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ITU-T Technical Report

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ITU-T Focus Group on Application of
Distributed Ledger Technology
(FG DLT)

Technical Report FG DLT D1.3

Distributed ledger technology standardization landscape

FOREWORD

The International Telecommunication Union (ITU) is the United Nations specialized agency in the field of telecommunications, information and communication technologies (ICTs). The ITU Telecommunication Standardization Sector (ITU-T) is a permanent organ of ITU. ITU-T is responsible for studying technical, operating and tariff questions and issuing Recommendations on them with a view to standardizing telecommunications on a worldwide basis.

The procedures for establishment of focus groups are defined in Recommendation ITU-T A.7.

Deliverables of focus groups can take the form of technical reports, specifications, etc., and aim to provide material for consideration by the parent group in its standardization activities. Deliverables of focus groups are not ITU-T Recommendations.

The ITU Telecommunication Standardization Advisory Group established the ITU-T Focus Group on Application of Distributed Ledger Technology (FG DLT) in May 2017.

FG DLT concluded and adopted its Deliverables on 1 August 2019.

Type	**Number**	**Title**
Technical Specification	FG DLT D1.1	DLT terms and definitions
Technical Report	FG DLT D1.2	DLT overview, concepts, ecosystem
Technical Report	FG DLT D1.3	DLT standardization landscape
Technical Report	FG DLT D2.1	DLT use cases
Technical Specification	FG DLT D3.1	DLT reference architecture
Technical Specification	FG DLT D3.3	Assessment criteria for DLT platforms
Technical Report	FG DLT D4.1	DLT regulatory framework
Technical Report	FG DLT D5.1	Outlook on DLTs

The FG DLT Deliverables are available on the ITU webpage, at https://itu.int/en/ITU-T/focusgroups/dlt/.

For more information about FG DLT and its deliverables, please contact Martin Adolph (ITU) at tsbfgdlt@itu.int.

Technical Report FG DLT D1.3

Distributed ledger technology standardization landscape

Summary

This technical report is a deliverable of the ITU-T Focus Group on Application of Distributed Ledger Technology (FG DLT).

It describes the standardization landscape for distributed ledger technology (DLT), as of July 2019.

Keywords

DLT; distributed ledger technology; ledger; blockchain; standardization; standards; specifications

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CONTENTS

Page

Technical Report FG DLT D1.3

Distributed ledger technology standardization landscape

1 Scope

This document describes the standardization landscape for distributed ledger technology (DLT), as of July 2019.

2 Abbreviations and acronyms

This document uses the following abbreviations:

API	Application Programming Interface
BIA COI	Blockchain for Industrial Applications Community of Interest
BiTA	Blockchain in Transport Alliance
DFC	Digital Fiat Currency
DFS	Digital Financial Services
DLT	Distributed Ledger Technology
DPM	Data Processing and Management
EIP	Ethereum Improvement Proposal
ERC	Ethereum Request for Comment
ETSI	European Telecommunications Standards Institute
FG	Focus Group
IEEE	Institute of Electrical and Electronic Engineers
ISG	Industry Specification Group
ISO	International Organization for Standardization
ITU-T	International Telecommunication Union - Telecommunication Standardization Sector
NFV	Network function virtualization
NGN	Next-generation network
NIST	National Institute on Science and Technology
PDL	Permissioned distributed ledger
Q	Question
SDGs	Sustainable Development Goals
SDN	Software-defined networking
SG	Study Group
UNECE	United Nations Economic Commission for Europe
UN/CEFACT	United Nations Centre for Trade Facilitation and Electronic Business
W3C	World Wide Web Consortium

3 Standardization landscape

3.1 ITU-T

3.1.1 ITU-T Study Group 17: Security

SG17 established a new Question, Q14/17, security aspects of distributed ledger technologies, at its September 2017 meeting.

The Q14/17 terms of reference are available at https://itu.int/en/ITU-T/studygroups/2017-2020/17/Pages/q14.aspx.

Table 1 lists all DLT-related work items under development in SG17.

Table 1: DLT-related work items under development in Q14/17 and Q11/17

Recommendation	Title	Status
X.das-mgt	Security framework for data access and sharing management system based on distributed ledger technology	Under development
X.dlt-sec	Security considerations for using distributed ledger technology data in identity management	Under development
X.sa-dlt	Security assurance for distributed ledger technology	Under development
X.sct-dlt	Security threats of distributed ledger technology	Under development
X.sra-dlt	Security framework for distributed ledger technology	Under development
X.srip-dlt	Security requirements for intellectual property management based on distributed ledger technology	Under development
X.ss-dlt	Security services based on distributed ledger technology	Under development
X.stov	Security threats to online voting using distributed ledger technology	Under development
X.str-dlt	Security threats and requirements for digital payment services based on distributed ledger technology	Under development
X.tf-spd-dlt	Technical framework for secure software programme distribution mechanism based on distributed ledger technology	Under development
X.509 Amd.1	Proposed draft 1st amendment to Rec. ITU-T X.509 (2019) | ISO/IEC 9594-8:2017 Information technology - Open Systems Interconnection - The Directory: Public-key and attribute certificate frameworks Amd.1 Note – to address distributed PKI (blockchain based PKI).	Under development

The work items can be classified into three categories: (1) work for security for DLT, (2) work for security by DLT, and (3) security management, as shown in Figure 1.

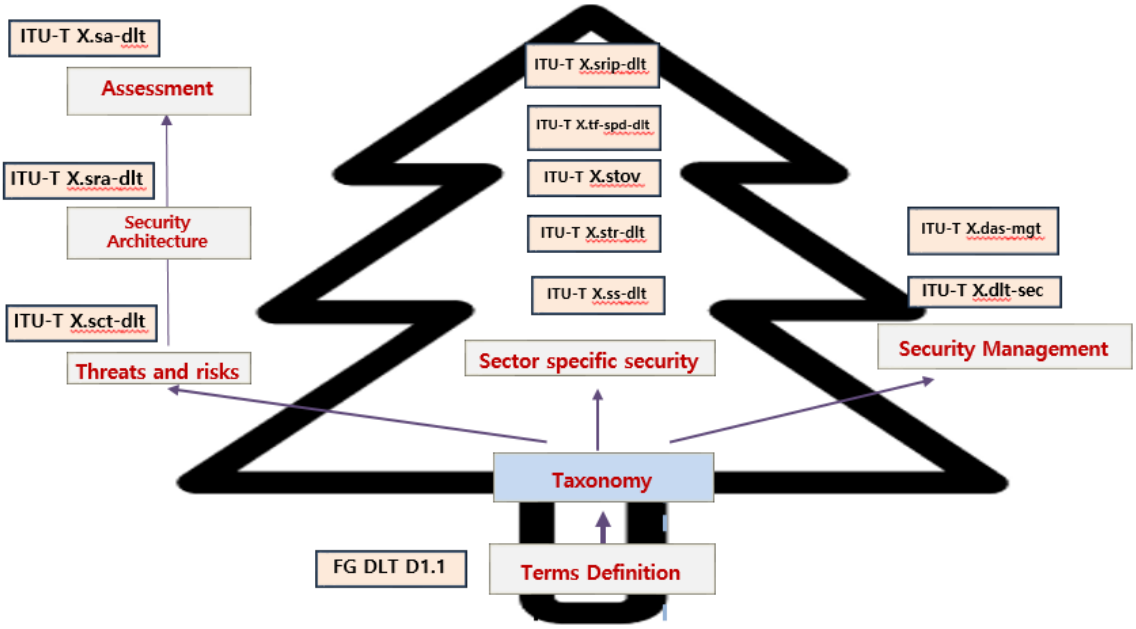

Figure 1: Categorization of work items in SG17

3.1.2 ITU-T Study Group 16: Multimedia coding, systems and applications

SG16 has established a new Question, Q22/16, Distributed ledger technologies and e-services.

The Q22/16 terms of reference are available at https://itu.int/en/ITU-T/studygroups/2017-2020/16/Pages/q22.aspx.

Table 2 lists all DLT-related work items under development in SG16 (this also includes work items in Q24/16).

Table 2: DLT-related work items under development in SG16

Question	Recommendation	Title	Status
Q22/16	F.DLS	Requirements for distributed ledger systems	Under development
Q22/16	F.DLT-AC	Assessment criteria for distributed ledger technologies	Under development
Q22/16	H.DLT	Reference framework for distributed ledger technology	Under development
Q22/16	H.DLT-DE	Digital evidence services based on distributed ledger technology	Under development
Q24/16	F.DLT.HC.req	Requirements of distributed ledger technologies (DLT) for human-care services	Under development
Q24/16	F.DLT.SM.PHR	Service models of distributed ledger technologies (DLT) for personal health records (PHRs)	Under development
Q24/16	F.HFS-BC	Requirements and framework for blockchain-based human factor service models	Under development

3.1.3 ITU-T Study Group 13: Future networks, with focus on IMT-2020, cloud computing and trusted network infrastructures

SG13 has DLT-related work items in Q2/13, Next-generation network (NGN) evolution with innovative technologies including software-defined networking (SDN) and network function virtualization (NFV), and in Q17/13, Requirements, ecosystem, and general capabilities for cloud computing and big data.

Table 3 lists all DLT-related work items under development in SG13.

Table 3: DLT-related work items under development in SG13

Question	Recommendation	Title	Status
Q2/13	Y.NGNe-BC-reqts	Scenarios and Capability Requirements of Blockchain in Next Generation Network Evolution	Under development
Q17/13	Y.BaaS-reqts	Cloud computing - functional requirements for blockchain as a service	Under development

3.1.4 ITU-T Study Group 20: Internet of things (IoT) and smart cities and communities (SC&C)

SG20 has DLT-related work items in Q3/17 (Architectures, management, protocols and Quality of Service), Q4/17 (e/Smart services, applications and supporting platforms), and Q7/20 (Evaluation and assessment of Smart Sustainable Cities and Communities).

Table 4 lists all DLT-related work items under development in SG20.

Table 4: DLT-related work items under development in SG20

Question	Recommendation	Title	Status
Q3/20	Y.dec-IoT-arch	Decentralized IoT communication architecture based on information centric networking and blockchain	Under development
Q3/20	Y.IoT-rf-dlt	OID-based Resolution framework for transaction of distributed ledger assigned to IoT resources	Under development
Q4/20	Y.BC-SON	Framework of blockchain-based self-organization networking in IoT based environments	Under development
Q4/20	Y.IoT-BoT-fw	Framework of blockchain of things as decentralized service platform	Under development
Q7/20	Y.SSC-BKDMS-arc	Reference architecture of blockchain-based unified KPI data management for smart sustainable cities	Under development

3.1.5 ITU-T Focus Group on Application of Distributed Ledger Technology (FG DLT)

The Focus Group on Application of Distributed Ledger Technology (FG DLT) was set up in May 2017 to identify and analyze DLT-based applications and services, draw up best practices and guidance for their implementation and propose a way forward for DLT-related standardization work in ITU-T Study Groups.

The terms of references are available at https://itu.int/en/ITU-T/focusgroups/dlt/.

FG DLT concluded and adopted its Deliverables on 1 August 2019 (see Table 5).

Table 5: Deliverables under FG DLT

Title	Status
Distributed ledger technology terms and definitions	Completed
Distributed ledger technology overview, concepts, ecosystem	Completed
Distributed ledger technology standardization landscape	Completed
Distributed ledger technology use cases	Completed
Distributed ledger technology reference architecture	Completed
Assessment criteria for distributed ledger technology platforms	Completed
Distributed ledger technology regulatory framework	Completed
Outlook on distributed ledger technologies	Completed

3.1.6 ITU-T Focus Group on Digital Currency including Digital Fiat Currency (FG DFC)

The Focus Group on Digital Currency including Digital Fiat Currency (FG DFC) was set up in May 2017 to analyze the impact of the introduction of DFC over mobile money and outline potential use cases and areas of standardization for DFC. The group held its final meeting in June 2019 and submitted its deliverables to TSAG for further consideration (see Table 6).

Table 6: DLT-related work items under FG DFC

Title	Status
Digital currency implementation checklist for central banks report	Completed
Regulatory challenges and risks for central bank digital currency	Completed
Reference documentation: Governance aspects of digital fiat currency	Completed
Taxonomy and definition of terms for digital fiat currency	Completed
Reference architecture and use cases	Completed
Protection assurance for digital currencies	Completed
Protection assurance use case for a payment transaction	Completed

3.1.7 ITU-T Focus Group on Data Processing and Management to support IoT and Smart Cities & Communities (FG-DPM)

SG20 established a Focus Group on Data Processing and Management in March 2017 to develop a standardization roadmap for data management.

Table 7 gives an overview of DLT-related work items that have been developed by the focus group.

Table 7: DLT-related work items under FG-DPM

Title	Status
Technical Report D3.5: Overview of blockchain for supporting IoT and SC&C in DPM aspects	Completed
Technical Specification D3.6: Blockchain-based data exchange and sharing technology	Completed
Technical Specification D3.7: Blockchain-based data management for supporting IoT and SC&C	Completed

3.1.8 ITU-T Focus Group on Environmental Efficiency for Artificial Intelligence and other Emerging Technologies (FG-AI4EE)

A new Focus Group on Environmental Efficiency for Artificial Intelligence and other Emerging Technologies was established by ITU-T Study Group 5 (Environment, climate change and circular economy) in May 2019. The goal of this Focus Group is to identify the standardization needs to develop a sustainable approach to AI and other emerging technologies, including DLT. The work of this group will address the environmental efficiency, as well as water and energy consumption of emerging technologies, and provide guidance to stakeholders on how to operate these technologies in a more environmentally efficient manner.

3.1.9 ITU-T Focus Group on Digital Financial Services (FG DFS)

The Focus Group on Digital Financial Services (DFS) operated between June 2014 and 2016 to analyze projects that support financial inclusion and develop a strategy for standardization of DFS. Table 8 gives an overview of DLT-related work items that have been developed by the focus group.

Table 8: DLT-related work items under FG-DFS

Title	Status
Distributed ledger technologies and financial inclusion	Completed
Competition aspects of digital financial services	Completed

3.2 ISO

3.2.1 ISO Technical Committee 307: Blockchain and distributed ledger technologies

ISO/TC 307, Blockchain and distributed ledger technologies, was established in September 2016.

As of July 2019, TC 307 is comprised of six working groups and one study group as shown in Table 9.

Table 9: ISO/TC 307 structure

Group	Title
WG1	Foundations
WG2	Security, privacy and identity
WG3	Smart contracts and their applications
JWG4	Joint ISO/TC 307 - ISO/IEC JTC 1/SC 27 WG: Blockchain and distributed ledger technologies and IT Security techniques
WG5	Governance
WG6	Use cases
SG7	Interoperability of blockchain and distributed ledger technology systems

The work items under development in each Working Group of TC 307 are listed in Table 10.

Table 10: Projects under development in ISO/TC 307 (as of June 29, 2019)

Group	Projects	Status
WG1	ISO 22739 Blockchain and distributed ledger technologies -- Terminology	DIS ballot before November 2019
	ISO 23257 Blockchain and distributed ledger technologies -- Reference architecture	2nd CD ballot before November 2019

Group	Projects	Status
	ISO TS 23258 Blockchain and distributed ledger technologies -- Taxonomy and Ontology	WD
	Study on “Data flow and data taxonomy for blockchain and distributed ledger technologies	Under study
WG2	ISO TR 23567 Sec management of digital asset custodians	DTR ballot
	Study on “Security evaluation of consensus models“	Under study
WG2 & WG3	Study on “Security issues of Smart Contracts”	Under study
WG3	ISO TS 23259 Blockchain and distributed ledger technologies -- Legally binding smart contracts	WD
	ISO TR 23455 Blockchain and distributed ledger technologies -- Overview of and interactions between smart contracts in blockchain and distributed ledger technology systems	Publication
	Study report on Supply chains and Trade facilitation	Under study
JWG 4 Joint WG with ISO/IEC JTC1 SC27	ISO TR 23244 Blockchain and distributed ledger technologies -- Privacy and personally identifiable information protection considerations	WD
	ISO TR 23245 Blockchain and distributed ledger technologies -- Security risks, threats and vulnerabilities	CD
	ISO TR 23246 Blockchain and distributed ledger technologies -- Overview of identity management using blockchain and distributed ledger technologies	WD
JWG	ISO TR 24332 Information and documentation – Application of blockchain technology to records management – Issues and considerations	PWI
WG5	ISO TS 23635 Blockchain and distributed ledger technologies -- Guidelines for governance	WD
WG6	ISO TR Blockchain and Distributed Ledger Technologies - Use cases	New TR
	Study on Non-Functional Requirements	Study period
SG7	ISO/NP TR 23578 Blockchain and distributed ledger technologies -- Discovery issues related to interoperability	
	ISO NP TS Interoperability Framework	For NWIP ballot

3.3 IEEE Standards Association

Table 11 gives an overview of DLT-related work items under development in various IEEE working groups.

Table 11: DLT-related work items under development in IEEE

WG	Work item	Title	Status
CEWG - Cryptocurrency Exchange Working Group	P2140.1	Standard for General Requirements for Cryptocurrency Exchanges	Under development
	P2140.2	Standard for Security Management for Customer Cryptographic Assets on Cryptocurrency Exchanges	Under development

WG	Work item	Title	Status
	P2140.3	Standard for User Identification and Anti-Money Laundering on Cryptocurrency Exchanges	Under development
	P2140.4	Standard for Distributed/Decentralized Exchange Framework using DLT (Distributed Ledger Technology)	Under development
	P2140.5	Standard for Custodian Framework of Cryptocurrency	Under development
BACWG - Blockchain Against Corruption Working Group	P2141.1	Standard for the Use of Blockchain in Anti-Corruption Applications for Centralized Organizations	Under development
EIBCTWG - E-Invoice Business Using Blockchain Technology Working Group	P2142.1	Recommended Practice for E-Invoice Business Using Blockchain Technology	Under development
CPWG - Cryptocurrency Payment Working Group	P2143.1	Standard for General Process of Cryptocurrency Payment	Under development
	P2143.2	Standard for Cryptocurrency Payment Performance Metrics	Under development
	P2143.3	Standard for Risk Control Requirements for Cryptocurrency Payment	Under development
TIDMWG - Trusted IoT Data Management Working Group	P2144.1	Standard for Framework of Blockchain-based Internet of Things (IoT) Data Management	Under development
	P2144.2	Standard for Functional Requirements in Blockchain-based Internet of Things (IoT) Data Management	Under development
	P2144.3	Standard for Assessment of Blockchain-based Internet of Things (IoT) Data Management	Under development
Blockchain working group (BOG/CAG/blockchain_wg)	P2418.1	Framework of Blockchain Use in Internet of Things	Under development
Data Format for Blockchain Systems (C/SAB/DBC)	P2418.2	Standard Data Format for Blockchain Systems	Under development
Distributed Ledger Technology in Agriculture (C/SAB/DTLA)	P2418.3	Standard for the Framework of Distributed Ledger Technology (DLT) Use in Agriculture	Under development
DLT in Connected and Autonomous Vehicles (VT/ITS/DLTCAV)	P2418.4	Standard for the Framework of Distributed Ledger Technology (DLT) Use in Connected and Autonomous Vehicles (CAVs)	Under development
Blockchain working group (BOG/CAG/blockchain_wg)	P2418.5	Standard for Blockchain in Energy	Under development
BDLTH WG - Blockchain and Distributed Ledger Technology(DLT) in Health	P2418.6	Standard for the Framework of Distributed Ledger Technology (DLT) Use in Healthcare and the Life and Social Sciences	Under development

WG	Work item	Title	Status
BSCF_WG - Blockchain in Supply Chain Finance_Working Group	P2418.7	Standard for the Use of Blockchain in Supply Chain Finance	Under development
BGAWG - Blockchain for Government Affairs Working Group	P2418.8	Standard for Blockchain Applications in Governments	Under development
CBSTWG - Cryptocurrency Based Security Tokens Working Group	P2418.9	Standard for Cryptocurrency Based Security Tokens	Under development
DAWG - Digital Asset Working Group	P2418.10	Standard for Blockchain-based Digital Asset Management	Under development

3.4 W3C

W3C working groups and community groups have published three draft documents as in Table 12.

Table 12: DLT-related drafts published by W3C

Group	Title	Status
Verifiable Claims Working Group	Verifiable Credentials Data Model 1.0: Expressing verifiable information on the Web	Candidate Recommendation
Blockchain Community Group	The Web Ledger Protocol 1.0: A format and protocol for decentralized ledgers on the Web	Draft Specification
Credentials Community Group	Decentralized Identifiers (DIDs) v0.13: Data Model and Syntaxes	Draft Specification

3.5 UN/CEFACT

The United Nations Centre for Trade Facilitation and Electronic Business (UN/CEFACT) under the UN Economic Commission for Europe (UNECE) has embarked on the development of regulatory/policy frameworks and international standards of emerging technologies including blockchain technology.

Their work has involved the exploration of relevant use cases of blockchain towards the attainment of the SDGs. UN/CEFACT has published two white papers on blockchain technology, with one focusing on an introduction to blockchain technology for trade policy makers, and the other focusing on a gap analysis of technical aspects of blockchain and its relation to UN/CEFACT deliverables.

A separate information paper on how blockchain technology can be used to facilitate trade-related business processes was published in its initial version. The final three sections covering use cases and challenges specific to finance, healthcare and government services require additional external input; the entire document will be re-edited and re-published – planned for the end of 2019.

3.6 ETSI

ETSI established an Industry Specification Group (ISG) on Permissioned Distributed Ledger (PDL) in 2018. The ISG PDL work items are listed in Table 13.

Table 13: Work items under development in ETSI ISG PDL

Work Item	Title	Status
DGR/PDL-001_Landscape	PDL Landscape of Standards and Technologies	Under development - Technical Body Approval
DGR/PDL-002_CDPR	PDL Applicability and compliance to data processing requirements for connected machines	Under development - Early Draft
DGR/PDL-003_App_scenarios	PDL Application Scenarios	Under development - Early Draft

3.7 CEN/CENELEC

In 2017, CEN and CENELEC established a joint Focus Group on Blockchain and Distributed Ledger Technologies, FG-BDLT, to identify gaps in blockchain and DLT standardization for Europe and map them to ISO/TC 307's ongoing work items.

FG-BDLT published a white paper in 2018 with recommendations for blockchain and DLT standardization in Europe. The group is expected to release a newer version of the white paper in 2019, to reflect emerging issues within Europe concerning Blockchain and DLT standardization.

3.8 NIST

The National Institute on Science and Technology (NIST) under the US Department of Commerce set up the Blockchain for Industrial Applications Community of Interest (BIA COI) in 2017.

The goal of this group is to provide guidelines that will improve the synergy between all the stakeholders in the blockchain ecosystem and reduce the complexity, cost, and delay of adoption of blockchain technologies.

BIA COI published NIST.IR.8202 in October, 2018 to provide a high-level technical overview of blockchain technology and to discuss its application to cryptocurrency in depth.

3.9 DIN

The German Institute for Standardization, DIN, is currently contributing to DLT-related standardization as a participating member of ISO/TC 307.

They are, however, engaged in their own DLT-related standardization work, separate from ISO, as listed in Table 14.

Table 14: DLT-related work items under DIN

Work Item	Title	Status
DIN SPEC 4997	Privacy by Blockchain Design: A standardised model for processing personal data using blockchain technology	Under Review
DIN SPEC 3103	Blockchain and distributed ledger technologies in application scenarios for Industrie 4.0	Completed

3.10 UNE

The Spanish Association for Standardization, UNE, within their CTN71/SC307/GT1 committee, established a work item titled "Modelo Descentralizado de Identidad", a DLT-based model for decentralized identities (DIDs) used by a variety of pilots within the European Self Sovereign Identity Framework (ESSIF). This "de-facto" standard is also implemented on Alastria.

Table 15: DLT-related work items under UNE

Work Item	Title	Status
CTN 71/SC 307/GT1	Decentralized Model of Identity	Under Review

3.11 Community standards

DLT standards development has been most actively done by industry and community organizations. Their work is different from that of formal standards developing organizations as the specifications developed are usually published with an accompanying repository of open-source implementation code.

The Linux Foundation is an example of a community-driven organization that provides support for a range of cross-industry blockchain applications. Hyperledger, hosted by the Linux Foundation, presently has a community of over 200 companies that are focused on the development and implementation of enterprise blockchain. Notably, their work has led one of their frameworks, Hyperledger Fabric, to be considered a de facto standard for enterprise blockchain platforms.

The Ethereum platform is also governed by a series of standards that have been developed and are continually maintained by the Ethereum community through a process known as the Ethereum Improvement Proposals (EIPs). They define standards for the Ethereum platform, which include core protocol specifications, interface/client APIs specifications and application-level standards, typically known as the Ethereum Request for Comment (ERC) standards.

Perhaps the most known standard in use is ERC-20, which is used for smart contracts on the Ethereum blockchain for implementing fungible tokens.

The cross-industry applicability of DLT has also created a need for industry-specific standards development. Organizations such as the Blockchain in Transport Alliance (BiTA), which was established in August, 2017, are working towards serving this need. BiTA have focused their standardization efforts on the transportation industry and have published two standards as listed in Table 16.

Table 16: DLT-related standards published by BiTA

Title	Status
BiTAS Std 120-2019: Location Component Specification	Completed
BiTAS Tracking Data Framework Profile	Completed

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