Case Traffic

Kevin Naik

Smart Traffic System

- Implementation in Taiwan
- Number of cars are increasing
- 33 car per 100 people

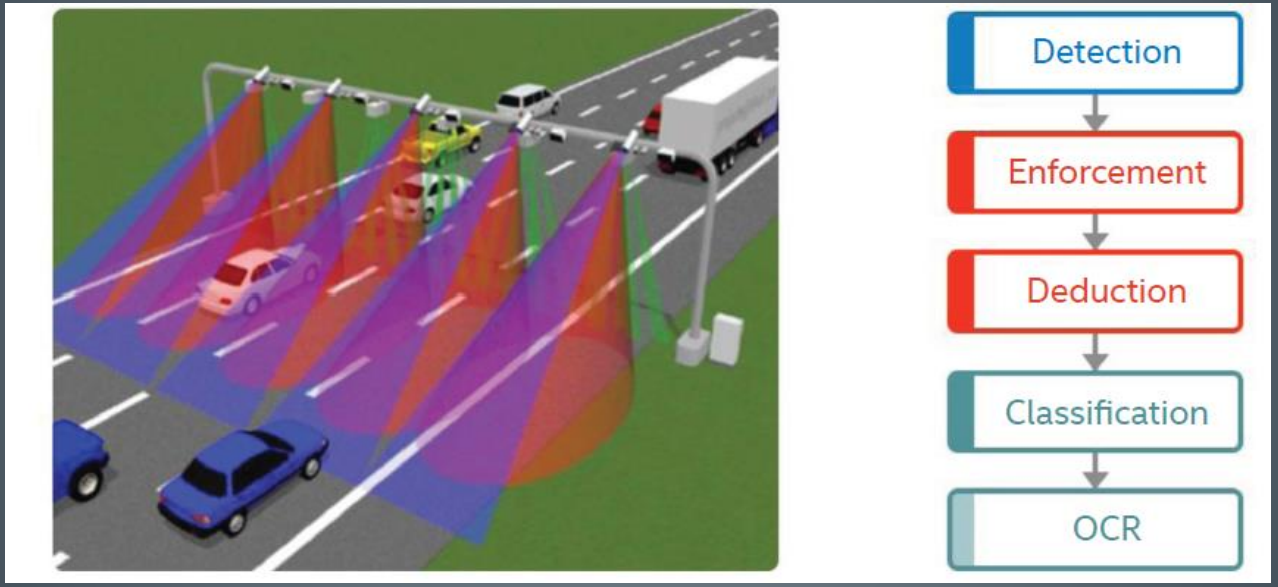
Problems

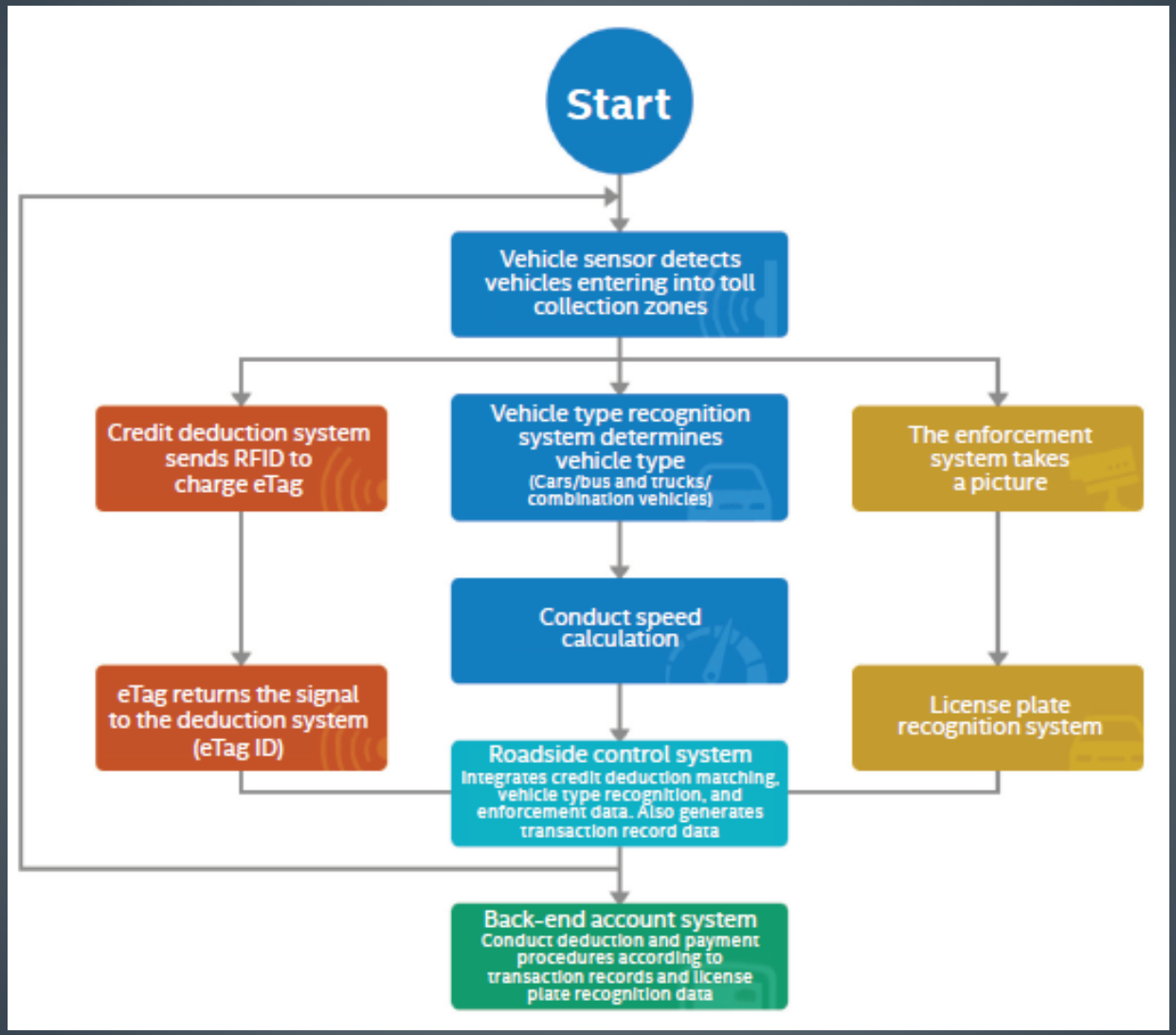
- Traffic congestion
- Insufficient parking
- Environment pollution
- Frequent accidents

Solution

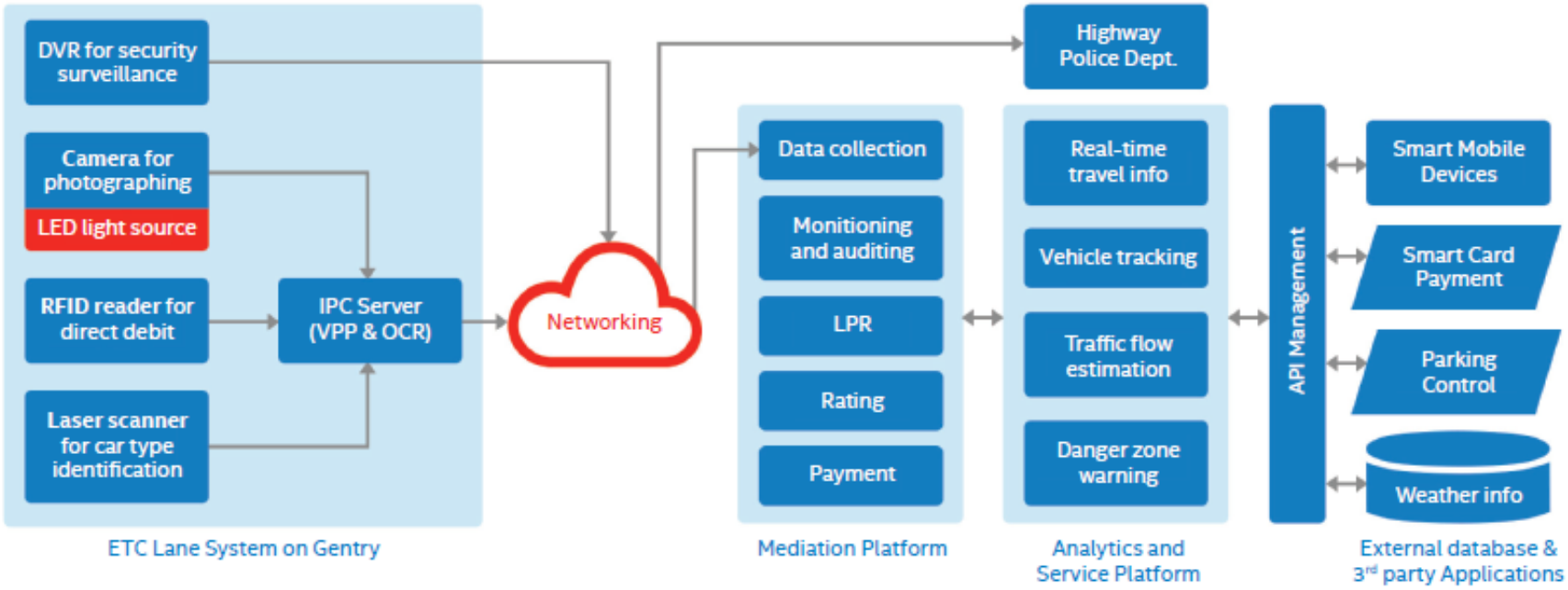
- Etags
- RFID tags

Insufficient toll collection slow down traffic




Start
Vehicle sensor detects vehicles entering into toll collection zones
Credit deduction system sends RFID to charge eTag
Vehicle type recognition system determines vehicle type
(Cars/bus and trucks/ combination vehicles)
The enforcement system takes a picture
Conduct speed calculation
eTag returns the signal to the deduction system (eTag ID)
License plate recognition system
Roadside control system
Integrates credit deduction matching, vehicle type recognition, and enforcement data. Also generates transaction record data
Back-end account system
Conduct deduction and payment procedures according to transaction records and license plate recognition data

Logical Definition of The Intel® IoT Platform




Smart Parking
Smart Safety
Smart Payment
Smart Traffic
Smart Security
Smart city
Internet of Things
4G internet
Cloud big data
eTag

Sensor and Actuator

Kevin Naik

Sensor

- RFID
- NFC
- Camera
- Temperature
- Light
- Ultrasonic
- PIR
- Gas Sensor
- Pressure Sensor
- Humidity sensor
- Accelerometer and Gyroscope
- Humidity sensor
- Touch sensor
- Heart Rate Sensor
- Biometric Sensor
- GPS

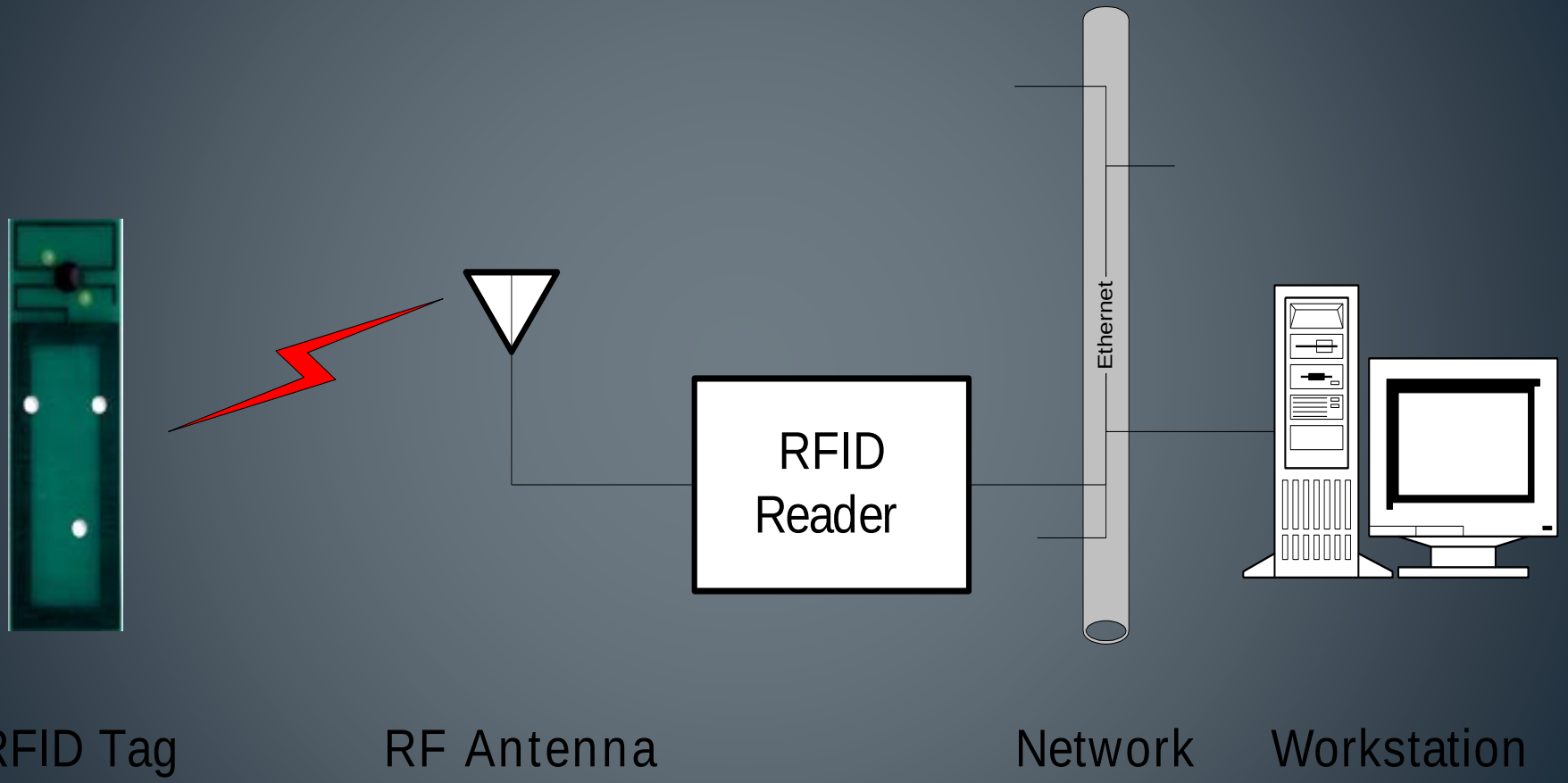
RFID

- RFID stands for Radio-Frequency IDentification.
- An ADC (Automated Data Collection) technology that:

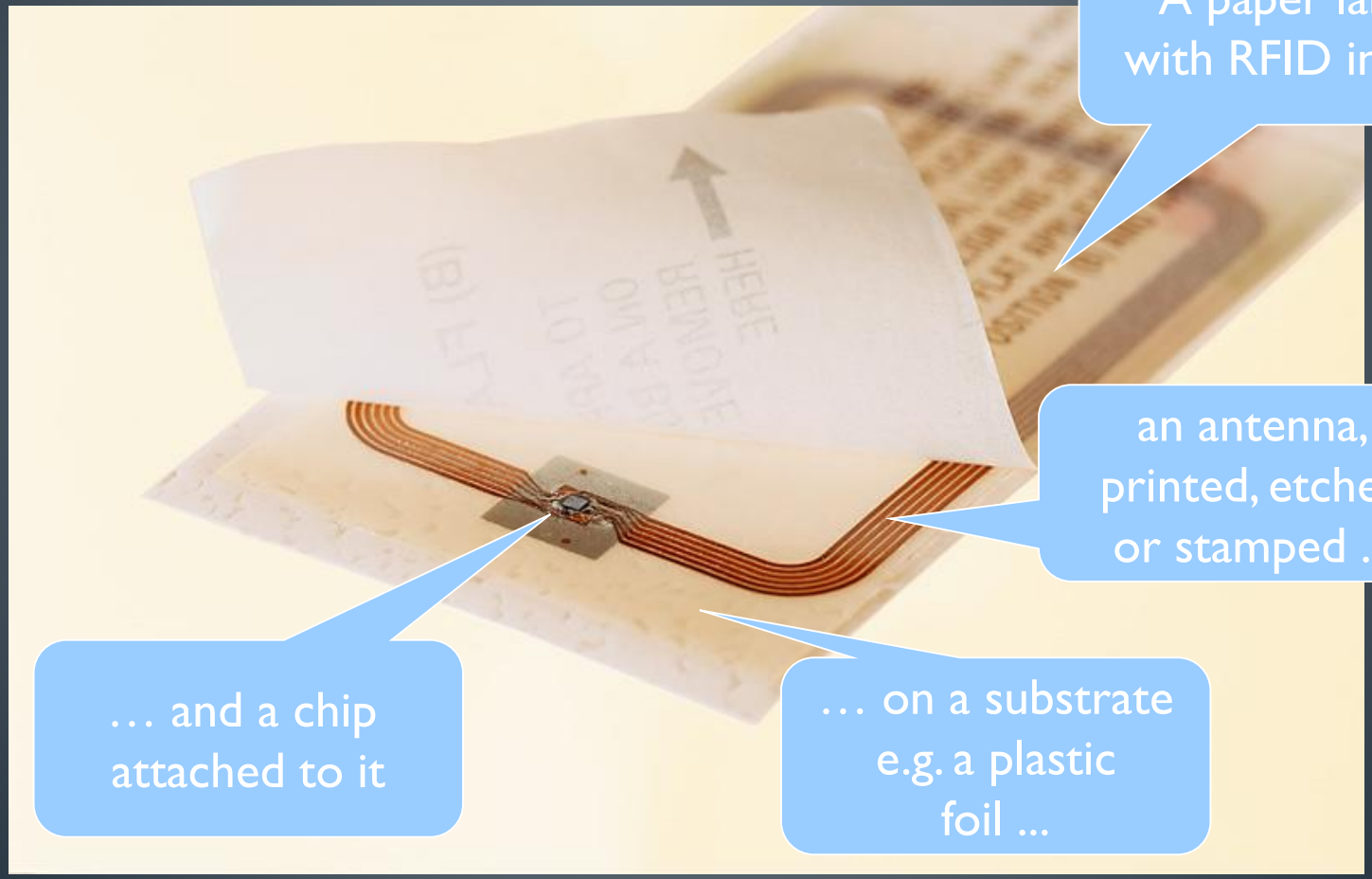
uses radio-frequency waves to transfer data between a reader and a movable item to identify, categorize, track..

- Is fast and does not require physical sight or contact between reader/scanner and the tagged item.
- Performs the operation using low cost components.
- Attempts to provide unique identification and backend integration that allows for wide range of applications.
- Other ADC technologies: Bar codes, OCR.

RFID system components

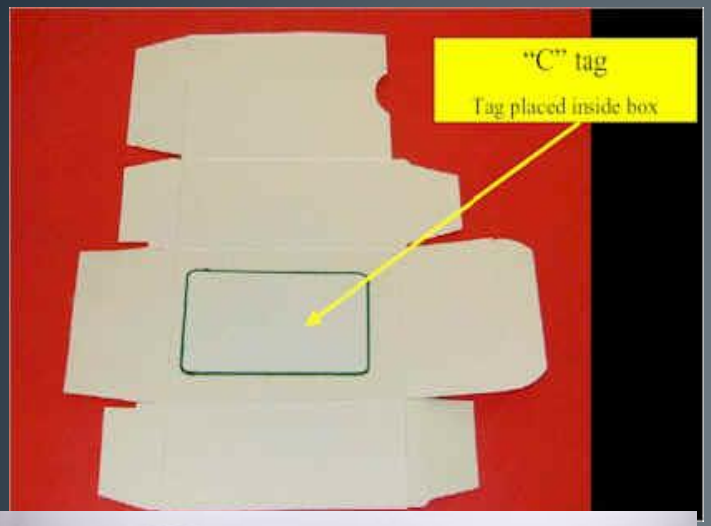


RFID tags: Smart labels



Source: www.rfidprivacy.org

Some RFID tags

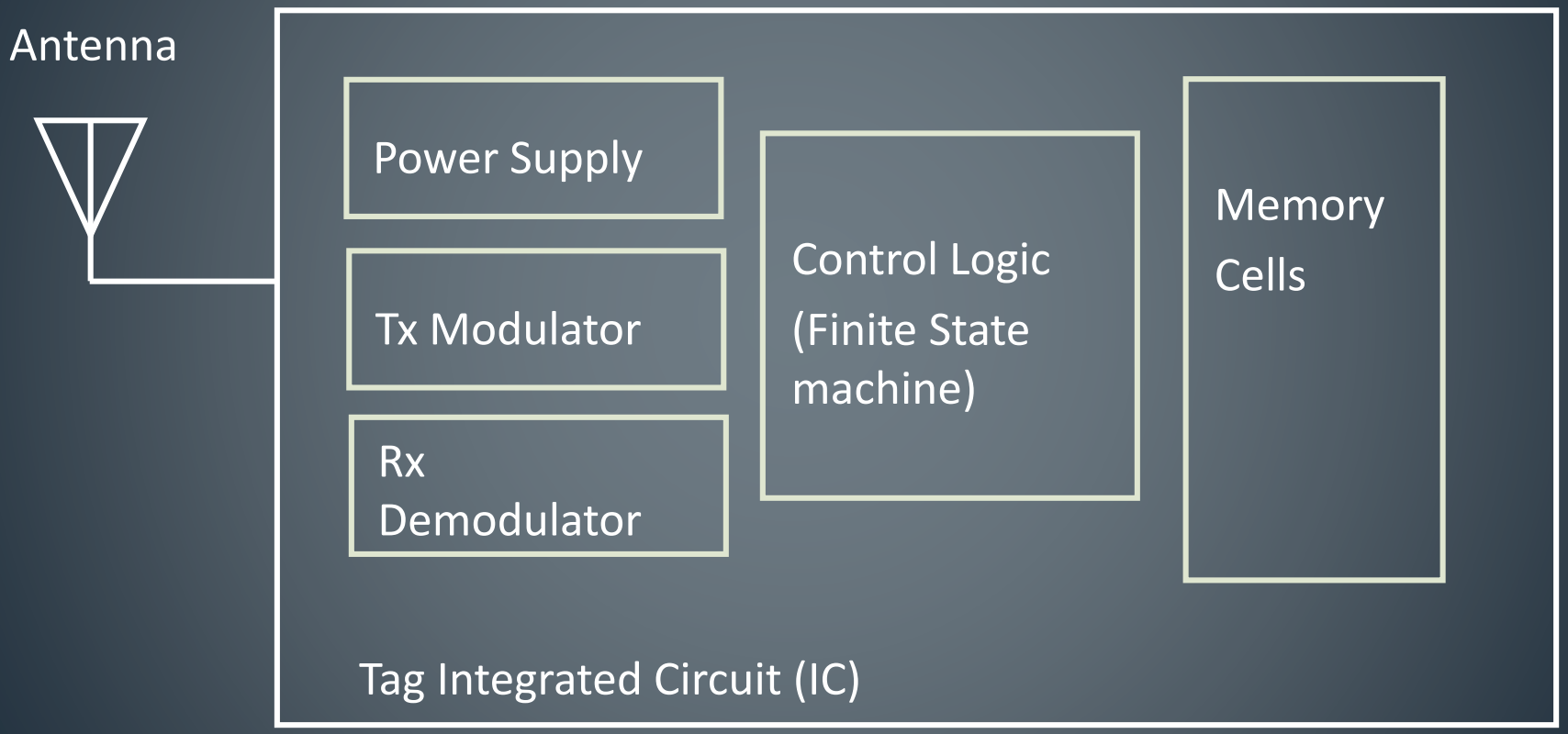


Source: www.rfidprivacy.org

RFID tags

- Tags can be attached to almost anything:
  - Items, cases or pallets of products, high value goods
  - vehicles, assets, livestock or personnel
- **Passive Tags**
  - Do not require power – Draws from Interrogator Field
  - Lower storage capacities (few bits to 1 KB)
  - Shorter read ranges (4 inches to 15 feet)
  - Usually Write-Once-Read-Many/Read-Only tags
  - Cost around 25 cents to few dollars
- **Active Tags**
  - Battery powered
  - Higher storage capacities (512 KB)
  - Longer read range (300 feet)
  - Typically can be re-written by RF Interrogators
  - Cost around 50 to 250 dollars

Tag block diagram



RFID tag memory

- Read-only tags
  - Tag ID is assigned at the factory during manufacturing
    - Can never be changed
    - No additional data can be assigned to the tag
- Write once, read many (WORM) tags
  - Data written once, e.g., during packing or manufacturing
    - Tag is locked once data is written
    - Similar to a compact disc or DVD
- Read/Write
  - Tag data can be changed over time
    - Part or all of the data section can be locked

RFID readers

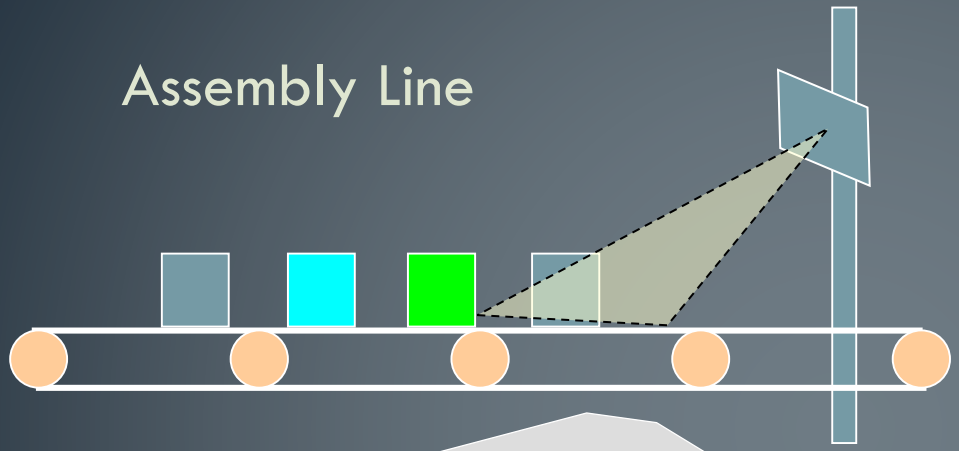
- Reader functions:
  - Remotely power tags
  - Establish a bidirectional data link
  - Inventory tags, filter results
  - Communicate with networked server(s)
  - Can read 100-300 tags per second
- Readers (interrogators) can be at a fixed point such as
  - Entrance/exit
  - Point of sale
- Readers can also be mobile/hand-held

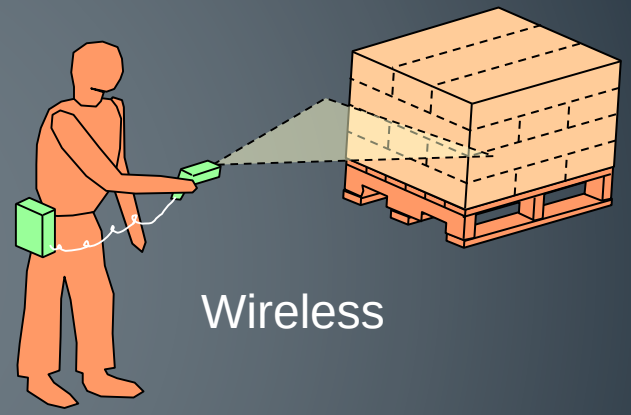
Some RFID readers

Source: www.buyrfid.org

RFID application points

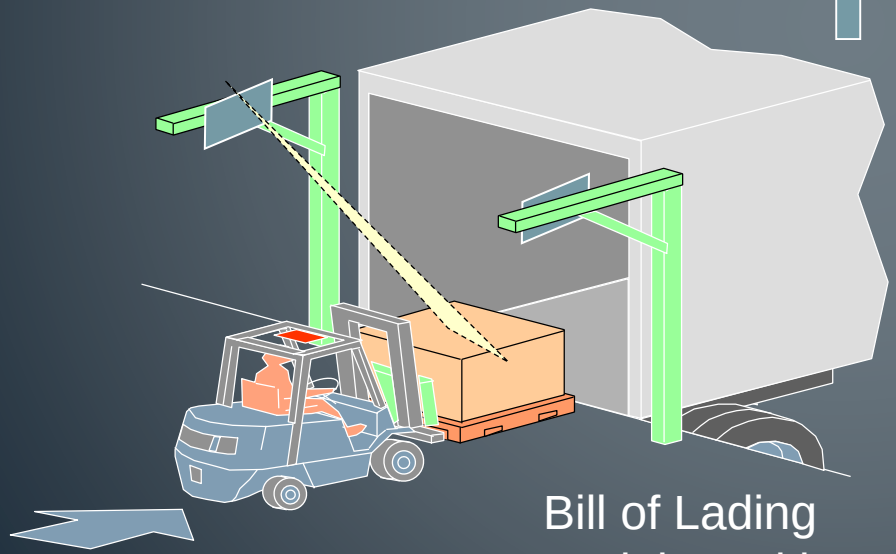
Assembly Line





Wireless

Handheld Applications



Bill of Lading
Material Tracking

Shipping Portals

RFID applications

- Manufacturing and Processing
  - Inventory and production process monitoring
  - Warehouse order fulfillment
- Supply Chain Management
  - Inventory tracking systems
  - Logistics management
- Retail
  - Inventory control and customer insight
  - Auto checkout with reverse logistics
- Security
  - Access control
  - Counterfeiting and Theft control/prevention
- Location Tracking
  - Traffic movement control and parking management
  - Wildlife/Livestock monitoring and tracking

NFC

- NFC or Near Field Communication is a short range high frequency wireless communication technology.
- A radio communication is established by touching the two phones or keeping them in a proximity of a few centimeters.
- NFC is mainly aimed for mobile or handheld devices.
- NFC is an extension of Radio frequency identification or RFID technology.
- RFID is mainly used for tracking and identification by sending radio waves.

Evolution of NFC Technology

- In 2006

First mobile phone(nokia 6131) with NFC released by NOKIA.

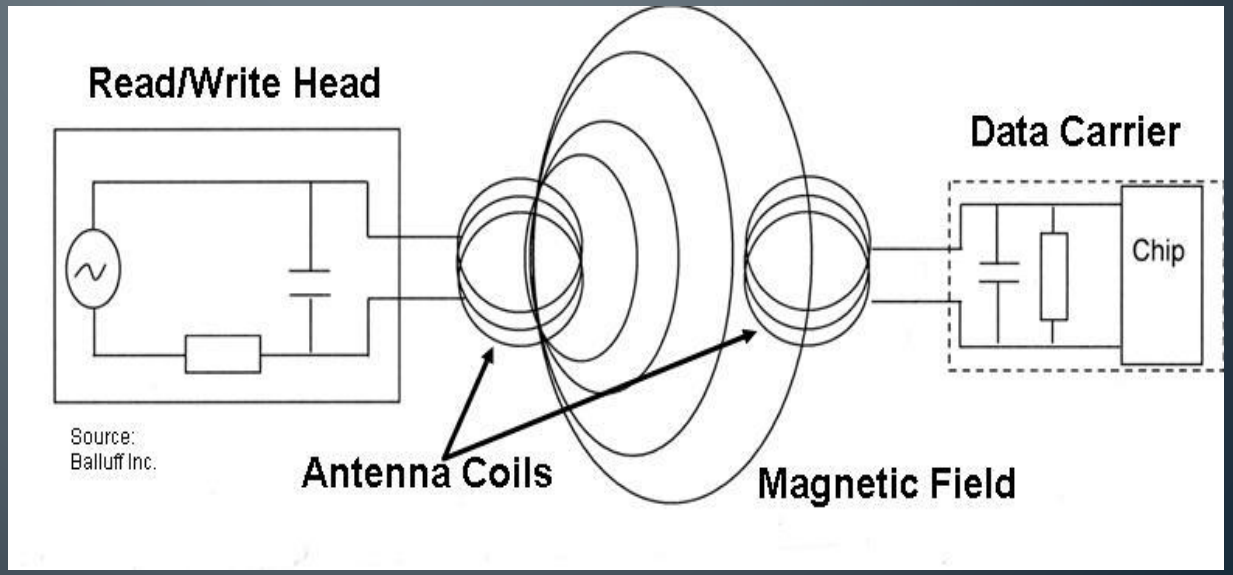
Evolution of NFC Technology

- In 2010

First android phone SAMSUNG NEXUS S with NFC support released.

Operation of NFC

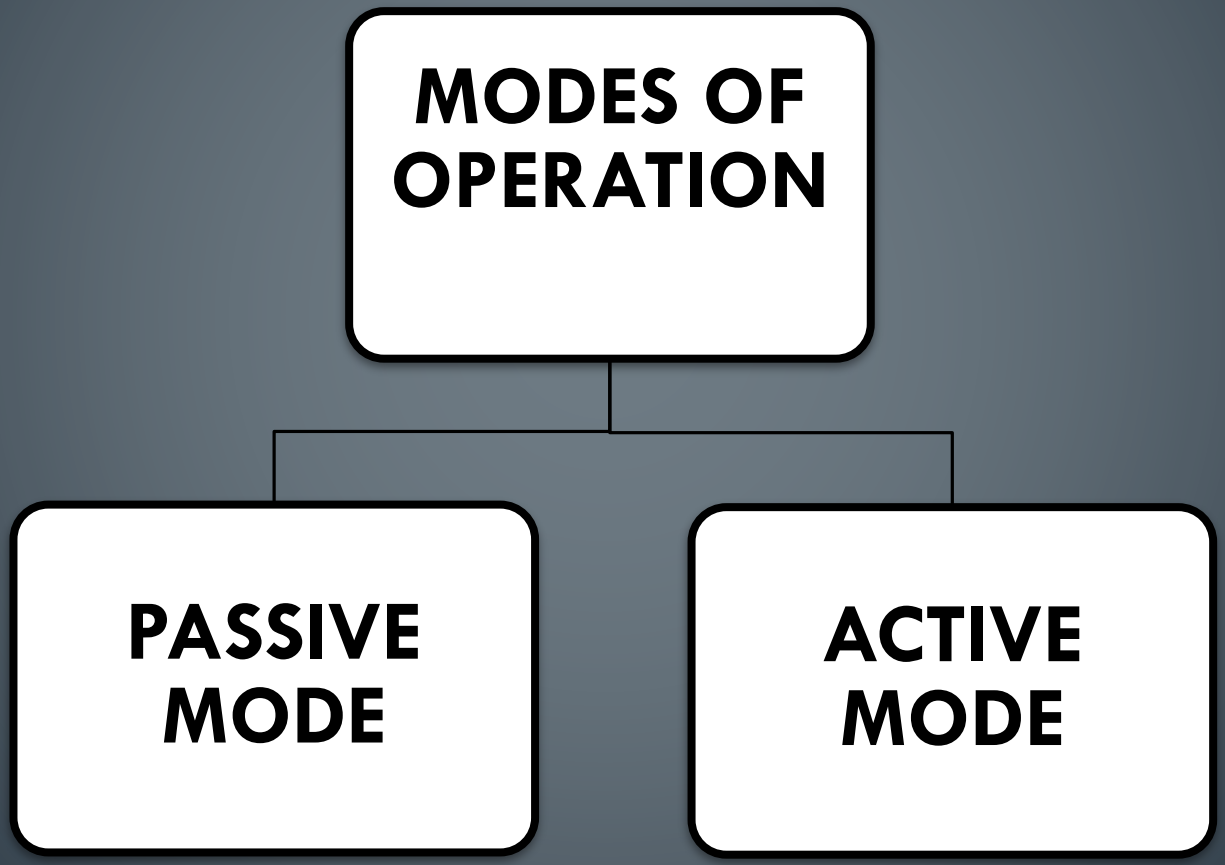
- Near field communication is based on inductive-coupling.
- NFC works using magnetic induction between two loop antennas located within each other's 'near field'.



Operation of NFC

- operating frequency 13.56 MHz.data rate 106 kbit/s to 424 kbit/s.
- NFC use an initiator and a target; the initiator actively generates an RF field that can power a passive target.

Modes of operation



MODES OF OPERATION

- In Active mode, both devices with NFC chip generates an electromagnetic field and exchange data.

Two NFC enabled devices transfer-ring data in active mode

MODES OF OPERATION

- In Passive mode, there is only one active device and the other uses that field to exchange information.

A NFC-enabled mobile phone is paired with a RFID-tagged "smart poster"

Application of NFC

- NFC applications can be split into the following three basic categories:

- **Touch and Go**
- **Touch and Confirm**
- **Touch and Connect**

Advantages of NFC

- High convenience to the user, because the data exchange is done by bringing two mobiles together.
- Reduces cost of electronic issuance .
- Secure communication.
- No special software.
- No manual configuration and settings.
- No search and pair procedure.

Disadvantages of NFC

- The system has the limitation that it can be operated only with devices under a short range i.e around 10 cm.
- The data transfer rate is very less at about 106kbps, 212 kbps and 424kbps.

Devices with technology

	STATION AIRPORT	VEHICLE	OFFICE	STORE RESTAURANT	THEATER STADIUM	ANYWHERE
Area						
Usage of NFC Mobile Phone	Pass gate Get information from smart poster Get information from information kiosk Pay bus/taxi fare	Adjust seat position Open door Pay parking fee	Enter/exit office Exchange business cards Log in to PC; Print using copier machine	Pay by credit card Get loyalty point Get and use coupon Share information and coupon among users	Pass entrance Get event information	Download and personalize application Check usage history Download ticket Lock phone remotely
Service Industries	Mass Transport Advertising	Public Transport	Security	Banking Retail Credit Card	Entertainment	Any

OPERATION NFC

1) Touch NFC logo to receive order SMS

2) Press 'send' to order a ticket

4) Ticketing Platform generates a ticket

5) Receive Ticket via SMS

And now in hotels!!!

Before & After

Previously Used Methods

Current & Future Methods

Application of NFC

- **Touch and Go**

  Applications such as access control or transport/event ticketing, where the user needs only to bring the device storing the ticket or access code close to the reader. Example for picking up an Internet URL from a smart label on a poster.

Touch and go
Mode of application

Application of NFC

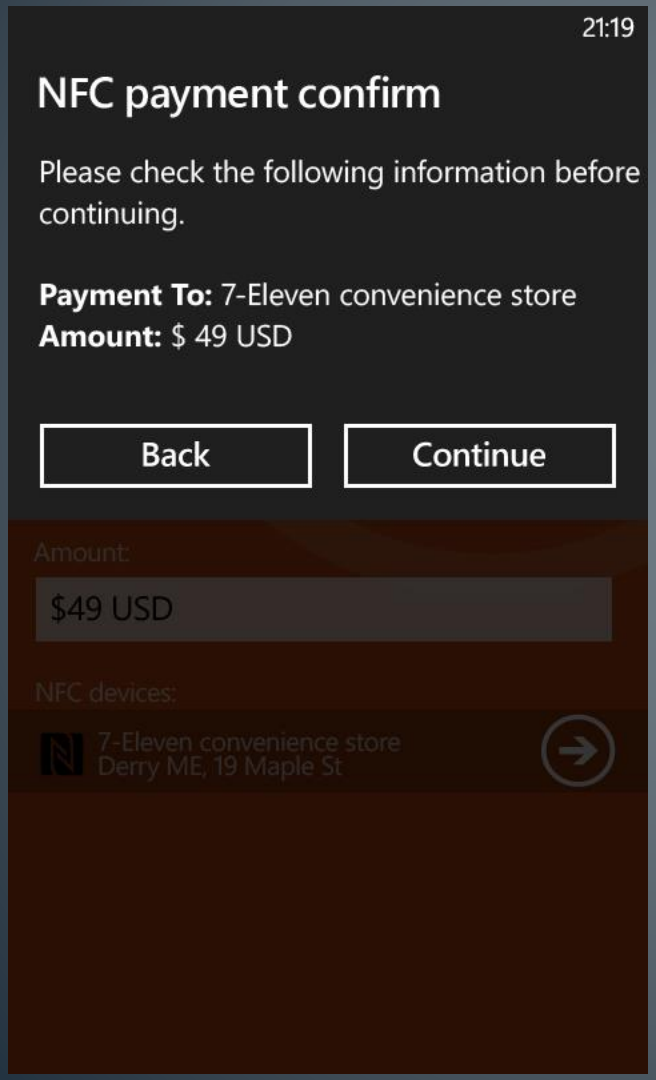
Movie buff gathering info about a movie using his NFC enabled Mobile Phone

Application of NFC

- **Touch and Confirm**

  Applications such as mobile payment where the user has to confirm the interaction by entering a password or just accepting the transaction.

Application of NFC



The screenshot from a mobile device showing the confirmation message.

Application of NFC

- **Touch and Connect**

  Linking two NFC-enabled devices to enable peer to peer transfer of data such as downloading music, exchanging images or synchronizing address books.

Data transfer via NFC

Barcode & QR Code

- Barcode - a code consisting of a group of printed and variously patterned bars and spaces and sometimes numerals that is designed to be scanned and read into computer memory and that contains information (as identification) about the object it labels.
- QR Code - a matrix barcode (or two-dimensional code), readable by QR scanners, mobile phones with a camera, and smartphones.
- Scanner – a device that interpret different imagery, in this case: barcodes.

Different Codes

Code 39

- Defines 43 Characters.
- Typically used in non-retail areas.
- Arguably the simplest barcode.

Different Codes

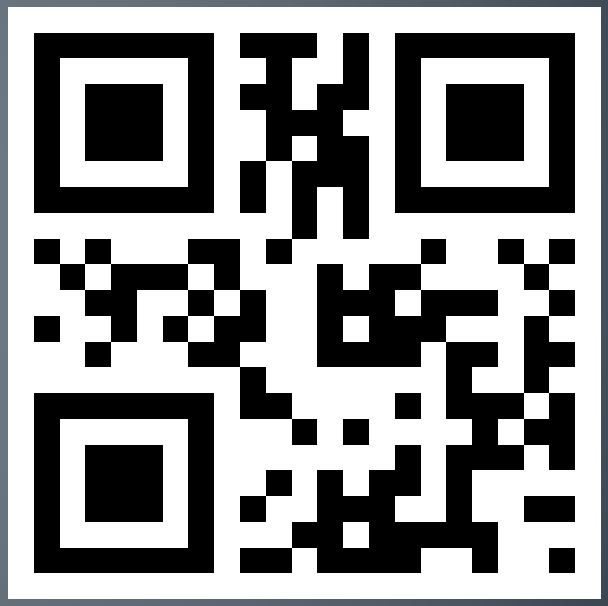
Code 128

- Defines the entire 128 ASCII character set.
- Typically used in shipping/retail.

Different Codes

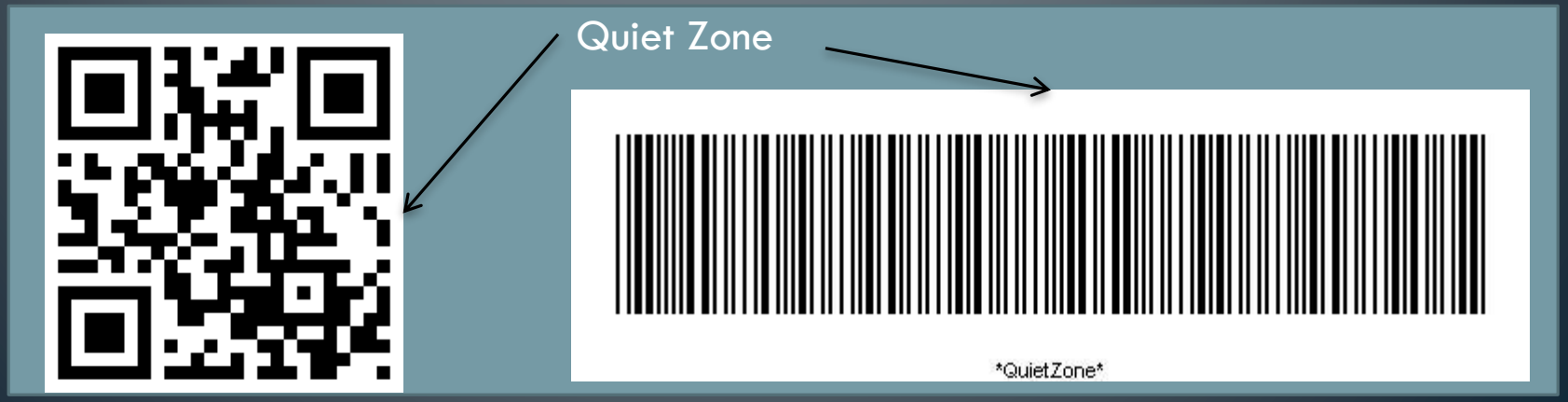
QR Code

- Most commonly used barcode as of recent especially with mobile phones.
- Has various numbers of functions: linking to websites, send SMS functions, etc.



No/Quiet Zones

- For all commonly used barcodes, each has a no or quiet zone. Each one varies.
- In general, these must not be covered or the scan of the barcodes will not work.
- For QR Codes, there are no zones as well as a quiet zone.
- With Codes 39 or 128, they have a quiet zone surrounding it.

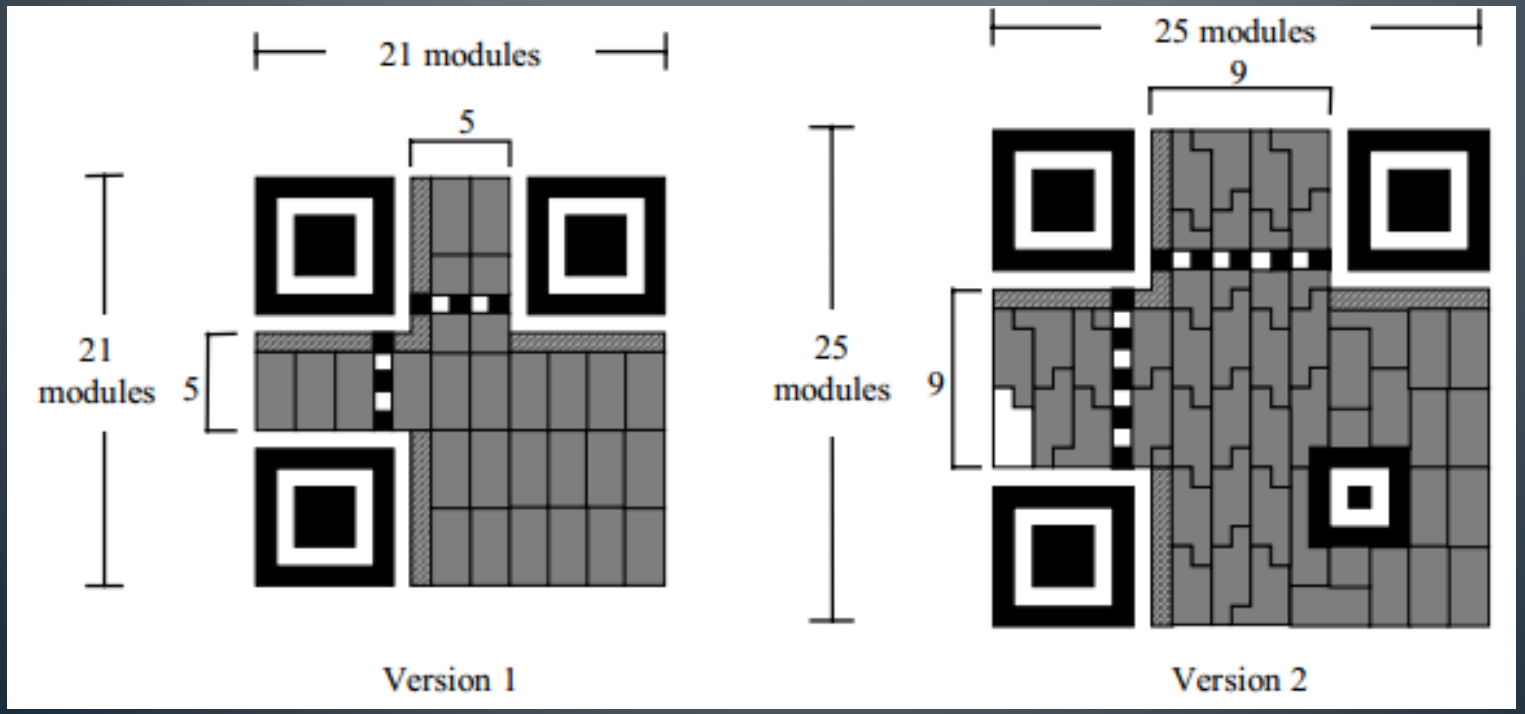


QR Code

- Position Markers
- Format
- Version Number
- Alignment Marker

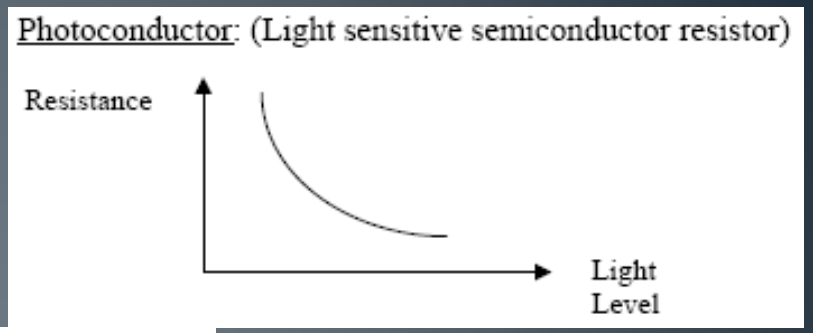
QR Codes

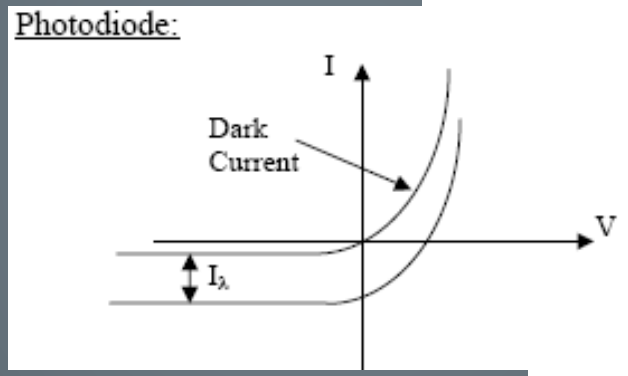
- Interpretation of the code is that excluding the no zones, each black module is a 1 bit and a white one is a 0 bit.



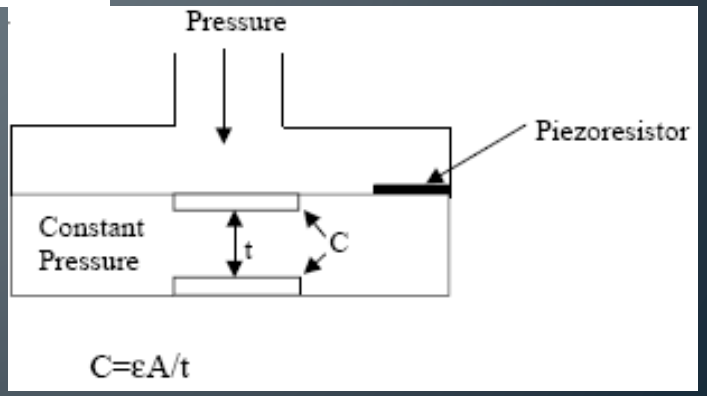
Light Sensor

- Light Sensor
  - photoconductor
    - light → ΔR
  - photodiode
    - light → ΔI
  - membrane pressure sensor
    - resistive (pressure → Δ R)
    - capacitive (pressure → ΔC)





$I=I_o[\exp(eV/kT)-1]-I_\lambda$
I_λ is proportion to the light level



Temperature Sensor Options

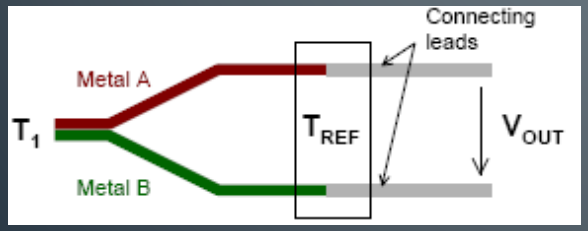
- Resistance Temperature Detectors (RTDs)

$$R_T = R_0\left[1+\alpha_1 T+\alpha_2 T^2+\cdots\alpha_n T^n+\right]\cong R_0\left[1+\alpha_1 T\right]$$

  - Platinum, Nickel, Copper metals are typically used
  - positive temperature coefficients

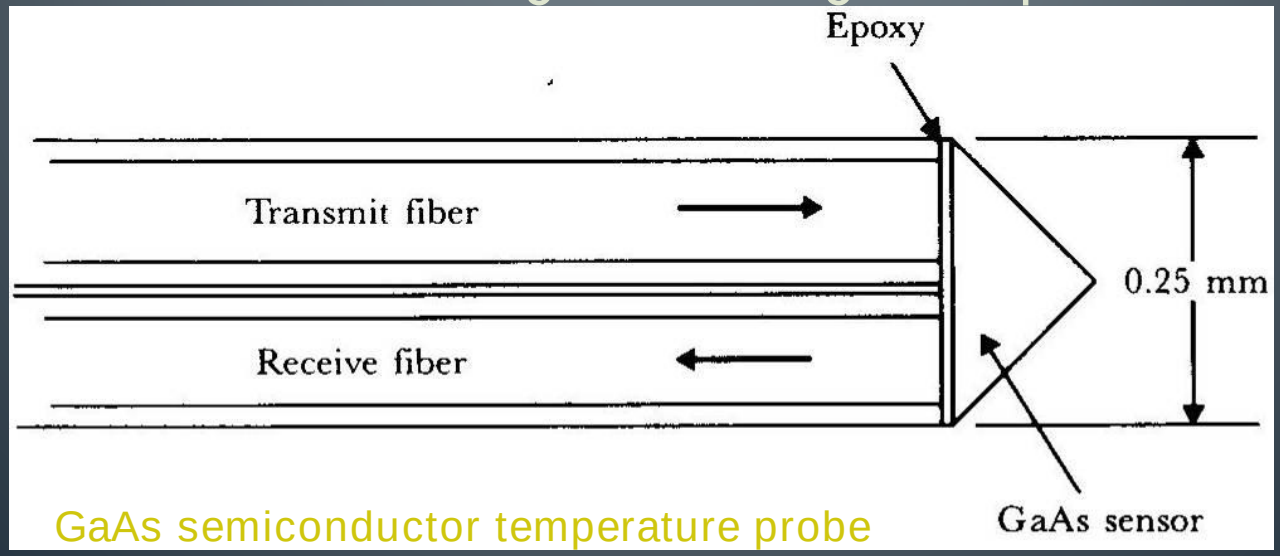
$$R_T = R_0 \exp\left[B\left(\frac{1}{T}-\frac{1}{T_0}\right)\right]$$

- Thermistors ("thermally sensitive resistor")
  - formed from semiconductor materials, not metals
    - often composite of a ceramic and a metallic oxide (Mn, Co, Cu or Fe)
  - typically have negative temperature coefficients
- **Thermocouples**
  - based on the Seebeck effect: dissimilar metals at diff. temps. → signal



Fiber-optic Temperature Sensor

- Sensor operation
  - small prism-shaped sample of single-crystal undoped GaAs attached to ends of two optical fibers
  - light energy absorbed by the GaAs crystal depends on temperature
  - percentage of received vs. transmitted energy is a function of temperature
- Can be made small enough for biological implantation



GaAs semiconductor temperature probe

Biometrics

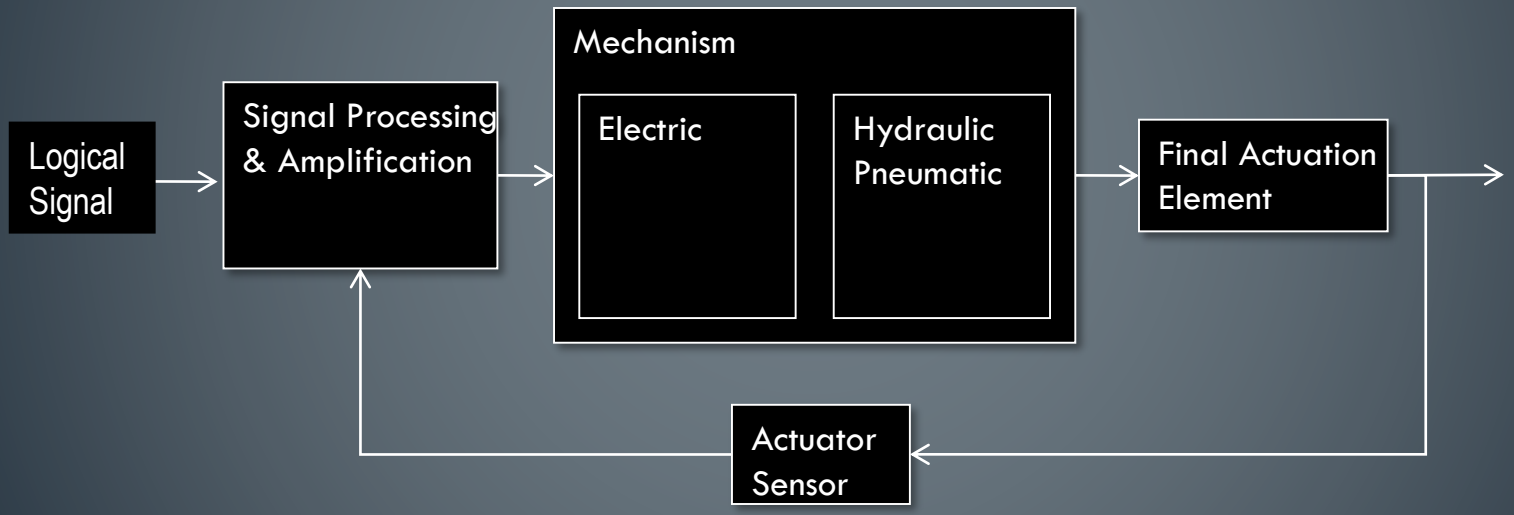
- Image capture
- Image processing
- Feature extraction
- Feature comparison
- Face, Fingers and eyes
-

- IOT\smartsensor.pdf

Actuators

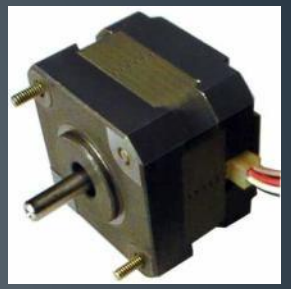
- Hardware devices that convert a controller command signal into a change in a physical parameter
- The change is usually mechanical (e.g., position or velocity)
- An actuator is also a transducer because it changes one type of physical quantity into some alternative form
- An actuator is usually activated by a low-level command signal, so an amplifier may be required to provide sufficient power to drive the actuator

Actuators

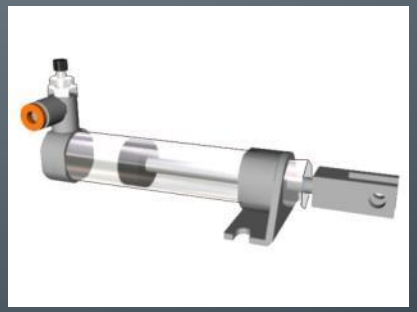

Logical Signal
Signal Processing & Amplification
Mechanism
Electric
Hydraulic Pneumatic
Final Actuation Element
Actuator Sensor

Types of Actuators

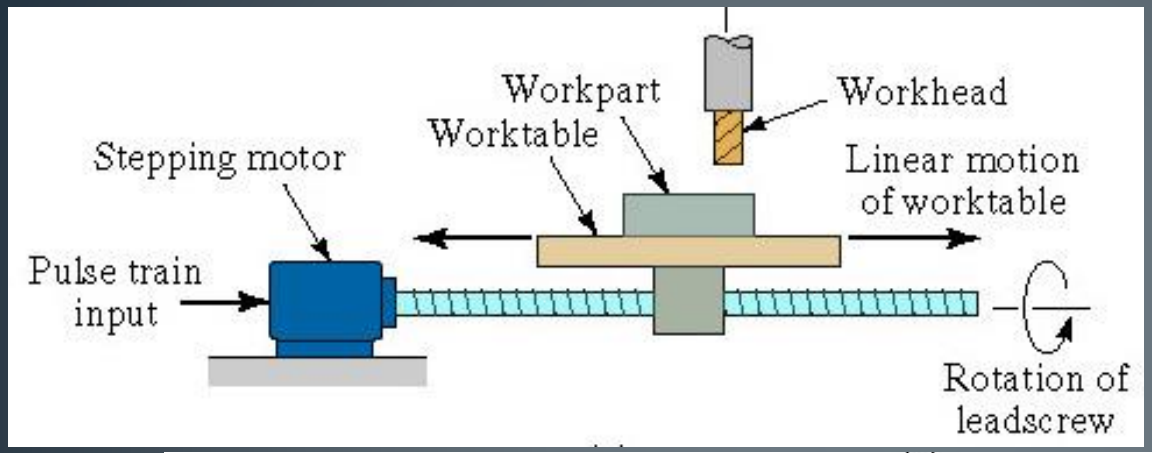
1. Electrical actuators
   - Electric motors
     - DC servomotors
     - AC motors
     - Stepper motors
   - Solenoids

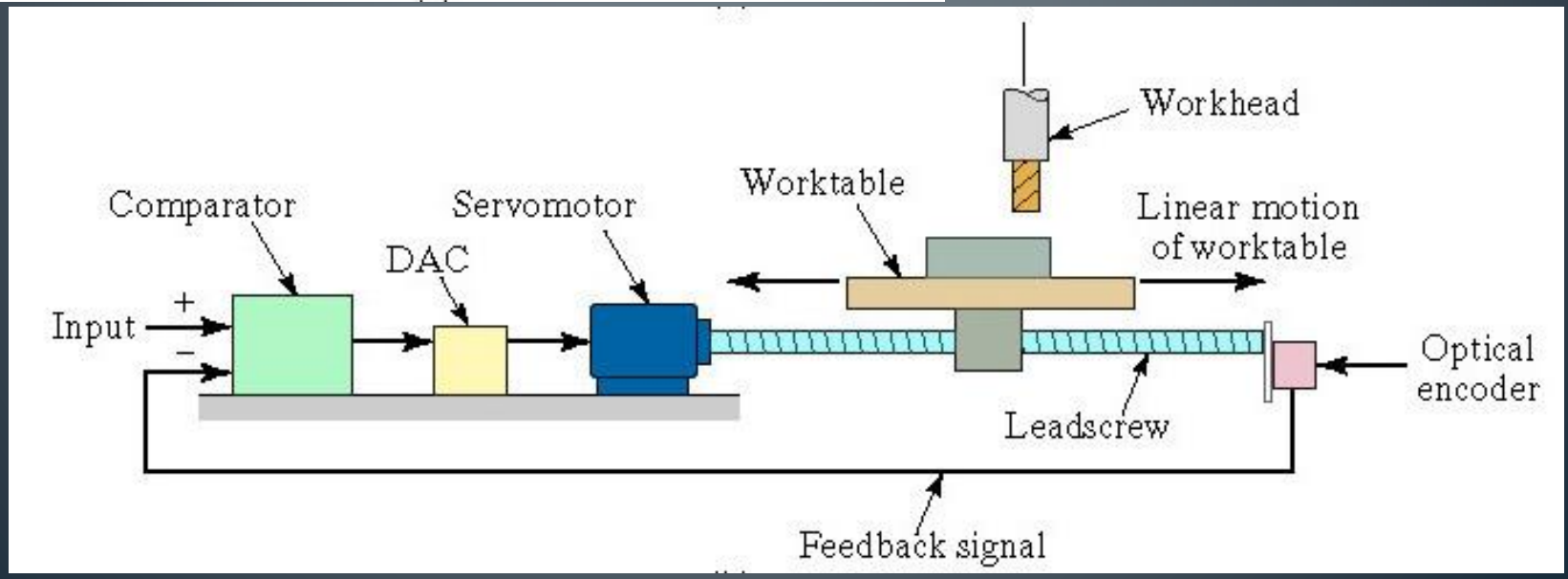


2. Hydraulic actuators
   - Use hydraulic fluid to amplify the controller command signal
3. Pneumatic actuators
   - Use compressed air as the driving force

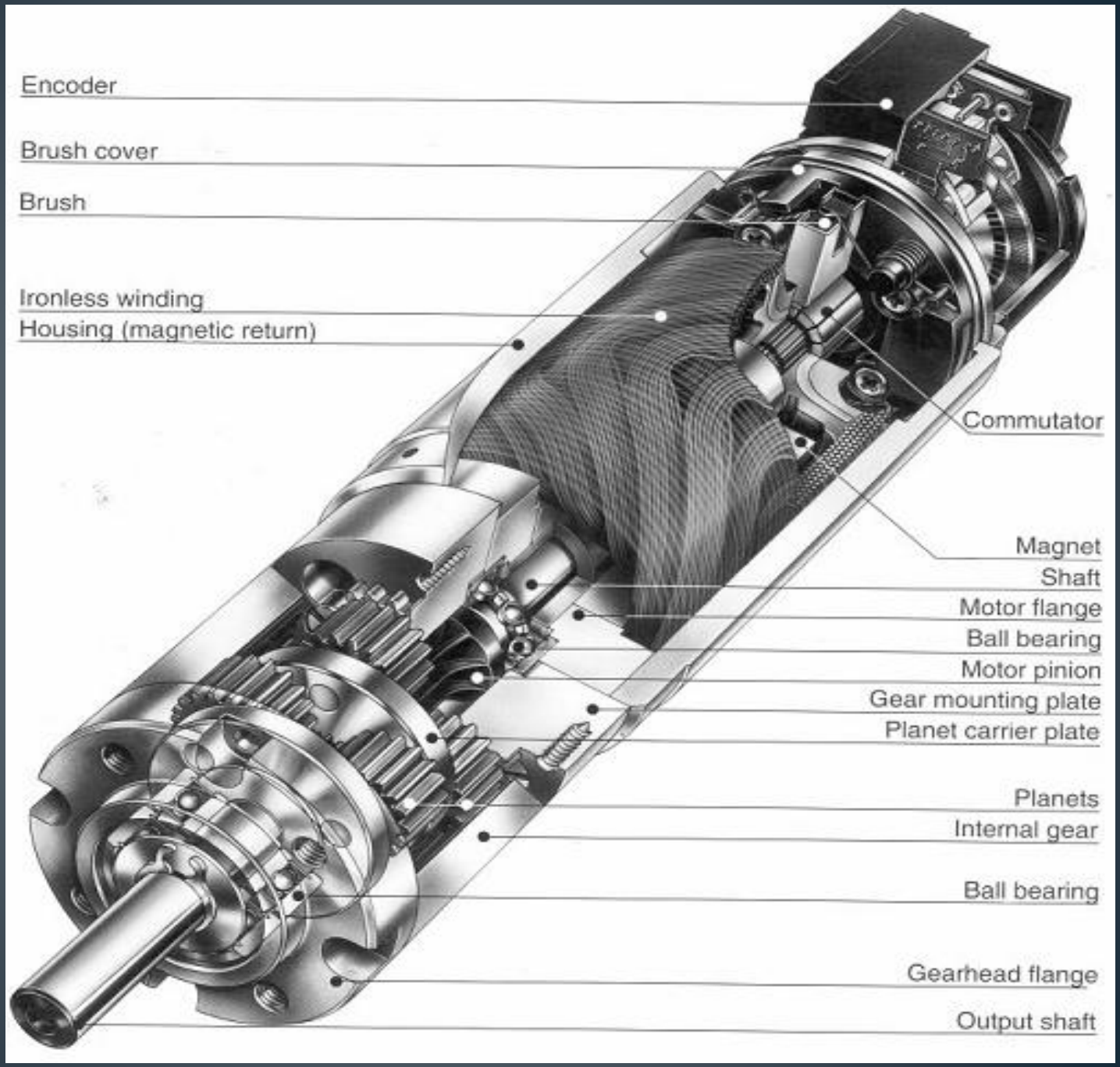


Stepper motor and Servomotor

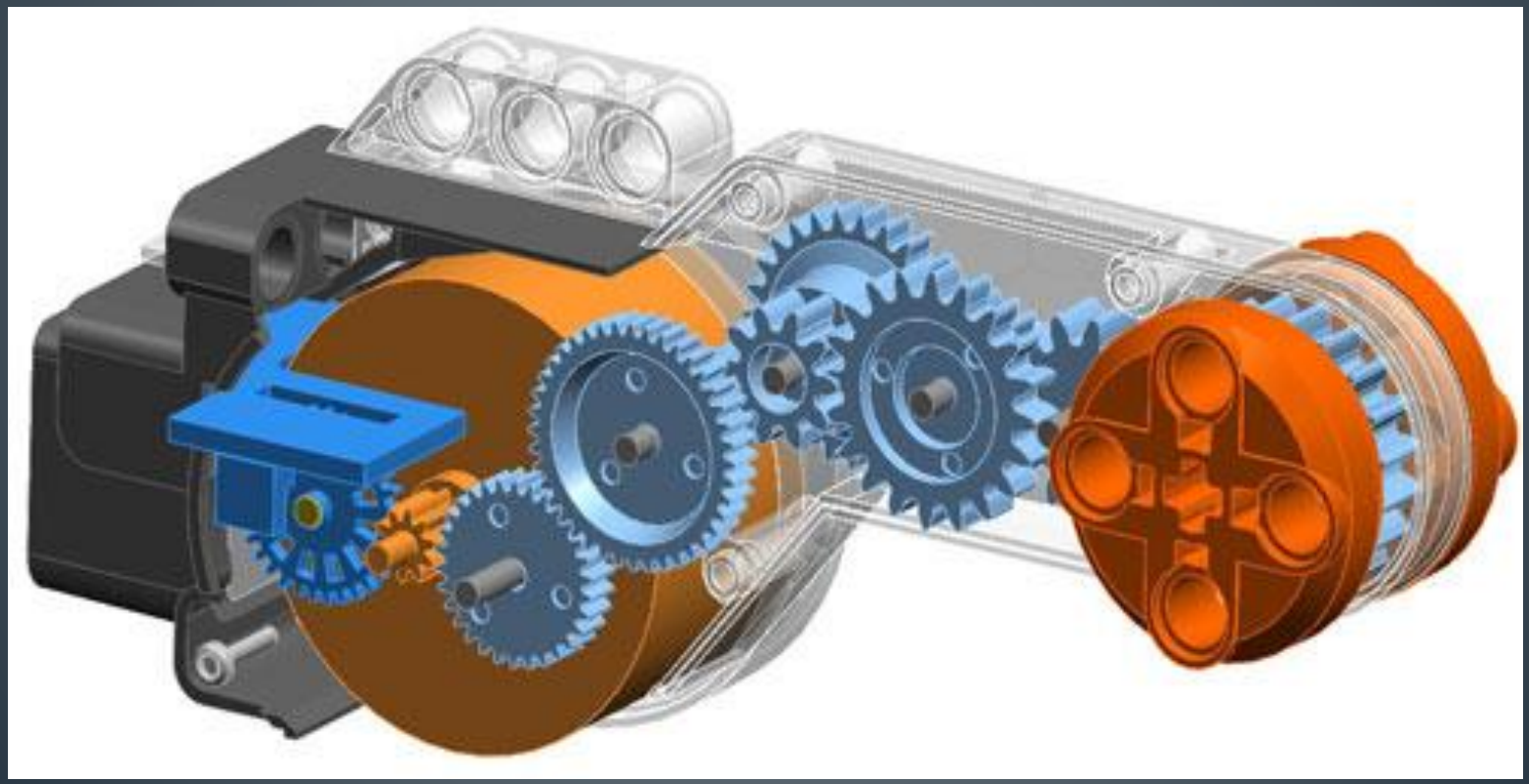




Servo Motor


Encoder
Brush cover
Brush
Ironless winding
Housing (magnetic return)
Commutator
Magnet
Shaft
Motor flange
Ball bearing
Motor pinion
Gear mounting plate
Planet carrier plate
Planets
Internal gear
Ball bearing
Gearhead flange
Output shaft

NXT Mindstorms - Servo Motor



Other type of actuator

Heaters - used with temperature sensors And temperature controller to control the temperature in automated molding Equipment and in soldering operation.

Lights - Lights are used on almost all machines to indicate the machine state and provide feedback to the operator.

- LED
- LCD's
- Gas plasma display
- CRT

Sirens/Horns - Sirens or horns can be useful for unattended or dangerous machines to make conditions well known.

Thank you