Medical Information Bus

Andreas Schleifer

Seminar Kommunikationsstandards in der Medizintechnik

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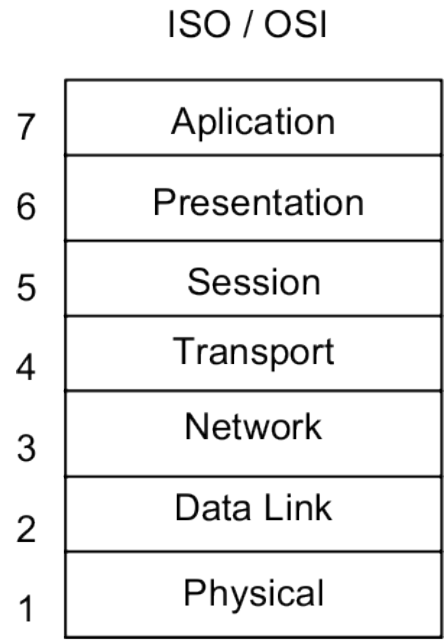
Outline

- What is the Medical Information Bus / ISO/IEEE 11073
- Development Timeline of ANSI/IEEE 1073
- Development Timeline of ISO/IEEE 11073
- Content of ISO/IEEE 11073
- Why isn't it widely used?

What is the MIB / ISO/IEEE 11073

- At the beginning:
  - Medical Information Bus was a standard for connectivity between medical devices

- Today:
  - Medical Information Bus is part of the ISO/IEEE 11073
  - ISO/IEEE 11073 is a standard for communication and interaction between medical devices of different vendors
  - Modeled after the OSI layer model
  - Synonym: X73 family



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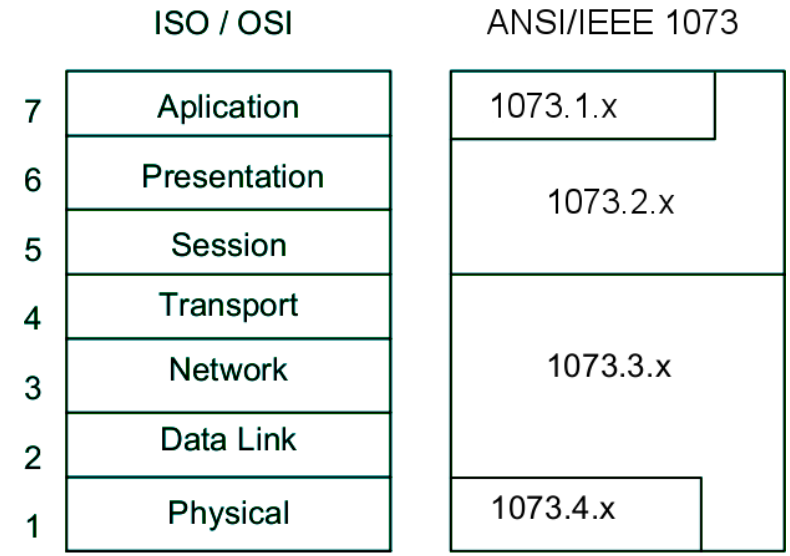
Development Timeline of ANSI/IEEE 1073

- 1982 – Professionals from leading medical institutions define requirements for acute care data communications
- 1984 – Formation of the IEEE 1073 MIB committee
- 1994 – ANSI/IEEE 1073.3.1 (Transport Profile) and ANSI/IEEE 1073.4.1 (Physical Layer) approved by IEEE
- 1995 – ANSI/IEEE 1073.2 (Medical Device Application Profile (MDAP) Framework and Overview) approved by IEEE
- 1996 – ANSI/IEEE 1073 (Medicale Device Communications Framework and Overview) approved by IEEE

- Substandards have been approved throught the last 15 years



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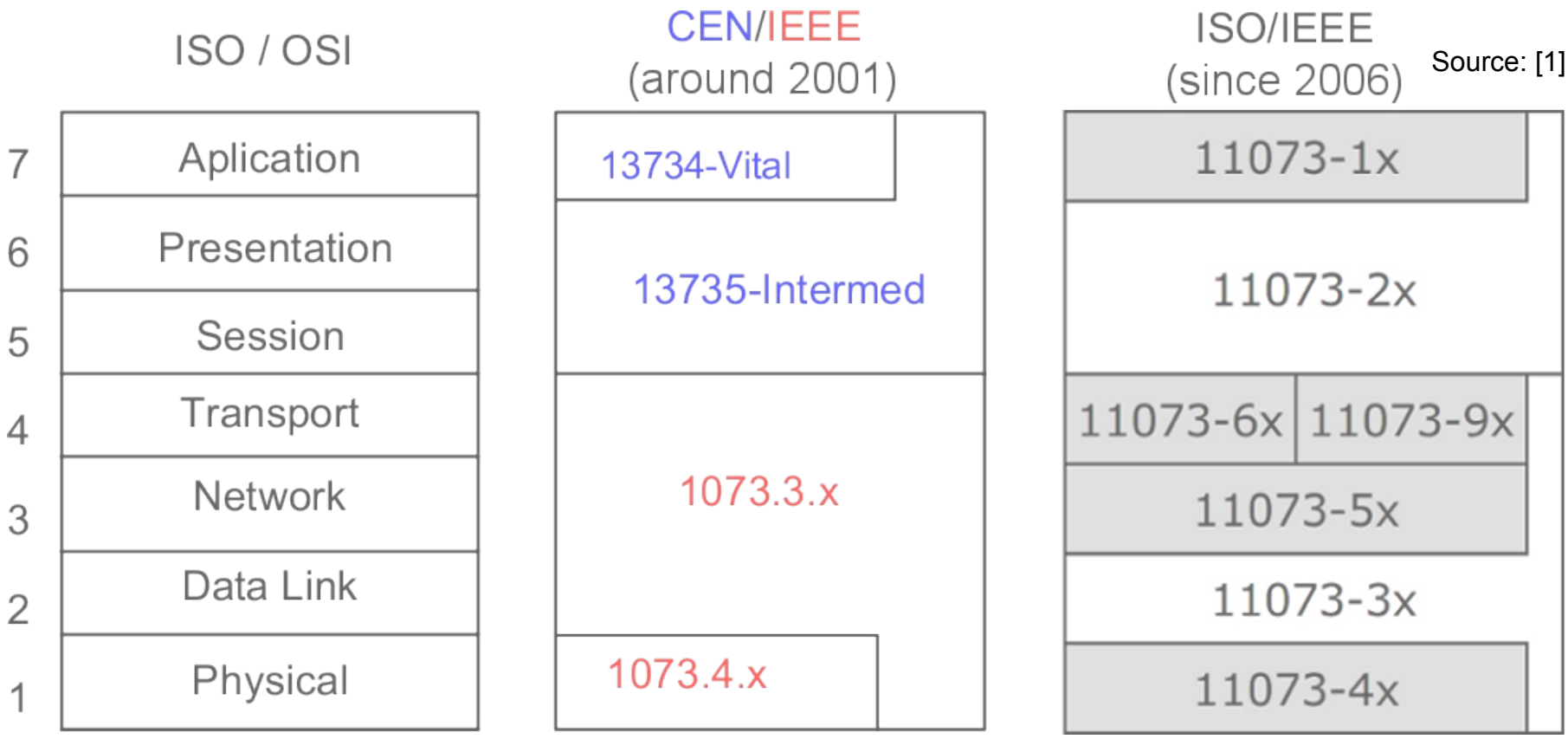
Development Timeline of ISO/IEEE 11073

- 2000/2001 – IEEE and ISO start to work together on a standard for device connectivity and interaction; CEN later joined this group
- Around 2001 – ENV 13734 (VITAL), ENV 13735 (INTERMED), 1073.3, 1073.4 are absorbed and integrated into the X73 family
- 2006 – naming unified to ISO naming norms



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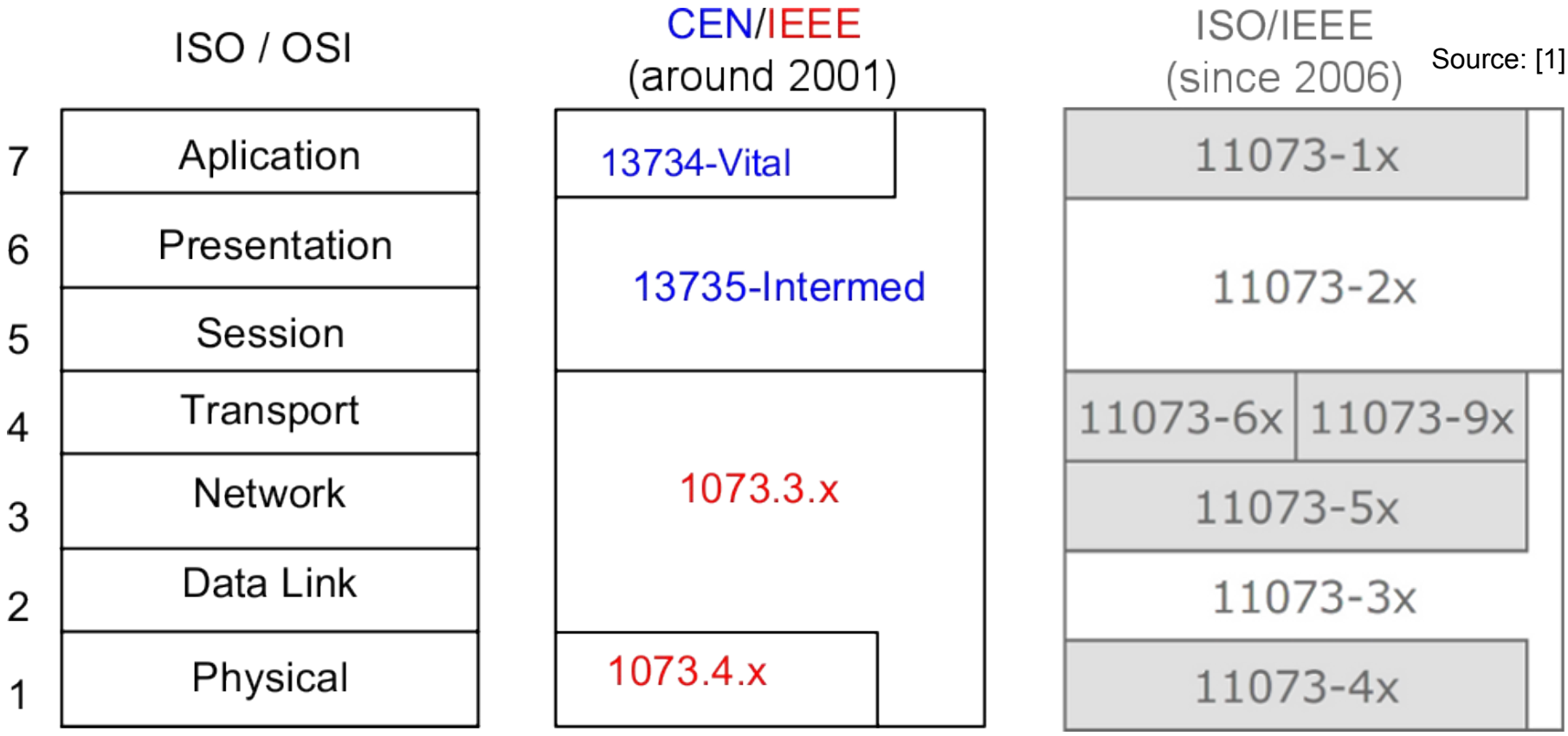

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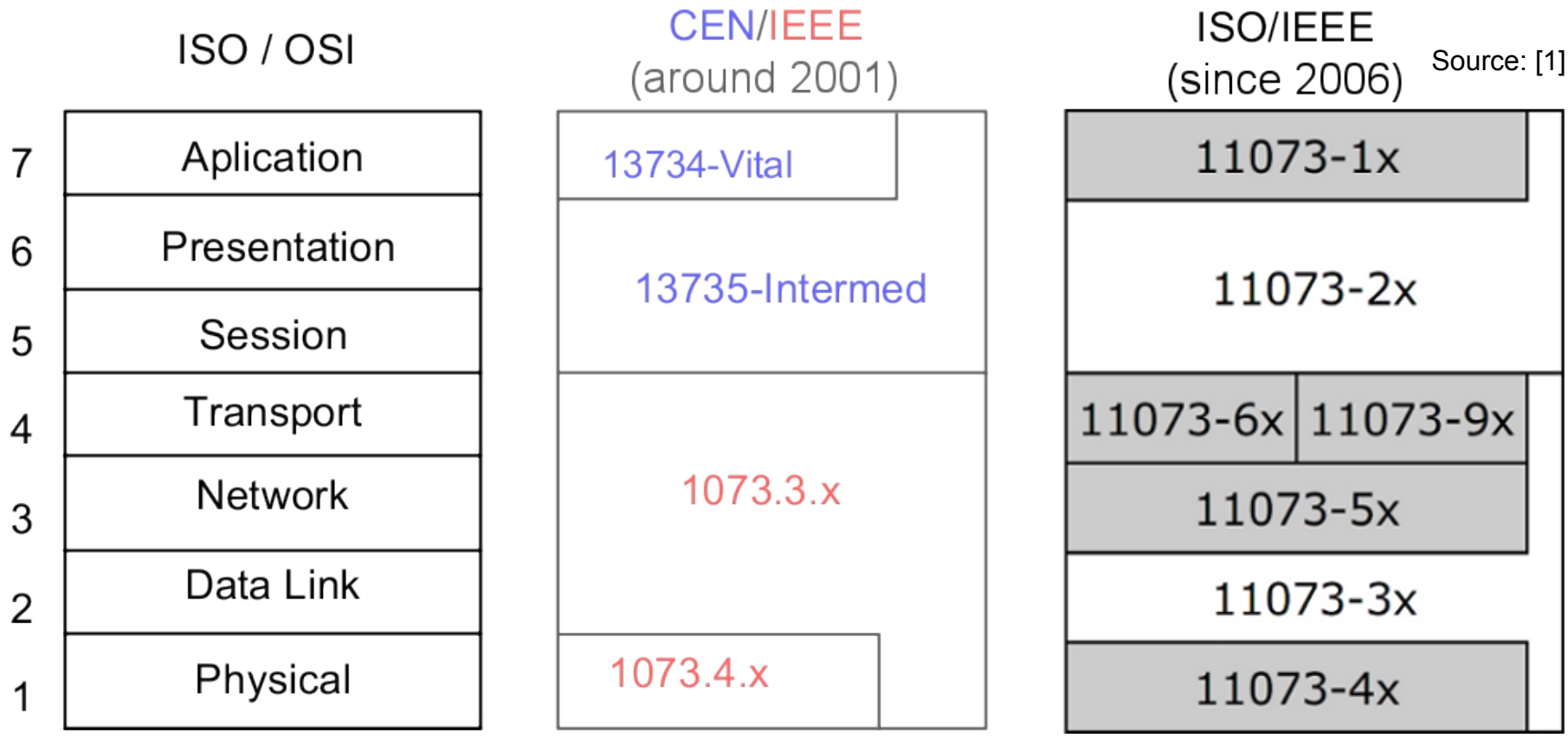

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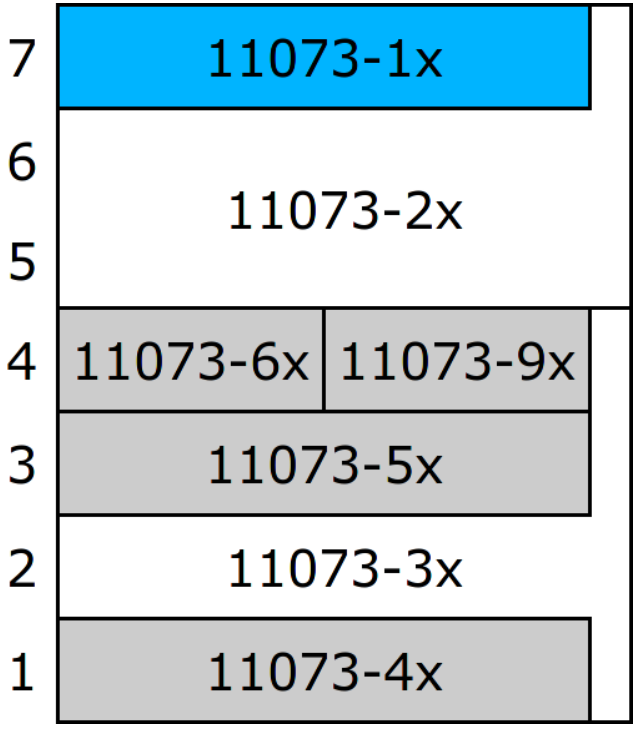
X73-1xxxx – Medical Device Data Language

- Defines the Medical Device Data Language (MDDL)
- MDDL is based on the Domain Information Model (DIM)
- DIM also defined in this section
- 11073-103xx defines specializations for concrete devices
- Examples:
  - *Infusion device (withdrawn)*
  - Vital signs monitor
  - *Ventilator (withdrawn)*
  - Pulse oximeter
  - Defibrillator
  - ECG



10101: MDDL – Nomenclature

- Defines the syntax for messages between medical devices and computers
- Defines the codification of messages (unique code as name)
- Contains terms, description and codes; e.g. for:
  - Units of measurement
  - Medical devices and device systems
  - Alerts

Code	Reference	Description
150324	MDC_SAT_O2_ART	Arterial oxygen saturation
150302	MDC_PRESS_CUFF_DIA	Non-invasive diastolic blood pressure
150303	MDC_PRESS_CUFF_MEAN	Non-invasive mean blood pressure
150301	MDC_PRESS_CUFF_SYS	Non-invasive systolic blood pressure
149546	MDC_PULS_RATE_NON_INV	Pulse rate
147842	MDC_ECG_HEART_RATE	Heart rate
28716	MDC_CONC_GLU_ART	Glucose Concentration in arterial blood
28868	MDC_CONC_GLU_PLASMA	Plasma Glucose Concentration
28948	MDC_CONC_GLU_GEN	Glucose Concentration in general

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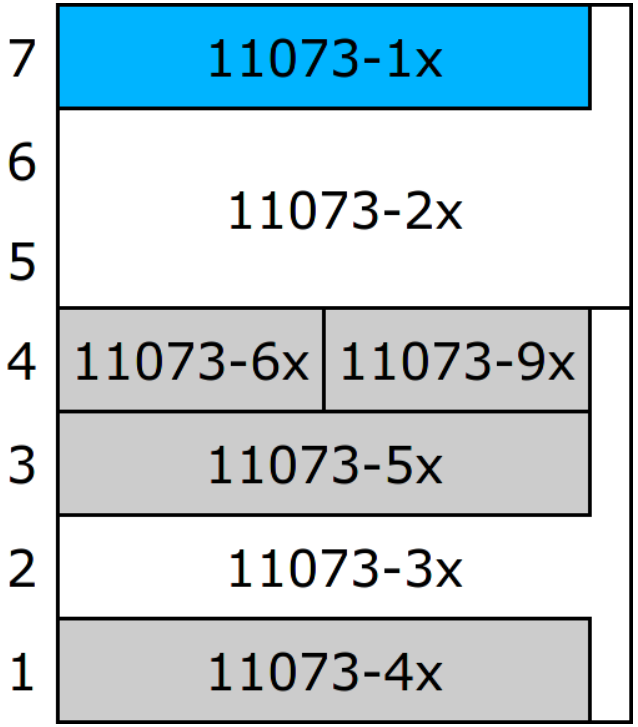
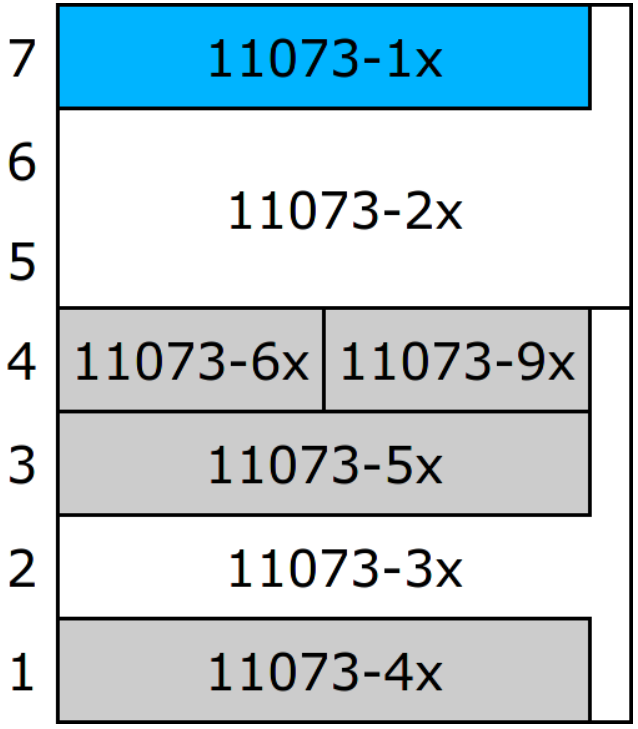
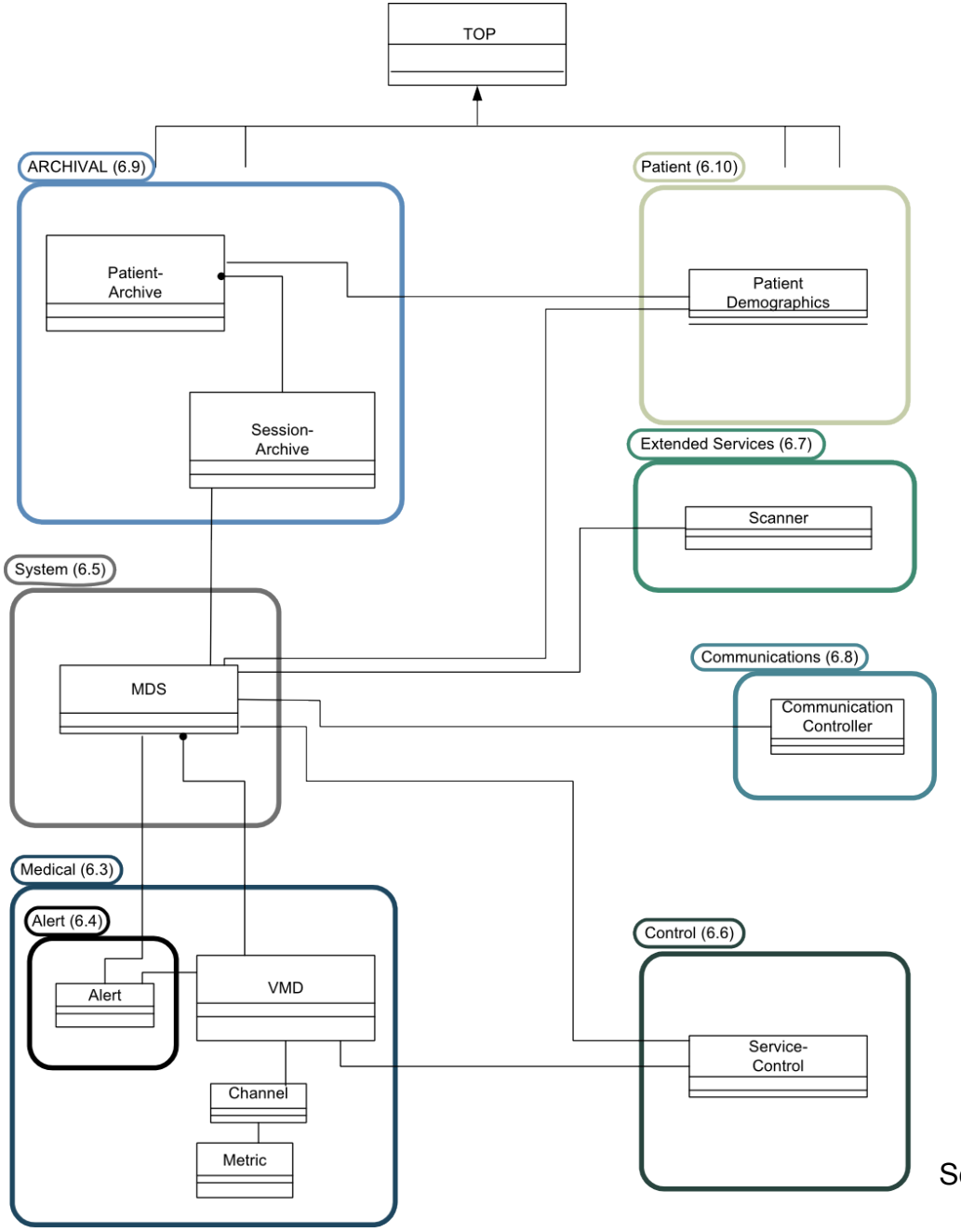


10201: Domain Information Model

- An object-oriented model which provides abstract representation of real world entities
- Consists of two parts:
  - Static Model
  - Dynamic Model



10201: DIM – Static Model



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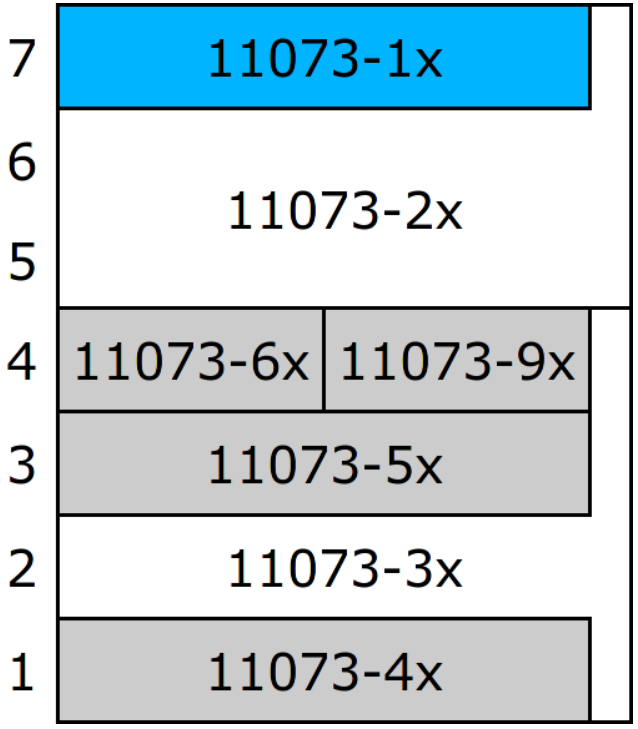
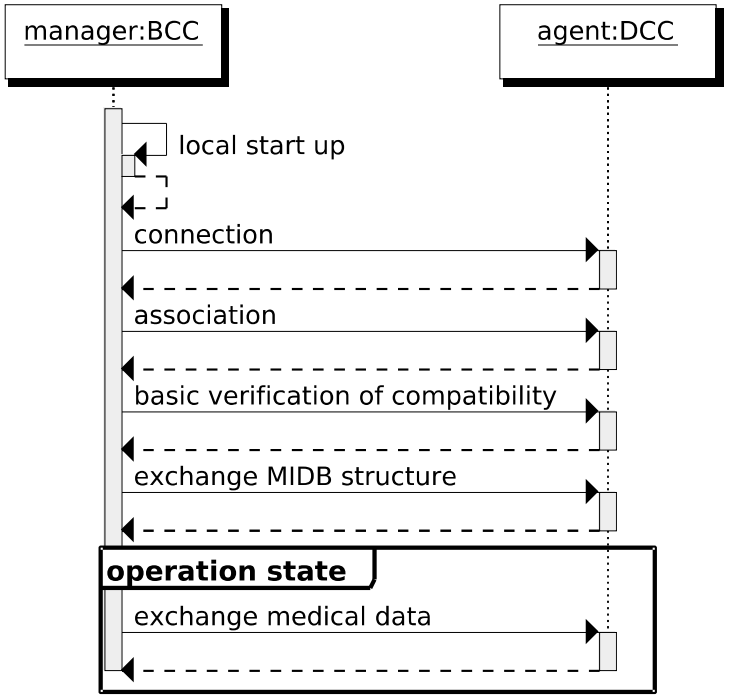
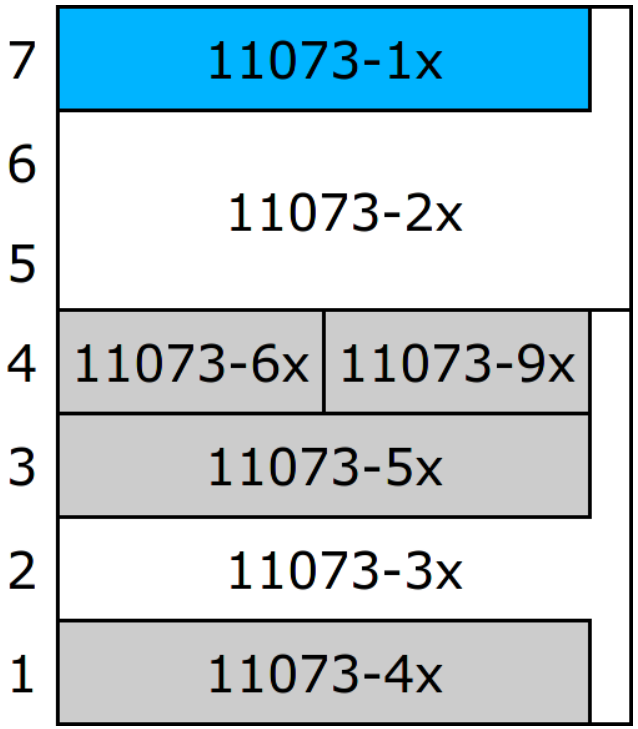


10201: DIM – Dynamic Model

- Provides a communication services model based on ISO agent-manager concept
  - Agent has a Device Communication Controller (DCC)
  - Manager has a Bedside Communication Controller (BCC)
- Four steps needed for two devices to work together:
  1. Connection
  2. Association
  3. Configuration
  4. Operation





103xx – Virtual Medical Device (VMD)

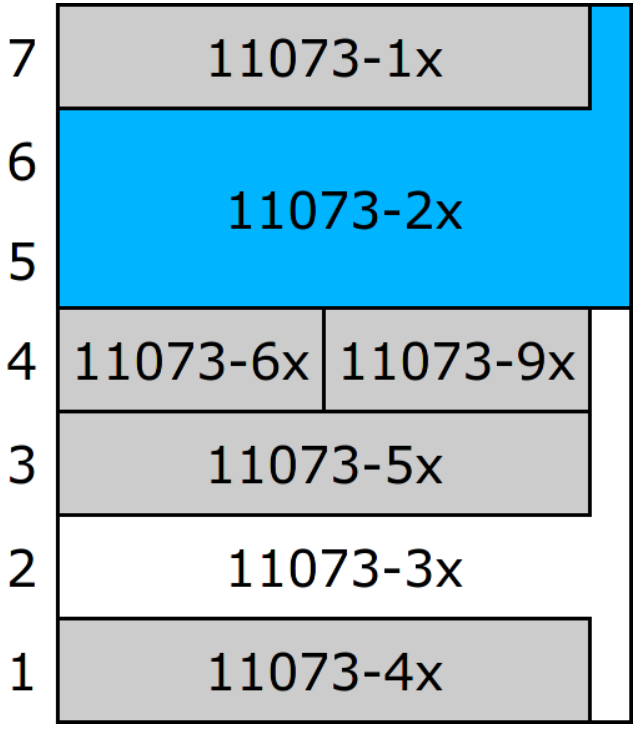
- Collection of specializations for concrete devices
- Some documents have been withdrawn at the moment
- Example for infusion pump

```
- <DIM xsi:schemaLocation="http://www.nist.X73.gov C:\ICS\xsd\DIM.xsd">
  - <Simple_MDS>
      <OBJECT_NAME Label="">Simple_MDS</OBJECT_NAME>
      <OBJECT_ID>MDC_MOC_VMS_MDS_SIMP</OBJECT_ID>
      <TERM_CODE>37</TERM_CODE>
      <Reference>clause 7.5.3</Reference>
      <MOC_RESTRICTIONS/>
      <MOC_APPLICATION_GUIDANCE/>
      <MOC_SERVICES_SUPPORTED/>
      <MOC_COMMENT/>
    + <Attribute_Info></Attribute_Info>
    + <Notification_Info></Notification_Info>
    - <VMD>
        <OBJECT_NAME Label="">VMD</OBJECT_NAME>
        <OBJECT_ID>MDC_MOC_VMO_VMD</OBJECT_ID>
        <TERM_CODE>2</TERM_CODE>
        <Reference>clause 7.3.2</Reference>
        <MOC_RESTRICTIONS/>
        <MOC_APPLICATION_GUIDANCE/>
        <MOC_SERVICES_SUPPORTED/>
        <MOC_COMMENT/>
      + <Attribute_Info></Attribute_Info>
      + <Notification_Info></Notification_Info>
      + <Channel></Channel>
      + <Channel></Channel>
      </VMD>
    </Simple_MDS>
  </DIM>
```

Source: [3]

ISO/IEEE 11073-2xxxx

- Defines the Medical Device Application Profiles (MDAP)
- Achieve Medical Device Communication data exchange based on MDDL
- Supports a large range of current and future medical devices

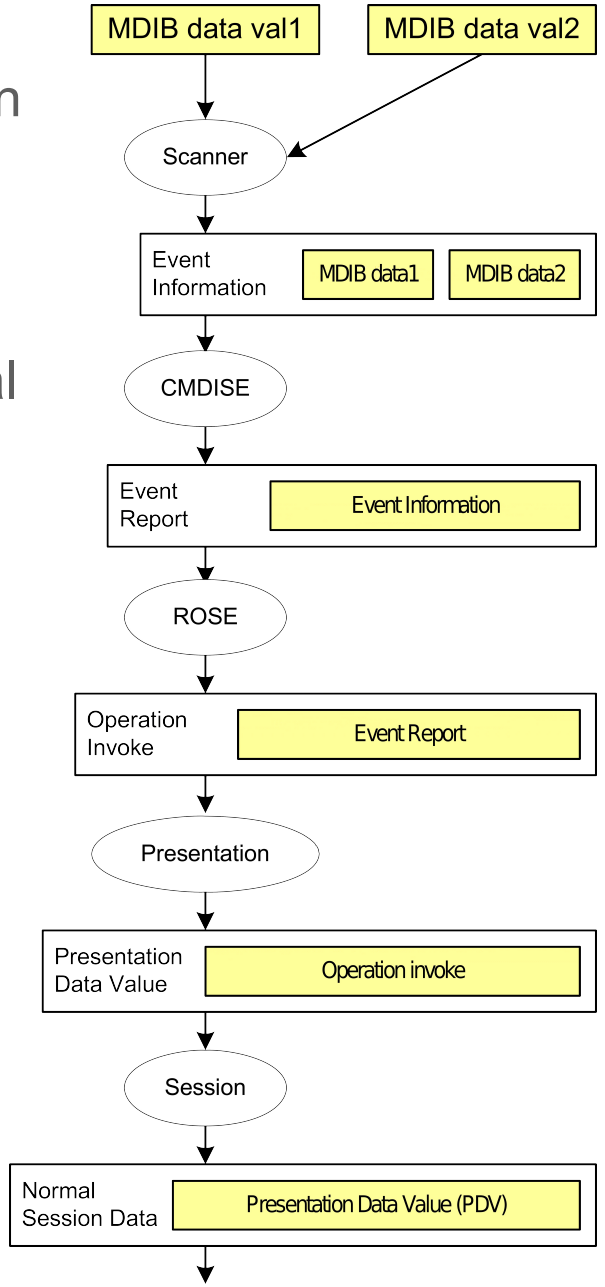


20101: MDAP – Base standard

- Defines the three higher layers for communication between medical devices (i.e. exchange of data defined with MDDL)
- Provides collection of services to communicate information as MDDL messages between medical devices and between BCC and DCC

- The following is covered in the subsections:
  - Basic encoding
  - Abstract syntax for messages sent from device to host
  - Services for the host to request information from a device

- In each layer a header is added to a message



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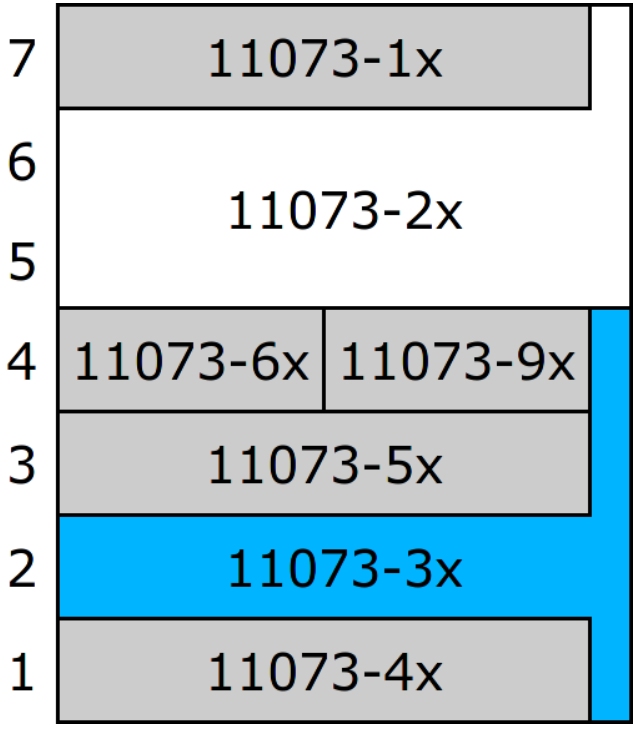
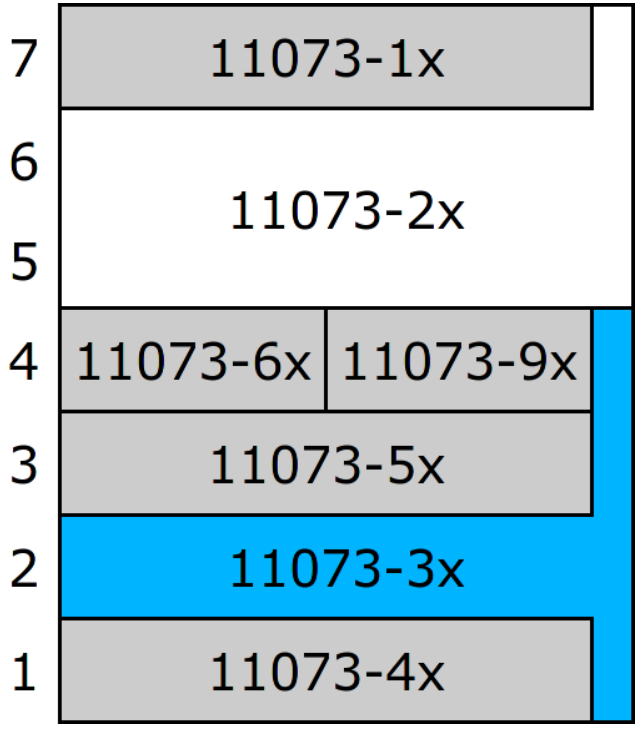
ISO/IEEE 11073-3xxxx

- Specifies protocols and services for the connections and transport messages
- Uses existing international standards where possible, e.g.:
  - Infrared standards
  - Bluetooth standards
  - TCP/IP
- Establishes implementation of the transport and pyhsical profiles
- Available transport standards:
  - Wired (IrDA-Based) [11073-30200]
  - Infrared (IrDA-Based) [11073-30300]
- Under development:
  - IP-Based [11073-30400]
  - RF WLAN (802.11x) [11073-30501]
  - wPAN (Bluetooth) [11073-30502]
  - Zigbee (802.15.4) [11073-30505]



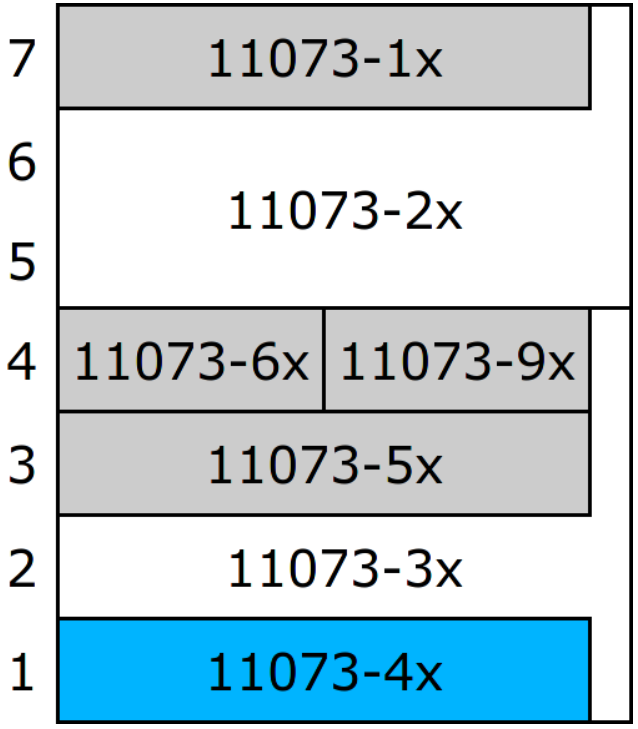
30300: Transport profile – infrared wireless

- Specifies the protocols and services for communications and transport messages using infrared connectivity
- Tries to provide connection oriented communication, services and protocols consisting of IrDA specifications
- Uses short-range infrared in the physical layer
- Maximum speed: 4 Mb/s
- Extends and complements 11073-30200 (IrDA cable connected)
- Defines:
  - Physical layer (power, transmission rates, parameters, …)
  - Connection layer (negotiation, discovery, connection, …)
  - Network layer
  - Transport layer
  - Time synchronisation
  - Cable to infrared adapters



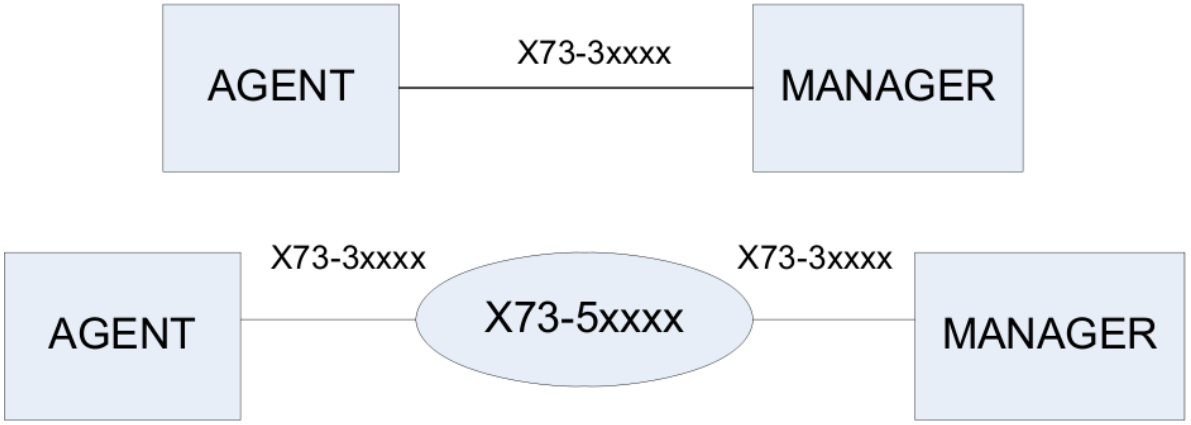
ISO/IEEE 11073-4xxxx

- Defines the Physical Layer Interface Profiles
- Specifies services and protocols required by the physical layer
- Also a physical interface for interconnection of computers and medical devices via cable
  - Highly robust
  - Specifies physical and electrical characteristics of connector and signal
- It also includes:
  - Capabilities of the BCC and DCC
  - Service specifications
  - Operation modes
  - Electrical connection specifications
  - Specifications of connectors and cables



ISO/IEEE 11073-5xxxx

- Refers to the interconnection support between networks
- Examples:
  - Several LANs of medical devices interconnected
  - Interconnection in a hybrid network (one cable one wireless)



Example of a manager-agent connection

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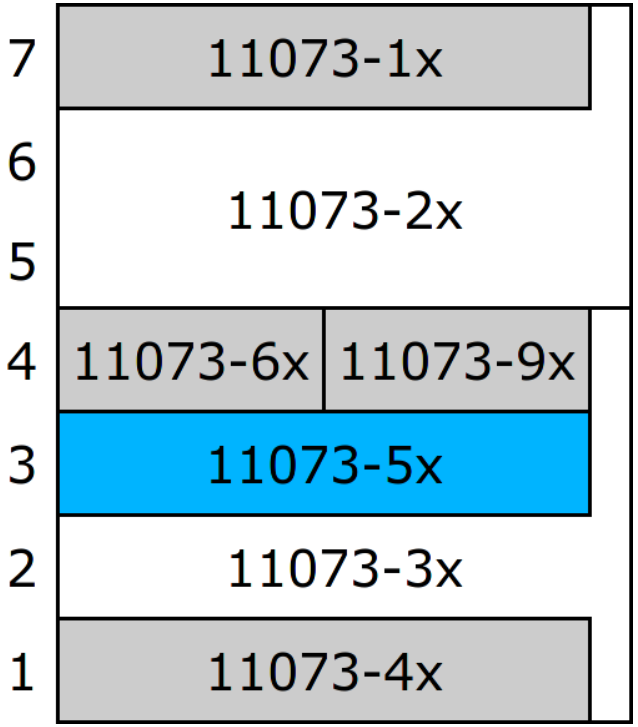
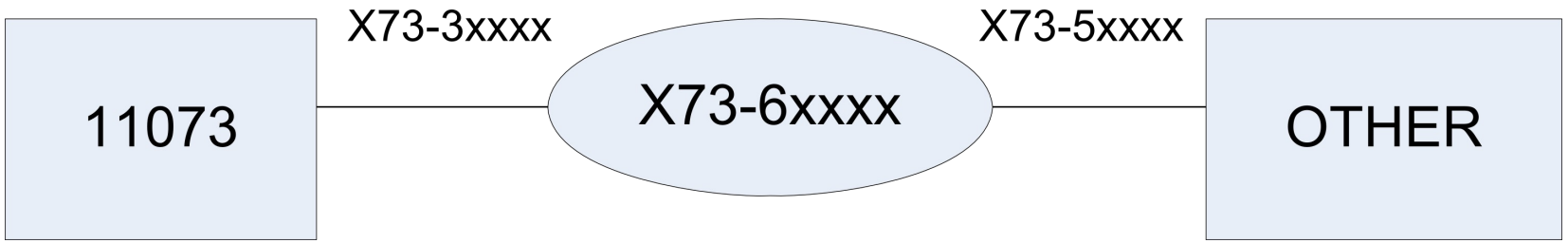
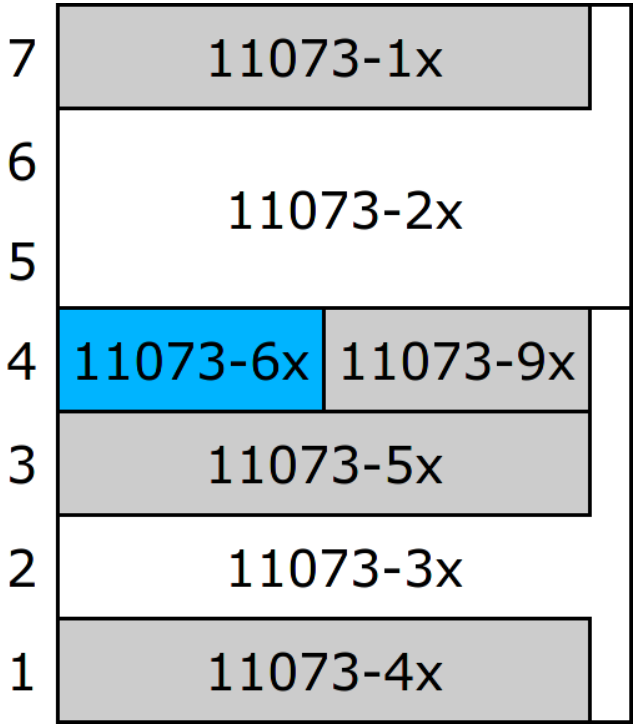


ISO/IEEE 11073-6xxxx

- Provides interoperability between different application-layer protocols
- Provides bidirectional transparency



- Example:
  - Gateway between HL7 and X73



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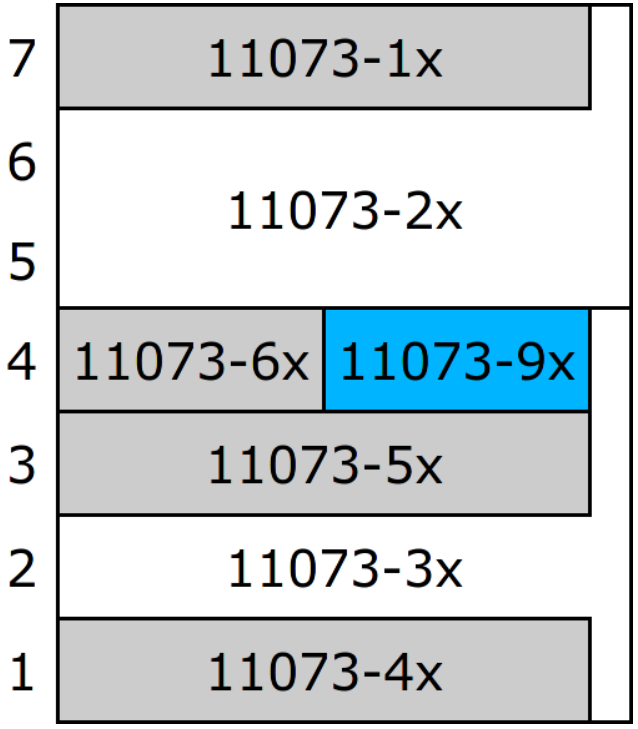
ISO/IEEE 11073-9xxxx

- Related with POCT1-A (PoC multi-vendor connectivity)
- NCCLS POCT1-A:
  - Part 1: device interface: connection POCT device; transmission of data over established connections
  - Part 2: observation reporting interface: transfer of the data to the higher system
- Based on existing IEEE and HL7 standards and on specifications of the Connectivity Industry Consortium (CIC)
  - VITAL
  - POCT-1
- NCCLS POCT1-A2 published 2006 by CIC



Continua Health Alliance

- Part of the ISO/IEEE 11073 standard family but not of the Medical Information Bus
- Defines a communication standard for Personal Health Devices
- ISO/IEEE 11073-20601 framework; defines:
  - Generic data types
  - Message types
  - Communication model
- Support for different (small) Personal Health Devices
- Personal Health Devices defined in subsections 11073-104xx
- One subsection for each device

Source: [2]

Continua® HEALTH ALLIANCE

Why isn't it widely used?

- Far too complex
- Many parts still under development, i.e.:
  - Virtual Medical Devices (11073-103xx)
  - Transport profiles (11073-3xxxx)
- No reference implementation
- Expensive to adapt medical devices

Thank you for your attention.

Any questions?

Sources

- [1] M. Galarraga, L. Serrano, I. Martinez Ruiz, P. de Toledo. "Review of the ISO/IEEE X73 - PoCMDC standard for medical device interoperability and its applicability in home and ambulatory telemonitoring scenarios".UPNA Press, pp.125-136 (ISSN: 978-1-59140-866-0). 1 cita. Septiembre. 2006.
- [2] http://en.wikipedia.org/wiki/File:Continua_registered_logo.JPG
- [3] http://xw2k.nist.gov/medicaldevices/ICSGenerator/slides/HL7-x73-bocaraton-sep2006.ppt