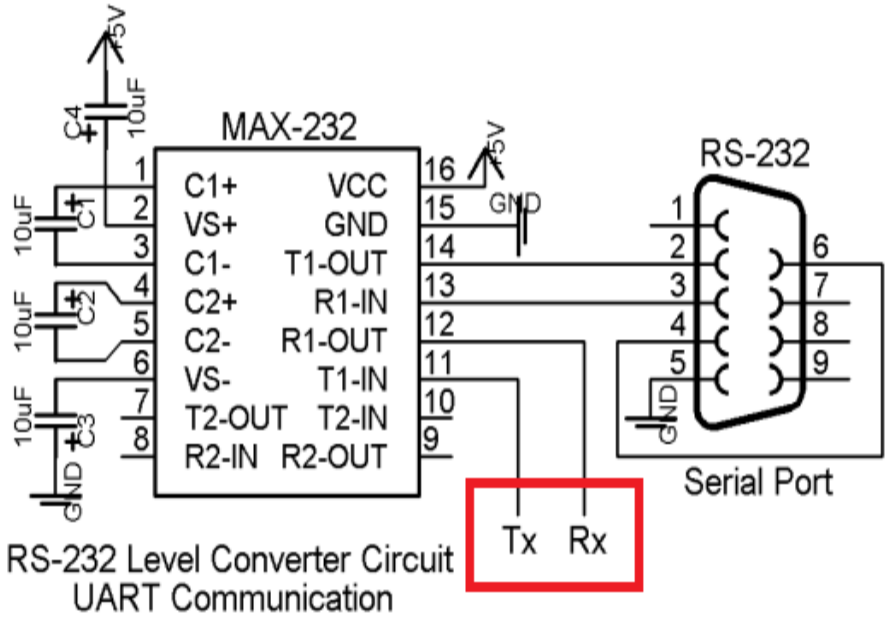
GND ? GND



Device 1

Device 2

MAX-232 AND USB-SERIAL



SPI – SERIAL PERIPHERAL INTERFACE

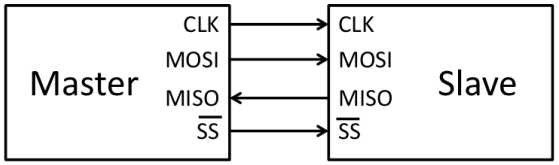
SPI

- Serial ??
- Because it works on serial mode of transfer. It is also synchronous and full duplex.
- Peripheral Interface.
- Because it has the capability of communicate with many nodes.
- How?? Let us see.

SPI

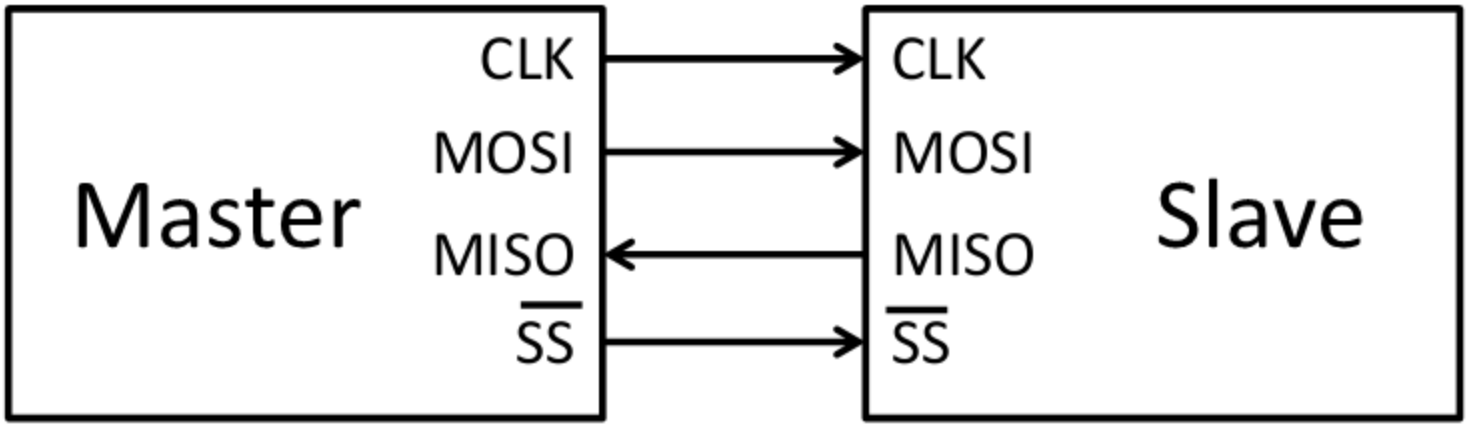
- In SPI, the sender and receiver follows a master-slave relationship.
- There may be multiple nodes in the network.
- One node is master, the rest are slaves.
- The communication is always initiated by the master.
- The slaves can communicate only with the master.
- How do master selects the slave??

SPI PINS

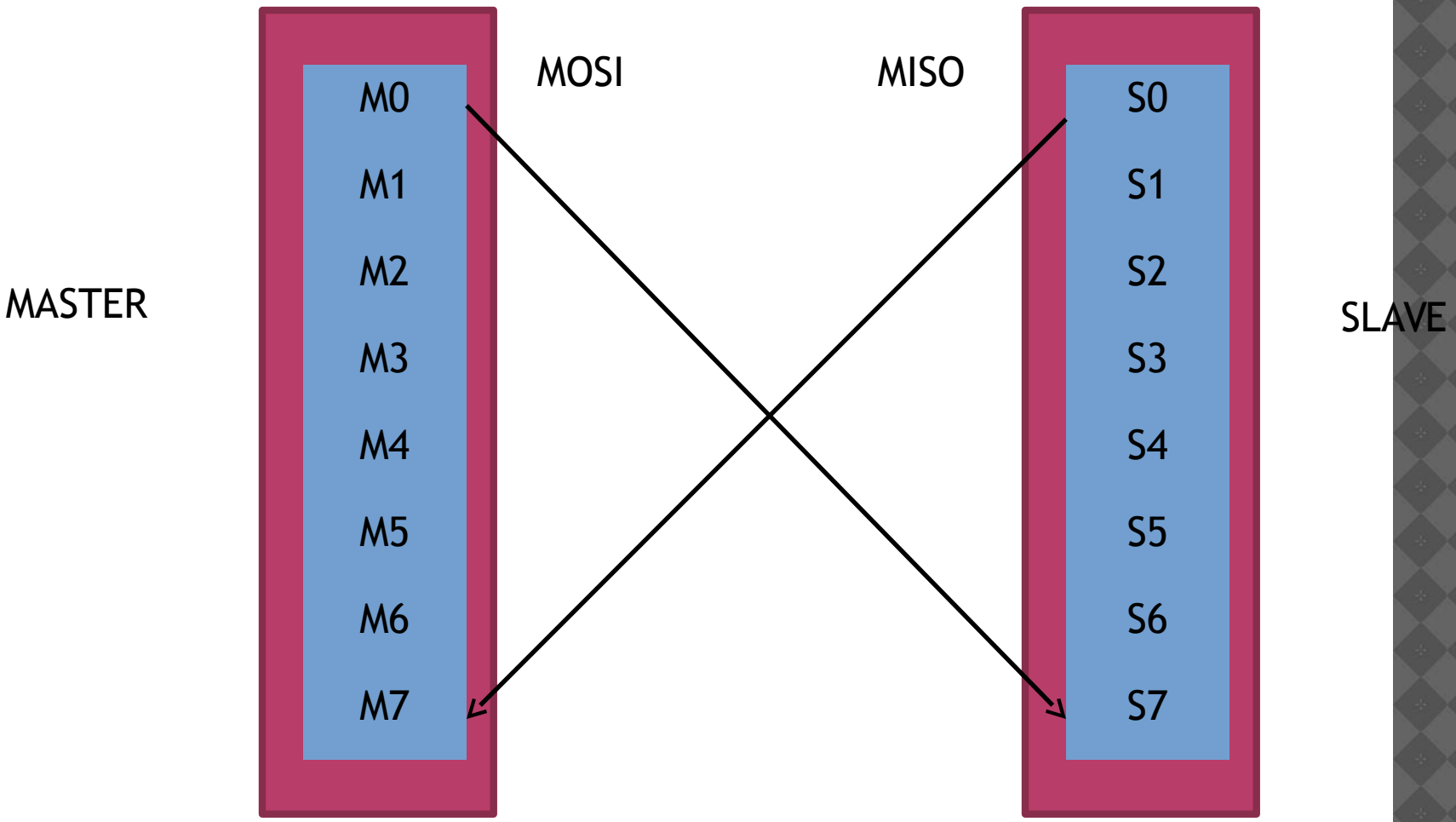


- CLK is generated by Master and is used as the mode is synchronous.
- MOSI is Master Out Slave In: Data sent by Master to Slave.
- MISO is Master In Slave Out: Data sent by Slave to Master.
- $\overline{S}\overline{S}$ is slave select: Slave communicates with Master only if this pin's value is set as LOW.

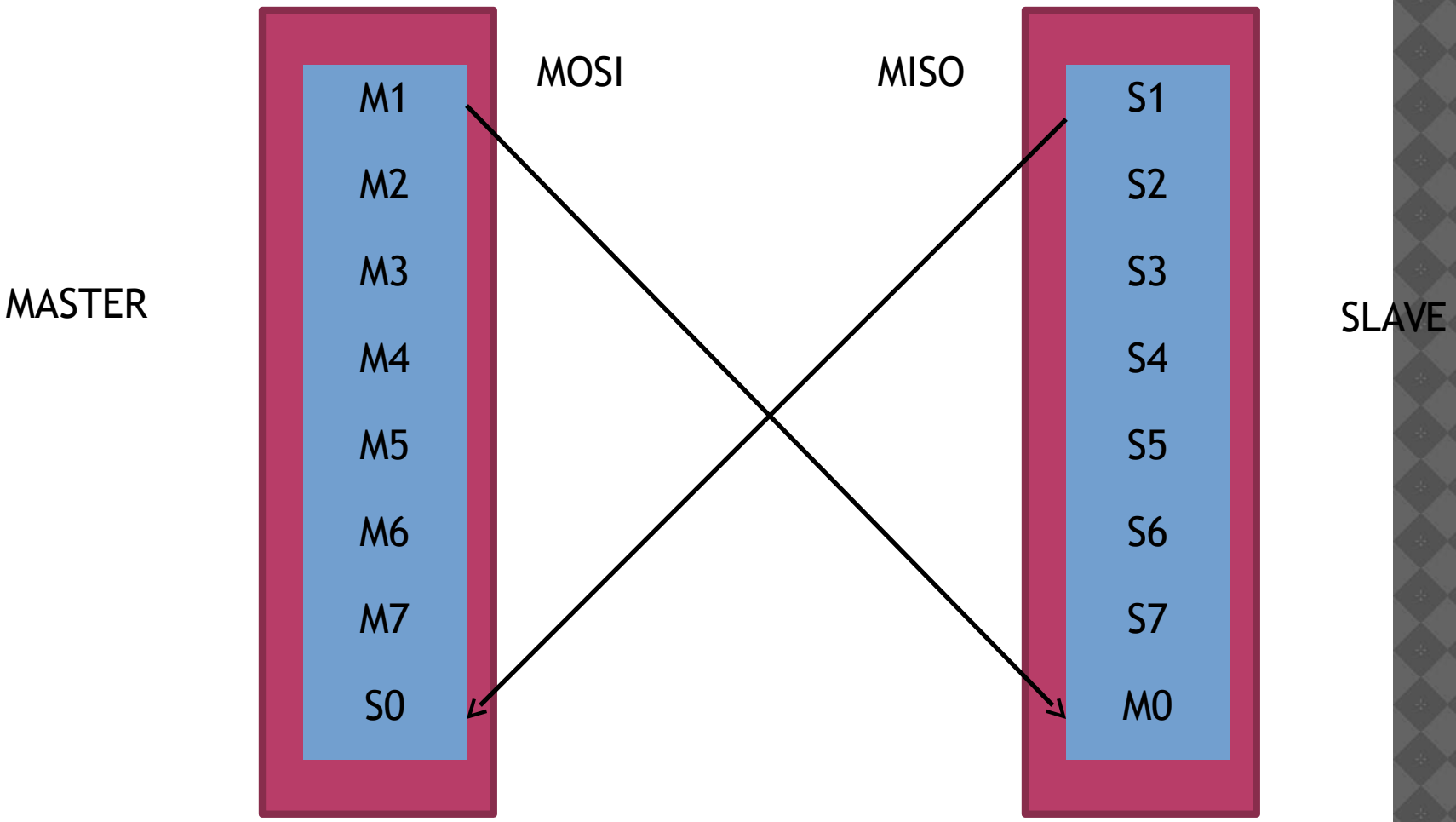
SPI SCHEMATICS: SINGLE SLAVE



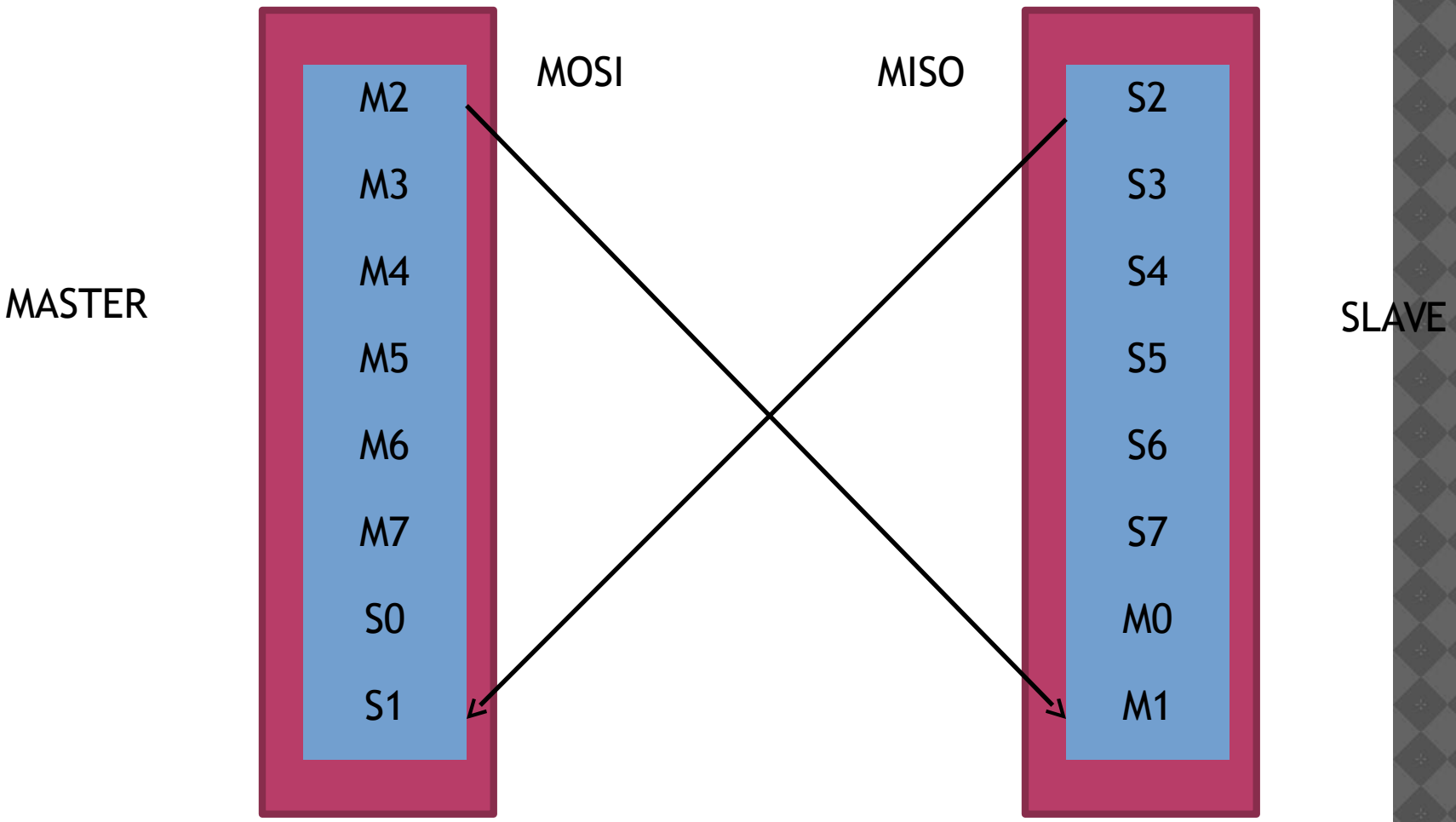
DATA TRANSFER IN SPI



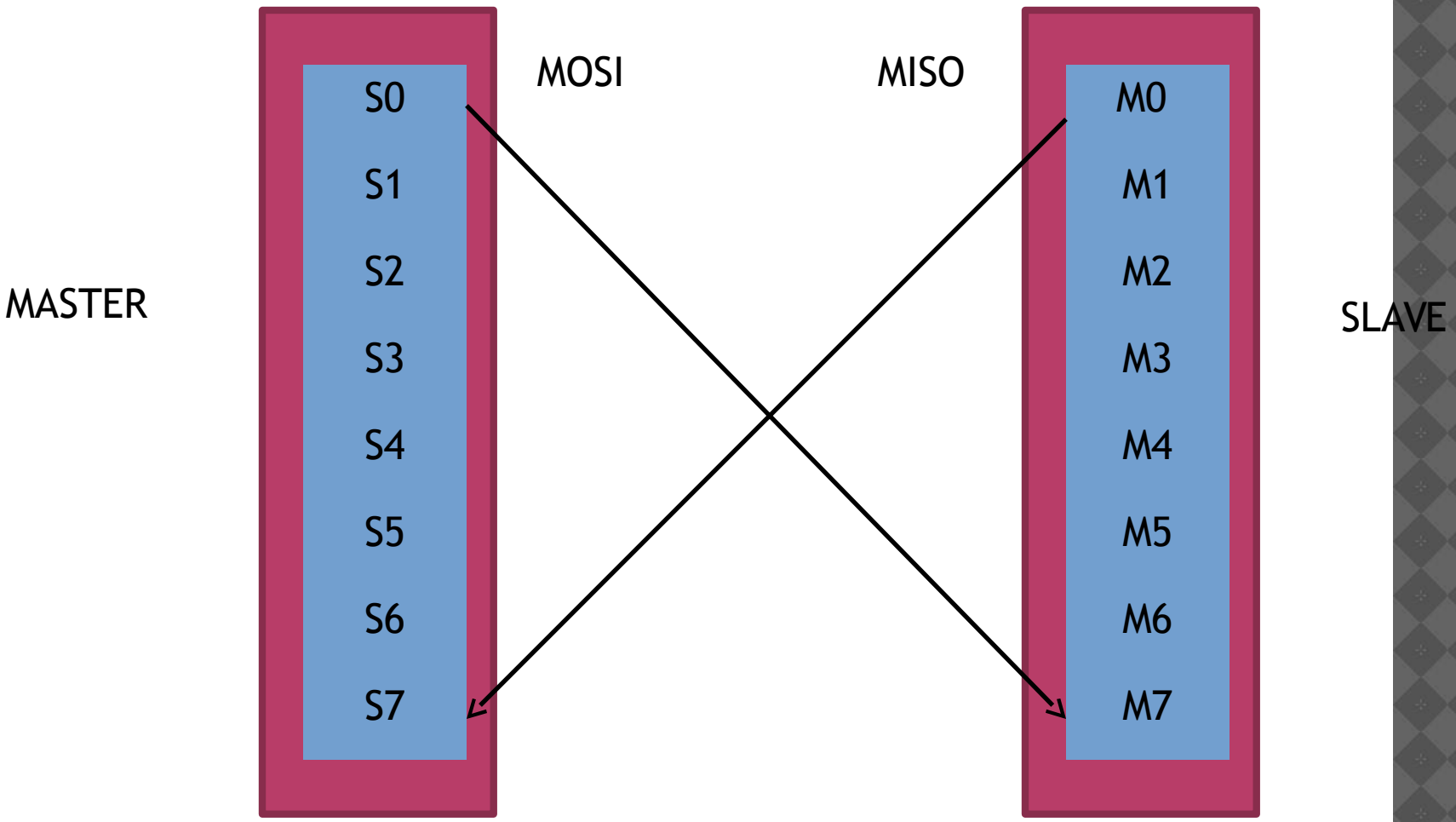
DATA TRANSFER IN SPI



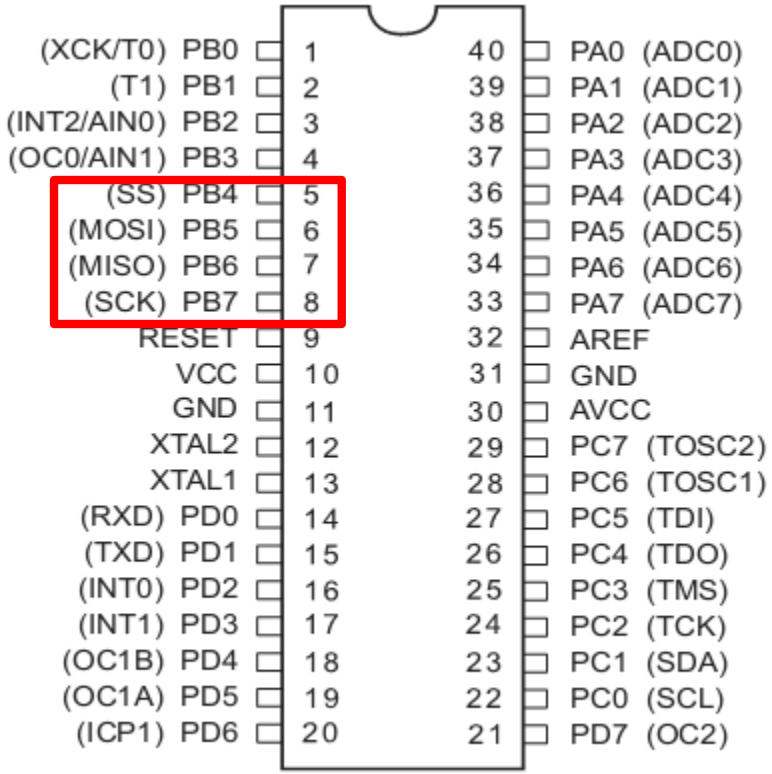
DATA TRANSFER IN SPI



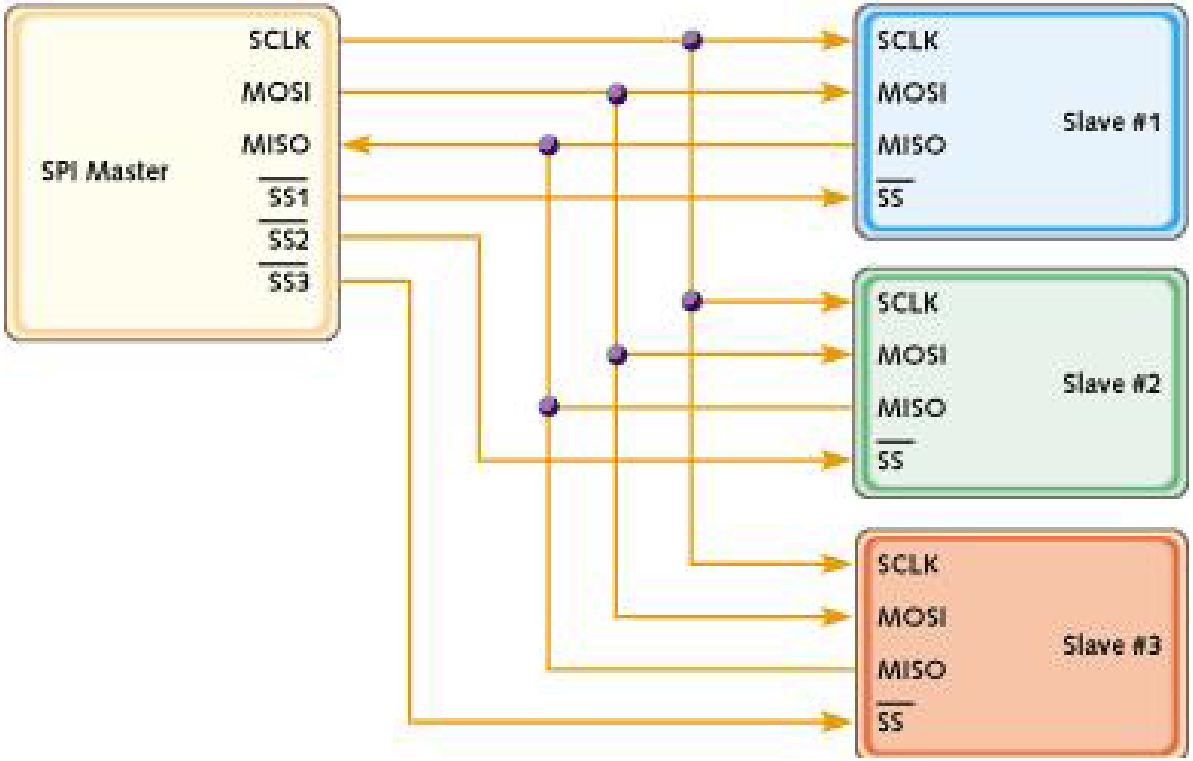
DATA TRANSFER IN SPI



SPI IN ATMEGA 16



SPI SCHEMATICS: MULTIPLE SLAVES



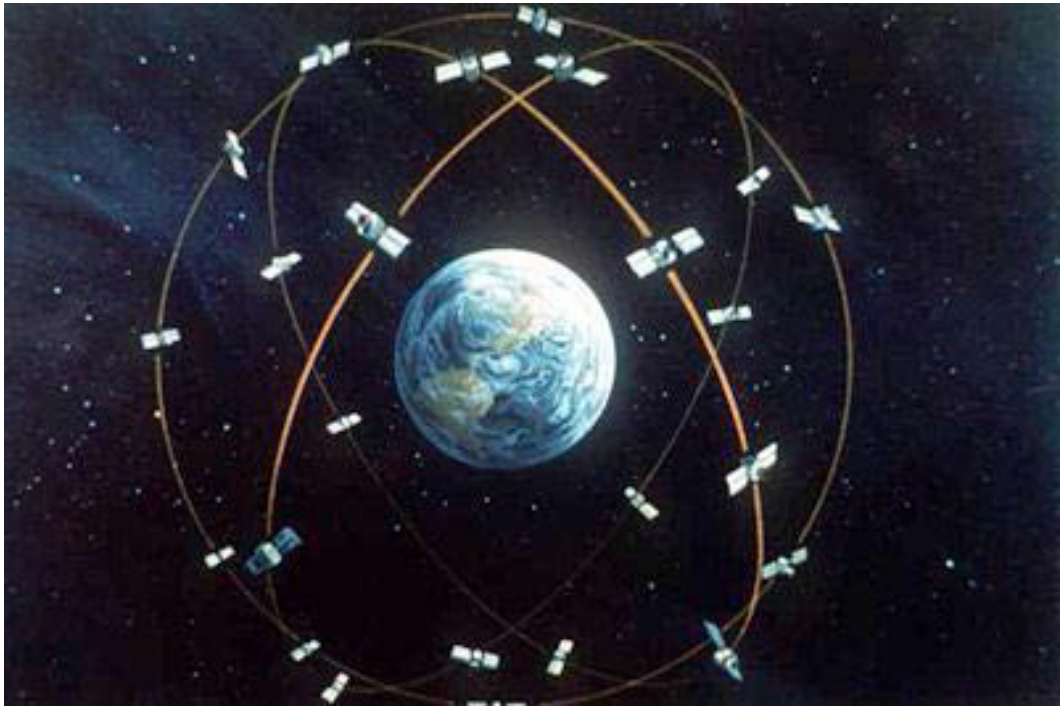
APPLICATIONS

GPS


Sixth Ave
38th St
New Core Labs
SIDBI
Environmental Engineering Bldg
Third Ave
35th St
34th St
33rd St
IIT M
Gate 4
Nankari
NW Labs
IIT Kanpur
32nd St
31st St
34
Overhead Water Tank
62nd St
A
IIT Kanpur
Hall of Residence II
Hall 5
Main Dr
Main Dr
Main Dr
21st St
22nd St
23rd St
11th St
First Ave
Hall of Residence 1
Hall of Residence IX
Hall of Residence III
41st St
Fifth Ave
Fourth Ave
12th St
ACES Grounds
24th St
Hall 7
Hall-10
25th St
Hall 8
64th St
Student Activity Center (new)

GPS SATELLITES

- Total 27 satellites out of 24 works at a time and rest 3 are emergency backup.



DISTANCE CALCULATION

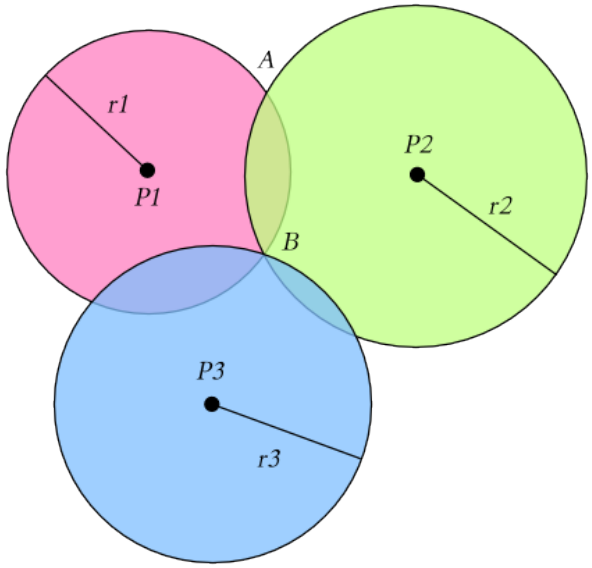
Value Sent: t1
Time Sent : t1

Value Received: t2
Time Received : t2

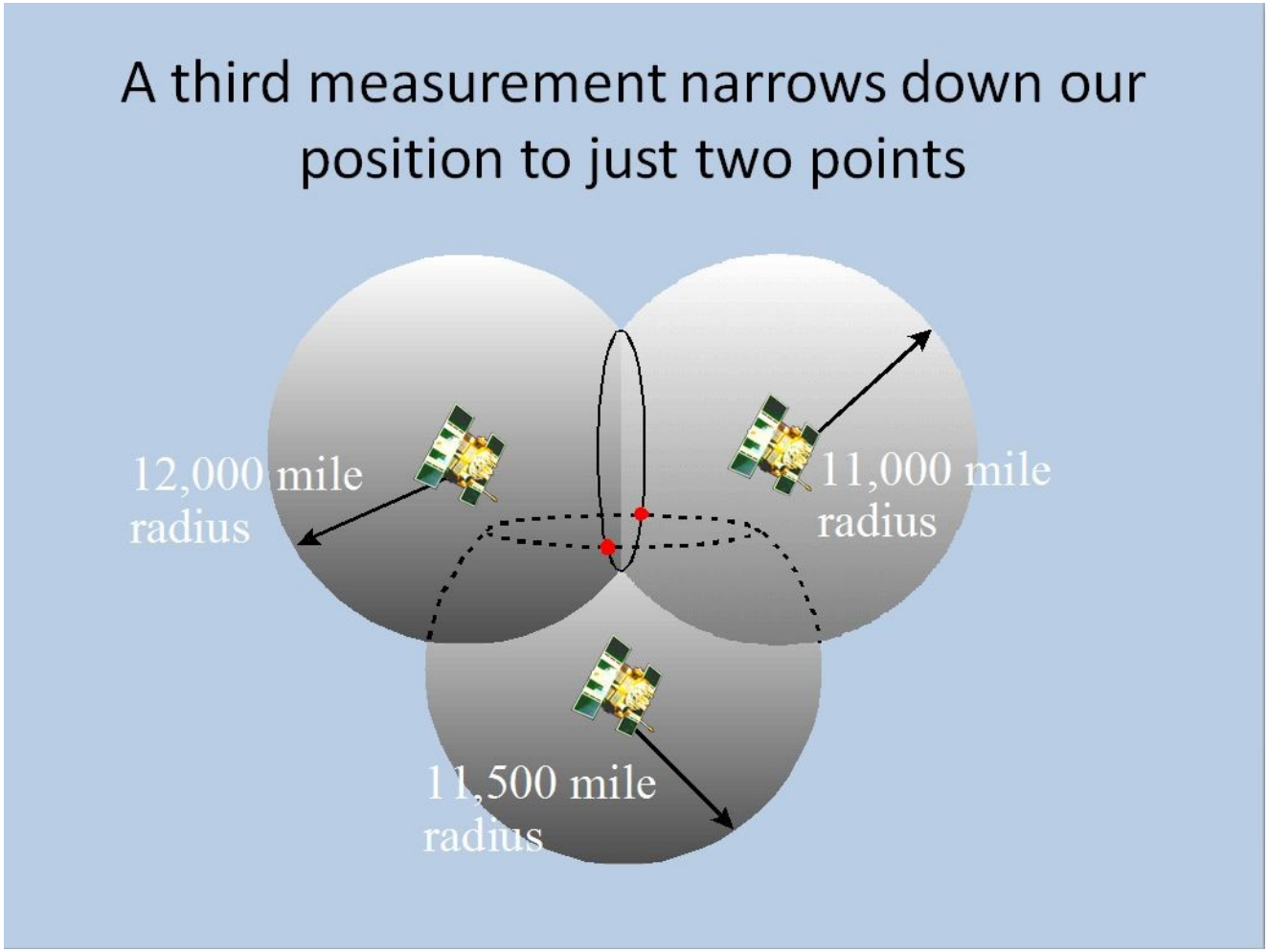
- Distance = speed xtime
  = c x (t2-t1)

TRILATERATION

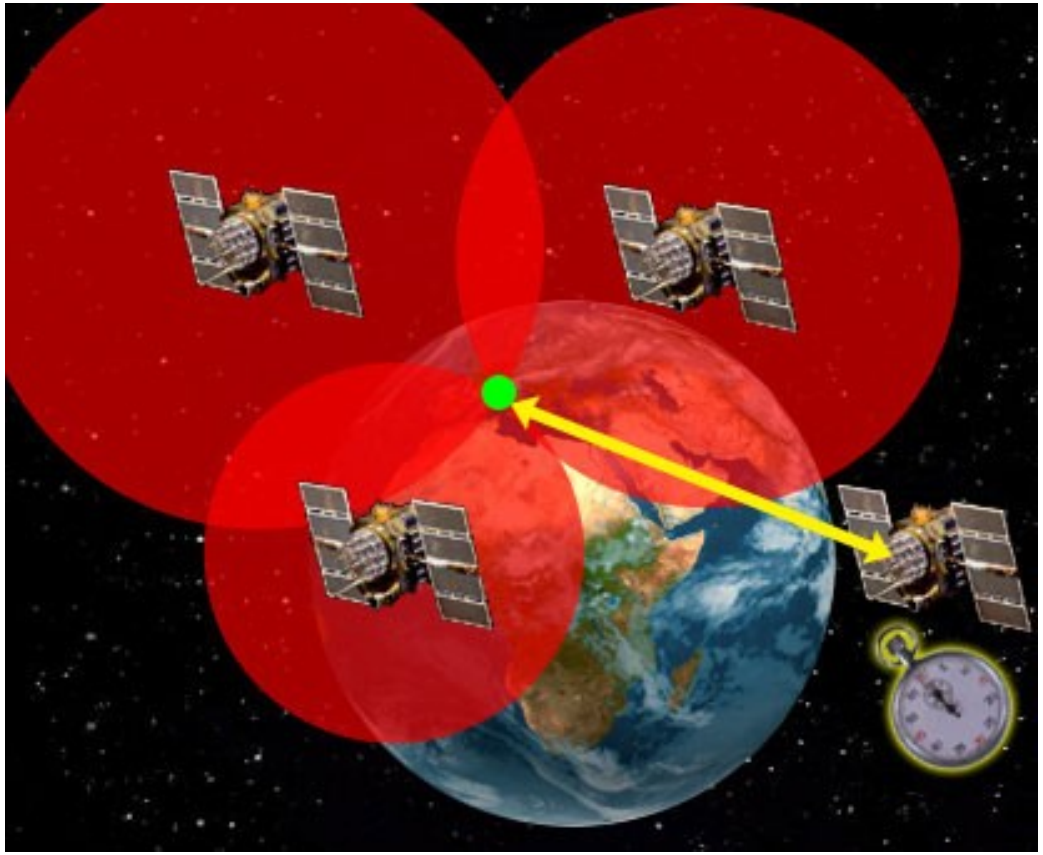
- In geometry, trilateration is the process of determining absolute or relative locations of points by measurement of distances, using the geometry of circles, spheres or triangles.



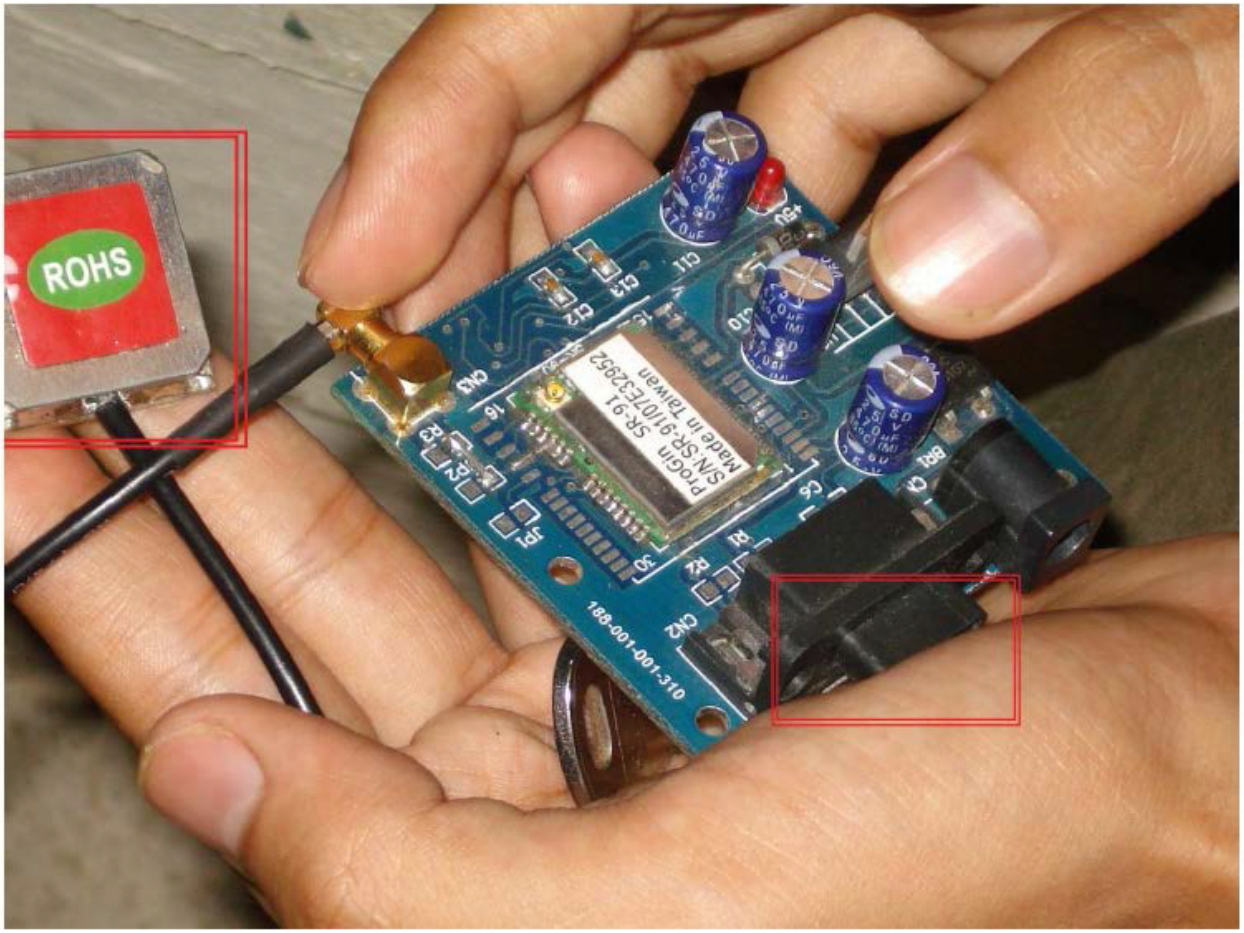
TRILATERATION IN GPS



TARGET ACQUIRED

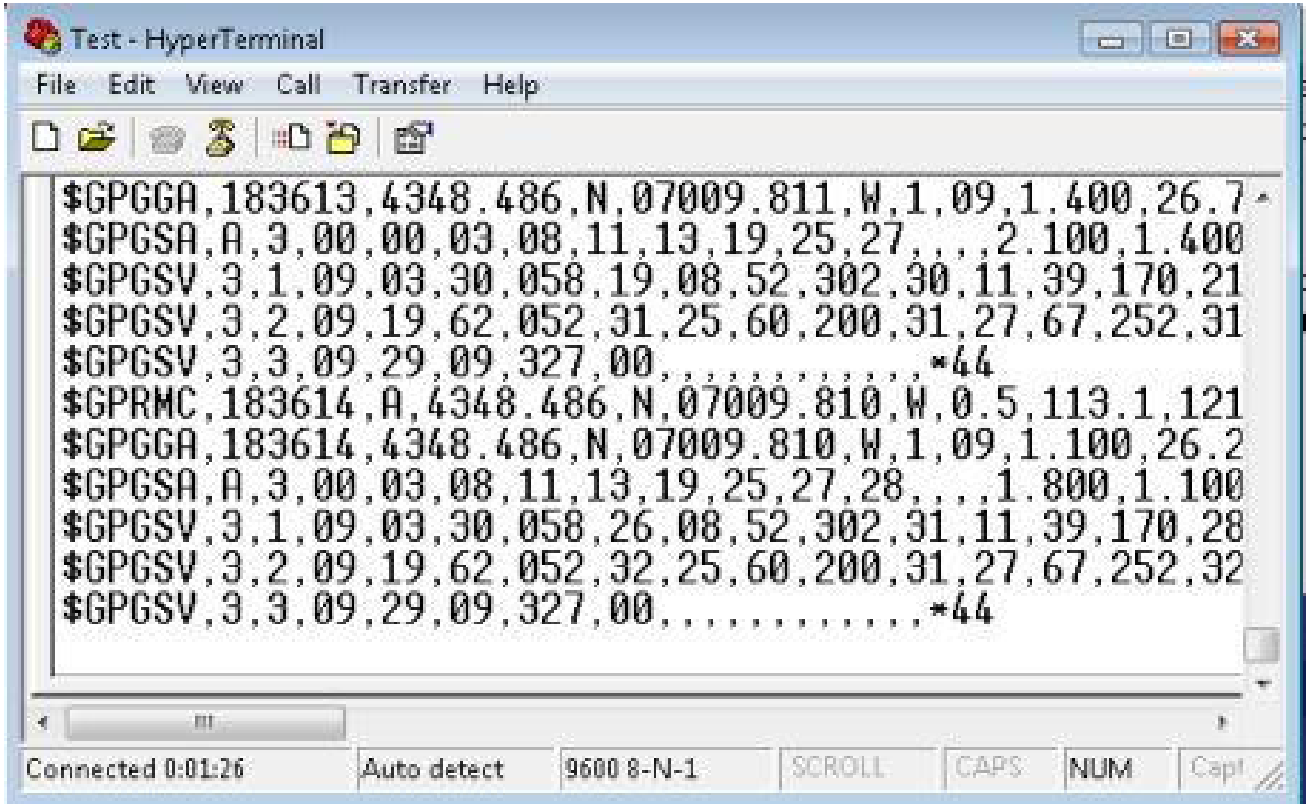


GPS MODULE



HYPERTERMINAL

- Software to communicate with other devices using com ports.



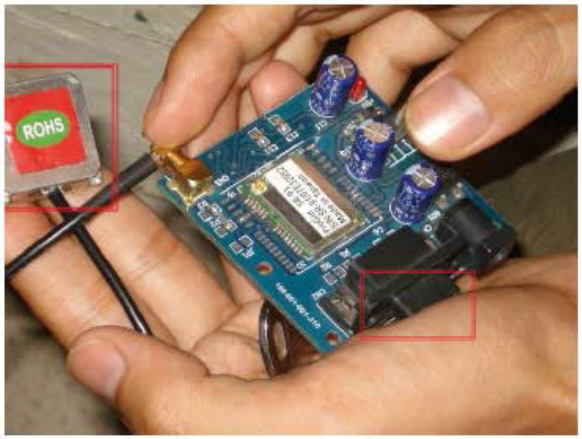
NMEA FORMAT (GPGGA)

- National Marine Electronics Association
- •$GPGGA,123519,4807.038,N,01131.000,E,1,08,0.9,545.4,M,46.9,M,,*47

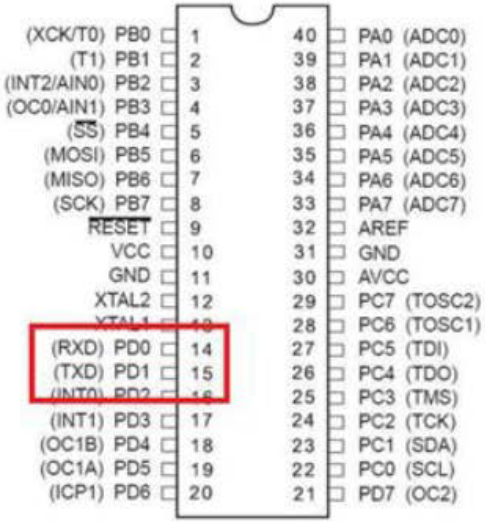
NMEA FORMAT (GPGGA)

Name	Example Data	Description
Sentence Identifier	$GPGGA	Global Positioning System Fix Data
Time	170834	17:08:34 Z
Latitude	4124.8963, N	41d 24.8963' N or 41d 24' 54" N
Longitude	08151.6838, W	81d 51.6838' W or 81d 51' 41" W
Fix Quality: - 0 = Invalid - 1 = GPS fix - 2 = DGPS fix	1	Data is from a GPS fix
Number of Satellites	05	5 Satellites are in view
Horizontal Dilution of Precision (HDOP)	1.5	Relative accuracy of horizontal position
Altitude	280.2, M	280.2 meters above mean sea level
Height of geoid above WGS84 ellipsoid	-34.0, M	-34.0 meters
Time since last DGPS update	blank	No last update
DGPS reference station id	blank	No station id
Checksum	*75	Used by program to check for transmission errors

GPS:MCU INTERFACE



Rx	?	Tx
Tx	?	Rx
GND	?	GND



Device 1

Device 2

GSM MODEM

1. Modem

2. SIM card

AT COMMANDS BASICS

- ATH //Hangs up call

- ATD 9559753551; //Calls number
  OK
- Entire AT command set can be accessed from:

http://www.developer.nokia.com/Community/Wiki/AT_Commands

SMS: USING AT COMMANDS

- AT+CMGF=1 //Text Mode
  OK
- AT+CMGS=“7607458472"
  > Hello World<
  +CMGS: 44
  OK

ANY QUESTIONS??