D5.2.2: Standardisation report

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Abstract:

This is the second year report of the standardisation task of the GreenICN project covering IETF/IRTF, ITU-T and MPEG.

In the IETF/IRTF, GreenICN progressed its work in the CDNI WG and ICNRG. In the ICNRG, two new contributions were made, and one existing contribution co-authored by GreenICN got accepted as Research Group Item. Presentations on the GreenICN contributions were made at all the 3 IETF meetings in the Year-2 timeframe.

In ITU-T the following results were achieved:

1. Focus Group on Disaster Relief Systems, Network Resilience and Recovery (FG-DR&NRR) finalized their deliverables in May 2014. GreenICN succeeded to include in the final document "Promising technologies and use cases – Part IV and V" that at a disaster, ICN works as a secure connecting engine among the fragmented physical networks such as mobile network cells, Wi-Fi access points, etc. which lose the links to the wide-area networks.
2. At ITU-T SG13.Q15 Rapporteur Group Meeting held on 2014/11/17-28 at Geneva, we contributed "Proposal of Use Cases for data aware networking" as a supplement to the Draft Recommendation of ITU-T Y.3033 (Y.sup.FNDAN). In the document, three problem space are defined namely 1) Scalable and cost-efficient content distribution; 2) Mobility and 3) Disruption tolerance. Within these three problem spaces we define, analyze and evaluate four different use cases where we exploit the fundamental design architecture of ICN.

In MPEG work has covered

1. Interfaces between a media decoder and a Green Metadata unit (International Standard)
2. A new edition of MPEG-M Extensible Middleware API for which it provides one of the editors (Committee Draft)
3. Publish/Subscribe Application Format (Committee Draft) for which it provides the editor
4. New edition of MPEG-M Architecture including High Level and Low Level API for which it provides the editor (Working Draft)
5. New edition of MPEG-M Conformance and Reference Software for which it provides one of the editors (Committee Draft).

Executive Summary

This is the second year report of the standardisation task of the GreenICN project covering IETF/IRTF, ITU-T and MPEG activities for the 2nd year.

In the IETF, GreenICN contributed with three documents in the CDNI WG. One of these is a working group document, and all these contributions have been well received by the CDNI WG and chairs, and are making good progress.

In the IRTF, GreenICN made several new contributions (regarding Publish/Subscribe in ICN and on decentralized authentication), and progressed an existing contribution (regarding Video Delivery in ICN) towards accepted Research Group Item.

In ITU-T the following results were achieved:

1. Focus Group on Disaster Relief Systems, Network Resilience and Recovery (FG-DR&NRR) finalized their deliverables in May 2014. GreenICN succeeded to include in the final document "Promising technologies and use cases – Part IV and V" that at a disaster, ICN works as a secure connecting engine among the fragmented physical networks such as mobile network cells, Wi-Fi access points, etc. which lose the links to the wide-area networks.
2. At ITU-T SG13.Q15 Rapporteur Group Meeting held on 2014/11/17-28 at Geneva, we contributed "Proposal of Use Cases for data aware networking" as a supplement to the Draft Recommendation of ITU-T Y.3033 (Y.sup.FNDAN). In the document, three problem space are defined namely 1) Scalable and cost-efficient content distribution; 2) Mobility and 3) Disruption tolerance. Within these three problem spaces we define, analyze and evaluate four different use cases where we exploit the fundamental design architecture of ICN.

In MPEG work has covered the following main standardisation activities

1. The Green Metadata standard (ISO/IEC 23001-11) provides a standard way that enables a video encoder to signal how the bitstream can be decoded with lower energy consumption, although at the cost of some loss in video quality and a a video decoder to signal to the encoder to send bitstream that would consumer less energy. GreenICN has contributed Green Metadata API which were included in ISO/IEC 23001-11 and has proposed the 3rd edition of ISO/IEC 23006-2 MPEG Extensible Middleware (MXM) API for which it provides the editor (the standard is currently at Committee Draft level,)
2. The Publish/Subscribe Application Format (PSAF) standard (ISO/IEC 21000-16), a format that can conveys semantically rich data to enable an effective use of PubSub in multimedia applications. GreenICN has contributed the main components of the standard for which it provides the editor (the standard is currently at Committee Draft level)
3. Standardisation of High Level API and Low Level API in part 1 of the Multimedia Service Platform Technologies (MPEG-M) standard (ISO/IEC 23006-1). GreenICN has submitted a proposal GreenICN based on the work done in project (currently at the level of Working Draft).

New edition of Conformance and Reference Software of MPEG-M. GreenICN has submitted a bug report based on the work done in Task 4.1. The report has been incorporated in the 3rd edition of the standard (currently at Committee Draft level).

Contents

Glossary

This glossary only includes terms that are used in this deliverable.

Table 1 – Terms and definitions

Term	Acron.	Definition
Application	App	Special purpose software that executes its functions using the GreenICN High Level API
Application Programming Interface	API	A software interface specifying how a program interacts with other programs
Computing Platform		The component of an End System that executes software and provides such functionalities as security and network access
Digital Item	DI	A basic unit of transaction in MPEG 21 framework
Dynamic Adaptive Streaming over HTTP	DASH	(ISO/IEC 23008) is a suite of standards that enable delivery of media content from HTTP servers to HTTP clients and caching of content by HTTP caches
End System		Device connected to the GreenICN network enabling humans to access GreenICN resources
Engine		An organised set of technologies communicating with other Engines and Applications via API
Event Report	ER	Message sent by a Peer in response to an Event Report Request when the conditions specified by an ERR are met
Event Report Request	ERR	Data requesting information about which events to report, what information is to be reported and to whom
GreenICN		An Information Centric Network
High Level API	HL-API	Programming interfaces that offer application developers easy access to Peer and GreenICN Network functionalities
International standard	IS	A standard produced by the International Organisation for Standardisation and/or the International Electrotechnical Commission
International Standardisation Organisation	ISO	An international standards organisation organised in Technical Committees the most important of which is the Joint ISO/IEC Technical Committee on Information Technology (JTC 1)
Internet Engineering Task	IETF	A standards organisation that develops standards for the

Force		internet
Internet Research Task Force	IRTF	A standards organisation that promotes research of importance to the evolution of the Internet by creating focused working groups
IRTF Information-Centric Networking Research Group	ICNRG	IRTF working group focused in ICN research issues
Media Presentation Description	MPD	A bounded or unbounded presentation of media content that includes segment identifiers and the context for identified segments
Metadata		Data describing or related to other data that includes information or annotations that allow to organise, navigate, and search media content.
Middleware		A collection of engines that support the execution of Applications via High Level API
Moving Picture Experts Group	MPEG	A working group of ISO/IEC with the mission to develop standards for coded representation of digital audio, video and related data
MPEG extensible middleware	MXM	(ISO/IEC 23006-2) a collection of multimedia functionalities offered by a MPEG standard exposing standard API
Peer		The network node that act as both sender and receiver of communication
Protocol Engine	PE	An Engine that handles a standard protocol for communication between peers
Rights Expression Language	REL	A machine readable language to express licences
Delay-tolerant networking	DTN	Computer network architecture in heterogeneous networks that may lack continuous network connectivity.
Focus Group	FG	An instrument created by ITU-T that augment the Study Group work programme by providing an alternative working environment for the quick development of specifications in their chosen areas.
ITU-T Telecommunication Standardization Advisory Group	ITU-T TSAG	TSAG acts as an advisory body to the study groups, membership and staff of ITU-T, keeping in mind the needs of all members, from developed and developing countries, and from industry and governments
Social Networking Service	SNS	A platform to build social networks among people to share interests, activities, backgrounds or real-life connections.

1 Introduction

GreenICN has placed great emphasis on standardisation. Indeed in the reporting period of 2014/04/01 to 2015/03/31 GreenICN partners have participated in and made several submissions to:

1. IETF and in particular the ICNRG (ICN Research Group) of IRTF
2. ITU-T Focus Group on Disaster Relief Systems, Network Resilience and Recovery
3. ISO/IEC JTC 1/SC 29/WG 11 (MPEG)

Some of the submissions to some of these bodies made have been accepted and a number of them have become the seed for new standard or have been turned into actual standardisation activities.

The following partners have committed resources to Task 5.2 in the form detailed in the following table

Legend: **Att** Attendance at meetings

Con Contributions

Std Ongoing standardisation activities resulting from GreenICN submissions

	IRTF			**ITU-T**			**MPEG**		
Partner name	**Att**	**Con**	**Std**	**Att**	**Con**	**Std**	**Att**	**Con**	**Std**
Universität Göttingen									
NEC Europe Ltd.	X	X	X						
CEDEO							X	X	X
Orange Labs Poland									
University College London									
CNIT									
KDDI R&D Laboratories Inc.									
NEC Corporation									
Panasonic							X	X	X
University of Tokyo				X	X	X			
Waseda University				X	X				
Osaka University									

2 Originally planned activities

To provide a complete picture of GreenICN standardisation activities this chapter provider an overview of original plans laid down in the DoW.

2.1 IETF/IRTF

The originally planned standardization activities in the IETF & IRTF – according to the GreenICN DoW (foreseeable at the time of writing) – were the following:

- "devote significant efforts targeted to the Standardisation community, i.e. IRTF Information-Centric Networking Research Group"
- "coordinate GreenICN participation in IRTF (NEC actively participates in the IRTF ICNRG WG)"
- "Adoption of GreenICN solutions for routing, addressing, naming, congestion control and access control into Working Group documents at the ICNRG WG and, possibly, as standards (RFCs) if the pace of standardization accelerates

2.2 ITU

The original plan for ITU standardization activities were as follows:

- When GreenICN project was launched in mid-2013, ITU had the Focus Group on Disaster Relief Systems, Network Resilience and Recovery (FG-DR&NRR) which had been established in January 2012. Since this focus group is to identify the future issues for ITU's study group (SG) meetings from the disaster point of view, we though this is the best place to input our academic results to their deliverables. They were focusing on the requirements for disaster relief systems.
- We made efforts to let them understand the possibility of ICN in their use cases and include this term in their final deliverables.
- Since FG-DR&NRR was planned to be finalized in 2014, we decided to start our contributions in SG13 since its theme is "Future networks (& cloud)" if we could achieve our goal in FG-DR&NRR from 2014.
- From 2014 to 2015, we planned to publish the results of GreenICN project as the recommendations or contributions inSG13.

2.3 MPEG

From the DoW:

CEDEO will concentrate on extensions to MPEG-M, adaptation of DASH/MMT to GreenICN needs and on Green MPEG technologies

3 Summary of activities in Y1

3.1 IETF/IRTF

In GreenICN Year-1, GreenICN contributed two drafts to the CDNI WG. These contributions concern the "Footprint & Capability Advertisement interface" (CDNI FCI) and were presented at the IETF-89 meeting.

In the IRTF, GreenICN made several contributions to the ICNRG (ICN Research Group). In particular, considerations and concrete use cases for using ICN in disaster scenarios were contributed to the IRTF ICNRG. Additionally, the deployment of a P2P live streaming system over ICN is considered in an Internet Draft named "Adaptive Video Streaming over ICN", contributed to the IRTF ICNRG by GreenICN.

The details on these contributions can be found in GreenICN D5.2.1.

3.2 ITU

In ITU-T a report was made at 5th meeting of FG-DR&NRR in May 2013 on the effects of the 2011 Tohoku earthquake and tsunami where most of the base stations were running without the connections to the core network, many people in offices could not use social networks because of company policy. The conclusion is that to get the most of such remaining network resources and to provide seamless network services, distributed network infrastructure and services/applications should be designed for a future generation network.

3.3 MPEG

This is a summary of activities carried out in GreenICN Y1:

1. Investigations were made on the suitability of a new verb "Match" in ISO/IEC 23000-5 – Rights Expression Language (REL) and several submissions made to MPEG. It has turned out that the REL model where a rights holder (licensor) grants rights to a licensee is too restricted for use in PSAF. ISO/IEC 23000-20 – Contract Expression Language (CEL) is a much more suitable language for PSAF because each of the parties in Publisher-MSP and Subscriber-MSP actually may grant or be granted rights. CEL is now part of the PSAF Committee Draft being balloted.
2. Thanks to the intense work done the Committee Draft of ISO/IEC 23000-16 – Publish/Subscribe Application Format (PSAF) is now being balloted. GreenICN experts are editor of this standard.
3. Edition 3 of ISO/IEC 23006-1 – Architecture has been proposed as a working draft. As planned this includes GreenICN as a practical MPEG-M use case in a new annex.
4. A contribution to Edition 3 of ISO/IEC 23006-2 – MPEG Extensible Middleware (MXM) API has been proposed. This includes API for Green Metadata Engine and has been integrated with other from other experts as a working draft Edition 3 of ISO/IEC 23006-2 – MPEG Extensible Middleware (MXM) API.
5. A contribution to Edition 3 of ISO/IEC 23006-3 – Reference Software and Conformance has been proposed. This includes extensions resulting from GreenICN and other submissions, and bux fixes implemented so far by GreenICN. The contribution has been integrated with other from other experts as a working draft Edition 3 – Reference Software and Conformance.
6. No need has arisen to establish a liaison between DASH activities in MPEG and GreenICN.
7. Work on "Processing and Sharing of Media under User Control" has not made significant progress in MPEG

4 Activities carried out in Y2

4.1 IETF/IRTF

GreenICN continued to contribute to several activities in the IETF and IRTF, namely to the ICNRG research group and the CDNI working group. These contributions are described below.

4.1.1 CDN Interconnection (CDNI) WG

NEE continued to contribute to the CDNI WG in the IETF. In particular, the following contributions were made in GreenICN Year-2:

4.1.1.1 CDNI Request Routing: Footprint and Capabilities Semantics

This document tries to capture the semantics of the 'Footprint and Capabilities Advertisement' part of the CDNI Request Routing interface, i.e. the desired meaning and what 'Footprint and Capabilities Advertisement' is expected to offer within CDNI. The discussion in this document has the goal to facilitate the choosing of one or more suitable protocols for 'Footprint and Capabilities Advertisement' within CDNI Request Routing. This document is a working group item in the IETF CDNI WG. The Year-2 progress is as follows:

- Documents in Year-2
  - draft-ietf-cdni-footprint-capabilities-semantics-03 (July 2014)
  - draft-ietf-cdni-footprint-capabilities-semantics-04 (October 2014)
  - draft-ietf-cdni-footprint-capabilities-semantics-05 (March 2015)
- Presentations in Year-2
  - IETF-90 (July 2014)
  - IETF-91 (November 2014)
  - IETF-92 (March 2015)
- Status and feedback from the WG:
  - This is a working group document in the CDNI WG, i.e. WG has adopted the document with the intention of publishing it as an RFC.
  - The document is quite mature and will hopefully enter the RFC-editor track within GreenICN Year-3.

4.1.1.2 CDNI Footprint and Capabilities Advertisement using ALTO

This document focuses on the CDNI Footprint & Capabilities Advertisement interface (FCI). Specifically, this document specifies a new Application Layer Traffic Optimization (ALTO) service to facilitate Footprint & Capabilities Advertisement in a CDNI context. The Year-2 progress is as follows:

- Documents in Year-2
  - draft-seedorf-cdni-request-routing-alto-07 (June 2014)
  - draft-seedorf-cdni-request-routing-alto-08 (March 2015)
- Presentations in Year-2
  - IETF-90 (July 2014)
  - IETF-91 (November 2014)
  - IETF-92 (March 2015)

- Status and feedback from the WG:
  - The working group has in principle been convinced that an ALTO-based approach is suitable for transport in the FCI interface.
  - The proposed approach and JSON object format is quite mature, and the immediate next step is to get this document adopted in the CDNI WG as working group document.

4.1.1.3 CDNI Footprint & Capabilities Advertisement Interface

This document describes an approach to implementing the CDNI FCI. In particular, it defines a JSON object format that can be transported via an ALTO service as defined in draft-seedorf-cdni-request-routing-alto-07. The Year-2 progress is as follows:

- Documents in Year-2
  - draft-ma-cdni-capabilities-05 (June 2014)
  - draft-ma-cdni-capabilities-06 (June 2014)
  - draft-ma-cdni-capabilities-07 (March 2015)
- Presentations in Year-2
  - These documents have been presented by co-author Kevin Ma (Ericsson) at the IETF-90 meeting and by Jan Seedorf (NEE, GreenICN) at the IETF-91 and IETF-92 meeting.
- Status and feedback from the WG:
  - The working group has in principle been convinced of the proposed JSON object format for the CDNI FCI interface.
  - The proposed JSON object format is quite mature, and the immediate next step is to get this document adopted in the CDNI WG as working group document.

4.1.2 IRTF ICNRG

4.1.2.1 Using ICN in Disaster Scenarios

The GreenICN project continued its contribution on “Using ICN in disaster scenarios” to the ICNRG research group (see Year-1 text for details). The draft was enhanced by the following sections:

- A section on “solution design” was added, outlining the approaches and solutions being investigated by the GreenICN project
- A section on “energy efficiency” was added, outlining the approaches and solutions being investigated by the GreenICN project regarding energy efficient information dissemination in a disaster scenario

Detailed progress is as follows:

- Documents in Year-2
  - draft-seedorf-icn-disaster-02 (June 2014)
  - draft-seedorf-icn-disaster-03 (March 2015)
- Presentations in Year-2
  - IETF-90 (July 2014)
  - IETF-92 (March 2015)
- Status and feedback from the WG:

- The working group is interested in this work and the GreenICN project is receiving very useful input and feedback from the working group. Currently, the document aims at disseminating the GreenICN WP2 results to the ICNRG community, but at a later stage a publication as informational RFC is envisioned.

4.1.2.2 Binding Self-certifying Names to Real-World Identities with a Web-of-Trust

A new contribution was made in the ICNRG on "Binding Self-certifying Names to Real-World Identities with a Web-of-Trust". This document discusses how how a binding of Real-World identities with self-certifying ICN names can be done, taking existing IETF specifications into account. Essentially, this work is a standardization output of the research done on Web-of-Trust based ICN authentication pursued by GreenICN in T2.3 (see D2.3.2 for details). The draft is named "draft-seedorf-icn-wot-selfcertifying-00" and was presented at the IETF-90 meeting (July 2014). Unfortunately, there was now time for feedback or discussion in the session.

4.1.2.3 Enabling Publish/Subscribe in ICN

A new contribution was made in the ICNRG on "Enabling Publish/Subscribe in ICN". The document outlines some research directions for ICN with respect to enhancing the inherently pull-based ICN approaches for achieving efficient pub/sub capability. The draft is named "draft-jiachen-icn-pubsub-00" and was presented at the IETF-90 meeting (July 2014). There was feedback that this is really interesting work and ICNRG should see more of it and look deeper into this issue. Overall, there was quite some feedback from the WG which is very useful for progressing the GreenICN work on pub/sub in ICN. For instance, it was advised to reference existing ICN approaches which implicitly include pub/sub functionality in the document.

4.1.2.4 Adaptive Video Streaming over ICN

This document presents the usage of Information Centric Networks (ICN) for adaptive multimedia streaming and identifies problems which have to be considered for such applications. Several important topics related to video distribution over ICN are presented, covering a range of scenarios: DASH over ICN, which leverages the recent ISO/IEC MPEG Dynamic Adaptive Streaming over HTTP (DASH) standard, layered encoding over ICN, PPSP over ICN and IPTV over ICN. DASH over ICN offers the possibility to transfer data from multiple sources as well as over multiple links in parallel, which is definitely an important feature, e.g., for mobile devices offering multiple network links. In addition to this, the named multimedia content is routed and cached efficiently by the underlying network. PPSP extends the P2P semantics to video streaming in ICNs. The real time constraints of IPTV and video- conferencing need to be addressed in ICN.

GreenICN (partner University of Rome Tor Vergata) contributed to this activity already in Year-1. In Year-2, the feedback of the ICNRG community was considered in order to improve and extend the draft. The following documents were contributed in Year-2 of the GreenICN project:

- draft-irtf-icnrg-videostreaming-01 (July 2014)
- draft-irtf-icnrg-videostreaming-02 (November 2014)

The document is well received by the ICNRG and has been adopted as a Research Group item, which means it is likely to eventually become an official RFC.

4.2 ITU

4.2.1 Focus Group on Disaster Relief Systems, Network Resilience and Recovery (FG-DR&NRR)

FG-DR&NRR concluded their activities in June 2014. Toward this aim, E-meeting was held on 18 April 2014 and Ninth meeting of FG-DR&NRR on Suva, Fiji, 12-15 May 2014. 8 reports were published as in http://www.itu.int/en/ITU-T/focusgroups/drnrr/Pages/default.aspx.

1) Overview of Disaster Relief Systems, Network Resilience and Recovery
2) Promising technologies and use cases – Part I, II and III
3) Promising technologies and use cases – Part IV and V
4) Gap Analysis of Disaster Relief Systems, Network Resilience and Recovery
5) Terms and definitions for disaster relief systems, network resilience and recovery
6) Requirements for Disaster Relief System
7) Requirements for Network Resilience and Recovery
8) Requirements on the improvement of network resilience and recovery with movable and deployable ICT resource units

At E-meeting, we presented GreenICN activities by the contribution "Information-Centric Networking in Disaster Areas" (DR&NRR-I-194) and its 5 requirements based on the analysis of the Great East Japan Earthquake:

- Requirement 1: 20% Reduction of Power Consumption of GreenICN for Normal Days
- Requirement 2: At Least 40% Reduction of Power Consumption of GreenICN (including end-user devices) for Disasters
- Requirement 3: Seamless Services before and after a Disaster
- Requirement 4: Migration Path
- Requirement 5: Scalability and size of the served contents and related names

At Ninth meeting of FG-DR&NRR on Suva, Fiji, the published 8 documents were discussed. We added "Information-Centric Networking" as a component technology of Disaster Relief Systems, Network Resilience and Recovery. It was described in the final document "Promising technologies and use cases – Part IV and V as follows.

> A service of Information Centric Networking (ICN), as well as Data Aware Networking (ITU-T Recommendation Y.3033), can be implemented initially as an overlaying network over the existing networks such as the Internet, wide-area ethernets, device-to-device layer of LTE Direct, etc. The gradual increase of the number of ICN terminals/routers improves the efficiency of content delivery which contents delivery networks (CDNs) currently perform in the normal situation. At a disaster, ICN works as a secure connecting engine among the fragmented physical networks such as mobile network cells, Wi-Fi access points, etc. which lose the links to the wide-area networks. If an SNS is implemented as an ICN application, it runs even at the disaster without any modifications, and can be used for safety confirmation

purposes. ICN also provides secure end-to-end communications which is important at a disaster to prevent possible malicious activities such as sabotages.

It was concluded that the conclusions of FG-DR&NRR should be promoted to be the inputs as the themes of ITU-T SG by members.

4.2.2 ITU-T SG13.Q15

At ITU-T SG13.Q15 Rapporteur Group Meeting held on 2014/11/17-28 at Geneva, we contributed "Proposal of Use Cases for data aware networking" as a supplement to the Draft Recommendation of ITU-T Y.3033 (Y.sup.FNDAN) under the name of the EU-JAPAN initiative by the EC Seventh Frame-work Programme (FP7/2007-2013) Grant Agreement No.608518 (GreenICN) and NICT under Contract No. 167 [[56].

In ITU Recommendation Y.3033, the overview of data aware networking or Information Centric Networking (ICN) and its problem spaces are addressed precisely. In the document, three problem space are defined namely 1) Scalable and cost-efficient content distribution; 2) Mobility and 3) Disruption tolerance. Within these three problem spaces we define, analyze and evaluate four different use cases where we exploit the fundamental design architecture of ICN.

1) For the problem spaces of the Scalable and cost-efficient content distribution and Mobility, we analyse the use case of "Empirical evaluation of the benefits of proactive caching with ICN for video delivery to the passengers (with smart phone or portable device) in a commuter train"[50],[51] . Exploiting the benefits of proactive caching in ICN architecture can enhance the user experience of the mobile users of the passengers of commuter train.

2) In order to address the energy flaw and enhance the energy efficiency of ICN (Information Centric Network) Architecture, we propose a novel Green ICN Architecture with adaptive power consumption ability based on the interest traffic to the server to optimize the working power of Servers/Content Providers [52]. We use different power consumption modes (ex, idle, adaptive etc.) to save the power consumption of server as well as we consider the caching dynamics for the power consumption of cache of the content routers (CR).

3) ICN architecture has the capability to reduce the AMI (Advanced Metering Infrastructure) network bandwidth. For this Content-Centric Networking Approach based Advanced Metering Infrastructure in Smart Grid, we propose a novel approach [53],[54] of applying the ICN on AMI system, which can be called ICN-AMI. This is the first attempt and novel approach to distribute contents or requests based on ICN in AMI system. We provide a simulation-based performance evaluation to evaluate the effectiveness of the proposed ICN-AMI approach in traffic control for developing AMI system in smart grid.

4) As for Proposal for providing disaster information sharing service in ICN, we explain that the ICN based disaster information service is a strong- survivable information sharing service. People could share disaster information via ICN network without connecting with specific server. It could help people publish and retrieve disaster information during disaster. Subject: Proposal for providing disaster information sharing service in ICN.

4.2.3 Software Distribution of Extension of NDN for Identity-Based Aggregate Signatures (IBAS)

In Named Data Networking (NDN), security is imposed on contents instead of end-to-end connections, therefore, every content contains a signature to prove its authenticity and integrity. While this property has many significant advantages, it causes big message overhead in some cases, especially if the content size is small. This overhead further increases if the content is generated by multiple authorities, such as in a moderator-controlled information sharing service, and needs to contain multiple signatures. A typical example is realizing authenticity and integrity over NetNews. The safety confirmation system is such type of application. We propose the use of Identity-Based Aggregate Signatures (IBAS) to decrease this overhead, and provide a proof-of-concept IBAS program module for the existing open source NDN implementation ndn-cxx[55], and compare its performance with existing Public Key Infrastructure RSA signatures. The source code is published through GitHub as https://github.com/byambajav/ndn-ibas.

4.3 MPEG

4.3.1 Planned activities for Y2

1) Study the need for a new REL verb "Match" to support governed distribution of Publications and Subscriptions and, if the study will confirm the current ideas, make a proposal for Amendment 4 to ISO/IEC 23000-5 – Rights Expression Language (REL);
2) Contribute to the development of ISO/IEC 23000-16 – Publish/Subscribe Application Format (PSAF), if the current MPEG exploration will be promoted to formal standardisation project;
3) Propose a new edition of the ISO/IEC 23006-1 – Architecture standard to accommodate GreenICN as a practical MPEG-M use case
4) Contribute to the new edition of the ISO/IEC 23006-2 – MPEG Extensible Middleware (MXM) API standard (already under way for other MXM technologies) to include the following initial list
    a. Publish/Subscribe API
    b. Green Metadata Technology Engine as a new Engine with corresponding API
    c. Generic low level API for security devices such as smart cards
5) Propose a new edition of the ISO/IEC 23006-3 – Reference Software and Conformance to include extensions and bux fixes implemented so far and probably to be fixed in the second year
6) Two-way liaison between MPEG DASH and GreenICN
7) Participation in the exploration activity called "Processing and Sharing of Media under User Control". This activity may provide new hints concerning security and privacy in multimedia communication and may influence the development of PSAF

4.3.2 Introduction to Y2 activities

In this second project year GreenICN has carried out the following specific activities:

1. GreenICN has contributed an architectural diagram that separates a media encoder/decoder from a Green Metadata encoder/decoder in the Green Metadata standard (ISO/IEC 23001-11) that

provides a standard way to enable a video encoder to signal how the bitstream can be decoded with lower energy consumption, although at the cost of some loss in video quality and a a video decoder to signal to the encoder to send bitstream that would consumer less energy.

2. GreenICN has submitted a proposal for specification of High Level API and Low Level API based on the work done in project. The submission is based on work done in and experience gathered from the implementation of GreenICN Peers. The proposal has been accepted as a starting point for an extension of part 1 Architecture of the Multimedia Service Platform Technologies (MPEG-M) standard (ISO/IEC 23006-1). The standard is currently at level Working Draft of MPEG-M Part 1 third edition.
3. GreenICN has proposed the 3rd edition of ISO/IEC 23006-2 MPEG Extensible Middleware (MXM) API for which it provides the editor (the standard is currently at Committee Draft level). This includes Green Metadata API that fit in the MXM Middleware architecture used by GreenICN Peers.
4. GreenICN has contributed bug reports to MPEG-M Part 3 Conformance and Reference Software. The reports are based on the work done in Task 4.1. The contents of the reports have been incorporated, with contributions from other parties in the 3rd edition of the standard (currently at Committee Draft level). GreenICN provides one of the editors of the standard.
5. After a year of work and a long list of submissions GreenICN has succeeded in achieving Committee Draft level for its Publish/Subscribe Application Format (PSAF) standard proposal, which is now ISO/IEC 21000-16. PSAF provides a format that can conveys sematically rich data to enable an effective use of PubSub in multimedia applications. GreenICN provides the editor of PSAF.

4.3.3 Green Metadata

4.3.3.1 Relevance to GreenICN

GreenICN has the specific goal to decrease the level of ICN energy consumption, both at the network and and system level. As video processing is a major contributor to battery depletion, it is important to

1. Be able to use "Green Metadata" embedded in or accompanying a video stream to trigger video decoder processing modes that decode an incoming video stream with reduced energy consumption albeit at the cost of a degree of controlled picture degradation
2. Communicate to an encoder the adoption of encoding modes that can lead to a reduction of energy consumption at the decoder.

These features are particularly important in a disaster scenario.

ISO/IEC 23001-11 – Green Metadata, now an International Standard, standardises a set of metadata carrying information on power consumption of an encoder and a protocol to communicate information on power consumption from a decoder to an encoder.

4.3.3.2 Contributions made by GreenICN

In a series of submissions spanning 4 MPEG meetings (from January 2014 to October 2014), GreenICN has proposed successively refined versions of the reference model of *Figure 1* and successively refined the Application Programming Interface (API).

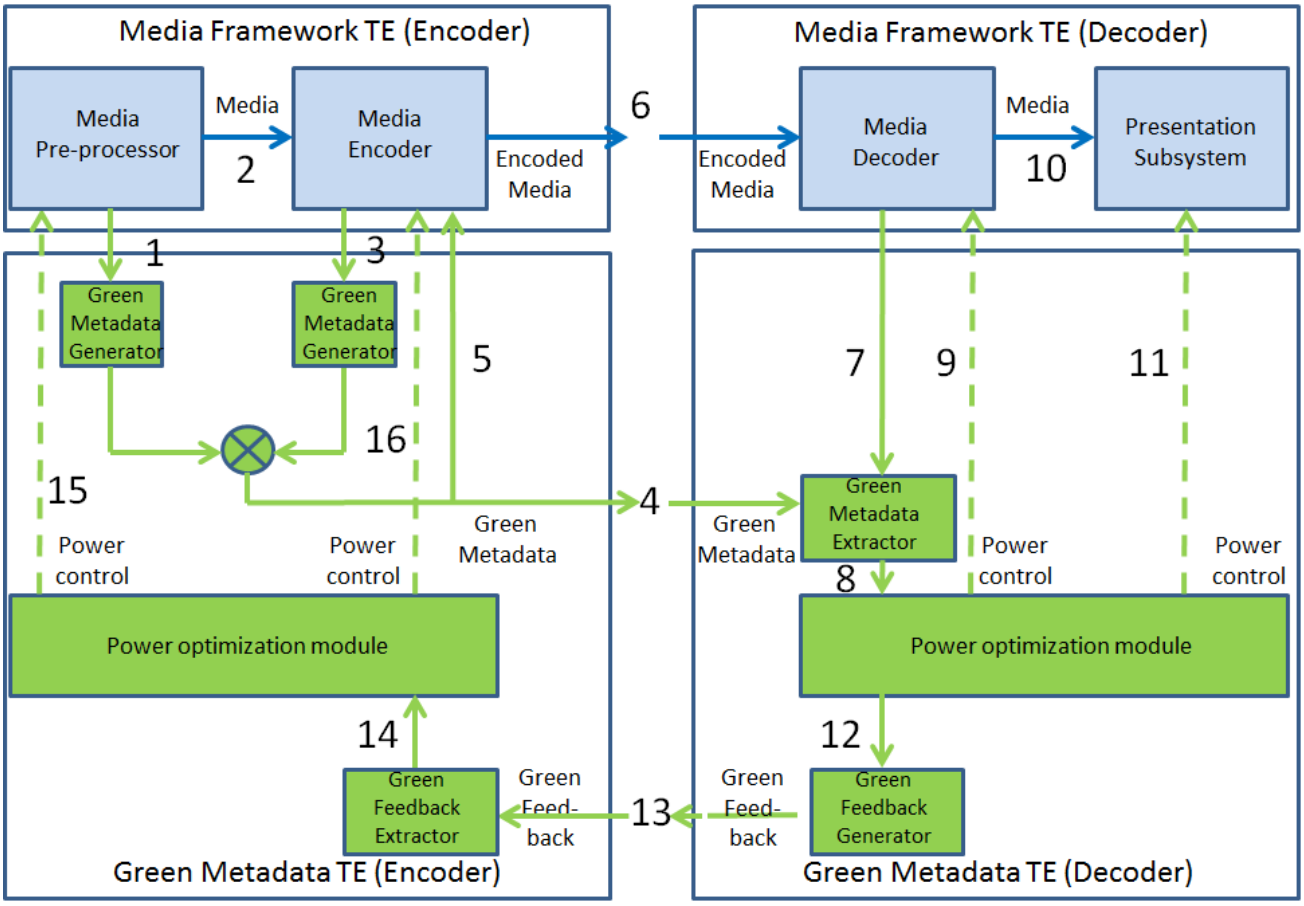

***Figure 1**: Green MPEG Functional Architecture*

The figure identifies the following elements

1. Media Pre-Processor generates metadata from source analysis
2. Media Pre-Processor sends pre-processed media to Media Encoder
3. Media Encoder generates metadata from media compression
4. Green Metadata are generated by combining 1 and 3 and possibly transmitted to Green Metadata Extractor via external channel
5. Green Metadata are fed back to Media Encoder for possible transmission in the compressed media bitstream
6. Compressed media (possibly including Green Metadata) are transmitted to Media Decoder using Supplemental Enhancement Information (SEI) messages (or alternative technologies)

7. Media Decoder sends Green Metadata to Green Metadata Extractor in case they are contained in the compressed media bitstream
8. Extracted Green Metadata (if external channel is active) are passed to receiver Power Optimisation Module
9. Power Optimisation Module sends control information to Media Decoder
10. Media Decoder sends decoded media to Presentation Subsystem
11. Power Optimisation Module sends control information to Presentation Subsystem
12. Power Optimisation Module sends control information to Green Feedback Generator
13. Green Feedback Generator sends Green Feedback information to transmitter
14. Green Feedback Extractor sends extracted Green Feedback to Power Optimisation Module
15. Encoder Power Optimisation Module sends control information to Media Pre-processor to adapt it for reduced power-consumption
16. Encoder Power Optimisation Module sends control information to Media Encoder to adapt it for reduced power-consumption

The Green Metadata standard does not specify APIs (this is done in the MPEG-M part 2 standard under development – see below). Several elements of the GreenICN submissions, in particular the model of *Figure 1*, have been adopted in ISO/IEC 23001-11. Interaction with experts active in the development of this standard coming from major device manufacturers (Samsung, Technicolor etc.) has allowed a refinement of the APIs used in ISO/IEC 23006-2 MPEG Extensible Middleware (MXM).

4.3.4 MPEG-M

4.3.4.1 Relevance to GreenICN

ISO/IEC 23006 – Information Technologies – Multimedia Service Platform Technologies is a suite of standards that provides various technologies that can be used to accelerate design and deployment of multimedia services. It is structured in 5 parts, as follows

Part	Title	Description
1	Architecture	Outlines the architecture that is part of an MPEG-M implementation
2	MPEG Extensible Middleware (MXM) API	Specifies the middleware APIs
3	Conformance and Reference Software	Specifies conformance tests and the software implementation of the standard
4	Elementary Services	Specifies elementary service protocols between MPEG-M applications
5	Service Aggregation	Specifies mechanisms to build aggregated services by combining elementary and other services

Part 2 of MPEG-M (MXM) is particularly important because the MXM middleware is the foundation of the GreenICN end system implementation. Indeed GreenICN is using several engines developed in ISO/IEC 23006 – Information Technologies – Conformance and Reference Software, has made several improvements to them and has developed new engines specific to GreenICN needs.

4.3.4.2 Contributions to MPEG-M Architecture

Figure 2 is the architectural diagram of a GreenICN Peer as developed in D1.2.1/D1.2.2 and implemented in D4.1.1 and D4.1.2. this is actually and extended of the original of MPEG-M architecture.

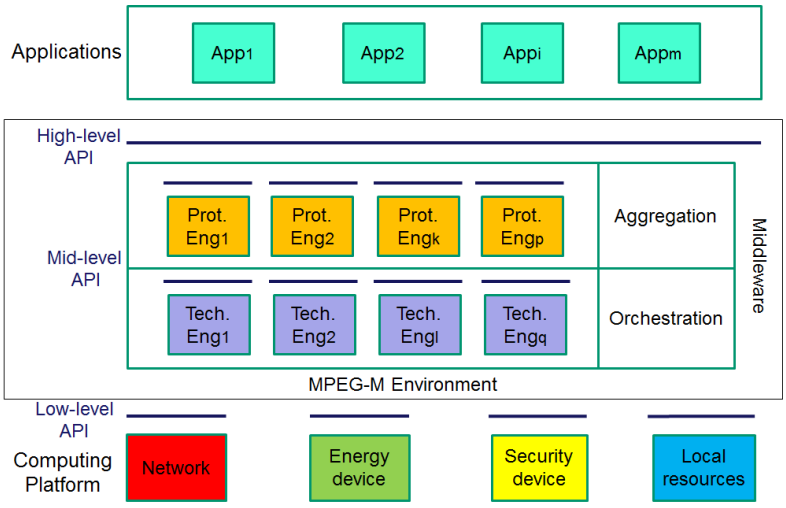

***Figure 2**: The GreenICN Peer Architecture*

1. **Applications** perform their expected actions by accessing the Middleware functionalities via the High-level API.
2. **High-level API** provide high level access to the functionalities of the Middleware.
3. **Middleware** is made up of a number of Engines.
4. **Engines** are of two types:
    a. *Protocol Engines* that implement Elementary Services
    b. *Technology Engines* that implement specific technologies
5. **Middleware API** are the combination of the API of all Engines in the Middleware.
6. **Device** is a combination of hardware and software interfaced to other devices, e.g.
    a. *Local resources* that provide computational resources
    b. *Security device* such as a smart card that perform cryptographic functions
    c. *Network* that provide connectivity with other devices

d. *Energy device* that provides information on battery status

7. *Low Level API* exposed by devices

GreenICN has submitted a proposal for specification of High Level API and Low Level API based on the work done in project. The submission is based on work done in and experience gathered from the implementation of GreenICN Peers. The proposal has been accepted as a starting point for an extension of part 1 Architecture of the Multimedia Service Platform Technologies (MPEG-M) standard (ISO/IEC 23006-1). The standard is currently at level Working Draft of MPEG-M Part 1 third edition.

4.3.4.3 Contributions to MPEG Extensible Middleware (MXM) API

ISO/IEC 23006 – MPEG Extensible Middleware (MXM) API is a collection of a large number of technologies structured in Engines, i.e. combinations of technologies that serve a specific need. Here are some of the technologies more relevant to GreenICN:

1. **Digital Item Declaration** (DID): technology to declare a Digital Item, i.e. a structured digital object with a standard representation, identification and metadata
2. **Digital Item Identification** (DII): technology to use existing identification schemes to identify Digital Items
3. **Rights Expression Language** (REL): a technology to enable machine creation and processing of rights declarations
4. **Contract Expression Language** (CEL): a technology to enable machine creation and processing of contracts between entities
5. **Event Reporting** (ER): a technology to request the provision of and distribute reports whenever a given event occurs
6. **Media Framework** (MF): a collection of technologies to encode, decode and more generally process digital media
7. **Security**: a collection of technologies to encrypt and decrypt data
8. **Orchestration**: a technology to create chains of Engines.

GreenICN has submitted two proposals that include specification of Green Metadata API that fit the MXM Middleware architecture. Other parties have made proposals for API that support Visual Search according to the MPEG Compact Descriptors for Visual Search (CDVA) standard (ISO/IEC 15938-13), and API that support a class of actuators specificed in the Media context and control (MPEG-V) standard (ISO/IEC 23005).

In February 2015 MPEG decided that these proposals had achieved sufficient maturity to be included in the Committee Draft of 3rd edition of ISO/IEC 23006-2 MPEG Extensible Middleware (MXM). GreenICN provides one of the editors.

4.3.4.4 Contributions made to Reference Software and Conformance

Part 3 of MPEG-M Reference Software and Conformance references the MPEG-M software contained in the MPEG Subversion (SVN). This software has been contributed over the years by

many experts and is available with a Berkeley Software Distribution (BSD) licence. This software has been the starting point of the GreenICN Peer implementation.

GreenICN has contributed bug reports to MPEG-M Part 3 Conformance and Reference Software. The reports are based on the work done in Task 4.1. The contents of the reports have been incorporated, with contributions from other parties in the 3rd edition of the standard (currently at Committee Draft level). GreenICN provides one of the editors of the standard.

4.3.5 MPEG-A

4.3.5.1 Relevance to GreenICN

ISO/IEC 23000 – Information Technologies – Multimedia Application Format (MAF) is is a suite of multimedia standards. The main feature is that MAFs use existing or, when necessary, profiled or extended standards, to define new formats without specifying new media technologies.

Existing MAFs, the development of 13 of which have been completed, cover formats for audio players, portable video players, multimedia streaming players, augmented reality players etc. Four more are under development.

One of the MAFs under development is ISO/IEC 23000-16 Publish/Subscribe Application Format (PSAF). PSAF has been proposed by GreenICN because Publish/Subscribe has not found wide adoption in the media distribution world in spite of its adoption in a variety of communication environments.

The main reason is that media content distribution is a rather complex business where a variety of concerns, such as Digital Rights Management, business relationships between publishers and intermediaries, user profile protection etc., dominate the business.

4.3.5.2 Contributions made by GreenICN

In a series of submissions spanning 5 meetings (from January 2014 to February 2015), GreenICN has proposed in succession the notion, the requirements and several solutions for the Publish/Subscribe Application Format.

The submissions have stimulated many discussions among the experts that have considerably improved the proposal. *Figure 3* represents the currently adopted model where actors and data sets are identified

a. PSAF actors
    a. Publisher
    b. Subscriber
    c. Match Service Provider (MSP)
    d. Consumer, not necessarily coincing with Subscriber
b. PSAF data sets
    a. Resource Information
    b. Publication Information

c. Subscription Information

d. Notification Information

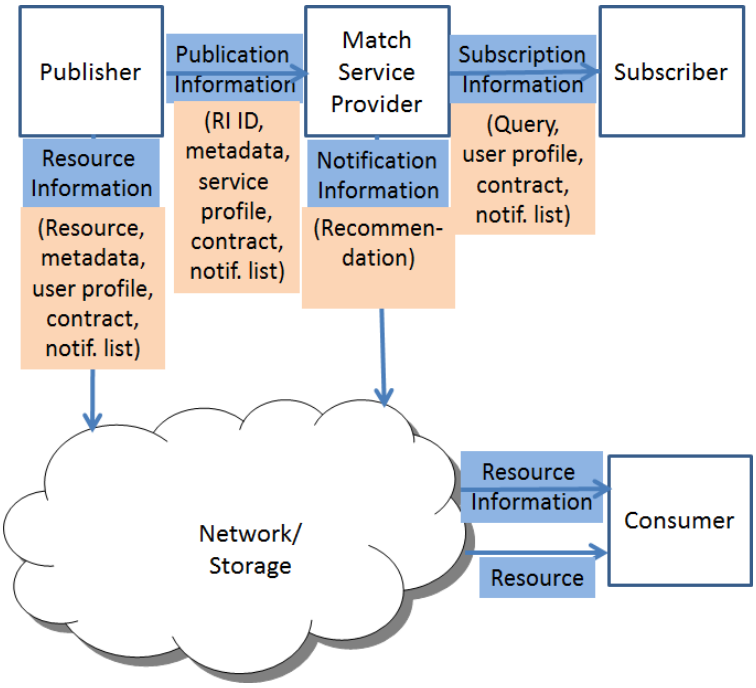

***Figure 3**: Entifies in Publish/Subscribe Application Format*

The data that are carried by the 4 formats

Table 2 – Data formats required by PubSub formedia applications

Data types	Reference standards
Resource Information (RI)	Digital Item Declaration
Resource Locator or Name the RI refers to	
Metadata describing the Resource	MPEG-7
RI creator's ID	
Contract between Publisher and eventual Resource Consumer that includes	Contract Expression Language
• IDs of parties	
• Locator/Name of Resource the contract refers to	
• Rights to use	
• Conditions to use	
Request to notify a list of User IDs that a specific use of a Resource has been made	Eventi Reporting
RI ID	Digital Item Identifier
RI creator's signature	
Publication Information (PI)	Digital Item Declaration
RI ID the PI refers to	
Metadata related to pubblication	
Publisher ID	

Contract between Publisher and Match Service Provider that includes	Contract Expression Language
• Permission to	
▪ Match PI with SIs	
▪ Use Metadata describing Publisher and Context etc.	User Description
• Condition on Subscriber ID	
• Duration of right	
• Match Service ID(s)	
Request to notify/not to notify a list of user IDs of a Match between a Publication and Subscriptions	Eventi Reporting
PI ID	Digital Item Identifier
Publisher's Signature	
Subscription Information (SI)	Digital Item Declaration
Query	
Subscriber ID	
Metadata describing eventual Users of the sought-after Resource and Context of use	User Description
Contract between Subscriber and Match Service Provider that includes	Contract Expression Language
• Permission to	
▪ Match SI with PIs	
▪ Use Query, Metadata describing Subscriber and Context etc.	
• Condition on Publisher ID	
• Duration of right	
• Match Service ID(s)	
Request to notify/not to notify a list of user IDs of a Match between a Subscription and Publications	Eventi Reporting
SI ID	Digital Item Identifier
Subscriber's Signature	
Notification Information (NI)	Event Reporting
RI ID	Digital Item Identifier
Recommendation Description	User Description

The PSAF proposal made by GreenICN and accepted with contributions from others integrates a number of MPEG standards

ISO/IEC 15938 – Multimedia Content Description Interface to let Publishers, Subscribers and Match Service Providers to use standard multimedia descriptions

ISO/IEC 21000-2 – Digital Item Declaration (DID). RI, PI and SI use this standard to convey the necessary information. As DID is a generic standard PSAF has defined a DID profile suitable for PSAF needs.

ISO/IEC 21000-3 – Digital Item Identification. To identify all data uses in PSAF

ISO/IEC 21000-15 – Event Report (ER). Publishers and Subscribers request Match Service Providers to notify a list of users (not necessarily only Publisher and Subscriber) that a PubSub match has been found using ER;

ISO/IEC 21000-20 – Contract Expression Language (CEL). Parties in a PubSub environment (Publisher, Subscriber and Match Service Provider) can enter into a machine processable contract that stipulates permissions and obligations in each publication and subscription;

ISO/IEC 21000-22 – User Description (UD). Recommendation Description (RD) is the format to express recommendations used by a Match Service Provider to notify the list or users defined in ER.

PSAF has reached the Committee Draft level at the February 2015 meeting. GreenICN provides the editor of PSAF.

4.3.6 Other standards

The new action Match PSAF makes wide use of MPEG-21 standards it has been necessary to make extensions to the **Contract Expression Language** standard. In particular

Match	The action of evaluating the relationship between the properties of two (or more) IP-Entities. Depending on the application context, the result is a simple boolean value or more complex structured information (e.g. ranking, confidence, statistical data). The input IP-Entities may play different roles in executing the action, e.g. one may be used as query or sample and another as candidate under matching evaluation.
Process	The action of creating new IP-Entities from two (or more) IP-Entities

An amendment to the Contract Expression Language has been initiated at the February 2015 meeting to incorporate these new definitions of actions.

The **User Description** standard has been designed without considering PSAF. The use made by PSFA has prompted some changes to the User Description working draft. At the same February 2015 meeting User Description, too, has achieved Committee Draft level. In the expected 12 months until both PSAF and UN will reach Final Draft Internationa Standard and the Contract Expression Language amendment will reach Final Draft Amendment level there will be ample opportunity to crosscheck the mutual influences among these standards.

ISO/IEC 23009 – Information Technology – Dynamic Adaptive Streaming over HTTP (DASH) continues to be supported by the GreenICN Peer. Work in this area has been monitored but no specific contributions have been made to this area of standardisation.

5 Planned activities for Y3

5.1 IETF/IRTF

In the IETF and IRTF, GreenICN has the following plans and strategy:

1) Progress the existing working/research group items with the objective of having them potentially finalized as RFC publication within the GreenICN project duration:
    a. draft-ietf-cdni-footprint-capabilities-semantics in CDNI

b. draft-irtf-icnrg-videostreaming in ICNRG

2) Mature the remaining contributions – taking feedback received into account – with the goal of having some of these documents accepted as working/research group item. This depends – on a case by case basis – to large extend on the feedback received and interest shown in the IETF/IRTF community on the individual work items.

5.2 ITU

ITU-T SG13.Q15 approved Recommendation Y.3033 in 2014-01 "Framework of data aware networking for future networks." However currently it just provides the overview of ICN, or "data aware networking" according to ITU-T terminologies, and describes problem spaces that are addressed by data aware networking. This document shows three problem spaces, namely 1) Scalable and cost-efficient content distribution, 2) Mobility and 3) Disruption tolerance. We provided our preliminary works as the supplement to the Draft Recommendation of ITU-T Y.3033 or Y.sup.FNDAN in 2014. The aim of the third year of GreenICN is to input the summary of our three-rear research results into ITU-T recommendations related to data aware networking.

5.3 MPEG

5.3.1 Green Metadata

Direct work on ISO/IEC 23001-11 is completed, but other work is continuing, in particular on

1. ISO/IEC 13818-1 – Generic coding of Moving Pictures and Associated Audio (so called MPEG-2) AMD 4 Carriage of Green Metadata. This concerns the transport of Green Metadata on MPEG-2 Transport Stream, the universally used transport technology for broadcast television
2. ISO/IEC 14496-10 Adavnced Audio Coding (future amendment) Codepoint for SEI message supporting energy-efficient media consumption (Green Metadata). This concerns stream 3 in *Figure 1*.

The two standards address the same problem: conveying Green Metadata to a decoder. The former does this at the system (MPEG-2 Transport Stream) level, while the latter achieves the same goal by embedding Green Metadata in the video stream.

GreenICN experts will monitor this work but do not expect to make major contributions to it.

5.3.2 MPEG-M

We expect that **MPEG-M Part 1 – Architecture** could progress the ISO approval process through the following steps

Month	Year	Status
June	2015	Committee Draft
October	2015	Draft International Standard
June	2016	Final Draft International Standard

GreenICN will continue participating in the development of this standard.

We expect that **MPEG-M Part 2 – MPEG Extensible Middleware (MXM) API** could progress the ISO approval process through the following steps (the February 2015 step has already been achieved).

Month	Year	Status
February	2015	Committee Draft
June	2015	Draft International Standard
February	2016	Final Draft International Standard

GreenICN will continue participating in the development of this standard.

We expect that **MPEG-M Part 3 – Reference Software and Conformance** could progress the ISO approval process through the following steps (the February 2015 step has already been achieved).

Month	Year	Status
February	2015	Committee Draft
June	2015	Draft International Standard
February	2016	Final Draft International Standard

GreenICN will continue participating in the development of this standard.

5.3.3 MPEG-A

We expect that **MPEG-A Part 16 – Publish/Subscribe Application Format** this proposal could progress the ISO approval process through the following steps (the February 2015 step has already been achieved)

Month	Year	Status
February	2015	Committee Draft

June	2015	Draft International Standard
February	2016	Final Draft International Standard

GreenICN will continue participating in the development of this standard.

5.3.4 MPEG-21

We expect that **MPEG-21 Part 20 – Contract Expression Language** could progress the ISO approval process through the following steps (the February 2015 step has already been achieved)

Month	Year	Status
February	2015	Committee Draft
June	2015	Draft International Standard
February	2016	Final Draft International Standard

GreenICN will continue playing a major role in the development of this standard.

We expect that **MPEG-21 Part 22 – User Description** could progress the ISO approval process through the following steps (the February 2015 step has already been achieved)

Month	Year	Status
February	2015	Committee Draft
June	2015	Draft International Standard
February	2016	Final Draft International Standard

GreenICN will continue participating in the development of this standard and assess the impacts on any changes made to the draft during the approval process.

5.3.5 DASH

GreenICN experts will monitor work in this area.

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