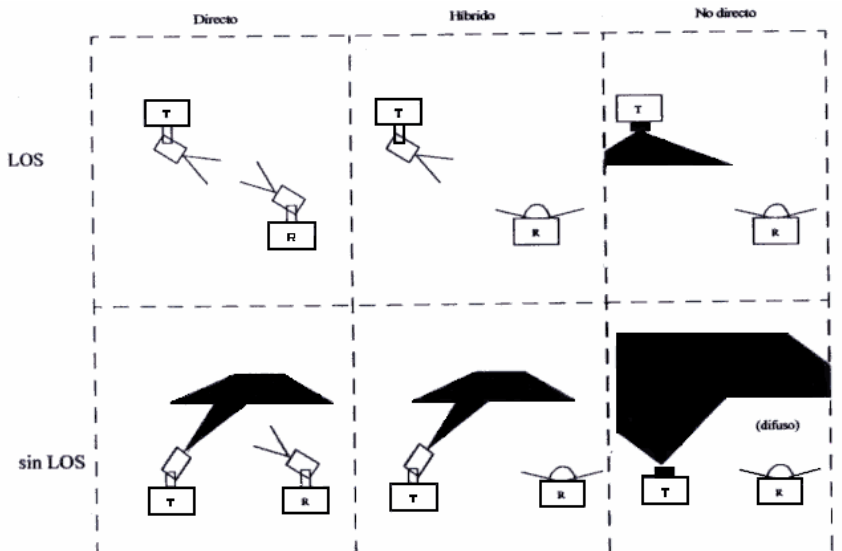
IrDA

Transferencia de Datos por Infrarrojos.

COMUNICACIÓN DE DATOS POR INFRARROJOS

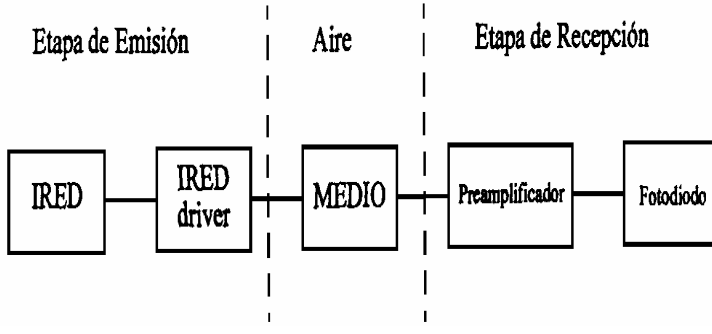
- Usos de la tecnología IR:
  - Enviar un documento de un PC portátil a una impresora.
  - Coordinar agendas y libretas telefónicas entre un PC de escritorio y portátiles.
  - Enviar imágenes desde una cámara digital a un ordenador.
  - Control remoto de aparatos electrónicos.



- Clasificación de los enlaces por IR:
  - Según grado de direccionalidad del transmisor y el receptor:
    - *Enlace Directo.*
    - *Enlace no Directo.*
    - *Enlace Híbrido.*
  - Según la existencia o ausencia de visión directa entre el transmisor y el receptor:
    - *Enlaces con Visión Directa (Line-Of Sight, LOS).*
    - *Enlaces sin Visión Directa.*

SISTEMA DE COMUNICACIÓN IR

- Ventajas de los sistemas que se comunican por IR:
  - Bajo costo.
  - Requiere poco espacio para su instalación.
  - Fácil implementación.
  - Bajo consumo de energía.
  - Permite la movilidad de los equipos.
  - Mayor fiabilidad.
  - Invulnerabilidad a las fuentes de interferencia.
  - No produce daños en la retina.
  - No se necesita permiso de ningún organismo.
  - No producen interferencias electromagnéticas.
  - Estándar universal.



COMUNICACIÓN DE DATOS POR INFRARROJOS

- Desventajas:
  - Todos los cuerpos a cierta temperatura emiten luz IR.
  - En caso de rotura del enlace es necesario compensar fallos con software.
  - El ruido medioambiental produce interferencias.

What's IrDA?

Infrared Data Association (IrDA) is a non-profit trade association providing standards to ensure the quality and interoperability of infrared (IR) hardware. The association currently has a membership of over 160 companies from around the world, representing computer and telecommunications hardware, software, components and adapters.

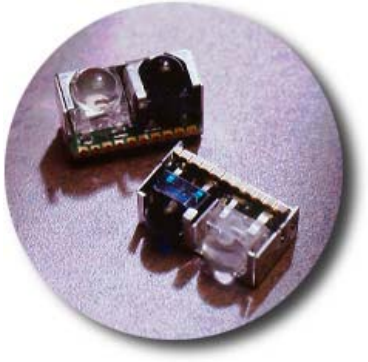
IrDA typically uses direct infrared i.e. point-to-point, line-of-sight, one-to-one communications.

Contact:
Home http://www.irda.org
Linux-IrDA support: http://cesdis1.gsfc.nasa.gov/linux/misc/irda.html
http://www.cs.uit.no/linux-irda/

Infrared Data Association®

IrDA Standard

IrDA defines standards for both the physical devices and the protocols they use to communicate with each other.
The standards include: IrDA Data (SIR, FIR, VFIR), IrDA Control, and AIR. Ports built to the above standards can be found in products such as PDAs, Palm devices, printers, desktop adapters, notebooks, and digital cameras.



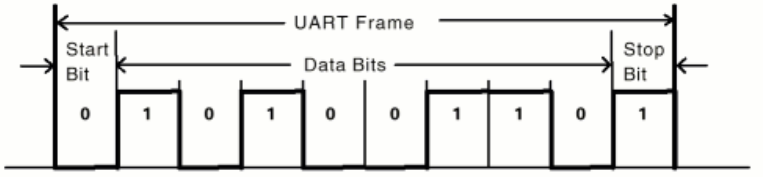
IrDA devices communicate using infrared LED's.
Wavelength used is 875 nm
(with a tolerance around 30 nm).

Receivers utilize PIN photodiodes in generation mode

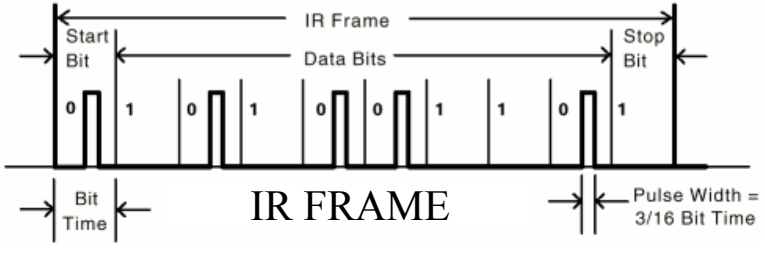
IrDA SIR (v. 1.0)

IrDA devices conforming to standards IrDA 1.0 and 1.1 work over distances up to 1.0m with BER 10^{-9} (on a maximum level of surrounding illumination 10klux, equivalent to daylight).

Values are defined for a 15 degree deflection (off-alignment) of the receiver and the transmitter; output power for individual optical components is measured at up to 30 degrees.



UART FRAME

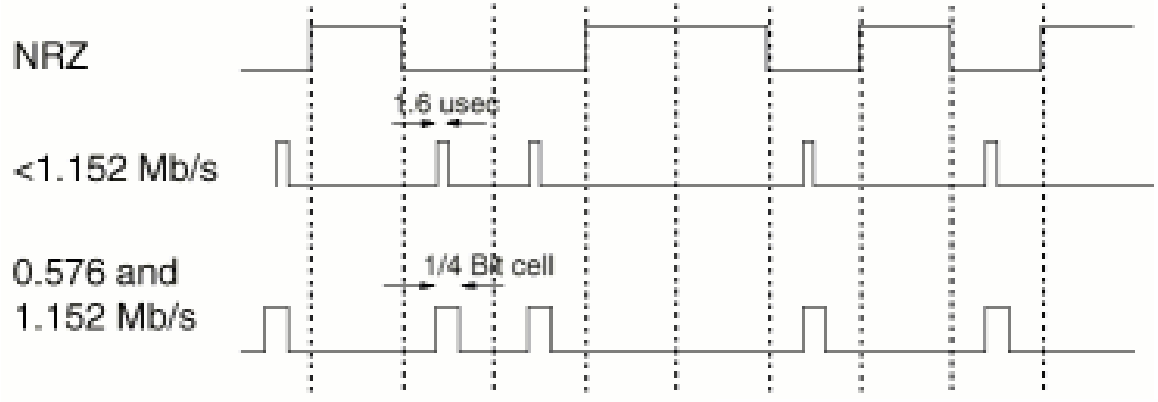


IR FRAME

Transmitter can use either 3/16 mark-to-space ratio for one bit, or a fixed length 1.63 µs of each optical pulse, which would correspond to 115kbps. With fixed length and speed of 38400 bps, each bit would take 3 pulses.

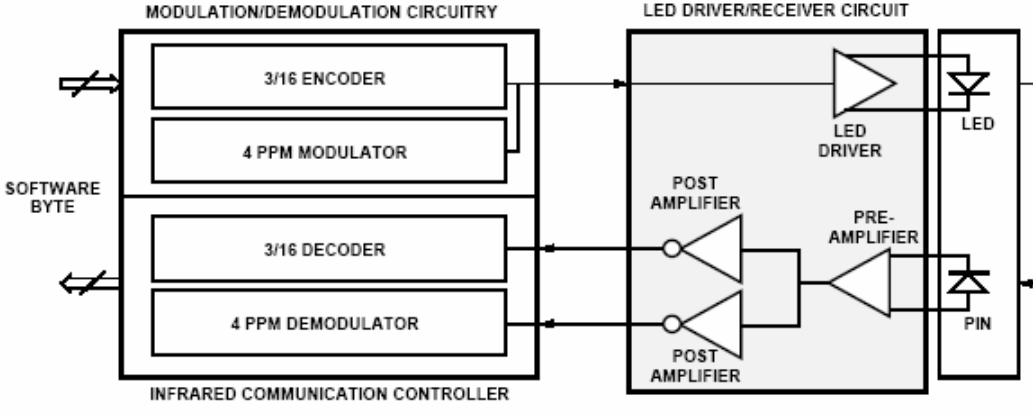
IrDA AIR (v. 1.1)

IrDA AIR has the same specifications than 1.0 on distance (up to 1.0m) and BER (10^{-9} on daylight).



IrDA 1.1 Signal formats

IrDA v. 1.1 defines speeds 0.576 and 1.152 Mbps, with 1/4 mark-to-space ratio. At these speeds, the basic unit (packet) is transmitted synchronously, with a starting sequence at the beginning. The NRZ signal in the figure is the original data signal without modulation. Now is intended for improved range



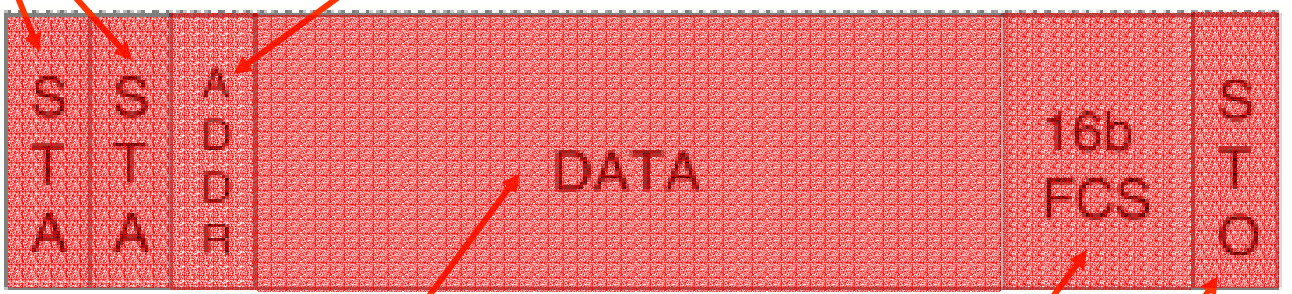
IrDA 1.1 Block Diagram

IrDA SIR-AIR PACKET STRUCTURE

A packet consists of:

STA: two start words, 01111110 (binary), it cannot appear anywhere else in the data stream

Target address (IrDA devices are assigned numbers by the means of IrDA protocol, so they are able to unambiguously identify themselves) of 8 bits



Data: 8 bit control field+2045 information bytes

FCS: CRC (16 bits), generated by IrDA compatible chipset

STO: two start words, 01111110 (binary)

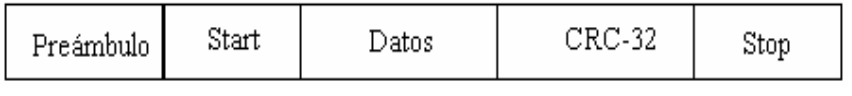
IrDA FIR

Designed for 4Mbps speed

Uses 4-PPM modulation with 1/4 mark-to-space ratio (using this, only half of the LED flashes are needed than in previous modulations; so, data can be transferred two times faster. Besides, it is easier for the receiver to maintain the level of surrounding illumination)

With the 4PPM modulation, a constant number of pulses is received within a given time, (transmitter flashes at 2MHz rate)

4Mbps packets use CRC-32 correction code. Most chipsets which can use this modulation can also generate CRC-32 by themselves, and check it when receiving, throwng away incorrectly received frames.



IrDA VFIR

Very Fast IrDA: A specification for connecting IrDA-enabled devices at a rate of 16 Mbps, half duplex.

All VFIR devices are also required to support FIR and SIR operation

Emplea codificación HHH(1.13) que garantiza entre 1 y 13 chips vacíos entre dos consecutivos en la señal IR transmitida.

La trama VFIR consta de siete campos:

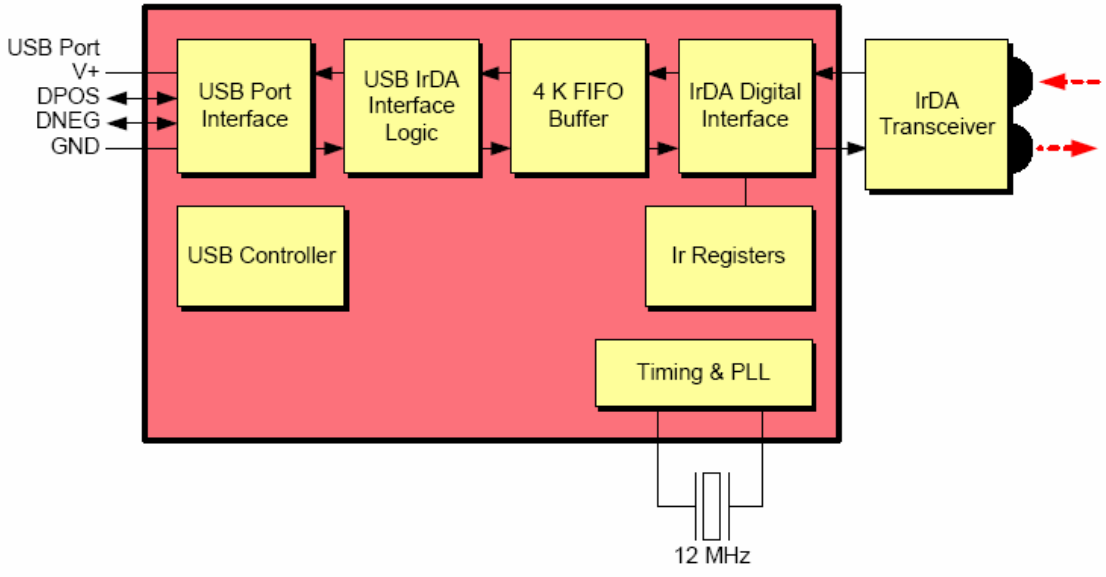
Preámbulo	Start	Datos	CRC-32	Byte de Relleno	Stop	NULO

IrDA VFIR APPLICATIONS

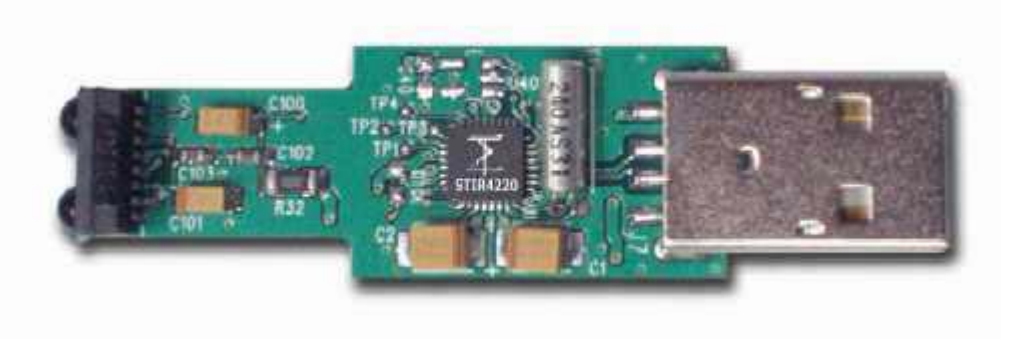
USB-to-infrared controllers enable IrDA capability on PCs for easy wireless transfer of data such as photos between the PC and mobile devices.

Also provides IrDA compatible communication for present-day standards such as fast infrared (FIR), medium infrared (MIR), and serial infrared (SIR) speeds.

Is capable of transferring a 3-Mbyte data file in approximately two seconds.

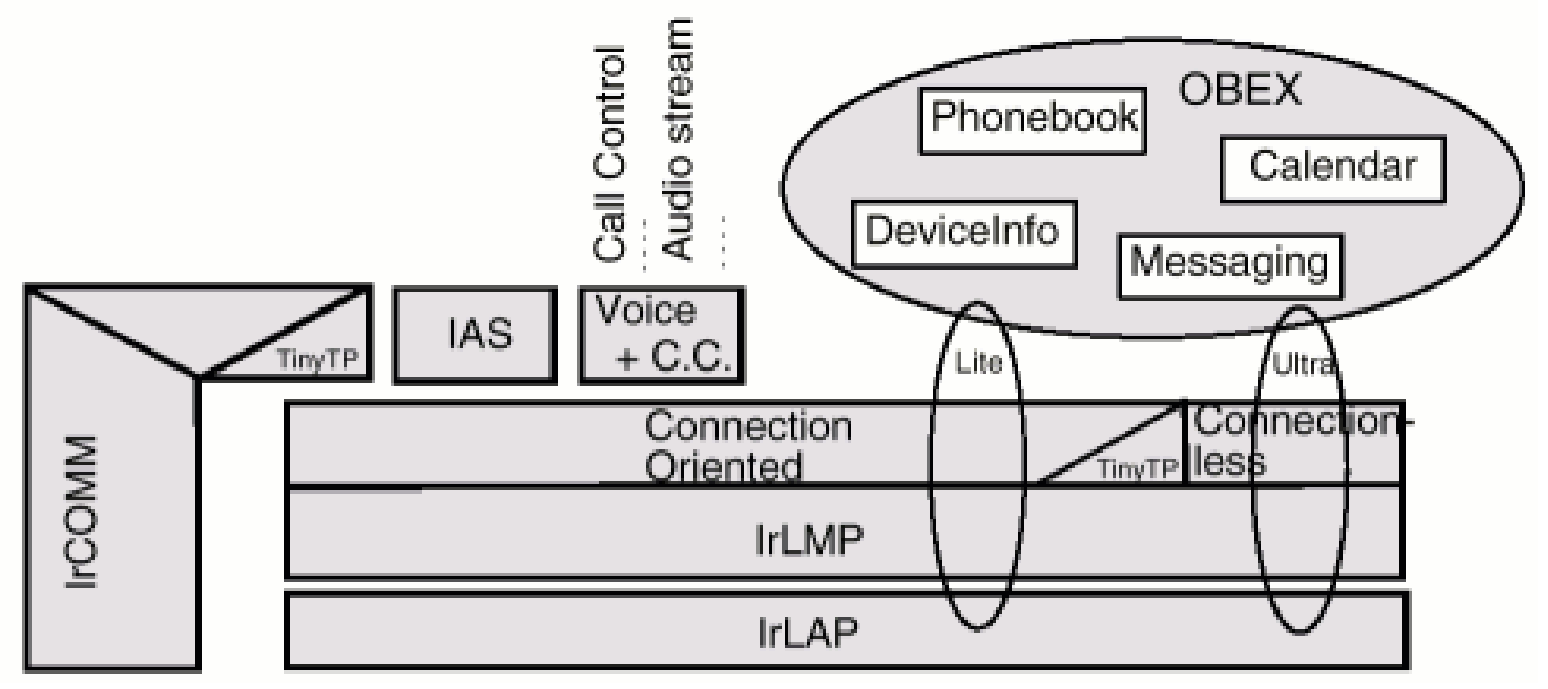


SigmaTel STIR4210/4220 VFIR-USB, Block diagram



SigmaTel STIR4210/4220 VFIR-USB

IrDA PROTOCOL LAYERS



PHYSICAL LAYERS (SIR, AIR, FIR, VFIR…)

IrDA MAC PROTOCOLS (I)

Is a modification of the HDLC protocol reflecting the needs of IrDA communication. In general, it encapsulates the frames and makes sure the IrDA devices don't fight among themselves - in multi-device communication, there is only one primary device, others are secondary. Note that the communication is always half-duplex.

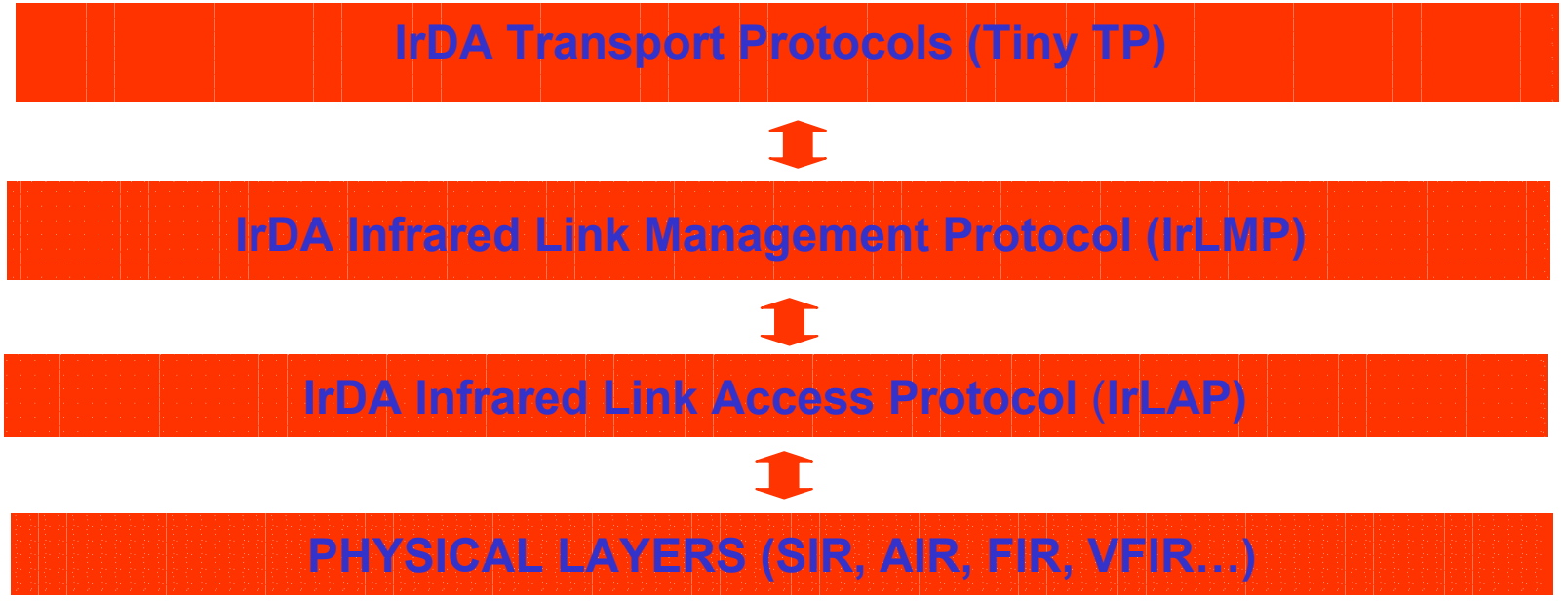
IrLAP describes how the devices establish connection, close it, and how are they going to be internally numbered. Connection starts at 9600 Bd; as soon as information about supported speeds is exchanged, logical channels (each controlled by a single primary device) are created.

IrDA MAC PROTOCOLS (II)

Since configuration of IrDA devices changes (you turn on your IrDA camera and put it next to your notebook), every device lets the others know about itself via the IrLMP protocol, which runs above IrLAP (IrLAP is a link protocol; It can be compared to the IP protocol, although address resolution is different). IrLMP's goal is to detect presence of devices offering a service, to check data flow, and to act as a multiplexer for configurations with more devices with different capabilities involved (compare to sockets in TCP/IP communication). Then, applications use the IrLMP layer to ask if a required device is within range, etc. However, this layer does not define a reliable way to create a channel (like in TCP); this is defined by IrDA Transport Protocols (Tiny TP).

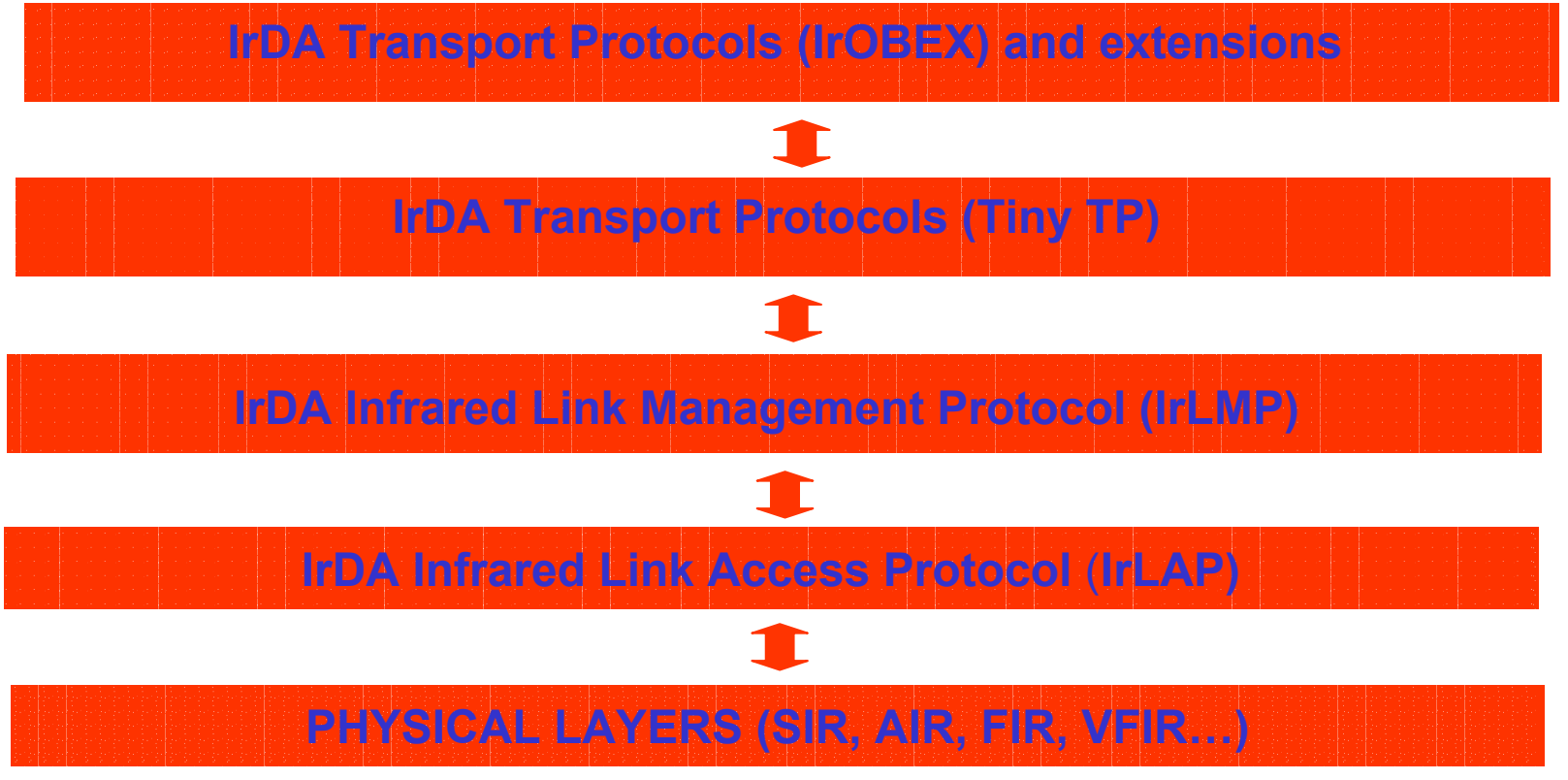
IrDA TRANSPORT PROTOCOLS

This layer manages virtual channels between devices, performs error corrections (lost packets, etc.), divides data into packets, and reassembles original data from packets. It is most similary to TCP.



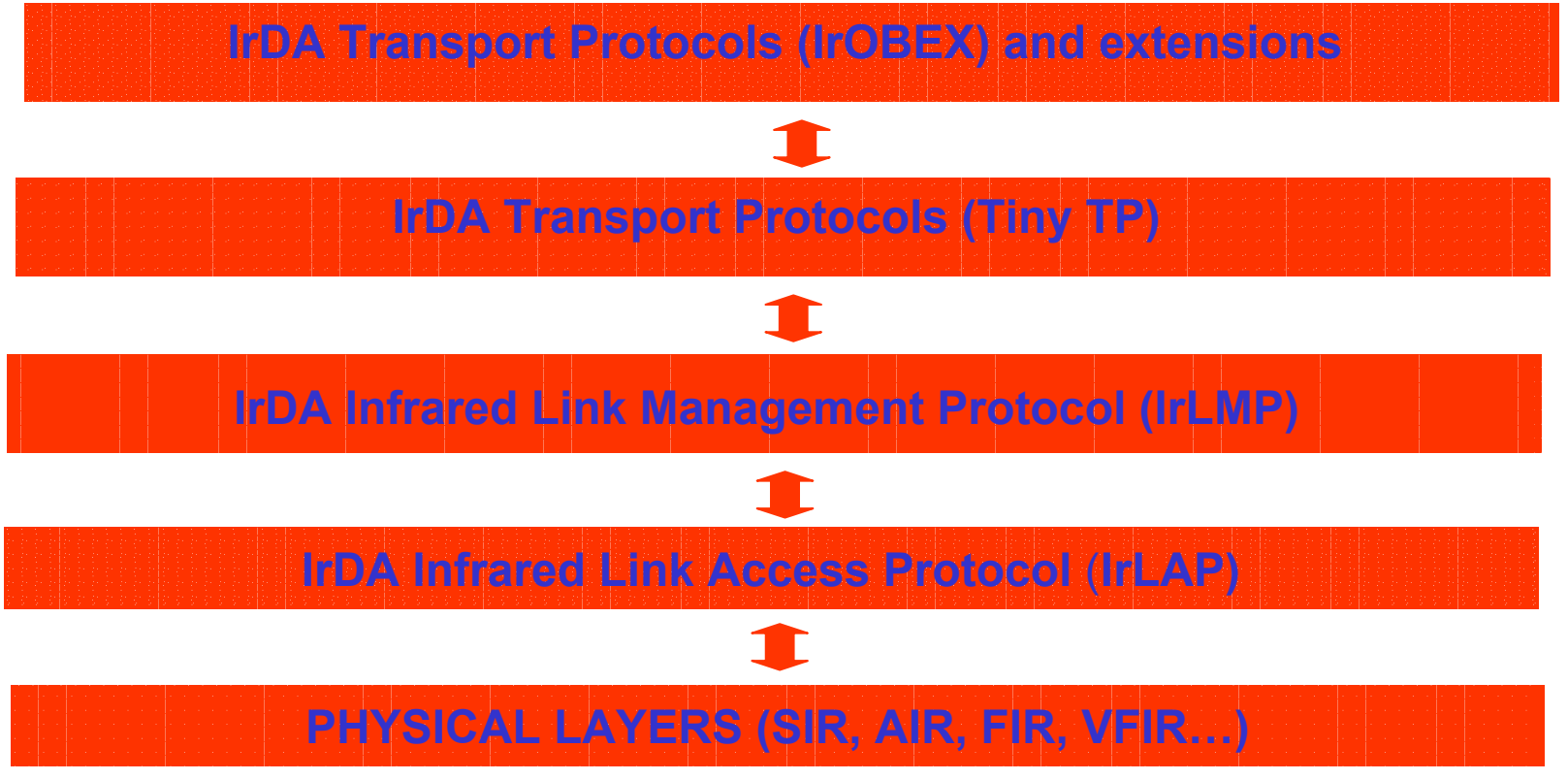
IrDA OBJECT-ORIENTED PROTOCOLS

IrOBEX: is a simple protocol, which defines PUT and GET commands, thus allowing binary data transfer between devices. It is built on top of TinyTP. The standard defines what a packet must contain in order for the devices to recognize each other and communicate.



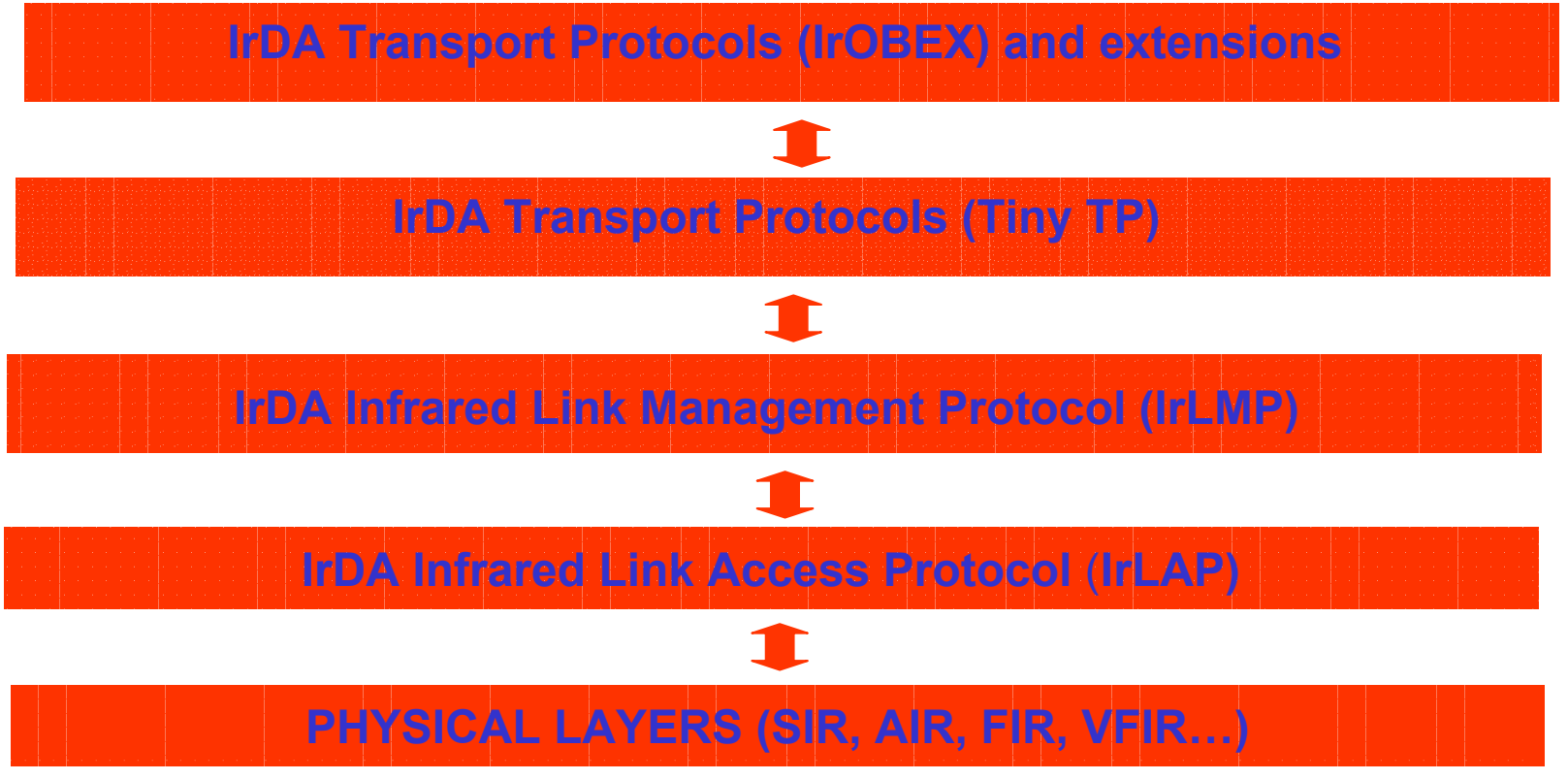
IrDA OBJECT-ORIENTED PROTOCOLS

Extensions to IrOBEX for Ir Mobile Communications -handhelds, PDA, cellular phones- defines how to transfer information pertaining to GSM network (address books, SMS, calendar, dialling control, digital voice transfer over IR, ...)

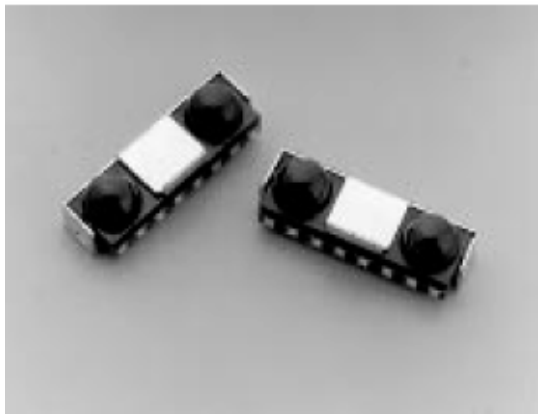


IrDA OBJECT-ORIENTED PROTOCOLS

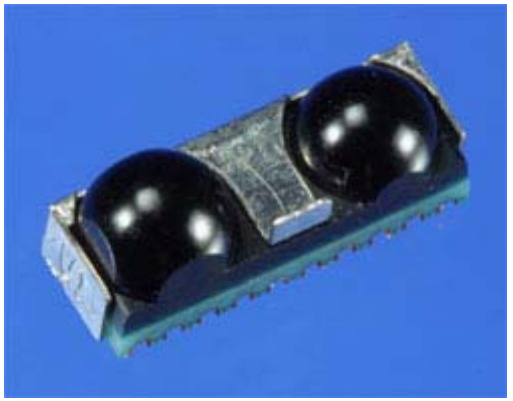
IrTran-P (Infrared Transfer Picture) Specification: This definition was made up by big companies manufacturing digital cameras and specifies how to transfer pictures over the infrared interface. It is built on top of TinyIP, too.



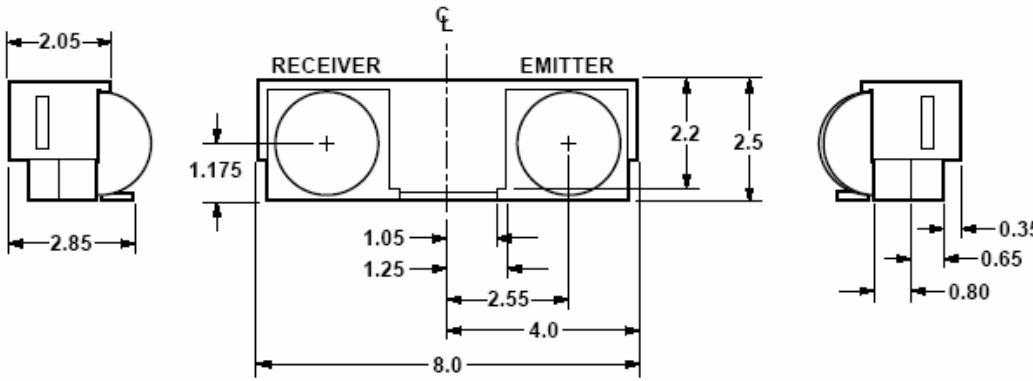
IrDA COMPONENTS



Agilent HSDL-3201 transceiver baud-rates from 115kbps (IrDA 1.0), works in half-duplex mode. Besides the transceiver itself, only several capacitors to filter the signal and to reduce noise are used.



SHARP GP2W1001YP, designed for IrDA FIR 4 Mb/s. Supports all previous version and data rate requirements

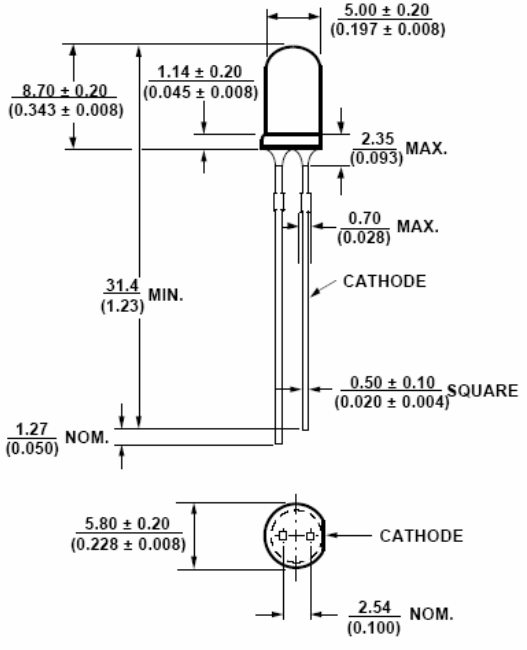


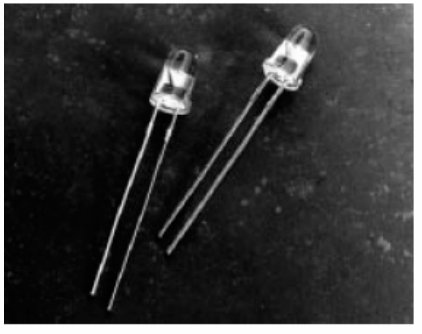
Typical dimensions (mm)

IrDA COMPONENTS: ANALYSIS OF AN IrDA IRED (I)

IREDs HSDL-4230 and HSDL-4220. LEDs withstand modulation speed up to 10Mbits, maximum current 0.5A (mark-to-space ratio 0.2) or 100mA (continuously). The only difference of the two versions in the HSDL-4200 family is their radiation angle (30 degrees for HSDL-4220, only 17 degrees for HSDL-4230).

Package Dimensions

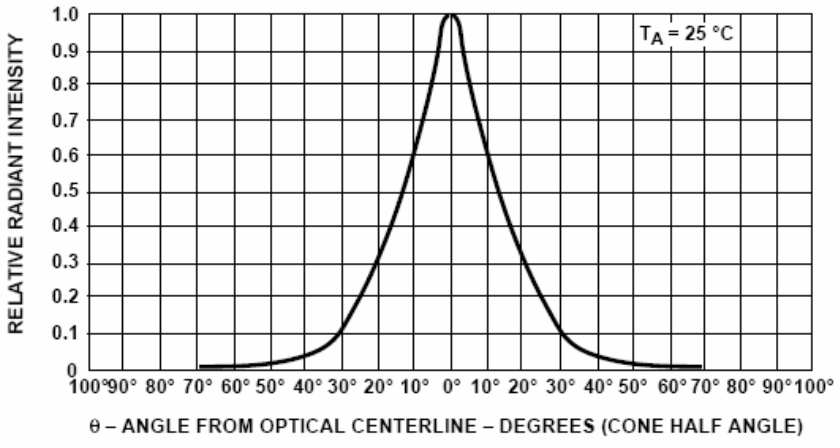




Features

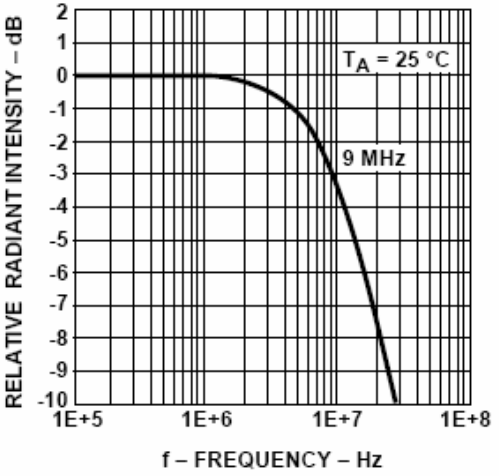
- Very High Power TS AlGaAs Technology
- 875 nm Wavelength
- T-1¾ Package
- Low Cost
- Very High Intensity:
  HSDL-4220 - 38 mW/sr
  HSDL-4230 - 75 mW/sr
- Choice of Viewing Angle:
  HSDL-4220 - 30°
  HSDL-4230 - 17°
- Low Forward Voltage for Series Operation
- High Speed: 40 ns Rise Times

IrDA COMPONENTS: ANALYSIS OF AN IrDA IRED (II)

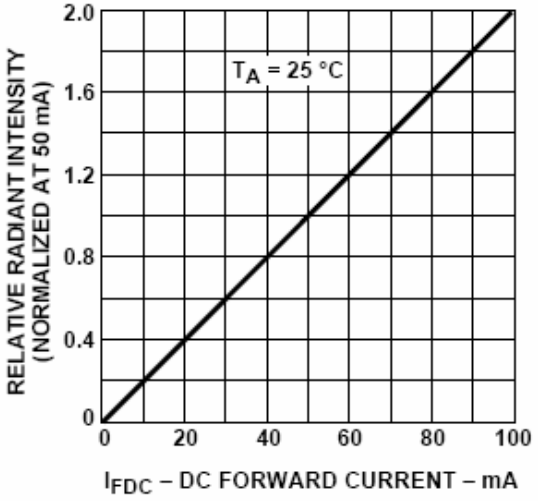


Radiant intensity vs. Angle displacement

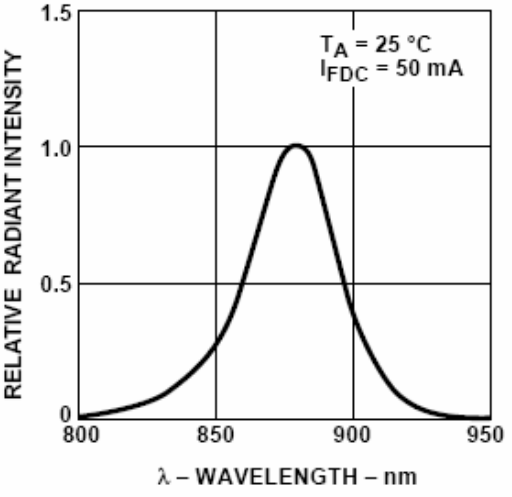
Radiant intensity vs. frequency



Radiant intensity vs. DC forward current



Radiant intensity vs. wavelength



IrDA COMPONENTS: ANALYSIS OF AN IrDA PIN-PD (II)

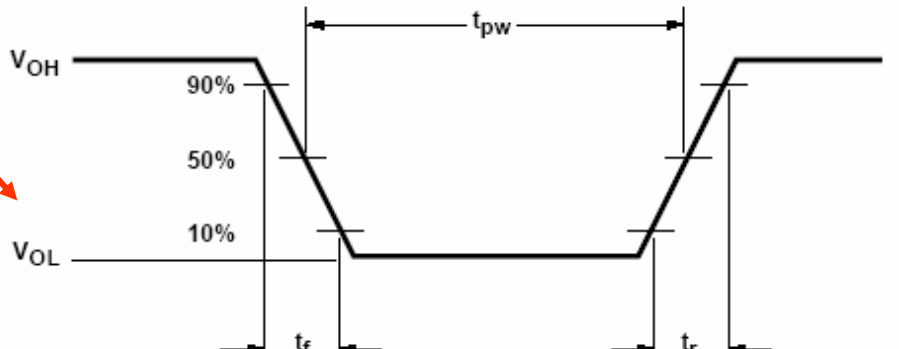
FOV

Wavelength

Parameter		Symbol	Min.	Typ.	Max.	Units	Conditions	Note
Receiver								
RXD Output Voltage	Logic High	V_{OH}	V_{CC} -0.2		V_{CC}	V	I_{OH}=-200 µA, EI ≤ 0.3 µW/cm²	
	Logic Low	V_{OL}	0		0.4	V	I_{OL}=200 µA	8
								8
							t_{PW} (EI)=1.6 µs, C_L =10 pF	
							t_{PW} (EI)=1.6 µs, C_L =10 pF	
Receiver Latency Time		t_L		25	50	µs		9
Receiver Wake Up Time		t_{RW}		28	40	µs		10

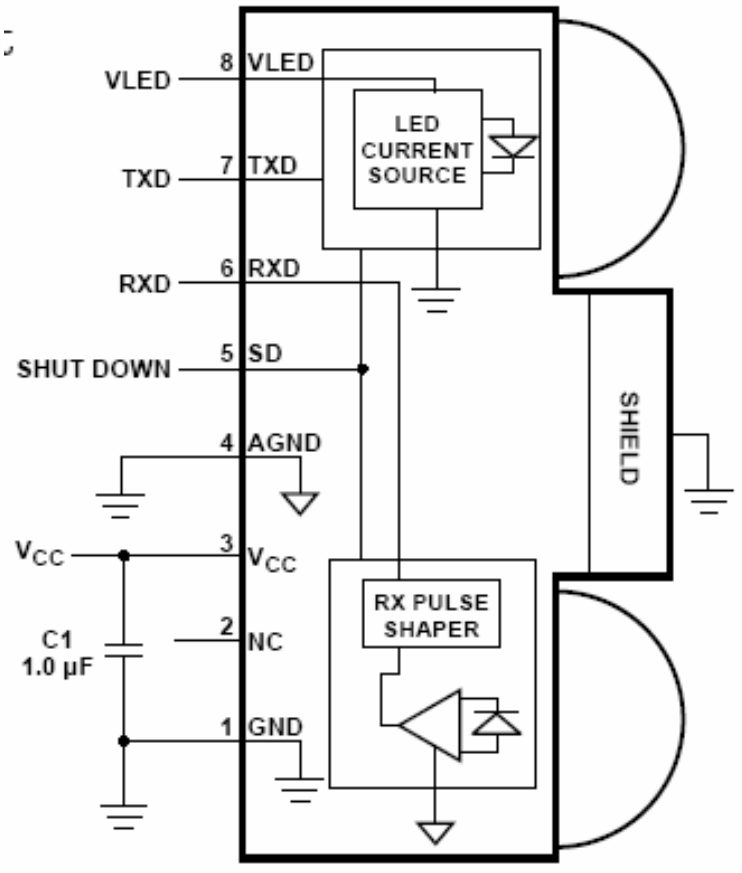
Maximum baud rate

From the HSDL-3201 transceiver, designed for baud-rates from 115kbps (IrDA 1.0)

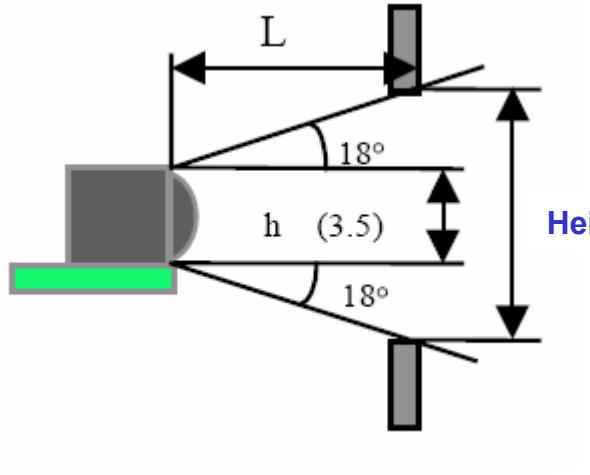


IrDA COMPONENTS: TRANSCEIVER ENCAPSULATION

Pin	Symbol	Description	Notes
1	GND	Ground	Connect to system ground.
2	NC	No Connection	This pin must be left unconnected.
3	V_{CC}	Supply Voltage	Regulated: 2.7 to 3.6 Volts
4	AGND	Analog Ground	Connect to a "quiet" ground.
5	SD	Shut Down Active High	This pin must be driven either high or low. Do NOT float the pin.
6	RXD	Receiver Data Output. Active Low.	Output is a low pulse for 2.4 µs when a light pulse is seen.
7	TXD	Transmitter Data Input. Active High.	Logic high turns the LED on. If held high longer than ~ 20 µs, the LED is turned off. TXD must be driven high or low. Do NOT float the pin.
8	VLED	LED Voltage	May be unregulated: 2.7 to 6.0 volts.
-	SHIELD	EMI Shield	Connect to system ground via a low inductance trace. For best performance, do not directly connect to GND or AGND at the part.

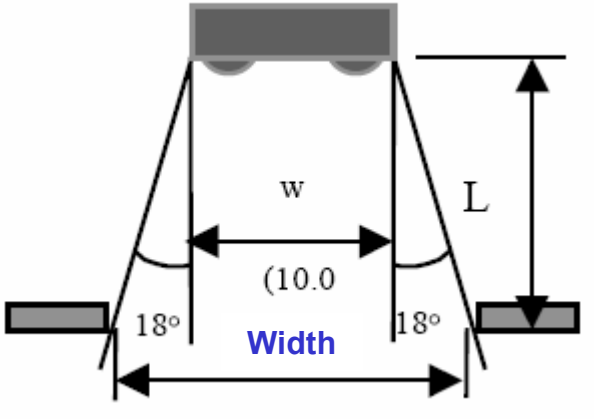


IrDA COMPONENTS: TRANSCEIVER ENCAPSULATION



Heigth

Design of the IR cosmetic window with +18º (The IrDA specifications require +15º) viewing angles, in vertical and horizontal axis.



Width

IrDA COMPONENTS: POWER CONSUMPTION

DC Supply Current	Shutdown	I_{CC1}		20	200	nA	V_{CC}=3.6 V,$V_{SD} \geq V_{CC}$ - 0.5, T_A=25°C	
	Idle	I_{CC2}		100		µA	V_{CC}=3.6 V, V_I(TXD) ≤ 1/3 V_{CC}, EI=0	
AC Supply Current	Active, receive	I_{CC3}		0.8	3.0	mA	V_{CC}=3.6 V, V_I(TXD) ≤ 1/3 V_{CC}	12,13
	Active, transmit	I_{CC4}		9.0		mA	V_{CC}=3.6 V, V_I(TXD) ≥ 2/3 V_{CC}	14

Notes at top of next page.

IrDA COMPONENTS: MANUFACTURERS

Links to manufacturers of IrDA components

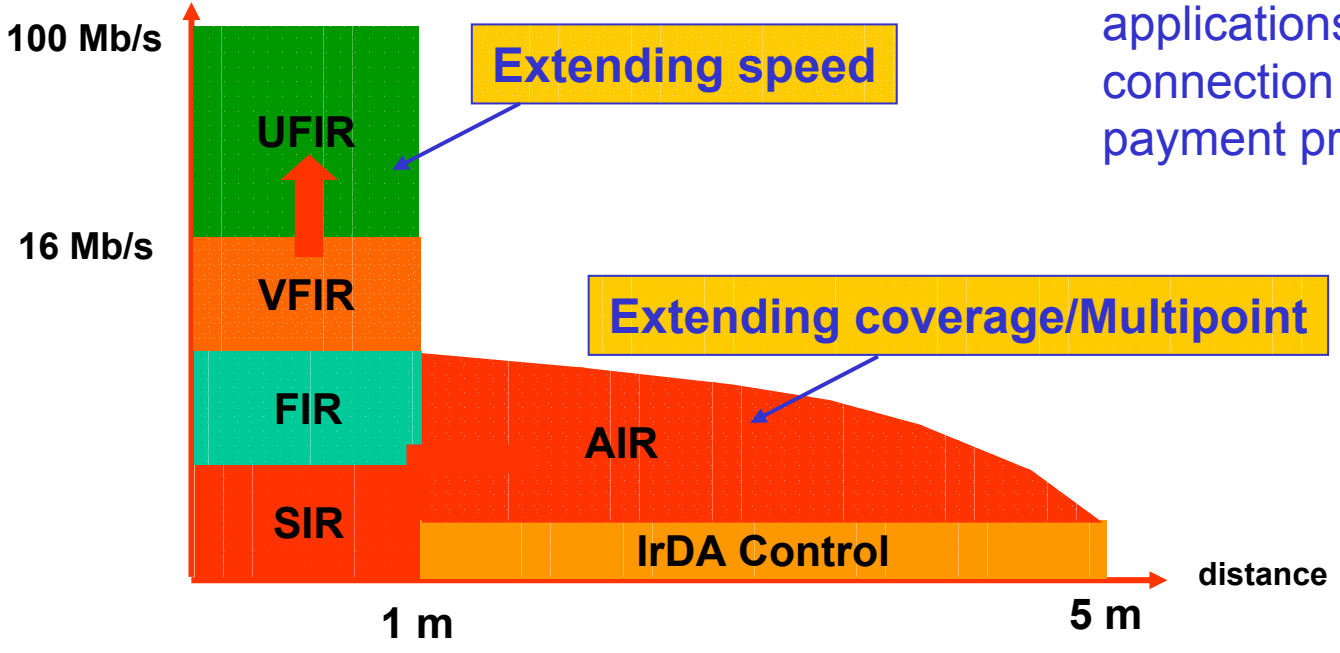
IBM:	www.IBM.com
Hewlett Packard:	www.hp.com
Texas Instruments:	www.ti.com
National Semiconductor:	www.national.com
Temic:	www.temic-sds.com

Software support for IrDA:

Microsoft (for windows XP)
http://www.microsoft.com/resources/documentation/windows/xp/all/proddocs/en-us/sag_irdaconcepts_102.mspx
(for miniport devices)
http://msdn.microsoft.com/library/en-us/network/hh/network/210irda_35b6e7e7-eaa0-4ec4-aa1f-cca9c04587c3.xml.asp
Linux (can be found in many places as freeware)
http://www.cs.uit.no/linux-irda/

IRDA STANDARD EVOLUTION: UFIR & IrFM

Banking and shopping: e.g. the user pays and downloads the content from vending machine on the street or on a shopping center. A good way for this applications is Infrared ad-hoc connection as IrDA Ir-FM payment protocol.



IEEE 1073 STANDARD FAMILY

The standards are separated into four basic areas:

1. **Device Data & Services** (1073.1.x)
2. **General Application Profiles** (1073.2.x)
3. **Transport & Physical Layers** (1073.3.x / .4.x)
4. **Internetworking (1073.5.x)** TCP/IP gateway

- ✓ Standards in each area are relatively independent-Changes in one do not mandate changes in others
- ✓ Additions may be made to each area as necessary (e.g., new device specializations or transports)

REQUIREMENTS FOR A MEDICAL INFORMATION BUS

- Safety
- Unambiguous Association
- Unambiguous Device Identification
- Wide Range of Topologies
- Cost to the User *(Commercial Viability)*
- Off-the-Shelf Technologies
- Bandwidth *(Communication and Processor)*
- Power Consumption
- Internetworking
- International Support
- Legacy Devices
- LAN Access
- Time Synchronization
- HL7 Interoperability
- Security (*following US Health Insurance Portability and Accountability Act of 1996 and EU regulations)*
- Remote Control
- Alarm Management
- Scalability

IEEE 1073.3.3

- IrDA-based standard
- Interconnection of computers and/or medical devices
- Suitable for new device designs, but targeted to ***legacy*** devices:

  - Already in use in clinical facilities
  - In active production at the facilities of medical device manufacturers, or
  - Beyond the initial stages of engineering development

In each of these cases, add a standardized communications capability might be prohibitive, unless developing a suitable standard

WHY INFRARED FOR MEDICAL APPLICATIONS?

• The standardization of communication processes that has led to the explosion of telecommunications products in the consumer area **has yet to take** hold in the world of clinical medicine

• Information technology (IT) standards within the commercial application domain (e.g., IEEE 802.x standards) are **inadequate** to fully address the needs of the clinical IT domain, particularly at the patient bedside

• RF systems have **security** and **operation** problems that not affect IR systems (e.g. with legacy equipment using ISM bands or privacy of medical data)

IEEE 1073.3.3 STATUS

Infrared Wireless transport draft standard (P1073.3.3) was **approved** on its first ballot.

The infrared wireless transport standard **extends** the capabilities of its **cable-connected** counterpart, IEEE 1073.3.2-2000, to include an infrared wireless physical layer. This interface is based on IrDA-based ports.

It also defines a **LAN access** point whereby devices can interact with other systems across a TCP/IP-based LAN.

The standard also closely tracks the NCCLS POCT1 standard for point-of-care test or diagnostic devices, which used IEEE 1073.3.2 and P1073.3.3 transport standards in its Device & Access Point (DAP) specification.

IEEE 1073 STANDARD FAMILY

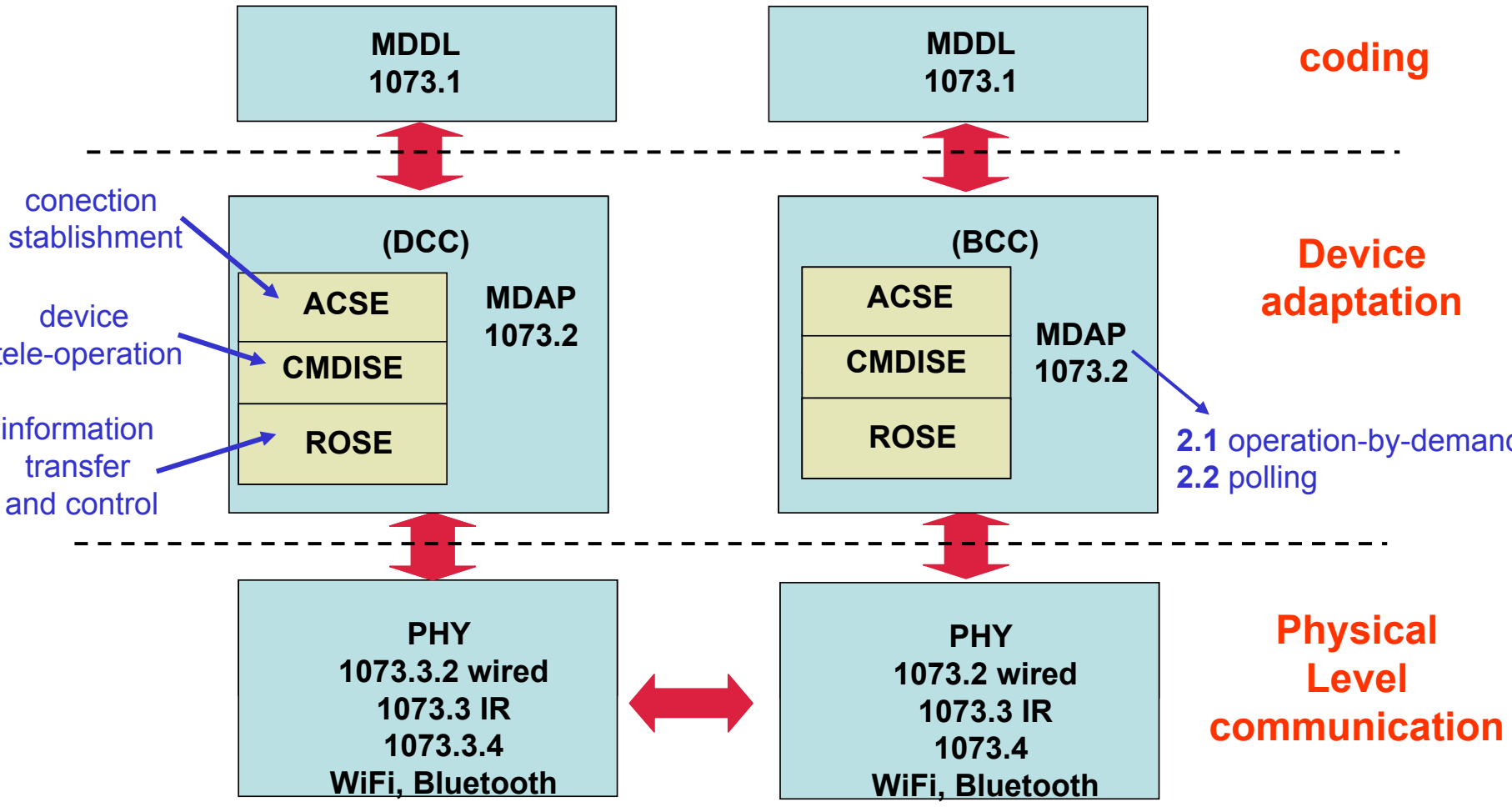
Also known as **MIB** (*Medical Information Bus*). Layered Family of Standards:

Device data/semantics (ISO/IEEE 11073-1xxxx series) *Medical Device data Language* o ***MDDL*** covers the design of 16 bits codeword familiy for device identification and alarms (discovery, conection, disconection….)

General communication services (ISO/IEEE 11073-2xxxx series)
Device adaptation profile (***MDAP***) for transmitting the MDDL between a *BCC* (e.g a sensor) and its controller (*DCC)*. It contains **ACSE** (ISO/IEC 8650) for conection stablishment, **ROSE** (ISO/IEC9072-2) for device tele-operation, including data demand. and **CMDISE** (ISO/IEC 9596-1-based) for information transfer and control. It supports both an operation-by-demand mode (1073.2.1) and a polling-based automatic response mode (1073.2.2)

Transports (ISO/IEEE 11073-3xxxx series) Physical levels

IEEE 1073 STANDARD FAMILY



IEEE 1073.3.3 PURPOSE

The 1073.3.3 standard (based on the IrDA standards) defines:

- A **point-to-point**, narrow angle (±15° half-angle cone) infrared physical layer that operates over a 0-1 meter distance at signaling rates of 9600 to 4M Bd.

- A transport-level device **discovery and communication** parameter negotiation process

- **Information Access Layer** (IAS) entries are defined for identifying the device and its services across an IrDA connection.

- **TinyTP** provides a transport layer that allows for independent flow control of multiple logical connections using the same physical link. Optionally Segmentation & Reassembly (SAR) may be used to communicate large blocks of data

- **Support** for both standard ISO/IEEE 11073 devices (infusion pumps, ventilators, vital signs monitors, etc.) and point of care test devices (e.g., glucometers, blood gas analyzers, etc.).

- Mechanisms for using **Simple Network Time Protocol** (SNTP) to synchronize clocks across the link

TOPOLOGY

IEEE 1073.3.2 defines a star topology, requiring each device to have its own connection directly into the network. Two types of nodes are allowed:

The BCC is the primary node (network controller and the hub of the star)

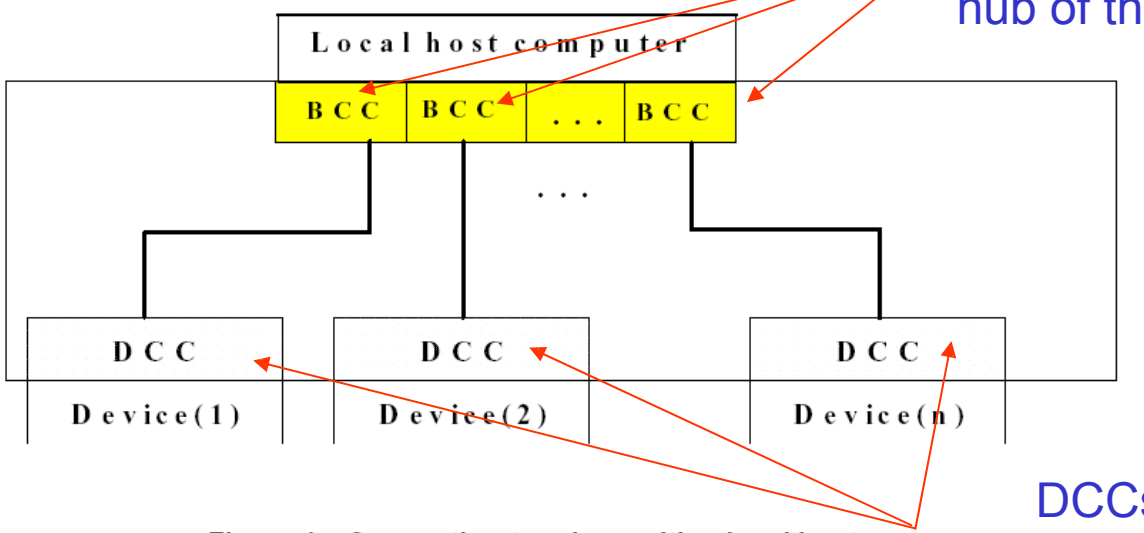
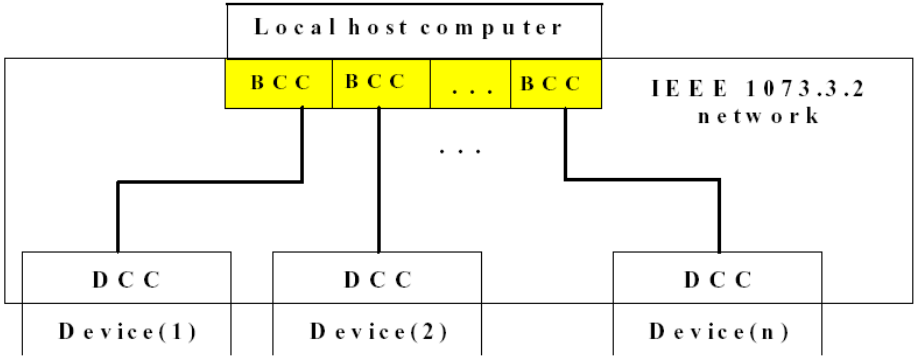


Figure 1—Connection topology with a local host

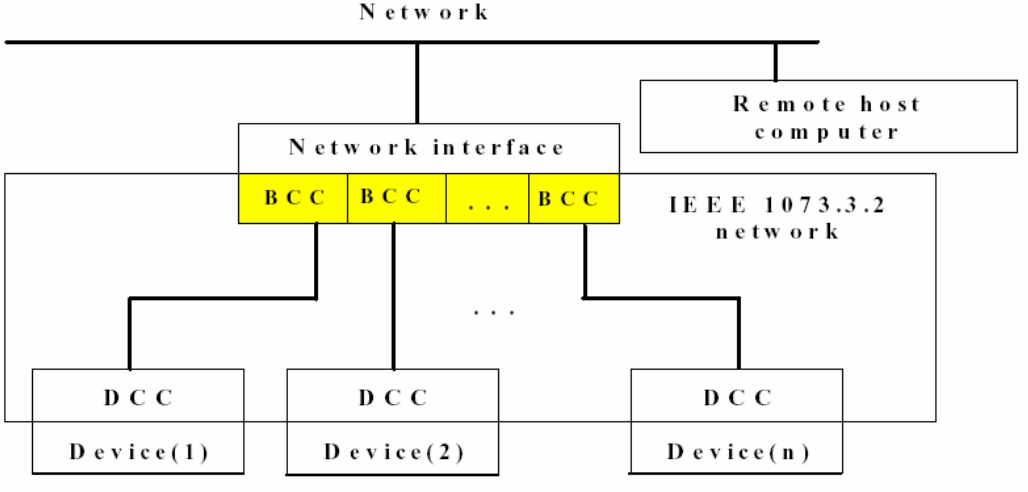
DCCs are secondary nodes and limited in number to the loading capacity of the BCC and/or number of physical port sockets

TOPOLOGY



… or to a remote host computer over a network, the BCC would also include internet-working functions in the latter case.

The BCC can interface directly to a local host computer



LAYERING

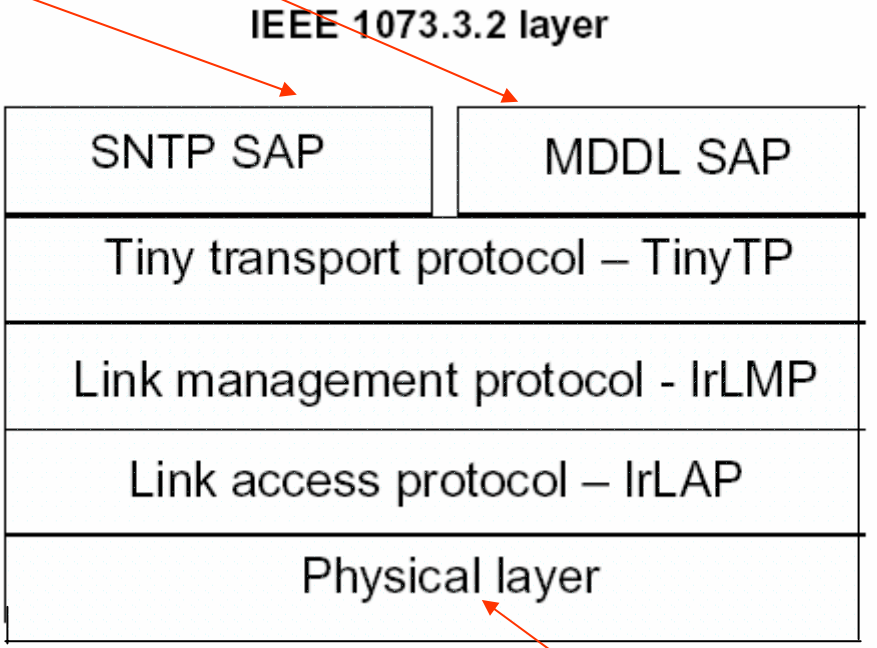
Simple network time protocol (SNTP) service access point (SAP), a SAP for an optional time synchronization service

Medical device data languages SAP

Tiny transport protocol (TinyTP), providing flow control on IrLMP connections

Infrared link management protocol (IrLMP), providing multiplexing of the IrLAP layer

Infrared link access protocol (IrLAP), providing a device-to-host connection for the reliable, ordered transfer of data, including device discovery procedures



Physical layer, defining a standard conector and electrical characteristics. provides point-to-point connection sensing, data transmission and power delivery between the BCC and DCC.

TIME SYNCHRONIZATION USING SNTP

Synchronization is necessary for MIB to support devices with real-time waveform capability, in order to acquire, analyze, and store waveforms with a high degree of confidence

Another use for a time-synchronization protocol is that it would allow a DCC to automatically verify, set, and periodically update its local clock using the clock in the BCC, which in turn could ultimately obtain its time from a highly reliable and accurate reference clock on the network.

Time synchronization would be a major convenience for clinicians and would promote accurate and consistent time-stamps on medical records.

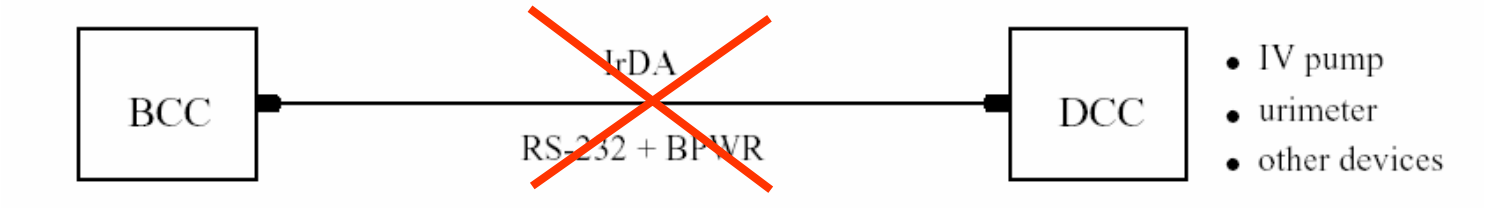
PHYSICAL LAYER

Provides point-to-point data transmission between the BCC and DCC, also supports optional connection sensing (as "*turn on the device*" or "*communication error*") and power delivery (in 1073.3.2.).

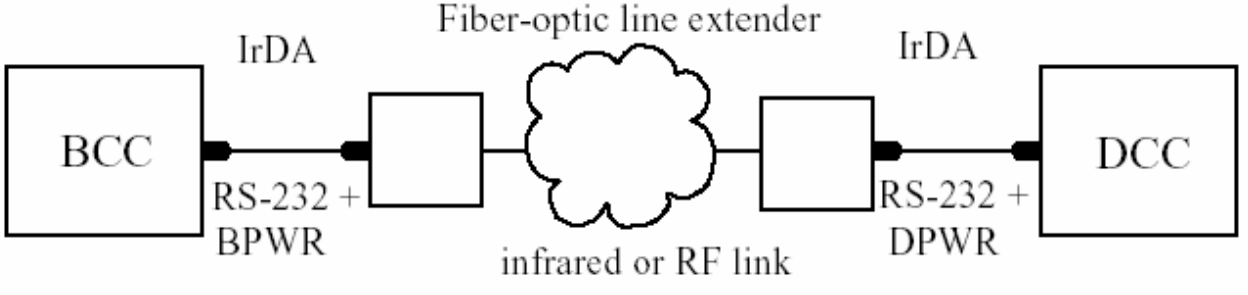
Compatibility with ANSI/TIA/EIA-232-F-1997 (RS-232) without the need for adapter boxes.

Standard includes specifications fot optical isolation, power supply drives only the output and not the LEDs, photodetector,or any output buffers

PHYSICAL LAYER



IEEE 1073.3.2



IEEE 1073.3.3 (and modifications)

SERIAL DATA COMMUNICATION

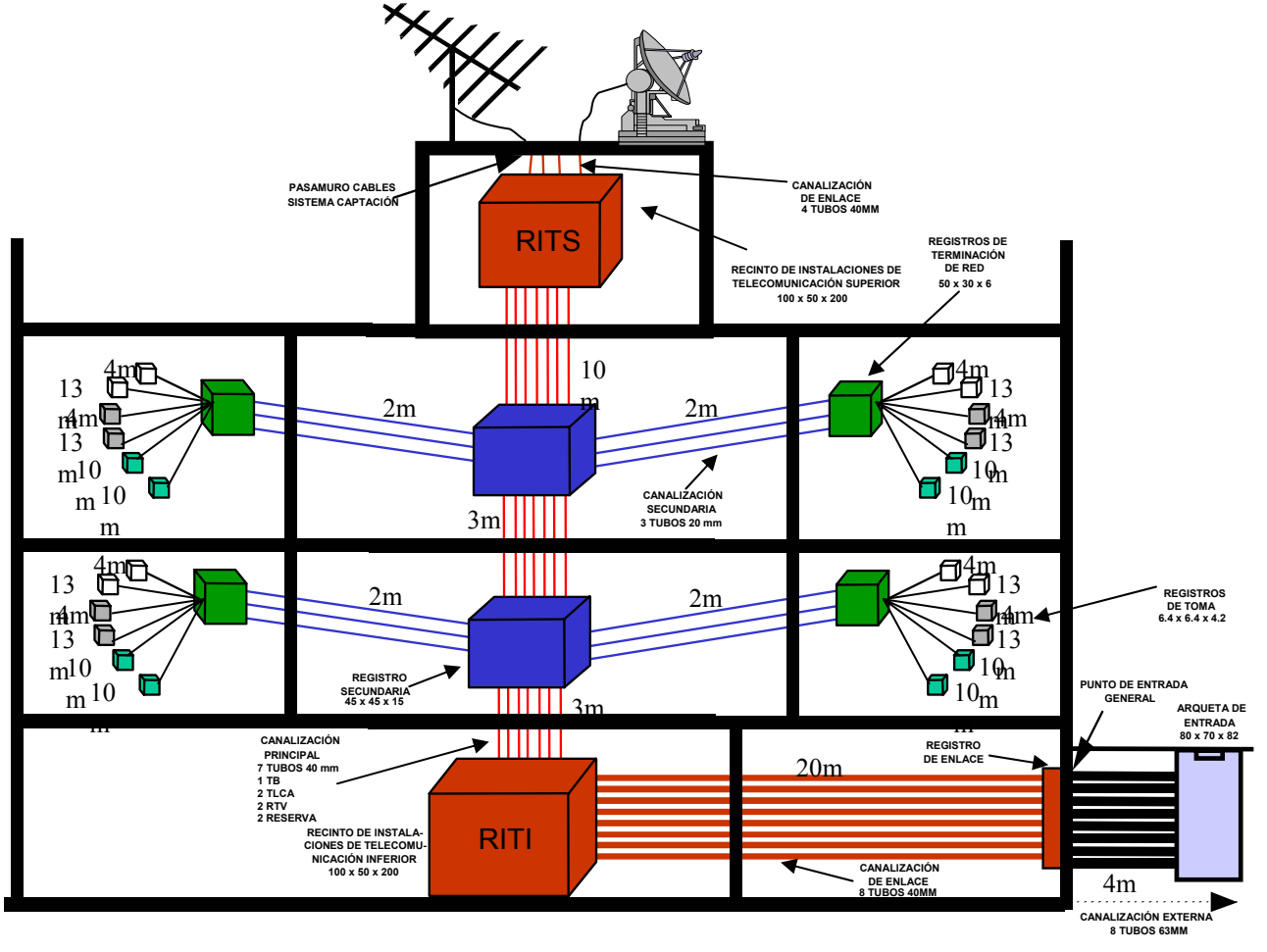
Signaling speed: may support one or more of the following signaling speeds: 9600 Bd, 19200 Bd, 38400 Bd, 57600 Bd, or 115200 Bd. At a minimum, BCCs and DCCs shall support 9600 Bd.

Transmission format: the transmission between BCCs and DCCs shall consist of contiguous octets. The octets are transmitted asynchronously.

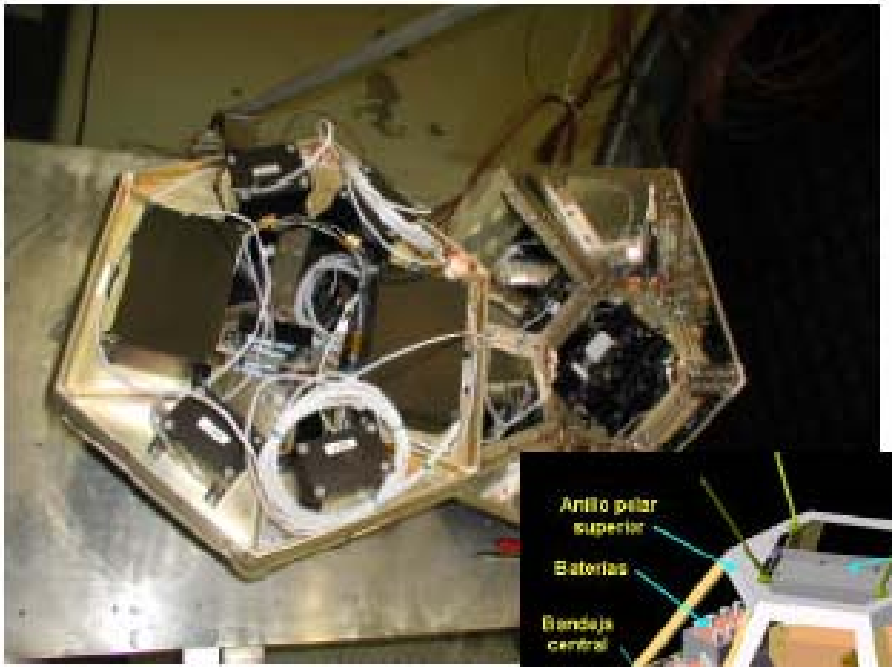
Octet encoding: Octet encoding shall use start/stop encoding. Each octet shall be encoded to include a start bit (logic '0', represented by a positive voltage), followed by eight data bits, followed by a stop bit (logic '1', represented by a negative voltage).

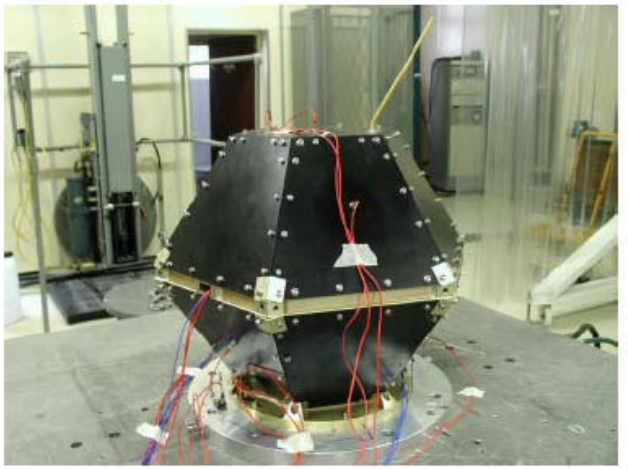
The bits of an octet are transmitted synchronously. The least significant bit (LSB) is transmitted first. The eight data bits may be logic '0' or '1'.

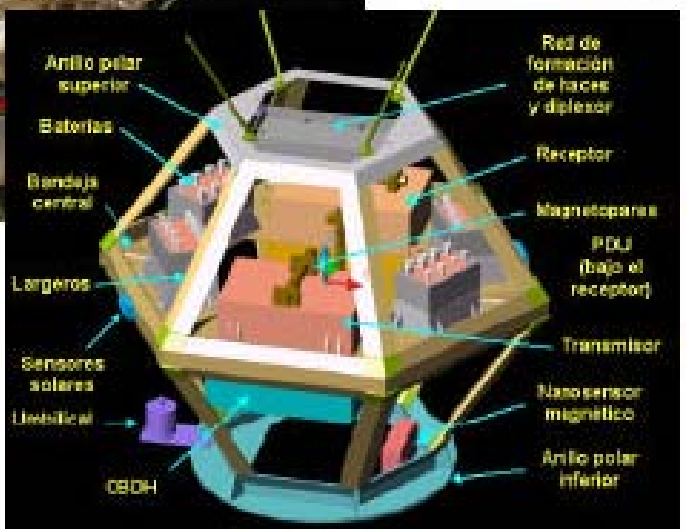
IN-HOUSE APPLICATIONS



SPATIAL ON-BOARD APPLICATIONS







FURTHER READING

comprehensive tutorials on optical wireless communications standards can be found in:

http://www.irda.org/
http://www.ieee.org/
http://www.esa.int

Aplicaciones de IR

- **SoundStation: producto para teleconferencia**
- **Auditel:sistemas de interpretación simultánea**