AIDC Standards Report 2018

Automatic Identification & Data Capture

Report on the continued standardization of Barcode, RFID and its data structures, including applications in automatic identification, traceability and the Internet of Things

Fig. 1) The participants of the ISO/IEC JTC 1/SC 31 Plenary-Meetings 2018 in Chicago have been delegated from all over the world

Flags of member countries of ISO/IEC JTC 1/SC 31 (extract)

Australia	Austria	Belgium	China	Canada	Switzerland	Germany	Finland	France
Japan	Singapore	S. Africa	S.Korea	Sweden	NL	Russia	UK	USA

.. and contributing organizations, e.g.:

AIM	**CEN TC225**	**NATO**	**EDC**	**ETSI**	**GS1**	**IATA**	**HIBC**	**ISO TC122**	**ISO SC17**	**ITU**	**UPU**

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DIN NIA 043-01-31 AIDC in cooperation with AIM, EDIFICE, EHIBCC and other liaison partners

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AIDC Standards 2018

Report on cross-industry and transnational standardization of the application of barcode, RFID & associated data communication for automatic identification and traceability to the "Internet of Things"

The report provides information on the evolution of AIDC technologies from a standardization and practical application point of view focusing on the 24th ISO/IEC JTC 1/SC 31 session series, this year in Chicago (USA). Highlights on AIDC activities of other standardization groups and on current application developments complement the report, for example in areas of health care, railways, fisheries and technical specifics that cover all areas.

AIDC - for the development of standards

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- **Standards developments on AIDC data carriers – Han Xin, DMRE, Just Another Barcode "JAB", ...**
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Liaisons from Industry and Healthcare Cooperating with the Report:

- AIM DACH - AIM Germany, Austria, Switzerland, www.AIM-d.de
- DIN NA 043-01-31 - German Institute for Standardization, www.din.de
- EDIFICE, Global Network for B2B Integration in High Tech industries, Europe, USA, Asia, www.edifice.org
- EHIBCC - European Health Industry Business Communication Council, www.ehibcc.com
- EDC - Eurodata Council, The Netherlands, www.EurodataCouncil .org
- IFA - IFA Information Center for Pharmaceuticals, http://www.ifaffm.de/en/ifa-coding-system
- JTCH AIDC - Joined Technical Committee Healthcare, www.hibc.de, www.vddi.de

Logos of contributing partners:

Fig. 2) ISO-Banner, Quelle www.iso.org/home.html

AIDC - Automatic identification and data acquisition, for the development of standards

As early as the 1970s, it was discovered that computing is fine, but errors always creep in when data from materials and processes is entered manually. These errors spoil the quality of the information and database contents. Barcodes, however, can solve this problem. As early as 1974, David C. Allais, founder of Interface Mechanism Inc (INTERMEC), developed the barcode Code 39 (3 of 9) for alphanumeric data. However, it took some time before the barcode method established itself as a global basis for automatic data acquisition. One reason was certainly the lack of internationally available standards. It was only when hardware manufacturers joined forces in an association to promote this technology through standards that barcodes became widely established. The consortium was called "AIM, Automatic Identification Manufacturers", and still bears the abbreviation "AIM" in extended objectives. The US-based AIM initiative produced the "Uniform Symbol Descriptions (USD)" in 1981, e.g. "USD-1" for the barcode "Interleaved Two of Five" (I 2/5) and "USD-3" for Code 39. For example, the automotive industry uses Code 39 as "AIAG symbol specification B1", the US military sector as "MIL-STD-1189" for the "Uniform Product Code Council-UCC" in 1984, the "UPC barcode" as barcode for trade, later known as the EAN code for Europe. National standardization institutes, such as the American Institute ANSI, adopted original AIM specifications as national standards and supplemented the data identifiers ANSI/FACT-1 in 1991 to form a complete system consisting of data carrier and syntax. But the internationality was still missing. This changed when the European Standards Committee "CEN" also launched an initiative in 1992 to bring the barcode method into European form so that the standards could also be referenced as binding standards under European law. For this purpose, the "CEN TC 225" Working Group for AutoID was founded. This group translated selected standards into European Standards (EN), such as Code 39 in EN 800 and the Data Identifiers Standard in EN 1571, and was supported by associations and organizations interested in the internationalization, dissemination and adaptation of AIDC standards to technical development. These have included and still include EDIFICE for the electronics industry, the EAN-UCC network, now GS1, ODETTE for the automotive industry, EHIBCC for healthcare and many others. However, national and European standards are still not sufficient to serve the global market. This requires standards from the International Standards Organization (ISO). To achieve this, the ISO/IEC JTC 1/SC 31 committee, SC 31 for short, was founded in 1996 with responsibility for AIDC under the umbrella of ISO/IEC JTC 1. SC 31 began to harmonize the ANSI and EN standards and to publish them as ISO/IEC standards. For example, USD 3 and EN 800 finally became ISO/IEC 16388 Code 39. After migrating the AIDC standards to the ISO level, the CEN members recognized the advantages of the decision to have the AIDC standards globally available and reduced the EN projects to those with specific European relevance alone. For example, the European Union asked for an appropriate emblem in connection with the "Privacy Regulation" for RFID. CEN TC 225 was able to adopt the RFID emblem ISO/IEC 29160 developed at ISO level as EN ISO/IEC 29160 and publish it in the 3 CEN languages D/E/F in a simple manner. However, regularly, the opinion is shared that AIDC standards intended for the expert can remain at ISO level in only one language, namely English. Today, in 2018, ISO/IEC SC 31 offers all necessary standards for the global use of AIDC media barcode, OCR and RFID, including quality test specifications and data syntax for information content.

Following the 20th anniversary plenary session in Sapporo in 2016 (see: https://jtc1historyblog.wordpress.com/sc-31/), further developments were also apparent at the 2018 session in Chicago. The "WG 8 AIDC Applications" Working Group, founded in 2017, will also be able to offer user groups specific user standards based on the existing barcode and RFID modules, as the SC 31 provides first-hand expertise in this area. There was a change in 2018, with the founding member Chuck Ivanhoe handed over the chairmanship to the US-American John Greave. The first project "ISO/IEC 22603 Standard for Electronic Labeling" is already in progress (see report WG 8).

The next SC 31 plenary session will take place in Qingdao, China, from June 3rd to 7th, 2019.

AIDC as a strategic module

In 1992, 26 years ago, Pieter de Meijer and Lucas Schouten wrote the book entitled "No Barcode, No Business". Indeed, this has come true today. No package without a barcode, no food or non-food product, no electronic component and in future no medical device is conceivable without a barcode. Even the advertising departments discovered that QR code is good for business. Ministries recognized that AIDC is essential for product traceability, such as medical devices in the healthcare supply chain. In April 2017, for example, the European Parliament decided that all manufacturers of medical devices and in vitro diagnostics must affix a clear ISO-compliant barcode wherever the products are manufactured. The term "Unique Device Identifier (UDI)" was created for this purpose, under which barcode is a must and RFID an option. The US parliament decided this 3 years earlier and more countries will follow. Manufacturers actually find themselves in the "No Barcode, No Business" situation, in accordance with legal requirements. The technology standards are provided by ISO/IEC JTC 1/SC 31 as modules for implementation, e.g. the "ISO/IEC 15459" module, which defines the hierarchical structure of uniqueness for unique codes.

Even if the laws do not directly dictate the use of barcodes & RFID everywhere, companies easily run into problems if they do not pursue a barcode strategy and are in competition with companies that do pursue an ISO-compliant barcode strategy that benefits them as well as the customer. It is a fact that the consistent use of AIDC avoids internal and external errors, simplifies all logistics and accelerates processes. Of course, the implementation of AIDC in the process stages of supply, production, supply and application requires specific expertise because reading the AIDC standards is usually not really the core competence of management. However, "high level" application recommendations are also available, such as "DIN SPEC 16599 Automatic identification and data acquisition procedures - traceability". DIN 16599 contains common practice, but also future aspects for the application already today. For example, the code functionality of unique object identification, combined with a direct link to information on the Internet, i.e. the "Internet of Things (IoT)". While regular barcodes according to basic standards are becoming a prerequisite for survival in specific markets, innovative options increase competitiveness. Current examples are the mentioned link from the product ID to the IoT, as well as a Data Matrix on delivery notes, called "PaperEDI". The latter enables the content of an entire pallet to be scanned, for example in incoming goods, "without unpacking or typing". Also the implementation of security mechanisms are already strategic possibilities to use barcode/RFID for more than one purpose, e.g. for identification plus verification or authentication. This is made possible with the "ISO/IEC 20248 Digital Signature" option. This report provides an insight into this and the team of authors is happy to advise on such strategic approaches in detail.

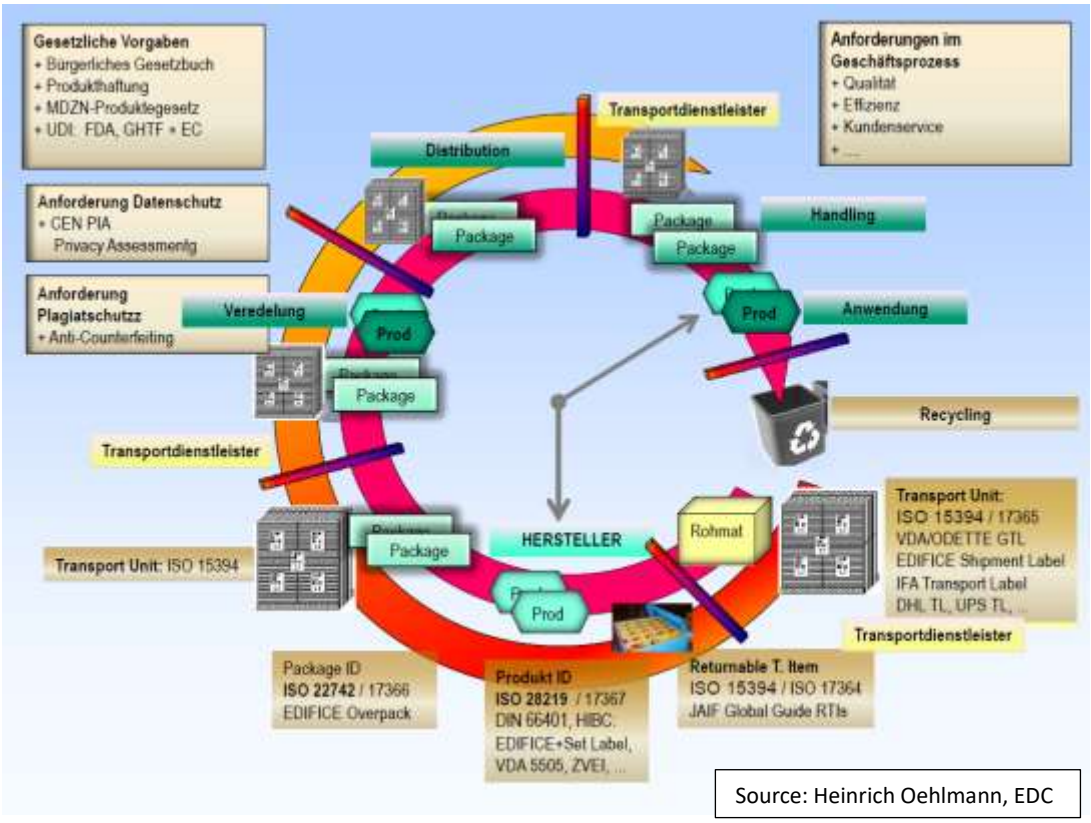

Fig. 3) AutoID standards for the documentation points in the traceability cycle (template for DIN 16599)

The structure of ISO/IEC JTC 1/SC 31 in the ISO/IEC network for standards that connect the world

The standardization institutes form numerous Working Groups for the most diverse areas of interest.
ISO/IEC JTC 1/SC 31 was specifically formed by stakeholders to harmonize standards for automatic identification and data collection. SC 31 is integrated into the infrastructure of the Joint Technical Committee (JTC1) of ISO and IEC with a focus on standards for information technologies. Figure 4 shows an excerpt from the structure of this standardization network.

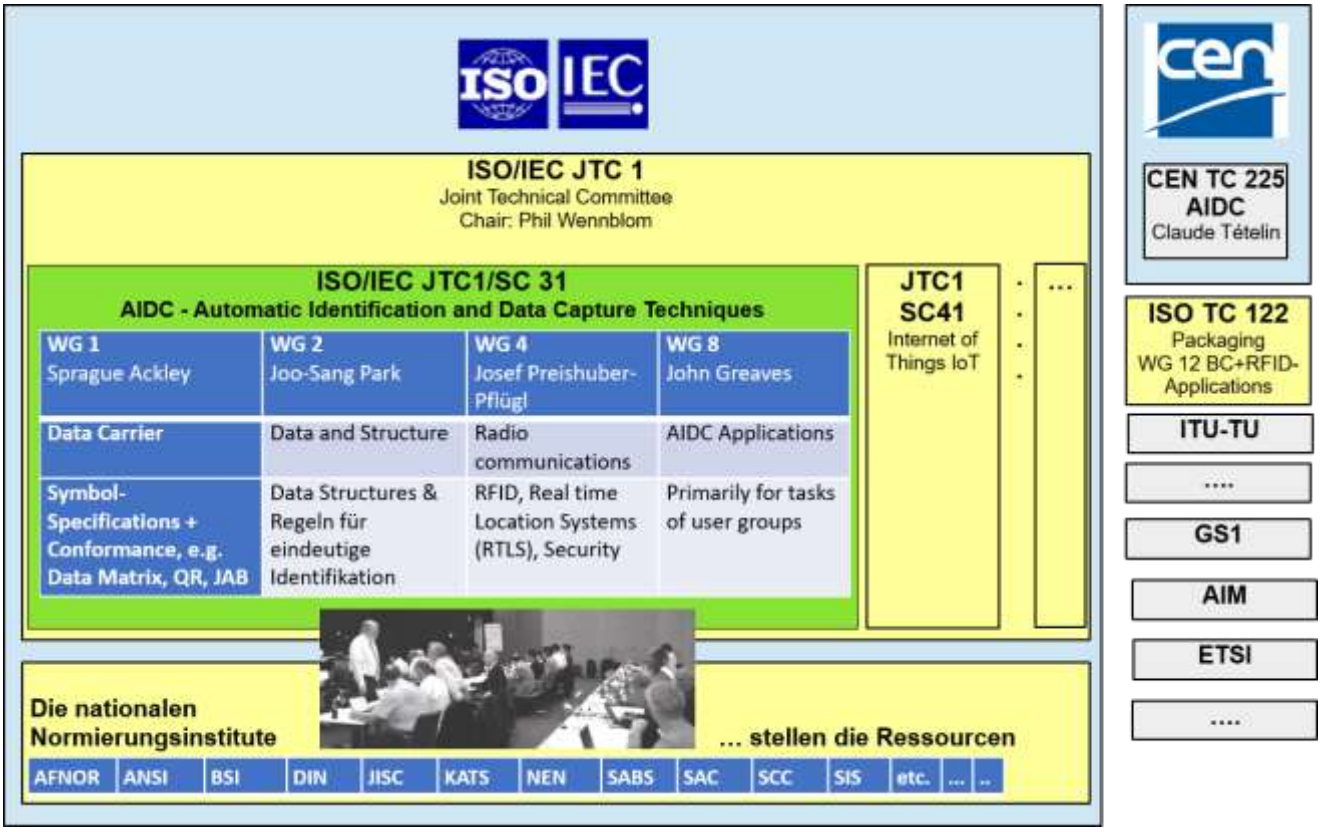

Fig. 4) Structure of ISO/IEC JTC1/SC 31, embedded in the network of ISO and IEC, and related organizations

The strength of the ISO/IEC JTC 1/Sub Committee 31 is the combined expertise and experience of the delegates of the National Standards Institutes who provide the resources. For example, last year the **German Institute for Standardization DIN celebrated its 100th anniversary** (1922 - the DIN paper format standard, today - high-tech standards).

DIN NA 043-01-31 is a mirror committee
The German mirror committee of ISO/IEC JTC1/SC 31 is the DIN Standards Committee NA 043-01-31 AA Automatic identification and data acquisition procedures, which deals with the standardization of technologies, syntax, semantics, authentication, encryption and coding of data, including their application and test methods in the fields of optical and radio frequency (RFID) identification procedures. Since 28 February 2018, this standards committee has been headed by Rainer Schrundner, who succeeds the long-standing chairman Heinrich Oehlmann.
See also **"Award of the Beuth commemorative coin to Mr. Heinrich Oehlmann"**.
DIN NA 043-01-31 is the contact for German industry with questions on or interests in standards at national, European or international level on automatic identification.
https://www.din.de/de/mitwirken/normenausschuesse/nia/nationale-gremien/wdcgrem:din21:54773446

ISO/IEC JTC1/SC 31 was given responsibility for AIDC by the controlling ISO/IEC Joint Technical Committee JTC1 and has the objective of bringing standardization projects (New Work Items - NWI) according to the ISO rules at the request of the members and ensuring the continuous maintenance of the standards already published. Each project has to go through an agreement procedure of the members before the elaboration process starts. Until 2016, only the positive vote of a simple majority and the active cooperation of 5 member countries was necessary, but new tighter ISO rules require a 2/3 majority of the members entitled to vote (P-Members) for the admission of new projects. Proposed standardisation projects with a 2/3 positive vote are allocated to the relevant Working Group (WG).
The actual standardization process with the development of ISO/IEC standards consists of several defined process stages, which are made visible by an indicator: Proposal (10), preparation stage (20), committee processing stage (30), survey stage for the "Draft International Standard-DIS" provided (40), positive vote on "Approval Stage" (50) and finally publication in stage (60). The revision level is (90). Each individual level is in turn assigned an additional attribute for detail steps within the level using a decimal point. Each project is listed in the ISO catalogue; the indicators make the status of the standard transparent, see "International harmonized stage codes" https://www.iso.org/stage-codes.html#60.00

The results of the Working Groups with status 40/50 have to be voted on by a 2/3 majority of the "P-Members" entitled to vote before it is published.
The SC 31 is involved in the ISO network with other committees. Through cooperation and exchange, duplications are to be avoided across the board. Figure 1) illustrates links to committees and organizations such as AIM, CEN TC 225, ETSI, GS1, ISO TC 122, SC 41, etc.
Each year, a different country invites members to the SC 31 session week. In 2018, it was the United States. Next year China will host the meeting week in Qingdao from 3 to 7 July 2019.

Award of the Beuth commemorative coin to Mr. Heinrich Oehlmann

On the occasion of the conference of the IT Security Coordination Unit (KITS) on 5 July 2018 at DIN, Mr. Dr.-Ing. Michael Stephan, member of the DIN management board, awarded the Beuth commemorative coin to Mr. Heinrich Oehlmann for his many years of service to standardization in the field of automatic identification and data collection procedures at national, European and international level. Mr. Oehlmann is the founder of the company "Elmicron", which specializes in identification and data capture solutions with barcode, Data Matrix code and RFID technology and implements cross-industry solutions.

Fig. 5) Dr. Michael Stephan, Member of the Executive Board of DIN (left) hands over the Beuth Medal to Mr Heinrich Oehlmann (source © DIN)

Until 2018, Mr. Oehlmann was chairman of the DIN Information Technology and Applications Standards Committee (NIA) NA 043-01-31 AA Automatic identification and data collection procedures.
Today, Mr. Oehlmann is Chairman of the Eurodata Council, the Foundation and Society for Applied Information Technologies and Data Logistics and a board member of the Health Industry Business Communication Council (EHIBCC), the globally active member association and the responsible registry for distinctive company codes according to ISO/IEC 1549 in Brussels.

Fig. 6) ISO flag, source: ISO, Geneva

ISO/IEC JTC 1/SC 31 Chicago 2018 Plenary and Working Group Meetings

The SC 31 Working Groups WG2, WG4, and WG8 and the SC 31 Plenary Session were held in Chicago from June 12 to 15. Between meetings there was some time for discussions and technical exchange on AIDC topics and the various positions of the delegates. Especially with controversial and complex topics it is much easier to find a consensus in direct conversation than in telephone conferences or with e-mails.

The meeting of the Working Group WG 2 on data structures was chaired for the first time by the new chairman Joo-Sang Park from Korea. Prior to 2018, Mr. Toshihiro Yoshioka from Japan had successfully managed WG2 for many years and during his time as chairman of WG2, key standards such as ISO/IEC 15459 Unique Identification, which forms the basis for unique identifiers (see Appendix 2), ISO/IEC 15434 Transfer Syntax for High Capacity Automatic Data Collection Media and ISO/IEC 29161 Unique Identification for IoT, emerged. While security features are specifically assigned to WG4 for RFID, WG2 is responsible for general security aspects, such as ISO/IEC 20248.

The editor for the **project ISO/IEC 20248 Digital Signature Meta structure (DigSig)**, Bertus Pretorius (Australia), was able to report on the completion of the project and the publication of this standard in March 2018. With the help of many interested experts, he had managed to complete the development of the standard within the specified time frame. The integration of security mechanisms into AIDC media is becoming increasingly interesting, for example for applications in which the data contents form the connection to fully automated M2M applications. To protect against criminal abuse, the DigSig standard allows the data to be verified via app and/or Internet. (See Annex 1).
On the occasion of the Trans Asian Railway, a solution is being sought with which tickets and containers can be marked in many languages and machine-readable. A special Working Group has been set up for this purpose. ISO/IEC 20248 could become the basis for an application standard.


Fig. 7) Meetings in action

The meeting of the Working Group WG 4 on RFID, in which about 50 delegates took part, was chaired by the chairman Josef Preishuber-Pflügl from Austria.
Obviously, RFID is still an emerging technology for supply chain management applications. A market analysis of the "RAIN RFID Alliance" belonging to AIM in 2017 shows that the market for UHF tags has grown from 5.8 billion ICs in 2015 to 10.3 billion ICs in 2016. WG 4 has certainly contributed to this growth through its standardization. The ambitious agenda of WG 4 included 19 RFID-related work items and reviews of other existing standards. The 12 editors of the individual standards were asked to report on the progress of the work. While barcode standards have long been established and mature, RFID standards still have some catching up to do, especially with regard to interoperability and for hybrid solutions with RFID and barcodes as reciprocal backups. Application standards such as the electronic type plate and RFID for railways, as well as industrial guidelines of user groups such as the automotive industry, are based on the standards of WG 4. Security mechanisms for RFID using cryptographic methods are attracting increasing interest for protecting the data in the RFID data stream. This is also reflected in an increasing number of work items. ISO/IEC 29167, Part 1 forms the basis for the implementation of various security features with RFID. This standard defines the architecture for security services for the air interface of RFID according to ISO/IEC 18000 by so-called "crypto suites", which can be used by the tags according to the applications. Each "Crypto-Suite" is described in its own ISO/IEC 29167-x standard part.
Currently, near to completion in WG 4 is part-19 "RAMON". To Part-21 "SIMON" and part-22 "SPECK" JTC 1/SC 27 recently rejected the SIMON and SPECK proposals.
An RFID tag can support one or a selection of "crypto suites". The names of the "suites" refer to the algorithm used. The security experts must make recommendations as to which mechanism provides the security required for the specific application.
The project part ISO/IEC 29167-20 "Algebraic Eraser" was withdrawn in Chicago after a very controversial discussion. The reason for this was doubts about the safety of the procedure and in particular doubts that the standard can also be used by competitors and that a monopoly for a service provider is not anchored in an ISO standard. The concrete reason for the withdrawal was that so much time had already been lost on these issues that it was no longer possible to complete the standard on time. For general information, "standing documents (SD-x)" are being prepared or proposed to increase transparency in this area:
SD-1 “Crypto Suite Evaluation Criteria” , SD-2 “Crypto Suite Framework” , SD-3 “Template for new ISO/IEC 29167 Crypto suites”, SD-4 “Information technology − Conformance test methods for security service crypto suites − Part 1: General requirements”.

Explanation of RFID Tag ID (TID)
On the occasion of this update on RFID standardization the tag ID, "TID" for short, is explained in this section. The TID is not in the spotlight as an RFID feature, but is a core functionality of RFID tags. The TID is a unique number that is branded by the chip manufacturer. While a "Unique Item Identifier (UII)" number can be assigned and changed by the user at any time, a TID cannot be changed. The RFID standard "ISO/IEC 15963 Unique Identification for RFID Tags" is currently being updated to include part 2 "Unique identification of RFID tags - Registration procedures". This part 2 describes the rules according to which the chip manufacturer is assigned a publicly accessible manufacturer number. The TID contains this manufacturer number and a serial number for the tag, which is assigned by the chip manufacturer.
The TID is suitable for the following applications:

- traceability of the chip during quality control in the manufacturing process
- traceability of the tag in the manufacturing process and during the lifetime of the tag
- for full reading with multiple antenna configurations
- for anti-collision mechanisms
- as a reference for authentication
- for traceability of objects to which the tag is attached when no UII is used

AIM Global has applied as a registry for the administration of the chip manufacturer numbers.

New SC 31 Working Group "WG 8" for Application Standards

The technology-heavy SC 31 was previously not equipped as a committee for special application standards, but only for the technological components as modules. Application standards based on the technical SC 31 modules have so far been developed by other technical committees, e.g. "ISO/IEC 15459 Unique Identification" is a module and basis of the standards for marking and identification of products up to containers, which are located in ISO TC 122 Packaging. ISO TC 122 has developed a series of standards focusing on all logistical levels and open supply chains. See also Figure 9 "Layer 0 to 4: ISO 15394, 22742, 28219 for barcode, ISO 1736x for RFID". SC 31 Decision 19 - "Consideration of a new work group related to the application of AIDC standards (ISO/IEC JTC 1/SC 31/WG 8)" at the Plenary 2016 in Sapporo has initiated the process of establishing the new Working Group on application standards in SC 31. The WG 8 kick-off took place in Stockholm with more than 20 interested experts. SC 31 is interested in taking responsibility for the TC 122 standards. This would make it easier to keep these standards in sync with the SC 31 standards, because so far the AIDC experts have been allowed to work in both the SC 31 and TC 122 to ensure that updates to SC 31 modules are also reflected in the applications.

Fig. 8) QRL Quick Resource Locator with reference to DELL information

User groups from other areas are increasingly interested in the SC 31 expertise, for example the Computer Association CASCO. Their delegate Gary Schrempp (DELL) has proposed a project for an application standard for SC 31 via ANSI. Dell uses the term "Quick Resource Locator (QRL)" for a solution that uses a QR code to refer to an Internet portal to provide approval information. CASCO wants to get the possibility through an appropriate ISO standard that approval information (e.g. CE or UL marking) no longer have to be printed on the product. DELL is looking for a joint solution for the electronics industry. This proposal resulted in the first and to date only WG8 project, the "ISO/IEC 22603 Standard for Electronic Labeling". The basic idea is that of a link or a view in an electronic display to provide approval information as an alternative to classic markings. In terms of content, both the presentation of the approval information on an electronic display and the reference via a QR code and the provision of this information on the WWW should be covered. Because of the very different characteristics, it was decided in Chicago to create a series of standards rather than a single standard.

Chuck Evanhoe was elected as the first chairman of WG 8 in the SC 31 Plenary 2017 in Stockholm and has actively performed the tasks associated with this function since then. However, he had to withdraw as chairman of the WG8 because of his numerous obligations. John Greaves, also from the USA, was elected as his successor in Chicago. John Greaves also chairs ANSI's mirror committee for ISO/IEC JTC 1/SC 31.

For a more complete picture of the status of standardization for marking devices it is also worth taking a look at "ISO 28219 Labelling and direct product marking with linear bar code and two-dimensional symbols", and for marking packaging of electronic components the "IEC 62090:2017 Product package labels for electronic components using bar code and two-dimensional symbologies" is of interest.

Working Group WG1 on AIDC media chaired by the chairman Sprague Ackley.

The chairman of WG 1 AIDC media mentioned the progress of the Chinese initiative, the Han Xin Code (ISO/IEC 20830), the conversion of the technical report on the DPM (direct part marking) quality directive into a regular standard (ISO/IEC TR 29158), and the progress of the standardization process for further rectangular Data Matrix sizes and formats DMRE, ISO/IEC 21471. The new ISO/IEC 21471 defines more rectangular Data Matrix formats, see below.

Extensions for rectangular DataMatrix codes "DMRE" (DataMatrix Rectangular Extension) become an ISO/IEC 21471 standard - by Harald Oehlmann - Elmicron

“DMRE” gives DataMatrix applications more possibilities to accommodate data on narrow or round surfaces and to adapt symbol sizes to the available space.

Figure 9) DMRE on a medical devices spplied with a UDI Health Industry Bar Code - HIBC as data content (Source: Sprague Ackley, Honeywell)

Table 1) is showing 4 examples of the 18 new rectangular formats of ISO/IEC 21471 DMRE, enabling encoding of higher data volume on smaller surfaces.

Table 1) Four of the 18 rectangular extensions of Data Matrix with their ratio of size to data capacity

	Format Capacity n/an	mm x mm X=10mil/ 0,25mm	Sample with generic example data as content ▼
1	8x48 36/25	2 x 12mm	123456789012345678901234567890123456
2	8X64 48/34	2 x 16mm	1234567890123456789012345678901234567890123456789012345678
3	12 x 64 86/63	3 x 16mm	1234567890123456789012345678901234567890123456789012345678901234567890123456789012345678901234567890123456
4	16 x 64 124/91	4 x 16mm	1234567890123456789012345678901234567890123456789012345678901234567890123456789012345678901234567890123456789012345678901234
			All DMRE-formats see: http://www.eurodatacouncil.org/de/dmre

The new rectangular Data Matrix formats make it possible to solve many marking problems where machine readable marking on small surfaces was previously not possible. This enables, for example, medical devices to be labelled and the requirements for their traceability to be met. Until DMRE is published as ISO/IEC 21471, the innovations are accessible in the already published AIM symbol Specification DMRE and DIN 16587. Freely downloadable open source tools for creating DMRE symbols are available on the E.D.C. page.

QR Code extension

QR codes with rectangular sizes were also presented as a new potential standardization project. The previously square MicroQR code according to ISO/IEC 18004 will serve as a basis and be supplemented by new formats. As with the DMRE, the focus is on symbols with a low height for limited available space. The project has not yet officially started as an ISO/IEC standardization project, but the advantages of rectangular matrix codes, for example for round surfaces, have been known since the recent work on ISO/IEC 21471 in WG1, and have been confirmed by the success of the rectangular Data Matrix code. The reactions have shown that there is a consensus that rectangular formats should also be standardized for the QR Code. An official project proposal has not yet been submitted, but is expected soon, and will certainly also be widely supported in the ISO/IEC JTC 1/SC 31.

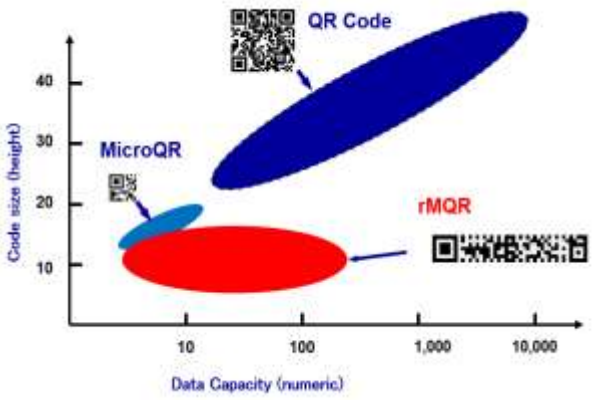

Figure 10) Target application area for rectangular MicroQR-Codes

Quality guideline for direct part marking (DPM)

In Chicago, the project of converting the technical report to the DPM (direct part marking) quality guideline (ISO/IEC TR 29158) into a regular standard was also discussed. This project is viewed very critically by the DIN mirror committee with its current content. Detailed proposals for upgrading the document are coming from industries (e.g. Automotive) and Healthcare (e.g. EHIBCC).

Code in Color: Just Another Barcode (JAB Code)

The highlight at the ISO/IEC JTC 1/SC 31 Plenary 2018 was the presentation of the JAB Code symbology as a future standardization project. This polychrome matrix code was initiated by the German Federal Office for Information Security and was developed by a team led by Waldemar Berchtold from the Fraunhofer Institute for Information Security (Fraunhofer SIT) in Darmstadt. The official project proposal to SC 31 has meanwhile been submitted by DIN. The proposed project manager for the ISO/IEC JTC 1/SC 31 standardization project is Mr. Berchtold.

Figure 11) JAB Code, consisting of master-symbol and 2 slave-symbols

In contrast to monochrome matrix codes, the information density can be increased to approximately 3 times the density by using several colors with JAB Code. The proposed design also allows more flexible shapes through docked slave symbols. With smartphones, 80% of consumers in Germany have a reader that is suitable for reading polychrome matrix codes from hardware with color photo sensors and sufficient computing power. Worldwide, by 2018, 2.6 billion smartphones are in the possession of consumers as potential readers of JAB codes.

Figure 12) From black & white to color: Data Matrix, HCCB, Ultracode and JAB Code

JAB Code is not the first attempt to introduce a polychrome barcode. Experts still remember Microsoft's "High Capacity Color Barcode (HCCB)", which is composed of triangles of different colors. This code was introduced by Microsoft in 2007 and "buried" by Microsoft in 2015. Ultracode, which was developed by Clive Hohberger after approximately 10 years of research and published as an AIM specification in 2015, is technically more mature. Compared to the Data Matrix and QR Code, Ultracode has twice the information density. Ultracode already contains a reference color palette in the symbol, so that effects such as fading can be recognized and corrected by the reader, within limits. Nevertheless, Ultracode has never found a noteworthy distribution.

JAB Code also uses reference color palettes, but for better readability not only a single color palette, but redundant 4-fold palette in remote areas. The proven concept of internal detection patterns and raster patterns has been adopted from the QR code. This is more robust than the exposed grid on the outside of the Data Matrix, and allows a quiet zone around the JAB Code symbol to be dispensed with.

Potential main areas of application for JAB Code are applications with a need for very high data capacity, as well as consumer applications. A very high data capacity with limited space is relevant, for example, for ID documents if additional biometric data is to be stored. Other security-relevant additional attributes such as digital signatures according to ISO/IEC 20248 also result in large amounts of data that "somehow" have to be stored in the symbol. In the consumer sector, the JAB code, with its bright colors and flexible shapes, is likely to inspire product packaging designers in particular.

Internet of Things in the ISO/IEC JTC 1

IoT was defined in ISO/IEC CD 20924 as follows: *"... an infrastructure of interconnected objects, people, systems and information resources together with intelligent services to allow them to process information of the physical and the virtual world and react.*" In fact, IoT requires additional expertise than "merely" AIDC. IoT was dealt with in various committees at ISO/IEC, but JTC 1 found the time ripe to bundle the work of ISO/IEC standardization on IoT into a group. This was the birth of "*ISO/IEC JTC 1/SC 41 Internet of Things and related technologies*". The secretariat of this committee is the "*KATS - Korean Agency for Technology and Standards*", secretary is Ms. Jooran Lee, elected chairman is Dr François Coallier, ETS, Montreal, Canada. Professor Coallier has been active in the JTC 1 Working Group on Smart Cities and is the Vice Chairman of the Canadian Committee for International IoT Standardization. Under his leadership, the scope of SC 41 was briefly but concisely defined as "*Standardization in the area of Internet of Things and related technologies. Serve as the focus and proponent for JTC 1's standardization program on the Internet of Things and related technologies, including Sensor Networks and Wearables technologies. Provide guidance to JTC 1, IEC, ISO and other entities developing Internet of Things related applications. // The scope of the SC41 Internet of Things includes IoT for consumers, smart home solutions and IoT for industrial applications. As synonyms for IoT for industrial applications, other terms are already in use, such as Industry 4.0, Machine to Machine communication (M2M) and Smart Factory."*

The first plenary session of ISO/IEC JTC 1/SC 41 took place from 2017-05-28 to 2017-06-02 in Seoul, Korea. By resolution 3 Working Groups started their activities concerning IoT architecture, IoT interoperability and IoT applications. The Plenary Session 2018 took place in Berlin at DIN.

See on the next page "Internet of Things - one year anniversary of the ISO/IEC JTC 1/SC 41 update by Detlef Tenhagen".

Many other groups will communicate with the SC 41 via liaisons. SC 31 will provide the modules for automatic identification, but also safety-relevant modules which are needed for "cross-responsibility" processes. Such SC 31 modules include ISO/IEC

15459 for unique identification and in particular ISO/IEC 29161 for unique identification in the IoT, but also data carrier standards for barcodes and RFID.

Of course, IoT also requires the inclusion of security concepts, and the ISO/IEC 20248 Digital Signature Meta Structure (see Appendix 1) DigSig is an essential module for this. IoT can be extremely complex, but with the freely available AIDC module for the direct "item to Internet" connection via "Pointer to Process (P2P)" data identifier, for example, a simple reference of things to the Internet is possible.

Internet of Things - first anniversary of ISO/IEC JTC 1/SC 41 - Update by Detlef Tenhagen
Main focus of the meetings in Berlin from 14 to 18 May 2018: The comprehensive results/reports of the study groups (SGs) and the resulting work for the study groups (WGs).
In the month of May the time had come: SC41 celebrated its first year of existence and this time Germany was the host of the first of two annual meetings on the part of the NL DIN.
Besides Rainer Schrundner and Detlef Tenhagen as the two chairmen of the mirror committees on AIDC/RFID (DIN NA 043-01-31 AA) and IoT (DIN NA 043-01-41 AA), many members of these two national gaming committees were also represented at this meeting.
The agenda included the conclusion and subsequent reports as well as subsequent decisions of the Study Groups:

- SG 10 - **Edge Computing**, May 2018: Technical Report (TR) in progress.
- SG 11 - **Real-Time IoT**, completion of work in May 2018: A new work item NWIP commissioned.
- SG 12 - Aspect of **IoT Use Cases** incl Classification and Verification: Work completion for May 2018: - Recommendations accepted and a new work item NWIP commissioned.
- SG 13 - **Reference Architecture and Vocabulary**, work completed in May 2018: recommendations adopted.
- SG 7 - **Wearables** 1st interim report on May 2018 - Recommendations for further continuation of work and intensification of cooperation with IEC TC 124 SG 8 - **Trustworthiness**, with intensive and partly controversial discussion on the further approach of the two quite different drafts by Japan and Canada.
- SG 9 - **IoT**, With 250 pages the most comprehensive study group report to the plenary on the entire standards and standardization landscape for the industrial illustration and use of the IoT with its numerous stakeholders from SDO's, consortia, committees, associations, etc., again with the assignment to prepare a technical report (PD)TR for the meeting in Yokohama. - again with the mandate to prepare a technical report (PD)TR for the meeting in Yokohama, respectively to propose it (PD Proposed Draft).

The establishment of new study groups in the final plenary session:
Reference Architecture and Vocabulary Harmonization, implementation strategy of the previous study group with working report for the upcoming meeting in Japan (November 2018) and after intensive discussion of the establishment of the following Working Groups:
Societal and Human Factors in IoT Based Services, which will focus in particular on the effects of IoT on people and society (Important!), as well as **Integration of IoT and Blockchains**, the integration of the increasingly important Blockchain technology with the IoT.

Quick Link to IoT via “P2P”

Internet access with smartphone via QR code is common practice today.

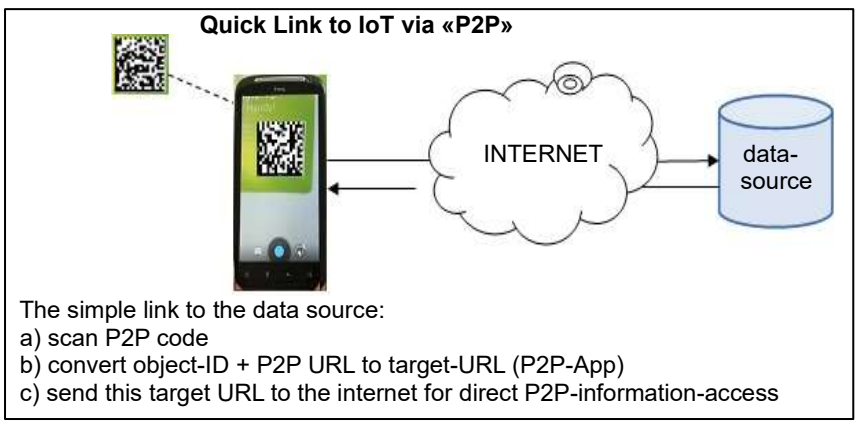

Fig. 13) Scanning P2P productcode leads to the data source in the web

This application shows how easy it is to get product-/object-related information from the web by scanning a code. However, the URL in the QR Code does not yet allow identification of the product and neither traceability data nor security functions. The expert group from Industry & Healthcare has therefore taken the initiative to develop a "Light IoT" system for this purpose, in which the access URL is formed from the combination of product ID plus short portal URL. This P2P URL formed in this way allows not only information on the specific product, but also the establishment of a dialogue ("pointing to a process"), as shown in Fig. 16). Accordingly, automatic access to a Material Safety Data Sheet (MSDS) or to maintenance instructions can be triggered, or a dialog for a repair or maintenance process.
For this purpose, two ISO/IEC 15418 ASC DIs have been applied for and registered with the ASC DI Maintenance Committee (DIMC): First, the URL DI "33L" (Uniform Resource Locator) which can be used to complete a unique item code (UID) with the corresponding URL, and second, the Pointer to Process (P2P) DI "34L". The DI "34L" definition contains the process description of how the "target URL" is automatically formed from the product data after scanning, for example from the product reference and serial number. This URL, which is precisely assigned to an individual product, can trigger a function via the Internet which is assigned exactly to this serial number and which the manufacturer or product manager, for example, has provided. The P2P solution has already been included in "DIN 66277 Electronic nameplate" in 2d + RFID hybrid solution, also IEC TC 91 integrated P2P in IEC 62090, Edition 2.0. for automated access to product-relevant information.

Note: For information on DIN SPEC 16589 product-to-Internet communication, see:
https://www.din.de/de/mitwirken/normenausschuesse/nia/din-spec/wdc-beuth:din21:288399037

Before the DIN standardization committee DIN NA 043-01-41 Internet of Things was founded, the mirror committee in DIN on the IoT activities at ISO/IEC JTC 1/SC 41 - originally there as "workgroup 10" - was the standardization committee DIN NA 043-01-31 Automatic Identification and Data Acquisition Methods. In the meantime, the topics in the ISO/IEC JTC 1/SC 41 IoT have naturally developed further, and most of the topics in the ISO/IEC JTC 1/SC 41 IoT no longer have any direct reference to AIDC. But nevertheless AIDC remains an important interface between the real world and the IoT. Mr. Detlef Tenhagen as chairman of DIN NA 043-01-41 Internet of Things and member of NA 043-01-31 Automatic Identification and Data Acquisition gives in the following an outlook to the upcoming requirements of the IoT for AIDC:

Internet of Things - and its requirements for automatic identification - *View from Detlef Tenhagen*

The topic of automatic identification finds reflection in many of the above-mentioned study groups of ISO/IEC JTC 1/SC 41 and its contents, and in particular in the analyses of SG IIoT the seamless integration of the newer 2-D AIDC as well as the extended possibilities of UHF identification in the RFID field, especially in the context of encrypted and secure "offline" storage of information, will be of growing importance.

However, it is also becoming more and more apparent that with the strongly growing spread of ever higher integrated components and system components in the context of sensor technology in the industrial IT environment, often the classic task of indication is no longer always realized by a singularly structured information carrier (barcode, RFID tag) alone, but instead already becomes an integral part of the intelligent ("smart") part of this sensor. The information of the barcode or RFID transponder is thus reduced or substituted instead of the originally economically or technologically expected increase in storage capacity and the associated possibility of storing data (offline) - to the function of more or less only a unique identification via a corresponding administration scheme. A clear change is thus emerging: barcodes and RFID are increasingly acting as "offline" carriers of a pointer/identifier (referencer/indicator) to an "online" data world (data storage and representation). Increasingly, aspects of security and trust are also becoming important. This trend will undoubtedly continue strongly and even intensify in the future under the expected further integration and miniaturization as well as the qualification through offline energy supply of corresponding sensors or even the smallest IoT units (formerly referred to as "Smart Dust"). The challenge and question for the SC 31 from the point of view of the SC 41 (especially the IIoT Verticals) will therefore be the further development of the Auto ID-RFID standards in exactly this context of use.

Project ISO/IEC 30141 Internet of Things Reference Architecture

The first project of ISO/IEC JTC1/SC 41 is the ISO/IEC 30141 Internet of Things Reference Architecture (IoT RA). This project was already started when the predecessor of SC 41 was still working as Workgroup 10. Mr. Wei Wei of IBM Germany is the driving force behind this standardization project. ISO/IEC 30141 is intended to be a basis for all other ISO standards for the IoT, and is therefore of fundamental importance.

In the following section, Mr. Wei explains what this standard is about:

ISO/IEC 30141 Internet of Things Reference Architecture (IoT RA) – Wei Wei – IBM

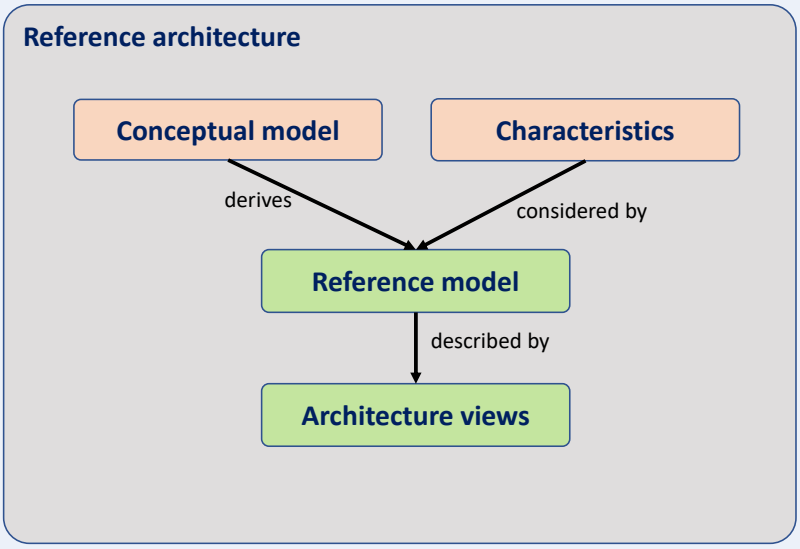

Figure 15) IoT Reference Architecture, source Wei Wei, IBM

The ISO/IEC 30141 Internet of Things Reference Architecture (IoT RA) specification sets a common language across the world for discussion and agreement on IoT topics. It consists of a general IoT reference architecture in terms of defining system characteristics, Conceptual Model, Reference Model, architecture views and trustworthiness for IoT. IoT RA uses a top down approach, beginning with collecting the most important characteristics of IoT, abstracting those into a generic IoT conceptual model, deriving a high level system based reference model and then breaking down from reference model to the four architecture views (functional view, system deployment view, usage view, and networking view) from different perspectives. It is a base for development of specfic content architectures that aims to give a better understanding to stakeholders, manufacturers, application developers, customers and users on how to develop IoT Systems.

Engineers and technical managers, who are going to develop or design IoT applications, will need this standard. Examples of possible users include the business manager, services delivery manager, development manager, system/service operator, architect, system/application developer, device developer, system integrator, security/safety manager, among others.

The major benefits of this standard for the users is to encourage openness and transparency in the development of a target IoT Architecture and in the implementation of IoT systems. It provides a common language in the IoT world for people with different backgrounds to understand each other. It shows the key concepts and guidance's for developing IoT systems.

Figure 16) Mr Wei Wei

←Wei Wei is Technical Relation Executive at IBM Europe. He is currently working as co-editor of ISO/IEC 30141 Internet of Things Reference Architecture and ISO/IEC 20924 Internet of Things Vocabulary. He is also the Vice-Chair of German IoT Standard Mirror Committee at DIN NA 043-01-41.

IBM is a global IT company. IBM Watson IoT Platform, which combines IoT, cloud computing and artificial intelligence together and delivers IoT applications across different vertical application domains, has been recognized as market leader. An IoT platform must connect devices, must collect data, must handle thousands of vendors and must be able to scale to millions of devices sending billions of messages. Therefore using and applying international standards is the key for developing high quality solutions, which ensures interoperability across products from different vendors. IBM strongly supports international standards and actively joined IoT reference architecture standard development by ISO/IEC JTC 1/SC 41 together with other IT companies. We bring our customer experiences and feedback directly into the ISO/IEC 30141 development to ensure the good quality of this international IoT reference architecture standard.

What is happening at European level in the "European Committee for Standardization - CEN"?

CEN TC 225 is responsible for AIDC's European standardization affairs. The last plenary meeting with Chairman Claude Tételin took place one week before the ISO/IEC JTC 1/SC 31 meeting at AFNOR in Paris, so that this meeting could also be used to prepare Europeans for the ISO/IEC JTC 1/SC 31 meeting. The projects "**EN 17071 Electronic Identification Plate**" of CEN TC 225 and the "New work item proposal (NWIP)" for SC 31/WG 8 "**Standard for Electronic Labeling (NP-ISO/IEC 22603)**" are of particular importance as points of cooperation between CEN TC 225 and SC 31. Both projects showed similar or partly identical requirements concerning AIDC. The project manager of EN 17071, Rainer Schrundner (ident.one), is also co-editor of the SC 31 project along with editor Gary Schrempp for the ISO/IEC project 22603 as an efficient way of avoiding contradictions and overlaps in content. This principle was welcomed by both sides, as EN 17071 already contains the IoT functions required for "Electronic Labeling" as a link between equipment and web for access to certificates and "Compliance Markings" in addition to the elements of unambiguous identification. The work on the content and all coordination on EN 17071 has been completed positively and the publication of EN 17071 is in progress at the CEN administration.
The projects "**Fish Box Labels**" and "**RFID for RAIL**" were discussed as specific projects for Europe.

The **CEN project for the labelling of fish boxes** is titled "EN WI 225083 Fish boxes and Fish products - requirements for labelling of distribution units and pallets in the trade of seafood products". This future EN standard 17099 will describe the requirements for labelling boxes and pallets in the distribution of the fish and seafood industry. A uniform machine-readable label will make it easier to ensure the flow of information along the value chain, which will also benefit traceability. It is the intention of the participants under Norwegian project management to create a Europe-wide uniform basis with which the EU regulations 1224/2009, 404/2011, 1379/2018, 1380/2018, ... for the traceability of fish and seafood can be implemented more reliably and easily. This initiative from industry makes it less likely that the EU Commission will be forced to adopt a strict regulation for the labelling of fish crates, as is the case with the use of AIDC in the Medical Device Regulation (MDR). CEN TC 225/WG 4 under the leadership of Rainer Schrundner took over responsibility for the preparation of EN 17099. The project manager is Lars Erik Jensen of Standards Norway. See also text box "New ISO/IEC 15418 ASC data identifiers".

Fig. 17) Label "Fish & Seafood Boxes"

CEN-Project "RFID for RAIL"

In 2016, railway network operators requested an "RFID for RAIL" standard for the uniform labelling of locomotives and wagons with RFID throughout Europe. This is intended above all to support proactive maintenance, e.g. when a warehouse gets hot or a wheel runs out of shape. This marking should also help to ensure that fewer wagons are lost somewhere in Europe. The project CEN TC 225 WI° 2250825 RFID for RAIL aims at using RFID tags compatible to the standards ISO/IEC 18000-63 UHF and ISO/IEC 15418 (EN 1571) ASC data identifiers and GS1 application identifiers for this application. Important aspects in the standard are the positioning of the tags and the data content of the tags. The chairman of CEN TC 225 WG 4 Rainer Schrundner has applied for a specific "Application Family Identifier (AFI)" for this project, which was assigned for the marking of railway vehicles. This will enable RFID tags for the identification of railway vehicles to be distinguished from RFID tags for the identification of other objects, such as road vehicles, packaging or individual parts. The draft standard is currently being voted on.

Fig. 18) RFID- Emblem

Note: The "Application Family Identifier (AFI)" is stored in defined bits in the tag and is used to quickly pre-select relevant tags for the application via the air interface. This reduces the transaction time for reading the tag, because only tags matching the AFI "respond". This avoids temporal overhead that could result from collisions and collision avoidance with signals from other tags. This aspect is particularly important when reading tags on fast trains. AFI's have so far been used, for example, to differentiate between packaging and products. "Application Family Identifiers (AFI's)" are listed in the ISO/IEC 15961 DATA CONSTRUCTS REGISTER (Part 2: Registration of RFID data constructs, Part 3: RFID data constructs). It is planned that the responsibility for the registration of AFIs will be transferred from ISO/IEC JTC 1/SC 31/WG 4 RFID Data Constructs Steering to AIM-Global once the administrative arrangements between the ISO Secretariat in Geneva and AIM-Global have been completed.

Not only for the electronics industry: EDIFICE guideline for simple keyboard and WEB interface compatible syntax for AIDC media

AIDC data structures are special compared for example with XML to the extent that the structuring of the data must take place with as few additional characters as possible, without the possible data content being significantly restricted. ISO/IEC 15434 defines a structure in which data is initiated and terminated with a complex start and stop sequence and in which special characters are defined as separators between data elements and segments. Both in the start and stop sequence and for the separators, "non-printable" special characters are used which do not appear on any keyboard. Advantages of this approach are that these sequences never appear "unintentionally", that all printable characters may occur in the data, and that different semantics and formats can be embedded, such as UN/EDIFACT, ASC DIs, binary data, ... The disadvantage of this complex data structure is that the non-printable characters are lost in keyboard and web interfaces. At the time when ISO/IEC 15434 was created in 1995 in CEN TC 225, serial interfaces and POS interfaces were still common. In the meantime, these interfaces hardly play a role anymore, and with today's standard hardware and software of keyboard emulation via USB and web applications, the implementation of ISO/IEC 15434 is a great challenge.

Fig. 19) Example of a barcode 2 data elements with ASC Data Identifiers

The "EDIFICE Guideline for Web and keyboard compatible encoding with ASC Data Identifiers" defines the "Flag-Character ." (dot) as a star. (dot) as the start character for a character string in which the individual data elements are separated with a Circumflex character "^" and each begin with ASC data identifiers. Figure 17) shows an example of a Code 128 with two data elements that start with ASC data identifiers and are connected with a separator "^". This allows the message to be coded with simple uncomplicated characters in such a way that keyboard or WEB interfaces no longer present a problem. This solution is freely available for all users and is not limited to specific industries or members.
An excerpt from the "EDIFICE Guideline for Web and keyboard compatible encoding with ASC Data Identifiers" can be found in Appendix 4. The full document can be obtained free of charge from: http://wp1.edifice.org/guidelines/adc/

AIDC in the healthcare sector

The European regulation provides for "UDI barcodes" for all medical devices and in vitro diagnostics and thus follows the recommendations of the International Medical Device Regulatory Forum - IMDRF - after the USA.

Fig. 20) UDI-Code in ISO/IEC 16022 Data Matrix

UDI stands for "Unique Device Identifier", a unique barcode (RFID optional) for products and/or packaging, whose associated master data is mirrored in a publicly-accessible database. In fact, this looks like an innovative step towards the "Internet of Things" (IoT), because database access can take place automatically with scanning.
Already in 1984 a milestone of product traceability was set with the development of the "Healthcare Bar Code (HIBC)", but it took a while until the bar code was also recognized in the areas of industry and distribution as a general means for lightning fast and secure data acquisition. Now, especially in the healthcare sector, parliamentarians and state leaders at state and interstate levels have recognized that AIDC can actually improve patient safety, efficiency and logistical security. Accordingly, the International Medical Device Regulators Forum (IMDRF) has launched the UNIQUE DEVICE IDENTIFICATION (UDI) project with the members of the European Commission, the USA and the national members of countries around the globe. UDI was enacted by law in the USA in 2013 and the "FDA" became the extended arm of the executive. Each medical device offered in the USA is subject to the requirement of having a barcode on the product and to have the master data centrally registered, starting on Sept. 24, 2014 for medical devices of safety class III. See also www.fda.gov/UDI or www.hibc.de/de/udi.html.
In Europe, the project was adopted by the Parliament in Strasbourg in April 2017 and submitted to the European Commission for implementation. The UDI conformity date for manufacturers of Class III products is already 2021. In accordance with the "MDR" and "IvDR" regulations, UDI will be binding step by step for medical devices of all classes and all in-vitro diagnostics. The new feature of AIDC for medical devices is that the change from the previous voluntary labelling with a unique barcode, e.g. with HIBC since the 1990s, becomes a legal requirement.
See also Annex 5 "UDI Book".

The European Regulation for the Labelling of Medicinal Products goes one step further, requiring serialized ISO/IEC 16022 Data Matrix

Fig. 21) Pharma Product Number (PPN) encoded in DIN 16587 DMRE

The EU Parliament and the Commission dealt with the regulation on medicinal products somewhat earlier than the UDI project. The "COMMISSION DELEGATED REGULATION (EU) 2016/161" was already published on 2 October 2015. This essentially contains the unmistakable identification of the pharmaceutical packaging by serialized ISO/IEC 16022 Data Matrix and the entry of the serial number (SN) by the manufacturer in the associated database before sale.
The pharmacies scan the package with the cash register scanner, at this moment an automatic check of the SN to the database is carried out via the pharmacy network. If the SN in question is contained in the DB, it is discharged and the drug is delivered. A second request with the same SN would presumably be a plagiarism and would trigger "STOP". In addition, the Ordinance contains measures for the detection of opened packages (tamper evidence). Both together are measures against counterfeiting, but the serialization of the packs can also be used excellently for the optimization of pharmaceutical logistics all the way to the clinic. Named pharmaceutical industry organizations are adapting their coding systems to the new requirements of legislation, for example the "IFA Coding System", which migrates the previous "Pharma Central Number PZN" to the internationally unique "Pharma Product Number-PPN". See also Figure 18) "PPN coded in DIN 16587 DMRE". Alternatively, serialized GTINs with country-specific pharmaceutical identification are also in use. The new feature of the "IFA Coding System" is that the PPN offers capacity for each national drug identification system and uses "ISO/IEC 15434 Syntax for High Capacity AIDC Media".
See also http://www.ifaffm.de/en/ifa-codingsystem.html.

Appendix 1) Application example ISO/IEC 20248 Digital Signature for Object Identification

- Verification of object data by DigSig -

ISO/IEC 20248-DigSig can be used to verify the contents of AIDC media such as barcodes, 2D and RFID.
Here is an example application:

A) The manufacturer adds the product code to identify a 20248-DigSig, but also to verify it via Internet recourse

B) The receiving partner can use it not only to verify the product, but also to verify the contents of AIDC media such as barcode, 2D and RFID.

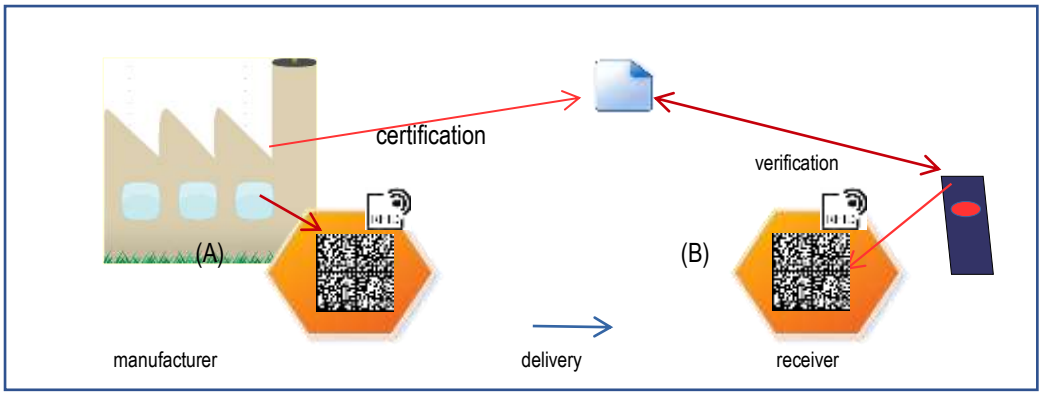

Fig. 22) Illustration of a DigSig application

The example code protected with DigSig contains the following data elements:

data element	***ASC-DI***	***value***	***ASC-data string***
Unique SN (UID)	25S	QCTRUE123456	25SQCTRUE123456
product reference	1P	MOT25X	1PMOT25X
production date	16D	2017-07-20	16D20170720
Additional element:	6R	*https://v1.20248.info/?wJgJlkAByOEAEZiABcUOiUS-CcR7en-awDzEaTiV4-kxodnqQZvEdjBZbwRV*	*6Rhttps://v1.20248.info/?wJgJlkAByOEAEZiABcUOiUS-CcR7en-awDzEaTiV4-kxodnqQZvEdjBZbwRV*

→ The DigSig for the verification of the above data is generated by the manufacturer during marking and provided with the standardized ASC-DI "6R" ISO/IEC 20248 digital signature data construct.

The "DigSig data element" structured according to 20248 rules is added to the object data. This in a suitable medium such as QR Code, Data Matrix or RFID encoded in "ISO/IEC 15434 Syntax for High Capacity Media" forms the protected code. In Data Matrix the start-[)><$^{R}_{S}$>06<$^{G}_{S}$> and the stop sequence <$^{R}_{S}$><$^{E}_{O T}$> is substituted by the control character "Macro 06" (Figure 20). Figure 21 shows a DatMatrix containing the above data elements for automatic identification of the object/product and DigSig for verification of the data.

<Macro06>25SQCTRUE123456<$^{G}_{S}$>1PMOT25X<$^{G}_{S}$>16D20170720<$^{G}_{S}$>6Rhttps://v1.20248.info/?wJgJlkAByOEAEZiABcUOiUS-CcR7en-awDzEaTiV4-kxodnqQZvEdjBZbwRV

Figure 23) ISO/IEC 16022 Data Matrix with object data and DigSig, size 40x40 Module, with X 0,25 = 10x10mm

VERIFICATION at the receiver/user is performed automatically via the Internet by sending DigSig plus data to the verification address of the "DigSig Verifier" where the certificate is located. The address information is contained in the DigSig.

→ For transmission to the "DigSig Verifier" via Internet, e.g. via smartphone and "App", the scanned data string is easily converted by pushing the DigSig to the front without DI "6R" and without 15434 start/stop and replacing the separator <$^{G}_{S}$> with the tilde "~". Thus the data string is perfectly prepared for transmission and verification.

Appendix 2) Quick Guide for the creation of global distinctiveness
The hierarchical A, B, C, D structure

ISO/IEC 15459 describes the overall agreed hierarchy for the production of unmistakable codes. Figure 22 shows the responsibility distributed from A to D. WG 2 adopted the original concept of the hierarchy from CEN EN 1572 and extended it from its original validity only for transport units to codes for the various levels of logistical application. The rule is as simple as it is effective: ISO accredits a "Registration Authority" (A), which in turn registers the actual awarding bodies (B), which assign unmistakable "Company Identification Codes" to companies and institutions (C) on request. Companies that have received a "CIN" are in a position to code everything that is to be unmistakably marked. This includes not only products, packaging, containers, transport units, but also everything else, such as locations, papers, facilities, people, or their ID cards or wristbands. The identifier tells the computer who the code comes from, what it is, the code of the issuing office "IAC" plus the company ID "CIN".

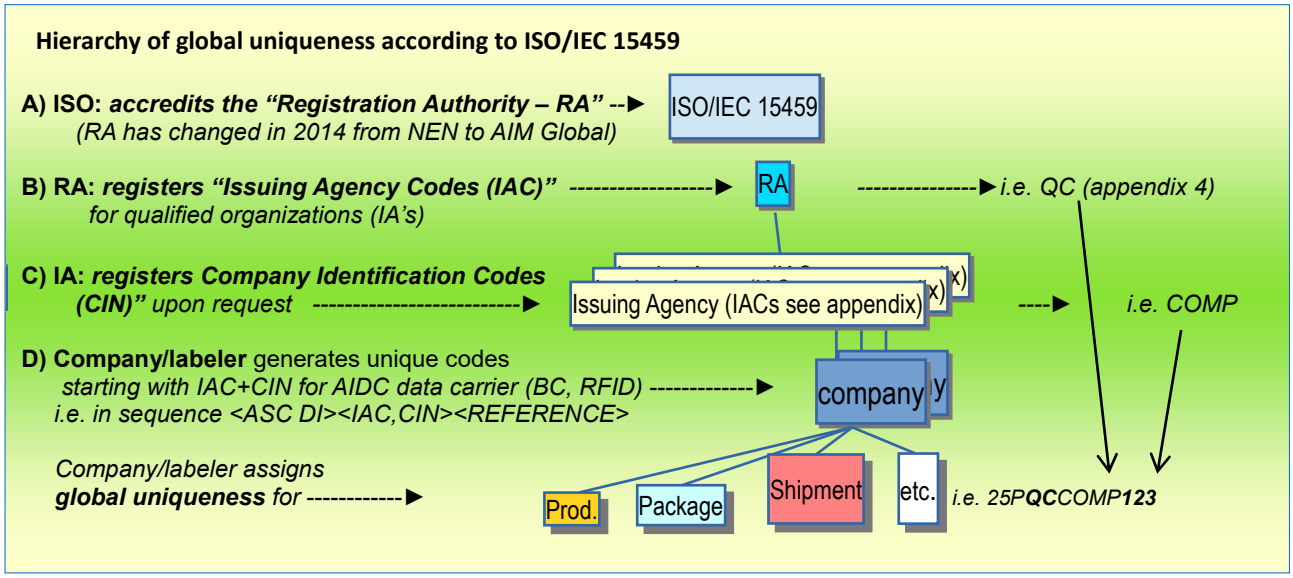

Figure 24) Hierarchically distributed responsibility for unmistakable unique labelling

For example, how do you generate a unique product code?

The prerequisite for generating an unmistakable code is the receipt of a CIN from an issuing agency. This issuing agency also determines the syntax of the relevant code. If the issuing agency supports the "ISO/IEC 15418-ASC MH 10 Data Identifier (DIs)", then the product reference can be alphanumeric, if it supports, and this is currently only GS1, the "ISO/IEC 15418 Application Identifier (AIs)", then it is numeric. The data length for ASC DI support can be from 1 to over 20 characters. For GS1 AIs, the product reference as "Global Trade Item Number (GTIN)" can typically be 3 to 5 digits long. The Issuing Agency EHIBCC supports ASC DIs as well as its own HIBC structure with up to 18-digit alphanumeric product codes. The "Quick Guide" below has 5 steps.

Quick Guide: 5 steps

to the unique product code, e.g. for the product reference REF: **M4215R73**:

I) Determine the format of the product reference, e.g. for **M4215R73**, to find the appropriate possible product code.
ISO/IEC 15418 format for the code:

II) Deciding on an issuing agency or its format specifications for product codes

a) if there are 5 digits, → both ISO/IEC 15418 ASC Data Identifiers and
GS1 Application Identifiers and HIBC syntax can be used (also depending on the customer group).

b) if more than 5 digits or alpha characters → go to a registry that supports ASC DIs.

III) Apply for a CIN, here for direct coding of **M4215R73** e.g. "COMP" at "E.D.C.". (IAC "QC")
with support for alphanumeric product codes, as indicated by ASC-DIs.

IV) Choose the appropriate ASC-DI for the sequence "unique product code" <DI><IAC><CIN><REF>
and form the data string,

→ a) here with the REF M4215R73: <25P><QC><COMP><**M4215R73**>

→ b) in case of individual serialization add DI "2S" and serial number e.g. 1234567 for complete coding:
25PQCCOMP**M4215R73**+S1234567 (Additional data element, such as LOT, date, etc. as required)

V) Choose the appropriate medium, e.g. Code 128 for a) or Data Matrix and/or RFID for b)

That's it --►  ...the unique code is generated.

Figure 25) Serialized unmistakable product code REF. M4215R73 from COMP in ASC syntax coded in Data Matrix and RFID

Annex 3) Issuing agencies for company IDs also determine the data format of the codes.

Issuing Agencies (IAs) for company IDs (Company Identification Codes - CIN) have a key role in creating distinctive codes. According to ISO/IEC 15459-2, they ensure that no company ID can occur twice. This is something that a manufacturer alone could not achieve without the hierarchy of awarding bodies (see also Annex 2). Even the awarding bodies are accredited and registered. The registration body (RA) designated by ISO for this purpose has currently listed 39 awarding bodies for company IDs. The list is public, because it is the purpose of the system that every company/institution in the world can be given a unique CIN, or must if it wants to send unmistakable codes into the world, see https://www.aimglobal.org/resource/resmgr/registration_authority/register-iac-def_2018.pdf

The ISO/IEC 15459-2 accredited registries not only register the company IDs according to their scheme, but also determine the data structure for the code for which the company ID is to be used. This can have an effect on the structure, for example, of the product and transport codes of the manufacturer concerned as a labeler. As a consequence, the choice for the awarding authority is also a choice for the code structure, which also offers various services in terms of code capacity. However, only a few basic structures are available for this purpose, which are referenced in "ISO/IEC 15418 GS1 Application Identifiers (AIs) and ASC MH 10 Data Identifiers (DIs)". Again, only the GS1 allocation authority requires the GS1 structure, the other 38 allocation authorities aim at the ASC-DI structure and differ technically only by company IDs of different length and character string.
Table 3) shows a selection of typical allocation points for consumption, industry and health care and associated structures for company ID, as well as for product and transport codes, for example.

Table 2) Issuing Agencies, their Issuing Agency Codes (IAC), supported structures and data capacity

Selection of ISO/IEC 15459 "Issuing Agencies" for Company IDs (CIN) ▼	**IAC** ▼	**Length of the CIN** ▼	**Typical registered CIN, i.e.** ▼	**Supported data structure & and related capacity, here for product- and transport-codes** (n= numerical, an = alphanumerical)		
Selection of 8 of 39 issuing agencies ▼				**Data structure** ▼	**Product code 2-20an ▼ (max. 50)**	**Transport code 2-20an ▼ (max. 35)**
Eurodata Council	QC	4an	CPRO	ASC	JA	JA
DUN - Dun & Bradstreet	UN	9n	123456789	ASC	JA	JA
GS1 and EPC Global	0-9	3-7	1212345	GS1 (EPC)	3-5n	9n
EDIFICE, European Electronic Industries Association	LE	3an	IBM	ASC	JA	JA
EHIBCC European Health Industries Association	LH	4an	ELMI	ASC, HIBC	18an	JA
ODETTE European Automotive Industry Assoc.	OD	4an	A2B3	ASC	JA	JA
TELECORDIA Telecom. Equipment	LB	4an	CSCO	ASC	JA	JA
UPU Universal Postal Union,	J	6an	D00001	ASC	JA	JA
EUROFER (Steel Industry)	ST	4n	1234	ASC	JA	JA
etc.						
Selection can be completed. Complete list 2018 of the ISO/IEC 15459-2 Registry, see: https://www.aimglobal.org/resource/resmgr/registration_authority/AIM_RA_Procedures_ISO_IEC_15.pdf						

Table 3) illustrates the connection between the choice of the awarding authority for the company ID and the resulting possibilities by means of the data structure provided with it with ASC-DI syntax or GS1-AI syntax for typically product and transport codes. These are technical selection criteria for the decision for one or the other awarding authority. The complete list of issuing authorities is publicly available at the link above to AIM Global.

Information on specific additional accreditation levels for awarding bodies
Specific, also legal regulations, which require unmistakable codes structured according to ISO, can once again make a selection from the list of ISO/IEC 15459 according to suitability or application for an earmarked accreditation. This is the case, for example, with the regulation for medical devices and in vitro diagnostics for Europe (MDR 2017), the USA (UDI 2014) and other countries. For these product areas, the awarding bodies GS1, HIBC and ICCBBA are again separately accredited by the legislator and are subject to additional regulations. However, other ISO/IEC 15459 awarding bodies may apply if they wish to become active in the health sector.

Appendix 4) In the view of the interface experts: Method for the simplification of AIDC applications

by solving the problem that certain syntax characters cannot pass through keyboard interfaces.

Keyboard interfaces and web input filter characters out or misinterpret them if the characters are not included as keys in the keyboard character set. This is the case, for example, when using the "Syntax for High Capacity Media ISO/IEC 15434". However, keyboard interfaces and web input are common for scanners and are available everywhere according to the state of the art. ISO/IEC 15434 was developed as a "Full ASCII Interface" at a time when keyboard interfaces were still operating at speeds of 100 bits/second and were therefore out of the question for large amounts of data. This is different today, because a USB keyboard interface allows up to gigabits/sec. and is therefore extremely attractive as a universal port to transfer data from the scanner directly into the application window. Unfortunately, not every character gets through.
EDIFICE has developed a guideline on how to solve this challenge. In the following, important sections of this guideline are listed.
The complete guideline "**WEB AND KEYBOARD COMPATIBLE ENCODING WITH ASC DATA IDENTIFIERS**" is available free of charge from EDIFICE: https://wp1.edifice.org/guidelines/adc/

========== Excerpt from the EDIFICE Guideline Original Text ==========

1.1 General Context

Media for Automatic Identification and Data Capture such as linear barcodes, two-dimensional barcodes and RFID are used to transfer data. The AIDC media with the contained data follows specific standards for the different layers.

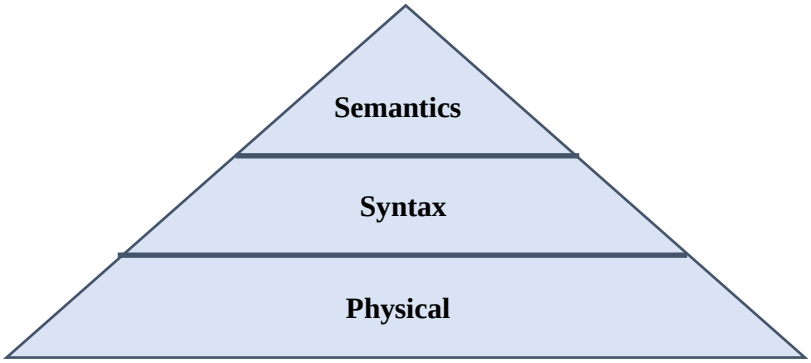

Figure 26 - Layers in AIDC Media

Examples for standards for the physical layer are linear Barcodes such as Code 128 according to ISO/IEC 15417, two-dimensional codes such as Data Matrix according to ISO/IEC 16022 or RFID in various technologies described in specific standards.

An example for standards for the syntax layer is the Data Transfer Syntax according ISO/IEC 15434.

Examples for standards for the semantics layer are the Data Identifier and Application Identifier according to ANS MH10.8.2.

Several organizations originating from different industry sectors have established consistent sets of syntactical and semantical rules for specific applications. Typically a “Flag Character” as first character introduces the encoded data, and is followed by data in syntax and sematic associated to this “Flag Character”.

Examples are the “+” (plus-character) from the Health Industry Business Communications Council (HIBCC) and the “FNC1” (Function Code 1 character) from Global Standards One (GS1).

Historically barcode and RFID has been implemented under the assumption that for automatic identification in open supply chain systems data syntax and semantics always follows standardized rules such as ISO/IEC 15434 in combination with MH10.8.2 ASC DIs. Barcodes not following standards for syntax and semantics have been expected to be used in closed loop, internal applications only.

Nevertheless the development of barcode applications increased rapidly as seen with the wide spread use of QR Code specifically for web connectivity.

In the past Web and keyboard compatible interfacing was neglected by promoting complex and non-Web and keyboard compatible syntax like ISO/IEC 15434.

3. Flag Character and Rules

3.1 Flag Character and Rules

- The Flag-Character is the "." (dot) character: this is the very first character of the data string.
- All data elements are headed by ASC Data Identifiers.
- Data elements shall not contain a "^" (circumflex) character.
- If more than one data element is encoded in the same symbol, then the data elements are separated by a "^" (circumflex) character.

3.2 Example Encoding Flow

An example for encoding flow is:

1. *Ensure that all data elements are headed by the appropriate ASC Data Identifiers, and that the data elements do not contain a "^" (circumflex) character.*
2. *Take the first data element and put a "." (dot) character in front of this data element.*
3. *In case of further data elements put a "^" (circumflex) before the next data element and then append the next data element.*
4. *Repeat step 3 until no further data elements are to be encoded.*

3.3 Example Decoding Flow

An example for decoding flow is:

1. *Read entire string of characters encoded in the symbol.*
2. *Check whether the first character of the encoded data string is a "." dot character.*
3. *Remove the leading "." dot character.*
4. *Split the data string at each "^" (circumflex) character into single data elements.*
5. *Interpret the single data elements by its Data Identifiers (first 1…4 characters) using the data element definitions of ASC MH10.8.2.*

3.4 Summary

Table 2 below gives a summary for the usage of the dot character as flag character.

Table 1 - Summary

FLAG CHARACTER	EXPLANATON
.	The "DOT" character is the flag character to identify Web and keyboard compatible encoding with ASC Data Identifiers. The separator between encoded data elements is the character "^" (Circumflex)

4. Examples

4.1 Example of "Unique Identification Mark – UIM"

The example in figure 5 shows a globally unique serial number with flag character "." identifying a test tube.

Figure 27) - UIM on a test tube applied with flag character

Data sequence of the example Fig. 5)

.25SQCCOMP**A9999999**

A9999999 → Serial Number

COMP → CIN

QC → IAC

25S → ASC Data Identifier

. → System Identifier for the ASC DI structure

4.2 Example of a stock location code

Figure 6 below shows a pallet stock with stock location codes.

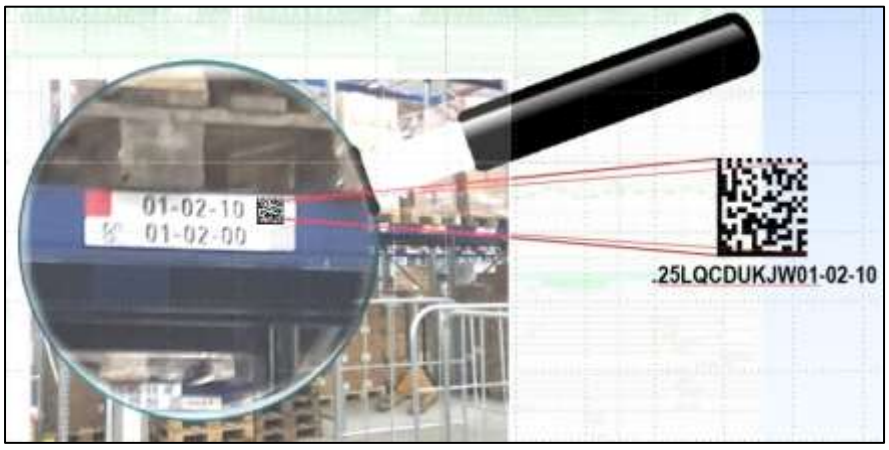

Figure 28) - Stock location code (source: Klinikum of the Friedrich Schiller University of Jena (UKJ), Germany)

Data sequence of the example Fig. 6)
. 25LQC DUKJ W01-02-10

Stock location of UKJ: W01-02-10
CIN: DUKJ
IAC: QC
ASC Data Identifier: 25L
"**.**" System Identifier for the ASC DI structure

4.3 Example with two concatenated data elements

Figure 7 shows two concatenated data elements.

Figure 29) - Example Code 128 with two ASC DI headed data elements concatenated by separator "^"

Data sequence of the example Fig. 7)
.25P LE BSA 47147115**^**S8765432

ASC DI "S" followed by SN 8765432
Separator "**^**"
Product reference no. 47147115
CIN: BSA
IAC: LE (EDIFICE)
ASC Data Identifier: 25P
"**.**" System Identifier for the ASC DI structure

Annex 5) The UDI Book

Figure 30) UDI book cover sheet

On 26 September 2014, the law for barcodes on every medical device (UDI) came into force in the USA; on 5 April 2017, the corresponding EU regulation for Europe was published. Due to the penetration of these projects for the entire healthcare supply chain, DIN/BEUTH-Verlag published the reference book "UNIQUE DEVICE Identification" on 16 May 2017. The publication date matches the publication date of the Medical Devices Ordinance (MDR), in which "UDI" is integrated as a core element. The book provides instructions for UDI-compliant labelling for the manufacturer, but also informs users in hospitals how they can benefit from the legal requirements for UDI, because UDI is intended to increase patient safety and efficiency for all parties involved. With UDI, legislators are aiming for 100% barcodes for all medical devices. This will motivate users to implement AIDC in all areas where error-free recording is required. The book is written in German.

URL to the book: http://www.beuth.de/de/publikation/udi/228007232
URL to the MDR and IvDR: http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32017R0745

Appendix 6) Selection of AIDC technology and application standards

Comprehensive document

ISO/IEC 19762 Harmonized Vocabulary, 5 languages (+ Japanese under work)

Documents of ISO/IEC JTC 1/SC 31/WG 1 Data Carrier

ISO/IEC 15417 Code 128
ISO/IEC 15438 PDF 417
ISO/IEC 16022 Data Matrix
ISO/IEC 18004 QR Code
ISO/IEC 15415 Bar code symbol print quality test specification-Two-dimensional symbols
ISO/IEC 15416 Bar code symbol print quality test specification-Linear symbols
ISO/IEC 16480 Reading and display of ORM by mobile devices
ISO/IEC 30116 OCR Quality Testing
ISO/IEC 21471 Extended Rectangular Data Matrix DMRE

Documents of ISO/IEC JTC 1/SC 31/WG 2 Data Structure“

ISO/IEC 15418 GS1 Application Identifiers and ASC Data Identifiers
ISO/IEC 15434 Syntax for High-Capacity ADC Media
ISO/IEC 15459 Unique Identification, Part 1 to 6
ISO/IEC 29162 Guidelines for using ADC Media (Bar code & RFID)
ISO/IEC 29161 Unique Identification for IoT
ISO/IEC FDIS 20248 Digital Signature meta structure

Documents of ISO/IEC JTC 1/SC 31/WG 4 RFID for Item Management

ISO/IEC 18000-1 REV 1 (including Battery Assistants, Sensor functions)
ISO/IEC 18000-2 AMD 1 (including Battery Assistants, Sensor functions)
ISO/IEC 18000-6, part 61 to 64, rev. 2 (incl. Battery Assistants, Sensor functions)
ISO/IEC 18000-7 REV 1 (including Battery Assistants, Sensor functions)
ISO/IEC 15963 Tag ID: applied with the list of IC manufacturer IDs
ISO/IEC 29160 RFID Emblem
ISO/IEC 24791-Part 1 to 6 Software System Infrastructure (SSI)
ISO/IEC 24753: RFID & Sensors with reference to IEEE 1451.7
ISO/IEC 15961, 15962: RFID Data protocol – Update
ISO/IEC 15961-4: Sensors commands (NP)
ISO/IEC 29172-19179 Mobile item identification and management
ISO/IEC 29143 Air Interface Specification for Mobile Interrogators

Documents of ISO/IEC JTC 1/SC 31WG 4/ Security on Item Management

ISO/IEC 29167 Air Interface for file management and security services for RFID
ISO/IEC 29167 part 10-19 crypto suites with ISO/IEC 19823-X Conformance test methods

Documents of Liaison ISO TC122/WG 10 for BC&RFID applications

ISO 22742 Linear bar code and two-dimensional symbols for product packaging
ISO 28219 Labeling and direct product marking with linear bar code and 2d- symbols
ISO 15394 Bar code and 2d- symbols for shipping, transport and receiving labels
ISO 17363 Supply chain applications of RFID – Freight containers
ISO 17364 Supply chain applications of RFID – Returnable transport items
ISO 17365 Supply chain applications of RFID – Transport units
ISO 17366 Supply chain applications of RFID – Product packaging
ISO 17367 Supply chain applications of RFID – Product tagging

DIN Standards

DIN 66401 Unique Identification Mark – UIM
DIN 66403 System Identifiers
DIN 66277 Identification plate with RFID tag and/or 2D bar code
DIN 16587 DMRE - Data Matrix Rectangular Extension
DIN Spec 16589 Product to Internet communication - Pointer to Process

Other relevant AIDC and Application standards

CEN 1573 Multi-Industrie-Transport Label
IEC 62090 Product Package Labels for Electronic Components using Bar Code & 2-d symbologies
Global Transport Label V3, www.odette.org
Global Guideline for Returnable Transport Item Identification, www.aiag.org
GS1 Global Specifications, www.gs1.com
HIBC Health Industry Bar Code, www.hibc.de
PaperEDI-Standard, www.eurodatacouncil.org
EDIFICE-Guideline WEB AND KEYBOARD COMPATIBLE ENCODING WITH ASC DATA IDENTIFIERS

Note: ISO, CEN and DIN standards are also available from all national institutes, e.g. via www.din.de