AIDC Standards Report

Automatic Identification & Data Capture

Update 2019

Fig. 1) CODE ART: QR ISO/IEC 18003, Jab-Code NP23634, Data Matrix ISO/IEC 16022 and DMRE ISO/IEC ISO/IEC 21471, source artwork ©ELMICRON.de

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

AIDC standards report update 2019

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in cooperation with AIM, EDIFICE, EHIBCC and liaison partners

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AIDC Standards 2019

Report update on cross-industry and transnational standardization of the application of barcode, RFID & associated data communication for automatic identification, tracking & tracing and 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 25th ISO/IEC JTC 1/SC 31 session series, this year in Qingdao (China).

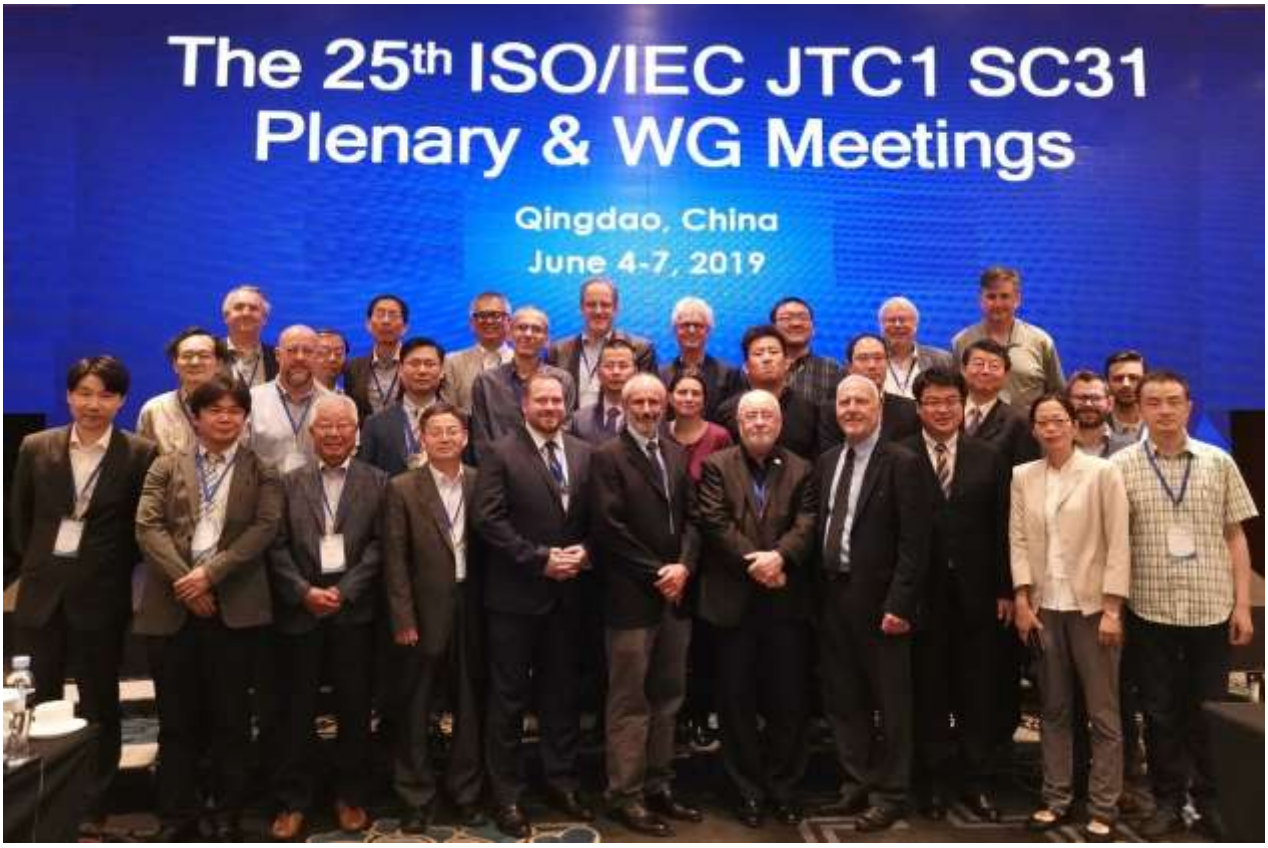

Fig. 2) The participants of the 25th Plenary and WG meetings of the international standardization committee for AIDC in Qingdao, China

Fig. 3) International Standardization: Excerpt of Flags of ISO/IEC JTC 1/SC 31 member countries

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**

Fig. 3) Excerpt of flags of ISO members and contributing liaisons

In addition to information about developments on the ISO level the report will include Highlights on AIDC activities of other standardization groups and on current application developments complement the report, for example in areas of health care, automotive, electronic industries, tobacco, and technical specifics that cover cross industry areas.

Fig. 4) ISO-Banner, source www.iso.org/home.html

AIDC- Automatic Identification and data collection more than a technology, a module of data processing and information systems

Some history: As early as the 1970's, 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 out of 9) for alphanumeric data. However, it took some time before the barcode method established itself as a global basis for automatic data acquisition.

Fig. 5) USD-3 Code 39 (3 of 9) now ISO/IEC 16388

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 that time.

International standardization of AIDC began in Europe

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.

Standards are required to be published from the International Standards Organization (ISO) to become effective for world wide application.

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 further developments were also apparent at the sessions 2017 in Stockholm, 2018 in Chicago and 2019 in Qingdao. The "WG 8 AIDC Applications" Working Group, founded in 2017, will also be able to offer user groups specific standards based on the SC 31 technology standards for common use.

The face to face (F2F) meetings will be continued on a yearly basis. Next SC 31 plenary session will take place June 2019 in Cape Town, South Africa.

AIDC for accuracy, efficiency and traceability

In 1992, 27 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 the recommendation of the International Medical Device Regulatory Forum (IMDRF) to implement UDI in the region. Due to UDI manufacturers actually find themselves in the "No Barcode, No Business" situation, in accordance with legal requirements. Same happens in other business areas like TOBACCO and Medicinal Products. For implementation 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. As a matter of fact 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 solutions, but also future aspects 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 P'EDI solution enables the content of an entire pallet to be scanned in one hit, for example in incoming goods areas, "without unpacking or typing". Increases "security mechanism's" are required in specific application areas of bar code an specifically of RFID, e.g. for pure identification plus additional verification or authentication. This is made possible with the "ISO/IEC 20248 Digital Signature" option. This report provides an insight into this interesting trend and the team of authors is happy to advise on such strategic approaches in detail.

The Committee ISO/IEC JTC 1/SC 31 for Automatic Identification and Data Capture

embedded 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 6) shows an excerpt from the structure of this standardization network.

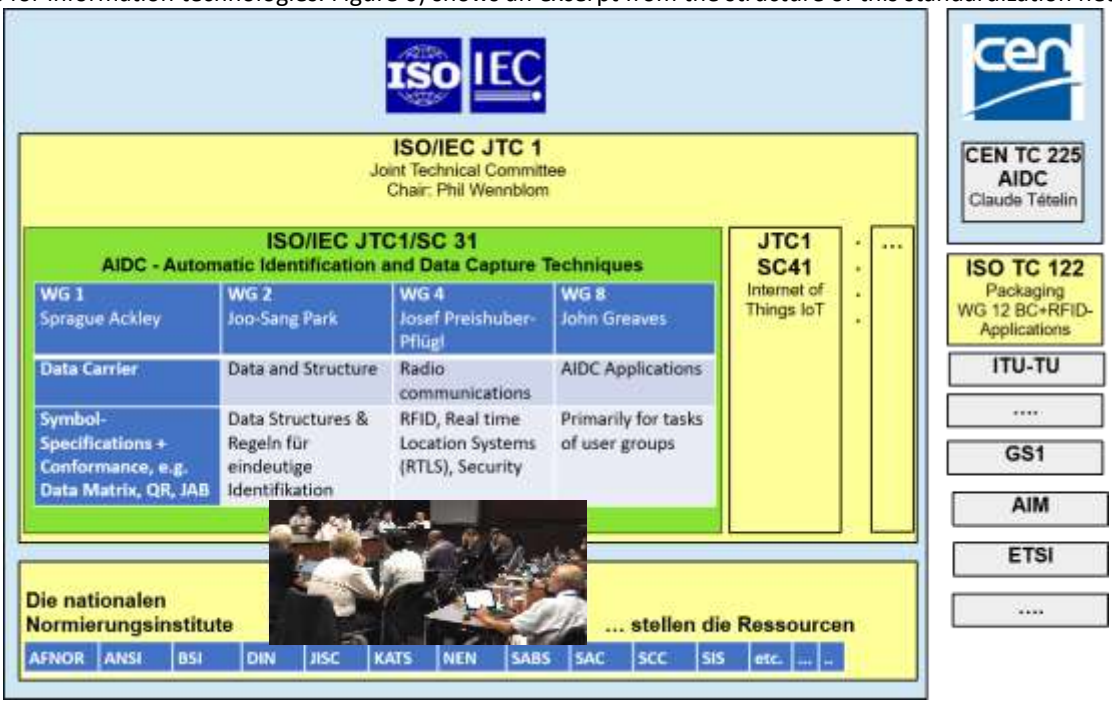

Fig. 6) Structure of ISO/IEC JTC1/SC 31, embedded in the network of ISO and IEC, and related organizations

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, 2017 the **German Institute for Standardization DIN celebrated its 100th anniversary** (1922 - the DIN paper format standard, like "A4" used for the report, today - high-tech standards).

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. 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. Next year South Africa will host the meeting in Capa Town.

Fig. 7) ISO flag, source: ISO, Geneva

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

Prior to the SC 31 Plenary meeting the SC 31 Working Groups WG2, WG4, and WG8 in Qingdao from June 4 to 7, 2019. Between meetings there was some time for discussions on various positions of the delegates and exchange on AIDC topics. 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.
Table 1) Attendees ISO/IEC JTC1/SC31 Qingdao meetings *(Source SC31 documentation)*

Attendees					
Mr Sprague	Ackley	ANSI (United States)	Mrs Sucai	Li	SAC (China)
Mr Henri	Barthel	ISO/IEC JTC 1/SC 31	Mrs Marisa	Lu	GS1
Mr Kai	Cui	SAC (China)	Mr Qiuke	Luo	SAC (China)
Mr Henk	Dannenberg	NEN (Netherlands)	Mr Richard	McDermott	ANSI (United States)
Mr Pat	Davison	ANSI (United States)	Mr Mmakgabo	Maheya	SABS (South Africa)
Mr Steyn	Geldenhuys	SABS (South Africa)	Mr Eddy	Merrill	ISO/IEC JTC 1/SC 31
Mr John	Greaves	ISO/IEC JTC 1/SC 31/WG 8	Mr Takemoto	Naoya	JISC (Japan)
Mr Haishan	Guo	SAC (China)	Mr Abdelkrim	Nehari	ILNAS (Luxembourg)
Dr Jackson	He	ANSI (United States)	Mr Joo-Sang	Park	KATS (Korea, Republic of)
Mr Imai	Hiroyuki	JISC (Japan)	Mr Dalibor	Pokrajac	SCC (Canada)
Mr Mikael	Hjalmarson	SIS (Sweden)	Mr Josef	Preishuber-Pfluegl	ASI (Austria)
Mr Guang	Hu	ANSI (United States)	Mrs Stéphanie	Salgado	SNV (Switzerland)
Mr J.A.M.	Hulshof	NEN (Netherlands)	Mr Rainer	Schrundner	DIN (Germany)
Mr Kim	Jinyong	KATS (Korea, Republic of)	Mr Yu	Shi	ANSI (United States)
Mr Kazuo	Kobashi	JISC (Japan)	Mr Claude	Tételin	AFNOR (France)
Mr Jongwon	Kwon	KATS (Korea, Republic of)	Mr Yi	Wang	SAC (China)
Mr Young-Bin	Kwon	KATS (Korea, Republic of)	Mr Tomohiro	Watanabe	JISC (Japan)
Mr Kim	Jinyong	KATS (Korea, Republic of)	Mr Ruoyun	Yan	SAC (China)
Mr Kazuo	Kobashi	JISC (Japan)	Mr Tao	Zeng	SAC (China)
Mr Jongwon	Kwon	KATS (Korea, Republic of)	Mr Chenghai	Zhang	SAC (China)
Mr Young-Bin	Kwon	KATS (Korea, Republic of)	Mr Tao	Zeng	SAC (China)
			Mr Chenghai	Zhang	SAC (China)

Resolutions summarize key acctivities of the meetings

According to the ISO directives each meeting has to produce resolutions to document status and progress of the work. This report will inform about resolutions below but explain specific activities with some more details and insights under the chapters “Working Groups” and with the annexes.

A glance on the resolutions of the 25th ISO/IEC JTC1/SC 31 Plenary Meeting *(Source: SC31 plenary resolutions 2019):*

- Appointment of Working Group Conveners:

ISO/IEC JTC 1/SC 31 approves the appointment of Working Group Conveners for another term. Nomination

WG2: Convener Mr. Joo-Sang Park, National Body – South Korea
WG4: Convener Mr. Josef Preishuber-Pflügl, National Body – Austria

- Update Liaison Representatives from ISO/IEC JTC 1/SC 31:

ISO/IEC JTC 1/SC 31 approves the Liaison Representatives for the following ISO/IEC JTC 1/SC 31 Liaisons and requests the Secretariat to notify the Secretary of the affected Liaison body: Category Liaison Representative Liaison from SC 31 to

TC 225: Mr. Claude Tételin, France
IATA: Mr. Don Ferguson, Canada

- Project Editors Appointment:

ISO/IEC JTC 1/SC 31 approves the appointments of the following Project Editors for the following ISO/IEC JTC 1/SC 31 projects: SC 31 Projects

ISO/IEC 15961_1-3, 15962: Project Editor Mr. Bertus Pretorius
ISO/IEC 16022 (and ISO/IEC 29158, Project Editor Mr. Harald Oehlmann

- ISO 1736X Project Editors:

ISO/IEC JTC 1/SC 31/WG 8 requests the SC31 Committee Manager to seek nominations for project editors for the ISO 17363, ISO 17364, ISO 17365, ISO 17366, and ISO 17367 standards

- ISO/IEC 22603 Multipart Standard:

ISO/IEC JTC 1/SC 31/WG 8 recommends to the SC 31 Committee Manager that ISO/IEC 22603 Digital Representation of Product Information be modified to allow for multiple parts, designating the existing ISO/IEC standard as ISO/IEC 22603-1 being general requirements applicable to all industries; ISO/IEC 22603-2 being requirements applicable to electronic devices; and subsequent Parts being applicable to specific industries as they arise.

- Revision to ISO 17363 through ISO 17367:

ISO/IEC JTC 1/SC 31/WG 8 requests the SC 31 Committee Manager, considering the proposal for new work items circulated as doc N5044, to register new work items in its active work program to revise ISO 17363, ISO 17364, ISO 17365, ISO 17366, and ISO 17367

- ISO/IEC 15418 MH10 Data Identifiers ISO/IEC JTC 1/SC 31

SC31 thanks the ANSI MH10 Committee for defining and documenting the process to maintain Data Identifiers by August 15 2019.

- Future meetings

On behalf of SABS, Mr. Steyn Geldenhuys offered to host the next SC 31 plenary meeting in Cape Town, South Africa. The meeting agreed and decided to hold the next SC 31 working groups and plenary meetings on June 9 to 12, 2020 in Cape Town.
2021: Mr. Dalibor Pokrajac said that Canada was considering hosting the meeting in 2021, possibly in Vancouver.
2022: The Chairman called for volunteers to hold the 2022 meeting in Asia/Pacific and the 2023 meeting in Europe / Middle East / Africa.

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AIDC projects of the Working Groups

“AIDC media” standardisation belongs to Working Group 1

Chairman Sprague Ackley.

AIDC media includes the linear and two-dimensional symbologies but also OCR and its quality test specifications.
The chairman of WG 1 AIDC media reported on the progress of the standardization of symbologies and quality test specification. The current projects include the Chinese initiative, the Han Xin Code (ISO/IEC 20830), the conversion of the technical report on the DPM (direct part marking) quality directive (ISO/IEC TR 29158) into a regular standard, and the finalization of the Data Matrix rectangular extension to be published as ISO/IEC 21471 DMRE. Detailed work has been undertaken in Face to Face meetings, like in Boulder (USA) 26 to-28 of March 2019 and by conference calls.

WG1 Projects of of specific interest

- Optical Character Recognition (OCR) quality testing" ISO/IEC 30116
- Han XIN code (ISO/IEC 20830)
- Rectangular Micro QR – rMQR (ISO/IEC 23941)
- Data Matrix rectangular extension – DMRE (ISO/IEC 21471)
- Just Another Barcode - JAB Code (NP23634)
- Quality guideline for direct part marking (DPM) (ISO/IEC 29158)

Below some of the highlights of the developments where the "DotCode" is not an ISO project yet, but as an AIM standard under observation of WG1 as well.

Fig. 8) Han Xin Code

Han Xin Code (ISO/IEC 20830)

After preparation the HAN XIN code specification by AIM (ISO/IEC 20830) to perform as base for an ISO/IEC standard HAN XIN was seen as ready to be completed as an ISO/IEC standard. The chairman of WG 1 AIDC media mentioned the good progress of the Chinese initiative, the Han Xin Code. As the QR Code is performing not only for carrying standard ASCII data formats but japanese typical characters as well, HAN XIN does it for the Chinese character set. The development of HAN XIN shows that the chinese experts of automatic identifcation technologies contribute actively with specific AIDC soultions rather than just to watch developments andertaken by others. Nevertheless it shows also that the know how for AIDC is increasing in the international arena in a fruitful and cooperative manner.

AIM DotCode release 4.0

The DotCode has not been applied yet for standardisation with ISO but it was under the observation of the WG 1 since the DotCode specification development came under the umbrella of the AIM Technical Committee. DotCode got importance for the TOBACCO industry in conjunction with the requirements of the European TOBACCO regulations (see chapter TOBACCO). AIM announced the release of rev. 4 of the DotCode, here the original announcement seen at the AIM web page:

<<Pittsburgh, Pennsylvania | July 31, 2019 | AIM, the trusted worldwide industry association for the automatic identification industry, providing unbiased information, educational resources and standards for nearly half a century, has announced the ratification and release of the revised International Symbology Specification – DotCode.

Fig. 9) AIM DotCode

DotCode, introduced in 2009, is a unique, variable size, variable shape, matrix (2-D) symbology specifically designed for high-speed marking applications where alignment or connection of individual dots is problematic. Because DotCode decoding does not rely on finding continuous lines, DotCode offers a practical method to provide unique item identification at full production line speeds. The revised (version 4.0) DotCode specification defines expanded symbology-specific print quality assessment (verification) parameters based on a more granular (1/10 of a point) scale. Most importantly, the new specification defines a revised encoding algorithm to prevent rare but significantly flawed dot patterns that could have been produced under the original DotCode encoder.

George Wright, IV, a member of AIM's Technical Symbology Committee and lead for the project, shared this comment on the relevance of the release, "This fundamental enhancement to DotCode defines a significant encoding improvement based on extensive new testing of the original encoder algorithm and real-world experience in printing and reading DotCode in anti-counterfeit and traceability implementations in the European tobacco industry over the past several years."

DotCode is a code performing for high speed printing processes but lower data volume. Such a code was required by high speed production processes like in the area of the TOBACCO industries. Automatic marking and automatic scanning became essential importance for Tobacco products for tax reasons and anti- counterfeiting reasons, but marking processes are pritty fast, so codes like DotCode are appreciated to solve speed problems. >>

QR Code extension:
Rectangular Micro QR "rMQR"

The QR code development team at DENSO WAVE joined the idea of DMRE to add rectangulr formats to the originally square sizes of the code. Tomohiro Watanabe reported that evaluations proofed, that rectangular formats would fill the gap of marking requirements for smaller sizes with limited hight but increased data volume (see Fig. 10). One more dvantage of rectangular matrix codes are is for example form fitting for round surfaces. The idea has been persued to serve as a basis the previously square MicroQR code according to ISO/IEC 18004 and become supplemented by new formats.
The project has officially started as an ISO/IEC standardization p

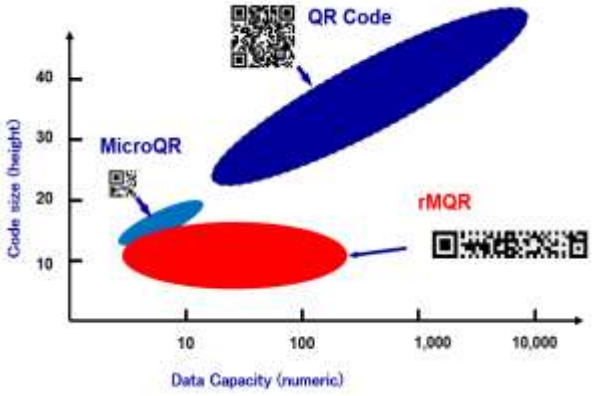

Fig. 10) Target application area for rectangular MicroQR-Codes

Data Matrix rectangular extension: "DMRE"
becomes DIS status for the ISO/IEC 21471 standard

After submission of the DIN Norm DIN 16587 DMRE to ISO, SC31 delegated it to WG1 to produce an ISO/IEC standard for extension of the regular Data Matrix features in terms of sizes and capacities for accommodation of more data on narrow or round surfaces (Fig. 11).

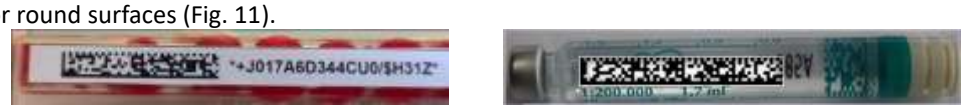

Fig. 11) DMRE on medical devices applied with a UDI Health Industry Bar Code - HIBC as UDI data content (Source: Sprague Ackley, Honeywell) and DMRE with IUID data on a round surfaceof a tube (Source Harald Oehlmann)

ISO/IEC 16022 Data Matrix includes 6 rectangular sizes already, DMRE will get additional 18 sizes as an extension.
The project has been numbered with ISO/IEC 21471. In the cause of the standardization process the number of rectangular formats of Data Matrix has been completed to 18 formats (some samples see table 2) and full list of sizes see table 3). Industries like Pharmazeutical Industries, Electronic Industries, Automotive and others supported the project in order to fill some gaps of marking options for small sizes to be coded. The status of ISO/IEC 21471 DMRE now is "Draft Committee Standard - DIS" this means the DMRE specification has been put in stabile condition and is ready for final administrative adaption, and more important, for implementation. Positive final voting is expected by the chairman for publication estimated for Q3/Q4 2019. The draft ISO/IEC DIS 21471 DMRE is available already by ISO:
-→ https://www.iso.org/standard/70947.html
Table 2) Four examples of the 18 rectangular formats of ISO/IEC 21471 DMRE, enabling encoding of higher data volume on surfaces of small hight.

Table 2) 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	1234567890123456789012345678901234567890123456789012345678901234567890123456789012345678901234567890123456789012345678901234567890123456789012345678901234
			For all DMRE-formats see table 2) or ISO/IEC 21471

Labeling software as scanners for DMRE are available in the market already and it is to expect that DMRE will become a regular add on feature to standard 2D bar code devices.

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 web page: www.dmre.info

The full list of 24 rectangular symbol sizes of both ISO/IEC 16022 Data Matrix (6 sizes) and ISO/IEC 21471 DMRE (18 sizes) can be seen in table 3)

Table 3) Data Matrix rectangular symbol sizes of ISO/IEC 16022 (DMX) and ISO/IEC 21471 DMRE

DMX/DMRE	Symbol sizea		Maximum data capacity	
	Row	Col.	Numeric	Alphanum.[c]
DMX	8	18	10	6
DMX	8x	32	20	13
DMRE	8	48	36	25
DMRE	8	64	48	34
DMRE	8	80	64	46
DMRE	8	96	76	55
DMRE	8	120	98	72
DMRE	8	144	126	93
DMX	12	26	32	22
DMX	12	36	44	31
DMRE	12	64	86	63
DMRE	12	88	128	94
DMX	16	36	64	46
DMX	16	48	98	72
DMRE	16	64	124	91
DMRE	20	36	88	64
DMRE	20	44	112	82
DMRE	20	64	186	124
DMRE	22	48	144	106
DMRE	24	48	160	118
DMRE	24	64	216	160
DMRE	26	40	140	103
DMRE	26	48	180	133
DMRE	26	64	236	175
	Note: Symbol size does not include quiet zones			

Source: Excerpts of content of ISO/IEC DIS 21471 table 7 and ISO/IEC 16022 table 7

Code in Color: Just Another Barcode (JAB)

Fig. 12) JAB Code formed as an angle(source Waldemar Berchtold, Fraunhofer Institut, Darmstadt, DE)

After presentation of the JAB Code symbology at the ISO/IEC JTC 1/SC 31 Plenary 2018 JAB Code became another SC 31 project dedicated to WG1. The project reference is NP23634. JAB Code, the polychrome matrix code was initiated by the German Federal Office for Information Security and was developed by a team led by Huajian Liu and Waldemar Berchtold from the Fraunhofer Institute for Information Security (Fraunhofer SIT) in Darmstadt. A reference implementation from the developer can be found under www.jabcode.org and the source code is available under www.github.com/jabcode/jabcode. Jabcode itself as well as the reference implementation can be used under the open source license LGPL v2.1. The official project proposal to SC 31 has been submitted by DIN. The proposed project manager for the ISO/IEC JTC 1/SC 31 standardization project is Mr. Berchtold.
In contrast to monochrome matrix codes, with JAB Code the information density can be increased to approximately 3 times the density by using several colors. 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.

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 already but did not get a standard status under AIM or ISO. 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.

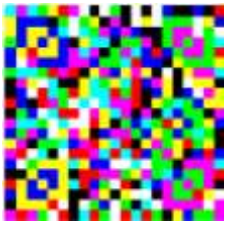

Fig. 13) JAB Code square

JAB Code was brought in by the German Ministry of Interior for primarily use for papers carrying personal IDs and passport photos. 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 high data density, as well as consumer applications. A 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.

Quality guideline for direct part marking (DPM)

getting upgrade becoming standard (ISO/IEC 29158)
Project editor: Harald Oehlmann (ELMICRON).

Fig. 14) Barcode Verifier for 2D-Symbols generating Quality Grades after measurement (Source REA Electronic)

Quality of Direct printed Part Marks (DPM) currently is measured by help of the Direct Part Mark (DPM) Quality Guideline ISO/IEC TR 29158. The paper is obtaining the status of a Technical Report (TR) rather than a standard. In absence of a DPM standard “ISO/IEC 15415 Bar code symbol print quality test specification — Two dimensional symbols” has been used partly but the measurement parameters do not fit perfectly. ISO/IEC 15415 does not include specific DPM parameters of the symbol and its illumination for the measurement process. Reflection from symbols on a smooth surface get different results than from DPM marks without the sharp black and white characteristics. Where imagers (Image scanners) are available for DPM reading in conjunction with appropriate illumination, the related quality test specifications have to be aligned with the practical solutions, accordingly VERIFIERs would need to get an update as well to produce standardized results (Fig. 14) shows an example of a bar code Verifier).

Proposals for upgrading the previous document came in from areas of industries (e.g. Automotive, Electronic) and Healthcare (e.g. EHIBCC) where DPM quality measurement is important for standard conforming part identification. Definition of the illumination of the artifact during the measurement process is one important feature of the DPM quality test specification. Different marking techniques need to be considered like “Dot Peening” and “Laser Edging”, partly performing with low contrast or even without contrast in terms of color. The specification will include the definition for camera and illumination angle. Figure 15) illustrates the setup. The essential parameter is the camera angle. Typical camera angles include 30°, 45° or 60° in relation to the marking plane.

ISO/IEC 15415 is defining 5 quality grades where A is best and F stands for FAIL. Discussion concluded that for DPM the quality grading has to be more granulate and even for assessment of smoothly printed codes the 5 grades are pretty roughly divided. The solution found was to stay in alignment with the 5 grades but to sub-divide the grades for DPM applications until 15415 might be updated as well. The term “Continuous Grading” was found but in real fact it is not a continuous put stepwise grading with 41 different values. This so called continuous grading definitions of ISO/IEC CD 29158 Annex B apply for the parameters "Axial Nonuniformity", "Grid Nonuniformity", "Unused Error Correction", "MOD or MARGIN" and "Fix Pattern Damage".

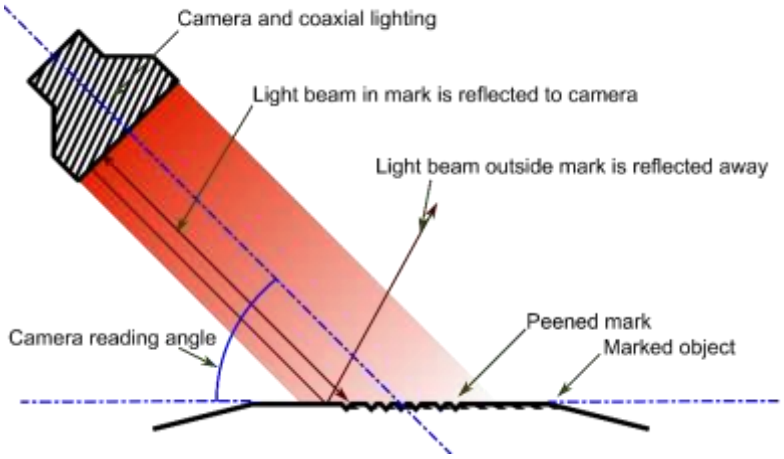

Fig. 15) shows Figure 1 of ISO/IEC CD 29158 camera and lightening angles

The 41 DPM grades mapping to the 15415 grades A to F are shown in Annex B.1 “Grades and Mapping” as follows:

- Grade A: 3.5, 3.6, 3.7, 3.8, 3.9, 4.0
- Grade B: 2.5, 2.6, 2.7, 2.8, 2.9, 30., 3.1, 3.2, 3.3, 3.4
- Grade C: 1.5, 1.6, 1.7, 1.8, 1.9, 2.0, 2.1, 2.2, 2.3, 2.4
- Grade D: 0.5, 0.6, 0.7, 0.8, 0.9, 1.0, 1.1, 1.2, 1.3, 1.4
- Grade F: 0.0, 0.1, 0.2, 0.3, 0.4

It is up to the application to define the appropriate DPM grade to be achieved as maximum and minimum.
Regulations like UDI see the quality measurement of the marking as part of the quality management for the product. This may explain the importance of the Barcode quality test specifications.

AIDC data structures under Working Group WG 2

Chairman of SC31 WG2 is Joo-Sang Park from Korea, the successor of Toshihiro Yoshioka from Japan who managed WG2 for many years. WG2 is responsible for key standards of AIDC such as ISO/IEC 15459 Unique Identification, which forms the basis for unique identifiers (see Appendix 2: Quick Guide), **ISO/IEC 15434** Syntax for High Capacity ADC Media and **ISO/IEC 29161** Unique Identification for IoT. While security features for RFID are specifically assigned to WG4, WG2 is responsible for general security aspects, such as ISO/IEC 20248 DigSig. Mr. Joo-Sang Park reported that the six parts of **ISO/IEC 15459** would enter systematic review at the end of 2019 / beginning of 2020:

ISO/IEC 15459 Unique identification
— Part 1: Individual transport units
— Part 2: Registration procedures
— Part 3: Common rules
—Part 4: Individual products and product packages
— Part 5: Individual returnable transport items (RTIs)
— Part 6: Groupings

The standard or parts of it are referenced by several national and international regulations becoming binding rules for unique IDs for companies and products such as for Medical Devices (UDI), TOBACCO Europe, Military (NATO) and everywhere where traceability under legal aspects is to be achieved.

Focus on: ISO/IEC 15418 - ASC Data Identifier Maintenance
→ 45 Issuing Agencies and their industries rely on it

Data Identifiers are irreplaceable modules in AIDC applications of key industries, healthcare, logistics, military, etc. and used globally making data elemets unique. So far, “Data Identifier Maintenance Committee – DIMC” has been in charge of care and registrations of desired new ASC DIs under the roof of ANSI and the US **Material Handling Industry (MHI)** committee MH10/SC8. ASC DIs have been upgraded from national to international standard by ISO/IEC 15418 completed with GS1 AIs jointly. The DIMC called AIDC experts from different areas and industries, so from USA, Asia and Europe supplying the necessary expertise. Last Chairman was Bill Hoffmann, USA. ANSI and MH10 management are in a restructuring process for SC8 currently. Acting secretary for ANSI MH10 SC8 is Mark Reboulet <mark@reboulet.net>, JT Mackey is the appointed acting Chairman. It was reported that an ad-hoc has taken the initiative to shrink the MH10.8.2 GS1 AIs and ASC DIs by deleting the mapping of ASC DIs with GS1 AIs. This might not be a good idea, this part was a valuable tool for support of cross industry communication by help of bar code and RFID. Since ASC DIs referenced by ISO/IEC 15418 and related syntax like ISO/IEC 15434 are included in key standards, like ISO/IEC 15459 Unique Identification, it might be estimated that ANSI with MH10 is intending to improve the support for ASC Data Identifiers. The importance of the responsibility of MH10 for ASC DI maintenance might be gathered from the chart at Fig. 16) showing 45 of 46 Issuing Agencies using and trusting ASC DIs used in each of the 45 user areas.
The slogan of MHI fit’s to the applications:
“THE INDUSTRIES THAT MAKE SUPPLY CHAINS WORK”.
Contact to MHI: Mr. Pat Davison, Director of Standards,
phone +1 704-676-1190, mail pdavison@mhi.org
Data Identifier Request: Link (2019-08-18): www.mhi.org/standards
DIMC, c/o MHI DIRequests@MHI.org, phone +1 704.676.1190

ISO/IEC 15418 GS1 Application Identifiers and ASC Data Identifiers refer to the responsible maintenance committees. Concerning maintenance of the part ASC Data Identifiers it was concluded that this in good hands of the appointed ASC Data Identifier maintenance committee at *MHI - Material Handling Industry, MH10.8.2 committee 8720 Red Oak Blvd., Suite 201, Charlotte, NC 28217-3992 USA, phone: +1 704/522-8644.*

In the past the **Data Identifier and Maintenance Group (DIMC)** under chairman of Bill Hoffmann was available for new ASC DI applications but also for consulting on the use of the Data Identifiers. The latest most innovative achievement, the publication of the "Pointer to Process (P2P)" identifier, the ASC DI "34L", met the trend toward the Internet of Things (IoT) connecting items with information sources in the web. Nevertheless, the maintenance of ASC DIs and GS1 AIs has to be done in a professional and continued manner as a live system referenced and recommended even in numberless ISO, IEC and industry standards, many of them put ASC Data Identifiers in a mandatory status.
Today
45 Issuing Agencies and their industry domains rely upon the functionality of ASC Data Identifiers and on it's maintenance and one for GS1 Application Identifiers (see Fig 16 and info box).

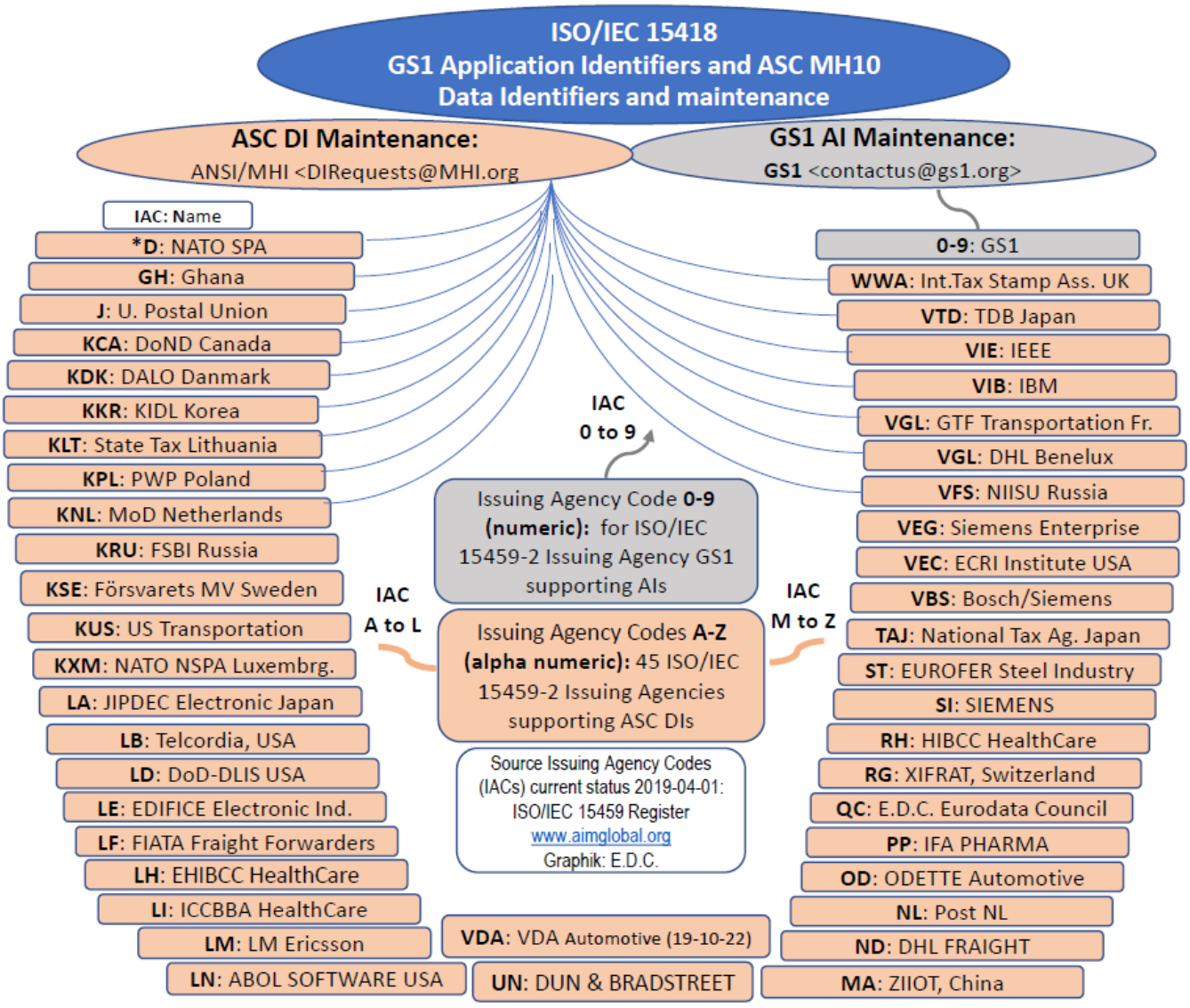

Fig. 16) 46 Issuing Agencies support ISO/IEC 15418, 45 Issuing Agencies support ASC Data Identifiers; IAC-Register see URL: *https://www.aimglobal.org/uploads/1/2/4/5/124501539/register-iac-def_2019.pdf*

Since **ASC Data Identifiers** belong to data structures and syntax the subject of maintenance would belong to to WG2 consequently as part of ISO/IEC 15418 and included in ISO/IEC 15434 syntax. The contribution of the chairman of WG8 John Greaves was the statement that the part ASC Data Identifiers "ANS MH10.8.2" are subject of intellectual property of MH10 and the responsible committee would be "MH10/SC8 under ANSI rules (see info box ISO/IEC 15418). Nevertheless this committee has the trust of 45 Issuing Agencies and its user groups all trusting to the quality of ASC Data Identifiers.

WG2 Project ISO/IEC 20248 Digital Signature Meta structure (DigSig)

ISO/IEC 20248 DigSig has been successfully implemented after publication. The integration of security mechanisms into AIDC media is becoming increasingly interesting, for example for applications in which the data link to fully automated M2M applications. To protect against criminal abuse, the DigSig standard allows the data to be verified via app and/or computer systems Internet. To support extended usage of the DigSig Joo-Sang Park and Steyn Geldenhuys reported about an Ad-hoc on a new guideline how to use the DigSig for securing Barcode e.g. on tickets used in different domains and language areas but with the same key (see Appendix 1).

Fig. 17) DigSig secured DataMatrix

Working Group WG 4 on RFID

Fig. 18) RFID Emblem ISO/IEC 29160

Fig. 19) Meetings in action

Chairman Josef Preishuber-Pflügl presented an update on the projects managed by WG 4. He commented on the increasing adoption of ISO RFID standards globally like the International Air Transport Association - IATA had agreed officially to move forward with baggage tagging by use if ISO/IEC specifications. The RFID emblem above is used for the indication “Where you see the RFID emblem – RFID is in”, It can be considered as a warning “pay attention – you might be identified”.
Obviously, RFID is still an emerging technology for supply chain management applications. A market analysis of the "RAIN RFID Alliance" shows that the market for UHF tags has grown from 5.8 billion RFID 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 includes quite a number of RFID-related work items and reviews of existing standards undertaken by about 12 editors. Still the basic standard is ISO/IEC 15963 for the Tag ID being important for the Tag identification and anti-collision in bulk reading processes (see box “Explanation of RFID Tag ID”).
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, like part-19 is defining the "RAMON" crypto suite. 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. For general information, "standing documents (SD-x)" are being 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.
ISO/IEC 20248 DigSig is another method to secure RFID applications. More and more countries use RFID for car license plate recognition where the DigSig is used for anti-counterfeiting. But DigSig can be used for any RFID application where authentication is required.

Explanation to RFID Tag ID (TID) ISO/IEC 15963

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 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 during the lifetime of the tag*
- *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 applied for the administration of the chip manufacturer ID registry.

RFID Conformance and Performance
The technical specifications of the Crypto Suites will be completed by ISO/IEC 19823 Conformance test methods for security service crypto suites split in parts e.g. for the Crypto Suites AES-128, GRAIN128A und RAMON. Performance is different to conformance accordingly the standard ISO/IEC 21277 will define Performance Tests for Crypto Suites.
Real Time Location Systems (RTLS) standards will be completed by ISO/IEC 24770 for performance tests-as well. The test methods for reader and transponder performance are under revision: Radio frequency identification device performance test methods -- Part 2: Test methods for interrogator performance and – Part 3 Test methods for tag performance

RFID standards maintenance and further developments

ISO/IEC 29160 „RFID Emblem“ is under maintenance and will be technically “polished”.
An add on will get „ISO/IEC 18000 Radio frequency identification for item management - Part 63: Parameters for air interface communications at 860 MHz to 960 MHz Type C“. An initiative has been started to integrate „Snap Shot Sensors“ in the standard. Such sensors are working with passive RFID tags without battery. Such „Snap Shots“ becoming active in an UHF activation field while the RFID tag is communicating. Today there are standard definitions for sensors just in connection with battery supported active tags with real time clock. This add on to the RFID air interface standard for UHF will allow development of cheaper UHF tags with integrated sensors.
A new work item of WG4 is the project ISO/IEC 22243 „Radio frequency identification for item management -- Methods for localization of RFID tags”. This standard will define a method how to measure the distance between UHF tag and UHF reader. The method has been developed by the Vienna University of Technology. It will allow to build effective Real Time Location Systems (RTLS) with regular RFID tags.

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AIDC Application Standards of SC 31 Working Group 8 include Internet of Things- IoT

Chairman John Greave (USA)

The technology driven SC 31 was previously not equipped as a committee for special application standards, but only for the technological specifications. 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 20) ISO standards for 4 layers: 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 technology standards, because so far the AIDC experts have been seen working in both the SC 31 and TC 122 to ensure that updates to SC 31 modules are also reflected in the applications. User groups get interested in the SC 31 expertise, for example the Computer Association CASCO. Their delegate Gary Schrempp (DELL) initiated 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. Fig. 21) is showing both on the label: Approval emblems and QR for access to electronic information. CASCO represented by DELL is looking for a joint solution for the electronics industry. This proposal resulted in the 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 but Gary Schrempp had to resign as editor of the project recently and a successor would be confirmed shortly, John Greave announced.

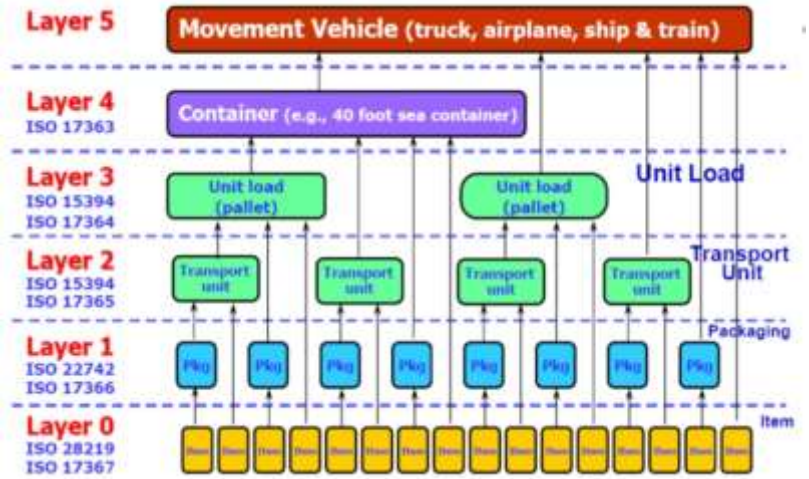

Fig. 20) ISO standards AIDC for the logistical levels of supply chains (C.Harmon)

Fig. 21) QRL Quick Resource Locator for access to information for the equipment, here DELL PC

Running projects of WG8 are:

- Standard for electronic labelling of electronics (Project editor open)
- Internet of Things (IoT) in the supply chain (Project editor Zhang Xu)
- Supply chain application of RFID ISO 17362, part 1 to 6, taken over from ISO TC 122 (project editor Hiroyuki Suzuki)

For a more complete picture of the status of application related standardization in other ISO groups it is also worth taking a look at ISO

TC122 "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 symbology's" is of interest.

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Internet of Things in the ISO/IEC Joint Technology Committee 1 "JTC1 SC41"

Contribution by Detlef Tenhagen, HARTING, DIN, JTC1 SC41, SC31

Above the SC31/WG8 activities with focus on AIDC for IoT the Joint Technology Committee ISO/IEC JTC1 formed SC41 for general IoT considerations. JTC1 SC 41 defined IoT 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. Various committees at ISO/IEC dealt with IoT already, 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."*

Fig. 22) Unique item ID + IoT in one: By SC31 tools, source DIN pres. 2016oeh

ISO/IEC JTC1 SC 31 provides the modules for automatic identification, but also safety-relevant modules which are needed for "cross-responsibility" processes. Such ISO/IEC JTC1 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.

IoT also requires the inclusion of security concepts. SC 31 can supply security features for barcode/RFID to Internet communication with ISO/IEC 20248 Digital Signature Meta Structure. IoT can be extremely complex, but AIDC modules like "DigSig "Pointer to Process (P2P)" data direct communication between items and Internet can ease and secure practical implementations (see Appendix 1 DigSig and Fig. 24 Quick Link to IoT via "P2P").

Work on IoT is performed by intense, but independent organized Liaison between ISO/IEC JTC1 SC 27 and ISO/IEC JTC1 SC41 as well as to ISO/IEC JTC1 SC 31 in common. Sustained standards development on core security functionalities are handled in both instances equally, which leads to a harmonized process indeed, and avoids "double-work" in case of overlapping technological scopes between SC 31 and SC41 i.e. on UID standards, used by IIoT "smart devices" electronically - as i.e. in case of NFC for instance, which now has become much more than a pure SmartPhone capability on payment but also influence UID functionalities in IIoT / Smart Factory applications. Many work in NWIPs by SC41 no refers to such kind of Devices (DIS 30162 on Compatibility requirements on industrial devices)
The high importance of AutoID Technologies was mentioned and referenced especially many times in regard to IoT based upon the very good work of SC31 and the engaged national bodies in the ballot on the DTR (Draft Technical Report) of ISO/IEC DTR 30166 on Industrial IoT in the introduction section as follows:

Industrial Internet of Things- IIoT

Fig. 22b) IoT connects physical and virtuell reality (source: Detlef Tenhagen, JTC1 WG41)

"The **IIoT** (Industrial Internet of Things) is an identified vertical of the IoT, as seen throughout this document in general. It consists of Industrial (electronic) communication-capable electronic systems and devices, which can be recognized as the integration base, to allow seamless communication, data processing, data access and data exchange in regard to sensors (sensing) Auto-ID (automatic (global, unique) identification), and actors (acting, steering)."

Also in the recognizability of IIoT Systems (Chapter Smart Manufacturing) the - importance of (Unique) Identification - was emphasized in the RAMI 4.0 classification referenced in the IIoT area by the degree of familiarity (Y-Scope) in the different degrees for classification of communication and identification capability and express the membership of a system by a combined numeric notation to it uniquely.

The user perspective on IIoT, meanwhile, is denominated in the same DTR 30166 Section on USER as a persona view:
Such characteristics of the manufacturing environment have several implications in terms of communications:
– Identification mechanisms: RFID based systems or other solutions to identify the worker and enable the access workstations or tools, only to authorized workers, allocated to the job based on their skills,
- RFID/AutoID is in Scope of ISO/IEC JTC 1 SC 31, also in Liaison to ISO/IEC JTC 1/SC 41.
In addition to global advanced industrial perspective the work by IEC SC 3D "Product properties and classes and their identification" refers also inside the development of IIoT Standards emphasis the importance of AutoID in this use-case scope!

Last but not least the OGC (Open Geospatial Consortium) – Link to W3C, references in addition to this, that it is clearer that the automatic processes of unification/identification of the location and movements of objects becomes necessary through modularization and tracking the movement of object autonomously, which in turn shows the importance combined between: autonomous identification - and – localization, to the same intention.

In addition to this ISO/IEC JTC1 SC 31 engagements the newest actual developments in ISO/IEC JTC1 SC41 regarding AutoID in the context of IoT (and IIoT as a vertical Use Case) - many new NWIPs has been raised by the last Plenary meeting in Chongqing in June 2019:
As a short reference, for instance the new proposal by the NB of China on "Internet of Things - Series Standards of Personnel Positioning Management System" shows on the other hand how the expansion on "classical" technical based unique identification is expanded to a more behavioral (personal) identification by "chipping" persons to enable permanent tracking capabilities to lifetime span. This initiative was seen critical in the plenary discussion as this kind of expanded IoT based unique identification enables the total control on people movement by any means (of time and location). The already established Liaison by ISO/IEC JTC1 SC41 to ISO/IEC JTC1 SC 31 were confirmed and sustained by Liaison resolution.
Interesting to see - by the engagement to this was the recognized expansion of radio-based identification besides the already classical (ISO/IEC JTC1 SC31 / WG 04) - frequency areas on LF / HF / UHF into section of IEEE 820.15.4.x and compliant frequency bands to 2.4 Ghz for intelligent identification purposes.
It is expected out of those topics that BLE and likewise technologies would expand themselves into these "classical" domains of RFID based UID and its functionalities.
Therefore it led to the capabilities to - combine - the AutoID native functionalities into the area of location based services especially to indoor use-cases.
This would touch SC31/WG05 and inside the NB of Germany at DIN NA 043-01-31 the potential reinitiating of the dormant groups of UA/RFID an UA/RTLS potentially.

ISO and CEN committees are liaison partners for AIDC standardization

Mr. Claude Tételin, liaison speaker of SC31+CEN TC225 submitted an update of the CEN TC 225 activities.
Since last SC31 plenary 3 European Standards have been completed:

• prEN 17230: **RFID in rail** is under formal vote, approval is expected for publication end of 2019 (see info box CEN TC 225: RFID in Rail).

Fig. 23) Wheel of a steam locomotive, synonym of railway but without RFID yet

• EN 17071 Information technology. Automatic identification and data capture techniques. **Electronic identification plate** has been published in March 2019

CEN TC225: RFID in RAIL EN 17230

CONTRIBUTION Erwin Schmidt, Pepperl & Fuchs

The European Standards Institute CEN TC225 AIDC, WG4 Applications has developed the standard EN 17230 "Information technology - RFID in railway applications". The standard is used to identify locomotives and railway wagons with RFID transponders. Two UHF transponders according to ISO / IEC 18000-63 are provided per vehicle on each side of the vehicle. It defines the areas in which the transponders are to be mounted so that they can be read properly by permanently installed readers. The transponder data also contains this information on which side of the vehicle the transponder is mounted.

At the heart of the data are the already existing identification numbers, which follow the International Union of Railways UIC Scheme. For European rail companies, this is the 12-digit European Vehicle Number (EVN). Other railway companies can use different identification numbers. The railway company is identified by the company code. This makes the standard applicable worldwide. For carrying the data, two possible data structures are offered by the standard. Either a data structure according to GS1 with a Global Individual Asset Identifier (GIAI), or the data structure with ASC Data Identifier can be used. For the latter, a special Application Family Identifier (AFI) has been registered for use with this specific application.

• prEN 17099: **Barcode for Fish and seafood products** - Requirements for labelling of fish boxes distribution units and pallets for of fish and seafood products is under formal vote, approval is expected and publication end of 2019

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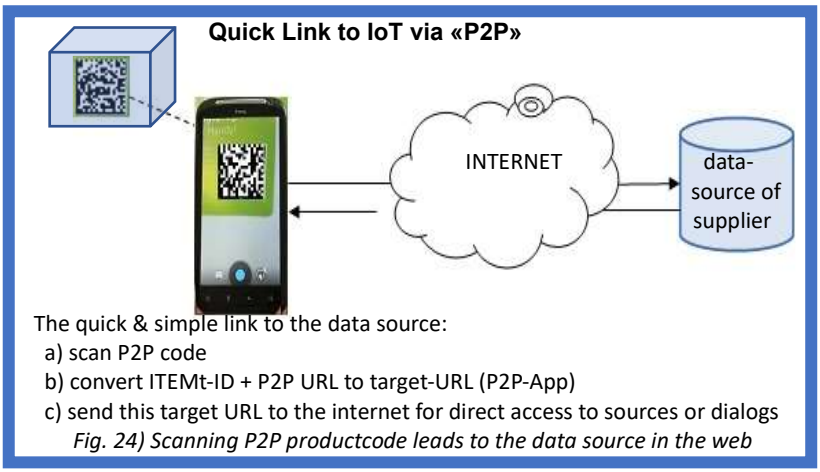
What else is developing featuring AIDC solutions using AIDC standards

INTERNET of THINGS project DIN SPEC 16589

Quick Link to IoT via "Pointer to Process -P2P"

Internet access with smartphone via QR code is common practice today, but there are even more developments featuring Internet access by regular barcode (or RFID).
This is a rising demand: Using IoT for access to item information by scanning a regular item code applied for item identification and tracking and tracing purposes. A regular URL in a QR Code does not allow identification of a specific product and neither traceability nor security functions, but applications require both, unique item identification in a backward compatible manner AND access to information via Internet.
DIN WG NA 041-01-31 responded to the initiative from Industry & Healthcare experts for a "Light IoT" system developing DIN SPEC 16589 Product to Internet Communication (Pointer to Process- P2P). The key of the solution is an add on to any unique item bar code or RFID Tag, like a UID according to ISO/IEC 15459 using ASC DIs, e.g. DI "25S". This unique item code will be applied by an add on consisting of the ASC P2P DI "34L" and a port URL. Access to the related IoT address will be executed generating the IoT target URL by extracting the P2P URL and moving the item code after the P2P URL.



The quick & simple link to the data source:
a) scan P2P code
b) convert ITEMt-ID + P2P URL to target-URL (P2P-App)
c) send this target URL to the internet for direct access to sources or dialogs

Fig. 24) Scanning P2P productcode leads to the data source in the web

This is forming the Internet compatible Target URL. The formatting and converting has been standardized by registration of the ASC DI “34L”. DIN SPEC 16589 describes the application of the quick and easy IoT by help of smart phone (Fig 24), by a scanner or by help of a data entry software tool.
The backward compatible Quick IoT solution using “Pointer to Process (P2P)” is smart because the item code can be used for item identification AND for IoT access. In addition to it, no additional third party web services are required, the labeler can target the URL to information or dialogs hosted by himself. Fig. 24) is showing the principle of a P2P IoT application enabling easy access to Material Safety Data Sheets (MSDS), to maintenance instructions, to a dialog for a repair or maintenance process any many other features Internet would allow to use.
The P2P solution is included in "DIN 66277 Electronic nameplate", 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

Initiative: Optimization Barcode data entry “Web and keyboard compatible encoding

Guideline for simple keyboard and WEB interface compatible syntax for AIDC media

AIDC data in AIDC media get structured in order to become globally unique. Structuring is specifically required in case of concatenated data elements in a code. There are structures using keyboard compatible character sets only, like HIBC, ISBT, Eurocode, but other structures are using extended character sets like ISO/IEC 15434 and GS1. GS1 defines the “Group Separator (GS)” character as separator between data elements and ISO/IEC 15434 is using prefix and termination with a complex start and stop sequence and in which “GS” is defined as separators between data elements and segments as well.
Example - An encoded string structured according to ISO/IEC 15434:
Advantages of this approach are that these sequences never appear "unintentionally”. Unfortunately, both in the start and stop sequence and for the separators, the "non-printable" special characters, do not appear on any keyboard. 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 for handling such data structures. 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.

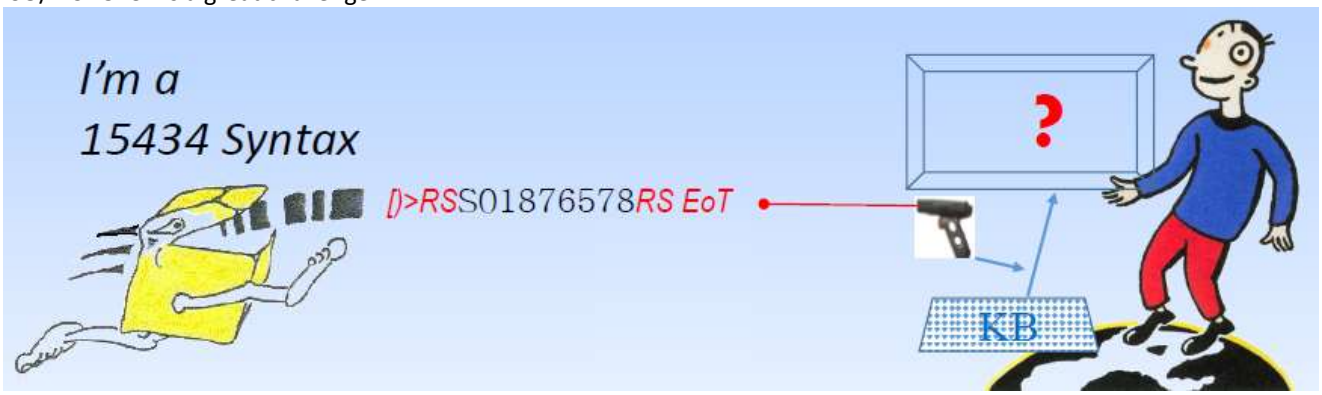


Fig. 25) Problem to be solved: Captured data applied with “non keyboard characters” do not pass keyboard interfaces

To avoid interface problems the "EDIFICE Guideline for Web and keyboard compatible encoding with ASC Data Identifiers" defines the "Flag-Character ." (dot) as the start character for a character string in which the individual data elements are separated with a Circumflex character "^".

Fig. 26) Solution: The Flag Character “.”(Dot) makes the barcode data unique and passing keyboard & web interfaces

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 for the Medical Device sector "UDI"

Unique Device Identifier "UDI": Regulation for Medical Devices and In-vitro-Diagnostica, Starting point for Europe May 26, 2020

The European regulation follows the recommendations of the International Medical Device Regulatory Forum - IMDRF as the USA Ministry of Health did already executed by FDA.

Fig. 27) UDI-Code in ISO/IEC 16022 Data Matrix

UDI stands for a unique barcode (RFID optional) for products and/or packages, 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 1990's, becomes a legal requirement.
See also Annex 6 "UDI Book".

The European Regulation for Medicinal Products

moves one step further, requiring serialized ISO/IEC 16022 Data Matrix

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.

Fig. 28) Pharma Product Number (PPN) encoded in DIN 16587 DMRE

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 Fig. 28) "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". One solution is addressing the transition from the national PZN code to the international PPN and for combi-products with embedded HIBC data (Fig. 29). See also http://www.ifaffm.de/en/ifa-codingsystem.html.

Fig. 29) Combi product label

AIDC for TOBACCO products sector in Europe

EU system for traceability and security features of tobacco products

The Tobacco Products Directive published with the Official Journal of the European Union "L96" April 16, 2018.
(see: https://publications.europa.eu/en/publication-detail/-/publication/536e4d37-4140-11e8-b5fe-01aa75ed71a1)
The Directive requires AIDC techniques for physical marking and storage of related information in repositories. After put in force March 20, 2019 the system is running and live as seen by the additional markings on tobacco products in practice. Like the Directive for medicinal products and for medical devices the Directive for TOBACCO enables both, unique identification and access to product related data stored in a regulator controlled data base. Nevertheless the methods differ slightly due to the project specifics. In addition to traceability for TOBACCO products control by the customs authorities belongs to the targets of the project. A specific structure has been defined by the European Commission to secure authentication of the identity of the TOBACCO items in relation to transmission and storage of the information in the Repositories (see Fig. 30). Data of Primary Repositories are copied in one universal Secondary Repository for access through the user interface.

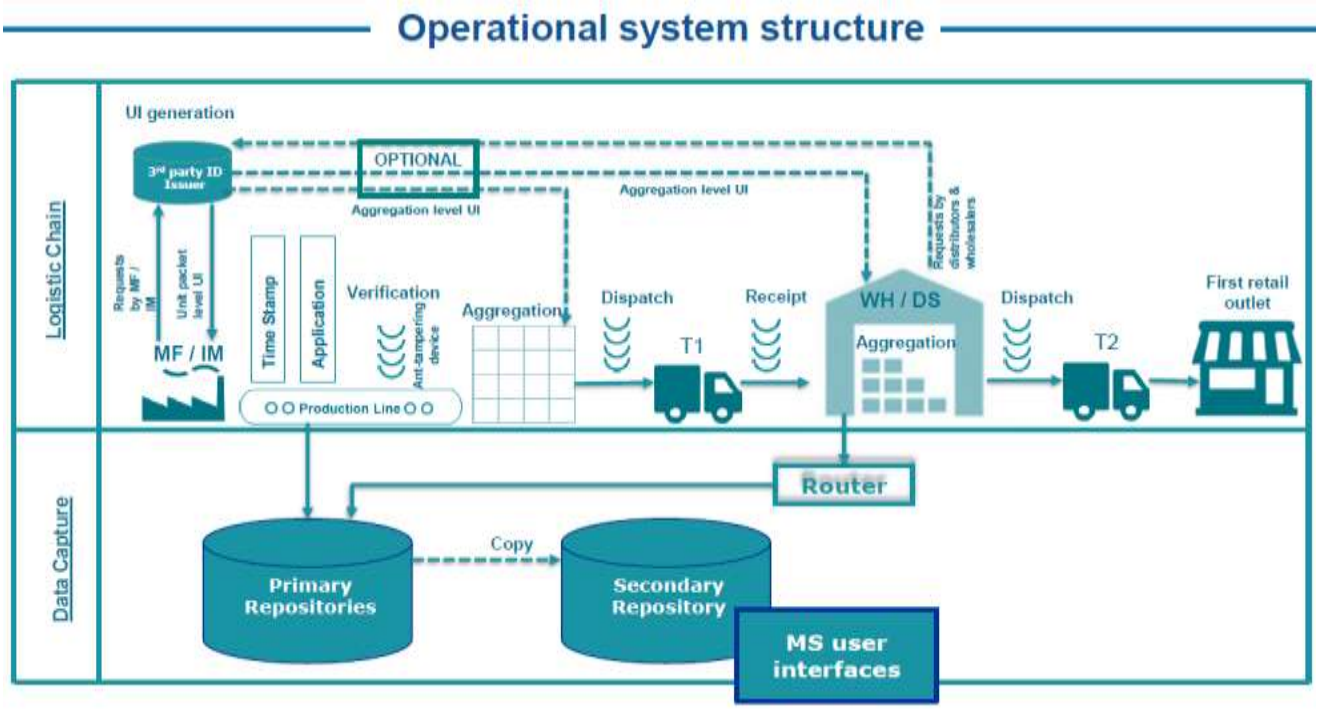


Fig. 30) Chart TOBACCO operational system structure, source EC Directorate General for Heath and and Food Safety, Stockholm Workshop 2018-01-25

In TOBACCO different physical levels apply: Unit level (packs) and aggregated level (e.g. carton or master case)
At "unit level" all packs have to be marked with a unique identifier (upUI), supplied by a "competent national ID Issuer" as third party to be consulted by the manufacturer. The competent national ID Issuer is in charge to generate a unique string of data conforming to ISO/IEC 15459-2/-3 to be submitted to the Economic Operator and to the repository for later access by the authorities like customs.
The structure of the unit level upUI generated by the competent national Issuer is:
<Data string Identifier><Issuing Agency Code><Competent Issuer ID><Serial number><Product information>.
The EO has to add a time stamp while marking the product package or affixing a Tax Stamp which carries the unique identifier , the format is: YYMMDDhh.

- Example of an upUI using the Issuing Agency Code "QC" *(EurodataCouncil.org)*:
- Data string Identifier: ASC Data Identifier **"5R"** for UI structured by the Competent Issuer (CI)
- Issuing Agency Code: **QC**
- Competent Issuer C: **ABCD**:
- Serial no.: **123aBcD890**
- Product information: **12123456712345n4Ts8P**
- Time Stamp: **19**09**01**09

Example unit level UI data string
with above data → 5RQCABCD:**123aBcD890**12123456712345n4Ts8P**19**09**01**09

*Fig. 31) Example → 5RQC… encoded with **Data Matrix** and/or **QR Code** (with same dot size)*

Aggregated UI (aUI) for the upper levels concatenated (carton, master cases, palettes)
If generated by the ID Issuer same rules as for the unit level apply for the aggregated. Despite the difference in Information which have to be included in the aUI. If the EO is generating the aUI for that level by himself then the rules of ISO/IEC 15459-1 Barcode for Transport Units or ISO/IEC 15459-4 Individual products and product packages can be used alternatively. For master case and pallets marked by the EO same rules apply for enabling traceability of packed products and cartons by reference to the higher level markings.

Data Carrier for TOBACCO

So far just UPC and EAN codes have been printed on the product for the purpose of scanning at Point of Sales. An additional code has to be added on packages and concatenated bundles for the UIs. For marking the levels different symbology's apply for encoding the UIs.
Unit Level UI: ISO/IEC 18004 QR Code, ISO/IEC 16022 Data Matrix but also AIM DotCode. The latter for reasons of high volume fast printing processes by ink jet printing systems (Unit level UI with DotCode see Fig. 32).

Fig. 32) ISO/IEC 16022 Data Matrix, ISO/IEC 18004 QR Code, AIM DotCode

Fig. 33a) ISO/IEC 16022 Data Matrix with Tobacco data Source: E.D.C.

Fig. 33b) AIM DotCode placed on unit level package source: Incert

For marking the upper levels ISO/IEC 16022 Data Matrix, ISO/IEC 18004 QR Code are the symbology's foreseen by the tobacco regulation in conjunction with ISO/IEC 15459-4 and Code 128 with ISO/IEC 15459-1 under the responsibility of the Economic Operator labeling that levels.

AIDC for MARINE EQUIPMENT required by the European Regulation EU/2018/608

DIRECTIVE 2014/90/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL required declaration of conformity by a specific emblem, the "wheel mark". It was indicated that the wheel mark might be supplemented by an electronic tag in due time. This happened 2018 already. The Official Journal L 101/64 published the IMPLEMENTING REGULATION (EU) 2018/608 of 19 April 2018 laying down technical criteria for electronic tags for marine equipment. The regulation requires a ISO/IEC 16022 Data Matrix and/or an UHF RFID Tag according to ISO/IEC 18000-6:2004 Type C (ISO/IEC 18000-63). The regulation defines also how to combine the marine emblem "wheel" with the RFID emblem ISO/IEC 29160 and/or a Data Matrix according to ISO/IEC 16022 (Fig. 34).

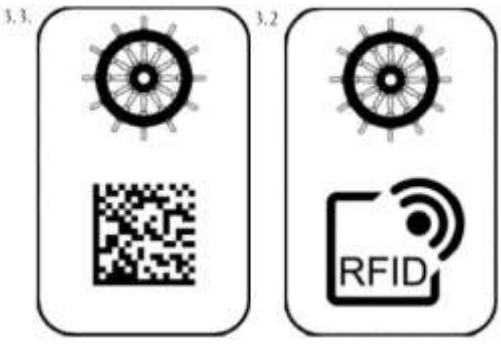


Fig. 34) Marine Equipment emblem for Data Matrix and/or RFID marking, source EU L 101/67, 20.4.2018

The required data elements in the electronic data carrier are the conformity certificate number, the ID of the notified body assigned by the Commission and a proceeding character indicating the type of conformity assessment undertaken. Additional item related data can be add optionally, like product code, the lot or serial number structured in accordance with ISO/IEC 15434 and using ISO/IEC 15418 Identifiers. The electronic tag contains key information, able to provide for a link to the database (https://www.mared.org/) with a full set of information like manufacturer data, certificates, document of compliance, etc. In essence, the tag shall ease control of conformity to EU regulations for increasing safety.

RFID partnership between IATA and CISC Semiconductor

for ISO/IEC conforming RFID installations for baggage tracking and its quality

Contribution by Josef Preishuber-Pflügl, CISC, SC31/WG4

Logo IATA

CISC Semiconductor recently joined IATA Strategic Partner program to support the current demand of RAIN (UHF RFID) tag and reader testing. CISC will engage in activities around RFID baggage workgroup to understand the requirements, set guidelines and educate the airlines and its partners on benefits of the RAIN technology. The **International Air Transport Association (IATA)** 75th Annual General Meeting (AGM) unanimously adopted a resolution supporting the global deployment of Radio Frequency Identification (RFID) for baggage tracking and the implementation of modern baggage messaging standards to accurately track passengers' baggage in real-time across key points in the journey. This resolution encourages the transition from bar-coded labels to baggage labels including UHF RFID inlay. IATA had also developed a Recommended Practice 1740C guideline, to reflect the latest developments in the UHF RFID technology and a set of tests to ensure global standard of performance to the tags and readers. IATA Recommendation 1740C in particular refers to the WG4 standards ISO/IEC 18000-63, ISO/IEC 15961 and ISO/IEC 15962 and related test standards.

With over 20 years of experience in the different standardization bodies and in implementation of the UHF RFID technology CISC hopes to support the airlines and the industry to understand the technology and the avoid the pitfalls for a smoother transition into UHF RFID.

Item Unique Identification – IUID for the Defense sector

Practiced over ten years but still worth to be mentioned is the IUID project of the United States Department of Defense and shared by the NATO partners. The system for Uniquely Identifying Items **UII** includes a uniquely serialized ID mark, the **IUID** being mandatory for all federal contractors on their government furnished military and non-military equipment with a value of above 5000 USD and a central governmentally driven IUID data base. By help of the IUID code and the data base any IUID labelled equipment can be found where ever it is located or was moved to. So nearest located spare equipment can be found or spare parts or specific tools. After introduction by information sessions and work shops it became very quiet around the project, why? Because it is running smoothly and very effective, a matter of course for any logistical processes.

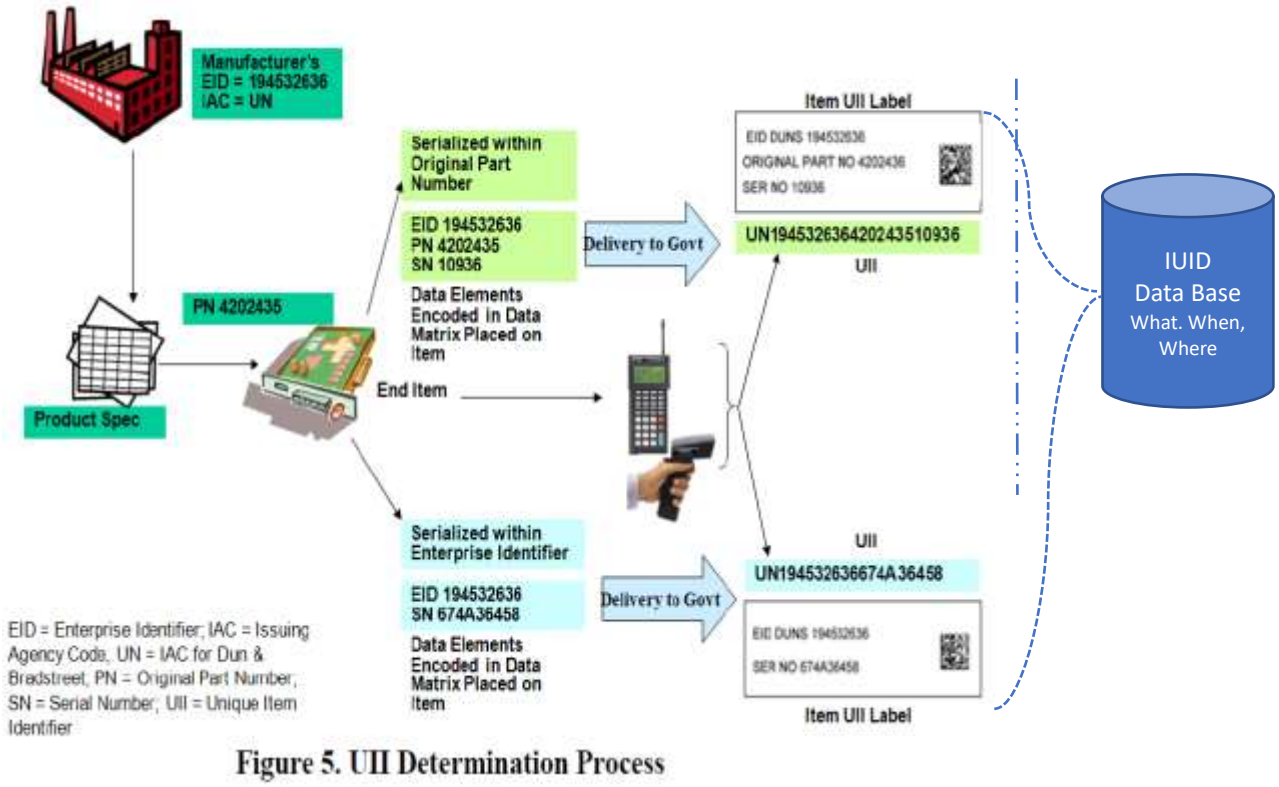


Figure 5. UII Determination Process

Fig. 35) Chart of Fig. 5. DoD Guide to Uniquely Identifying Items V3.0 - supplemented with IUID data base for illustration

Appendix 1) Application ISO/IEC 20248 Digital Signature
Example DigSig secured Object Identification

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

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 identify the product, but also to verify the contents of AIDC media such as barcode, 2D and RFID.

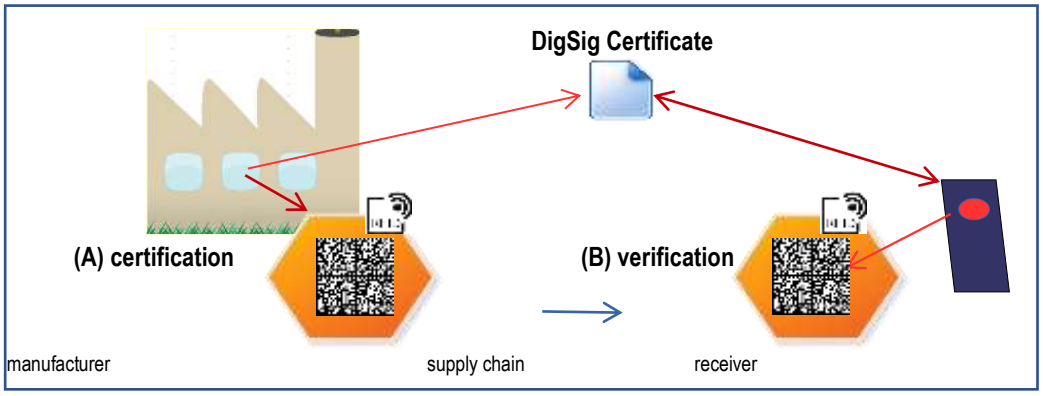


Fig. 36) Illustration of a DigSig application

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

data element	*ASC-DI*	*value*	*ASC-data string*
Unique SN (UID)	**25S**	QCTRUE123456	**25S**QCTRUE123456
product reference	**1P**	MOT25X	**1P**MOT25X
production date	**16D**	2017-07-20	**16D**20170720
Additional element:	**6R**	*https://v1.20248.info/?wJgJlkAByOEAEZiABcUOiUS-CcR7en-awDzEaTiV4-kxodnqQZvEdjBZbwRV*	***6R**https://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 45 shows a DatMatrix containing the above data elements for automatic identification of the object/product and DigSig for verification of the data.

<Macro06>**25S**QCTRUE123456<$^{G}_{S}$>**1P**MOT25X<$^{G}_{S}$>**16D**20170720<$^{G}_{S}$>**6R**https://v1.20248.info/?wJgJlkAByOEAEZiABcUOiUS-CcR7en-awDzEaTiV4-kxodnqQZvEdjBZbwRV

Fig. 37) 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.

Barcode DigSig Container
The term Barcode DigSig Container is used if the DigSig is embedded in a secured barcode symbol like shown with Fig. 38) For showing that a barcode is DigSig secured
a DigSig emblem can be add adjacent to the symbol.

Fig. 38) Data Matrix applied with DigSig and UID emblem

DigSig Cross Authority Container

Steyn Geldenhuis & Joo-Sang Park

The DigSig Cross Authority Container started as an idea of using barcodes from different authorities in different domains to display information relevant to each of these authority domain in a language and that the verifying entity can understand - thereby translating the document. This should use localization settings of mobile phones, web browsers and operating system APIs in general.

However in the WG2 ad-hoc it was soon pointed out that ISO/IEC 20248 can facilitate this type of functionality to a degree, with the correct setup and additions.

That an example of a train ticket issued by a Domain Authority (DA) A. This ticket is described by a ISO/IEC 20248 Data Definition Description (DDD) which defines how the data is encoded into a 2D barcode. It also defines how the data is decoded and presented to the verifying entity in a generic way.

This DDD (produced with English field names) is distributed by means of a X.509 certificate which also contain the public keys and is cryptographically signed by DA-A in order to facilitate non-repudiation.

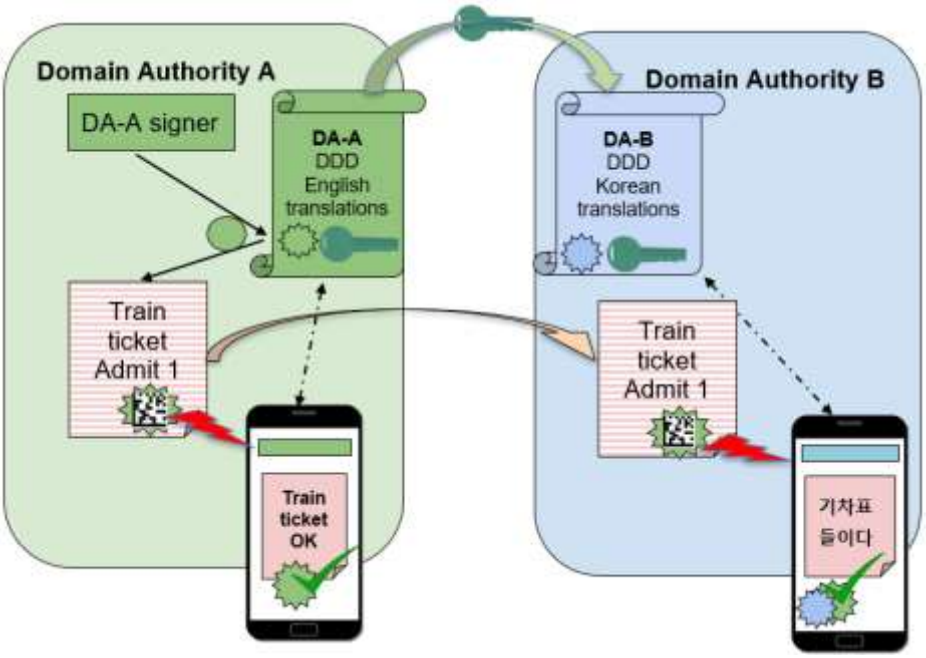


Fig. 39) DigSig secured ticked used in territory A (English) and in B (Korean)

A ticket can then be verified by a verifier that uses DA-A. However, if this ticket crosses a border into DA-B's jurisdiction this ticket should also be verifiable. There are 2 ways to do this:

1. Simply use the certificate from DA-A containing the DDD and public key.
2. Create a new based on certificate from DA-A so that it is distributable by DA-B containing a new DDD but reusing the public key from DA-A.

Option 1 can cater for multiple languages and but if a language is not supported it defaults to the first defined language in the DDD. This would also imply that DA-B does trust the information in the certificate and by extension DA-A implicitly.

Option 2 has the advantage that DA-B can translate the document on their own without input from DA-A. They would tweak the DDD to suit their needs - as long as they don't change the encoding the details and include the original public key from DA-A. DA-B can then create a certificate that is trusted in their domain and in their chosen set of languages.

Along with option 2 would be the ability to point the "structdocuri" to a structured document of their choosing.

In ISO/IEC 20248's DDD structured document URI is defined by: "structureddocuri":<structured document URI>

ISO/IEC 20248 does however not specify anything more than other than a URI is used.
It can be augmented by specifying further that it shall contain the following:

1. The language code of the structured document as per 20248.
2. The signature of the structured document template.

The DigSig fields to be populated in the structured document shall be done with DDD data. In the case that the DDD data and the structured document language differ, the default translated DDD data shall be used as specified in ISO/IEC 20248

It is also important to note that this type of use is not limited to the use of barcodes, seeing as ISO/IEC 20248 is AIDC agnostic, but NFC or RAIN RFID are particularly attractive carriers for this use case.
With this in mind, "Barcode Container" might not be an appropriate description for what is aimed to be achieved here.

By using ISO/IEC 20248 and the reissuance of X.509 certificates by a jurisdiction we get data structures that have integrity, translatable, are transferable between jurisdictions, presentable as the original creator of the document intended, and are explicitly trusted by the jurisdiction that adopts this data structure. A working name that might be more suitable would be "Transferable AIDC data structures".

Appendix 2) Quick Guide for the creation of global uniqueness for items

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".

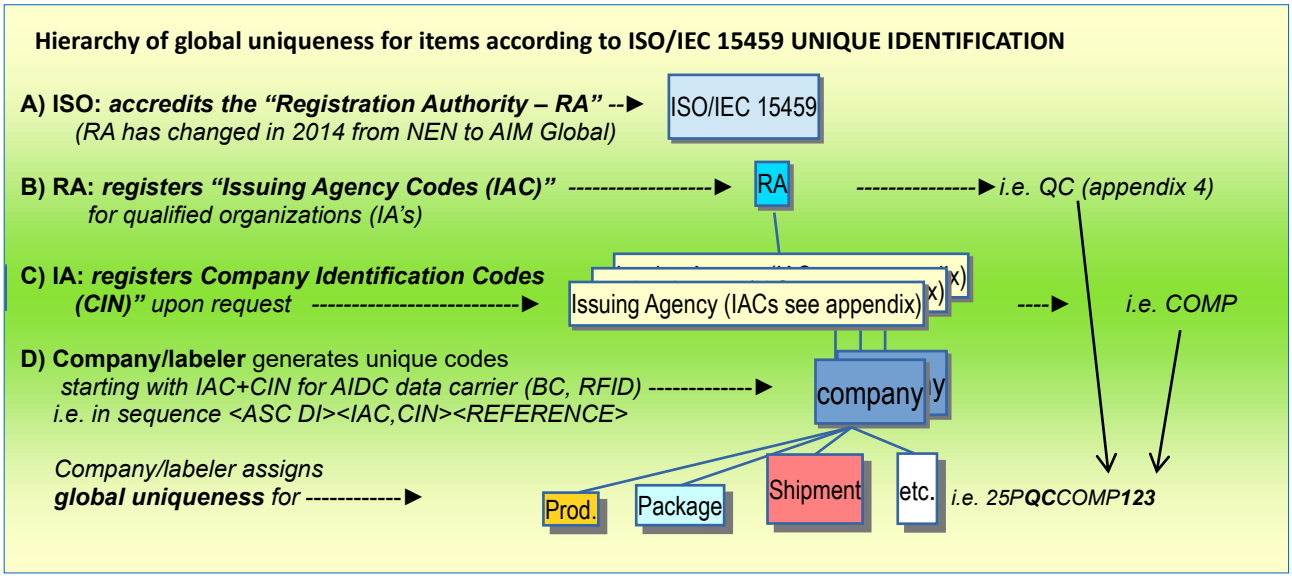


Fig. 40) Hierarchically distributed responsibility for unmistakable unique labelling

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.

Fig. 41) 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 (IA's) 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 45 Issuing Agencies accredited for issuing 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.

The ISO/IEC 15459-2 accredited Issuing Agencies (see Fig. 16) do 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 4) shows a selection of typical Issuing Agencies for industries and health care and it's associated structures for company IDs, as well as for product and transport codes, for example.

Table 4) 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	YES	YES
DUN - Dun & Bradstreet	UN	9n	123456789	ASC	YES	YES
GS1 and EPC Global	0-9	3-7	1212345	GS1 (EPC)	3-5n	9n
EDIFICE, European Electronic Industries Association	LE	3an	IBM	ASC	YES	YES
EHIBCC European Health Industries Association	LH	4an	ELMI	ASC, HIBC	18an	YES
ODETTE European Automotive Industry Assoc.	OD	4an	A2B3	ASC	YES	YES
TELECORDIA Telecom. Equipment	LB	4an	CSCO	ASC	YES	YES
UPU Universal Postal Union,	J	6an	D00001	ASC	YES	YES
EUROFER (Steel Industry)	ST	4n	1234	ASC	YES	YES
etc.						
Selection might be completed on request. Complete list of the ISO/IEC 15459-2 Registry, see: www.aimglobal.org https://www.aimglobal.org/uploads/1/2/4/5/124501539/register-iac-def_2019.pdf						

Table 4) illustrates the link between the choice of the Issuing Agency for the Company ID CIN and the bounding to the application of the CIN with the use of 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 Issuing Agency. The complete list of Issuing Agencies is publicly available via the above URL of AIM Global (see also Firg. 16).

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) Safe and easy AIDC data capture and transfer through keyboard and web

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

Keyboard interfaces are still barriers for specific characters and character sets captured by scanners. If such characters are not included as keys in the keyboard character set keyboard interfaces filter characters out or misinterpret them. Same happens with web interfaces. 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. As introduced unfortunately, not every character gets through.
Using the simplification option of DIN 66403 System Identifiers as a base EDIFICE has developed the guideline "**WEB AND KEYBOARD COMPATIBLE ENCODING WITH ASC DATA IDENTIFIERS**"
The guideline shows the method how to structure ASC Data Identifier data elements for quick and safe transmission through keyboard and web interfaces. The guideline is available free of charge from EDIFICE:
https://wp1.edifice.org/guidelines/adc/

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

WEB AND KEYBOARD COMPATIBLE ENCODING WITH ASC DATA IDENTIFIERS - Issue 1.0

1.2 Problems to Solve

1.2.1 **Ambiguity of data elements** applied with ASC Data Identifiers without any Flag Character
Data elements headed by ASC Data Identifiers are not secured against overlapping with encoded data of other nature or other structurers like “IUID” headed by Text Element Identifiers (TEI).

1.2.2 **Non-Web/Keyboard compatibility** of ISO/IEC 15434 Syntax
Unique syntax using control characters outside the keyboard set, like ISO/IEC 15434 Syntax for high capacity media (<rs>, <gs>, <eot>, etc) do not pass such physical or virtual interfaces and may even invoke unwanted functionalities that may be assigned to corresponding keys by the application.

1.3 **The scope of this guideline** is the definition of a unique encoding scheme of data elements applied with ASC Data Identifiers for use in applications where Web and keyboard compatible syntax is required and unambiguity compared to non ASC DI data elements.

Although the background of EDIFICE is the High-Tech Industry, the application of
this guideline is not limited to a specific industry sector or subset of Data Identifiers.

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	EXPLANATION
•	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)

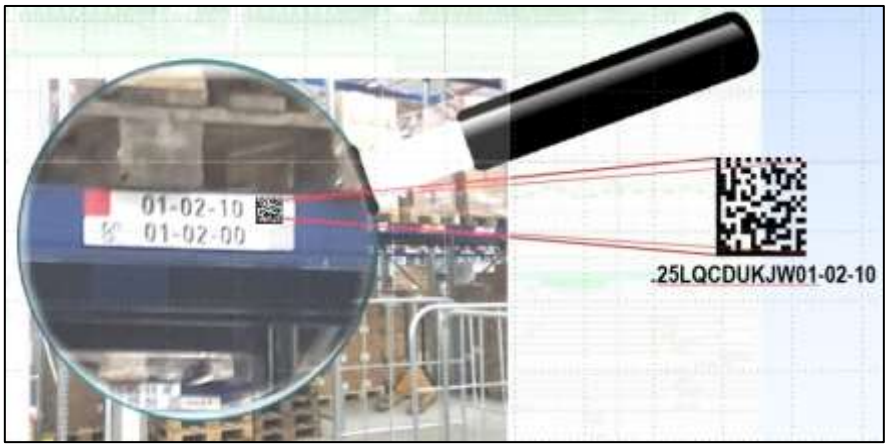
4.1 Example of “Unique Identification Mark – UIM”

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

Guideline Figure 5) - UIM on a test tube applied with flag character “.”(for unique distinction with other 25…. Values)

4.2 Example of a stock location code

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



Guideline Figure 6) - Stock location code (source: Klinikum of the Friedrich Schiller University of Jena (UKJ), Germany)

Data sequence of the example guideline 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

Guideline Figure (7) shows two concatenated data elements →

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

Appendix 5) 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/ RFID 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, www.din.de
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, www.edifice.org

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

Appendix 6) The UDI Book

Figure 42) 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 7) 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 - 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: