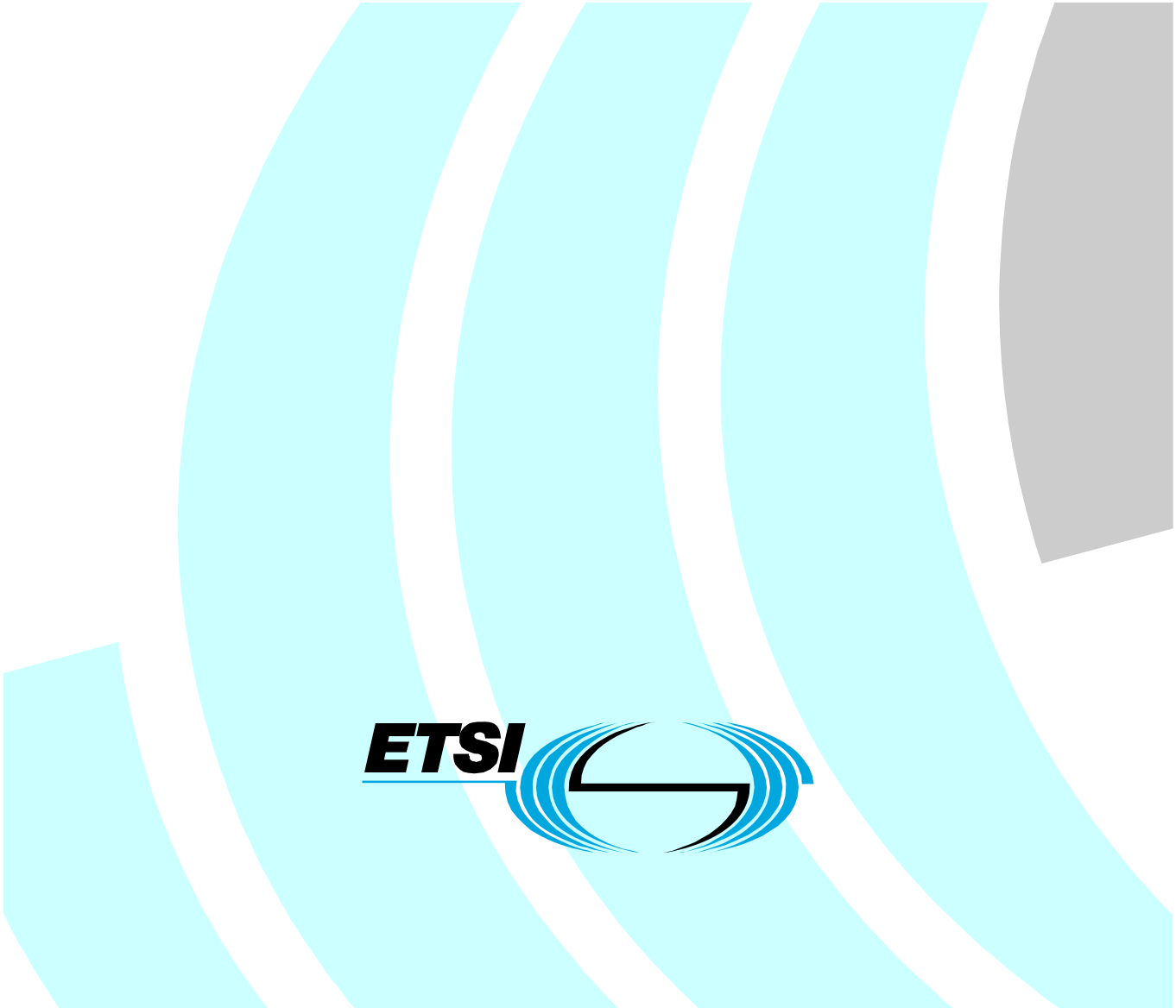
ETSI TR 102 688-2 V1.1.1 (2010-03)

Technical Report

Media Content Distribution (MCD);
MCD framework;
Part 2: Views and needs of content providers



Reference
DTR/MCD-00002

Keywords
audio, broadcast, content, IP,
multimedia, TV, video

ETSI

650 Route des Lucioles
F-06921 Sophia Antipolis Cedex - FRANCE

Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16

Siret N° 348 623 562 00017 - NAF 742 C
Association à but non lucratif enregistrée à la
Sous-Préfecture de Grasse (06) N° 7803/88

Contents

Intellectual Property Rights

IPRs essential or potentially essential to the present document may have been declared to ETSI. The information pertaining to these essential IPRs, if any, is publicly available for **ETSI members and non-members**, and can be found in ETSI SR 000 314: *"Intellectual Property Rights (IPRs); Essential, or potentially Essential, IPRs notified to ETSI in respect of ETSI standards"*, which is available from the ETSI Secretariat. Latest updates are available on the ETSI Web server (http://webapp.etsi.org/IPR/home.asp).

Pursuant to the ETSI IPR Policy, no investigation, including IPR searches, has been carried out by ETSI. No guarantee can be given as to the existence of other IPRs not referenced in ETSI SR 000 314 (or the updates on the ETSI Web server) which are, or may be, or may become, essential to the present document.

Foreword

This Technical Report (TR) has been produced by ETSI Technical Committee Media Content Distribution (MCD).

This is a multi-part deliverable identifiable by the same main number and a common part of the title. This set of partial deliverables (parts and sub-parts handled and published independently but treated in a coordinated form) build a whole deliverable handling the subject identified by the common part of the title.

The common part of the title is ***Media Content Distribution framework***.

Each part and sub-part of the present set of deliverables covers a specific subject specified in the corresponding scope and referred to in the specific part of the title. To each part and sub-part of the whole deliverable a specific number attached to the common main number of the deliverable will also be assigned.

The present document, the only one providing a collection of the concerns and needs expressed by Content Providers, **is part 2** of the multi-part deliverable covering the ***Media Content Distribution framework***, as identified in part 1 of this multi-part deliverable.

For a rational maintenance and easy usage of the complete set of the documents, only part 1 of the set of the documents, will maintain an updated list of the documents in the series, all the other documents should refer to part 1, working therefore as the central point of the series.

Introduction

In the context of MCD work, as explained in part 1 of this multi-part deliverable, the collection of Content Providers views and needs were early identified as a major step to proceed to the necessary analysis in this sector.

Content Providers have clear ideas on the consumers's needs, they understand the environment of MCD and start to take advantage of the different MCD means offered by the convergence of technologies and systems. Their opinion is therefore a central tool for the identification of MCD requirements and the specification of a roadmap for the standardization work to be developed.

In addition commercial solutions developed by different market players do not interoperate across platforms. The crux of the matter is that at one end, content providers face the challenge to provide different content formats to the various distribution pipes, which in turn generates unbearable costs, whilst at the other end, customers' buy-in remains well below expectations.

If some particular standards are centred in the Contents Providers needs and views, reference should be made to them. E.g. some discussions on H4TV, a standard for the authoring and interoperable delivery over broadcast and on line media of interactive services authored in a web technologies-based format, should be included since this standard is very much Content Providers' needs oriented.

Most important requests for MCD platforms and systems, like interoperability, Quality of Service (QoS) and Quality of Experience (QoE), Security and content owner rights, and many others are reflected in the structure of the present document in order to facilitate its usage and to help further discussions for the establishment of MCD requirements and roadmap. The conclusions achieved for each one of the areas of the identified needs may result later in new parts of this multi-part deliverable, where each one of the most relevant subjects will be handled in depth, beneficiating from conclusions obtained in other parts of this multi-part deliverable.

The work TC-MCD is undertaking intends to be based on a 'neutral, objective, independent approach' in order to prevent cooperation difficulties with relevant players and, most of all, to ensure that no biaising effect is introduced in the market own choices. No preference should be demonstrated for any solution or system on the market, but the objective advantages of some systems when satisfying some particular requirements should be noted.

1 Scope

The present document belongs to a set of deliverables proceeding to the widest possible coordinated study on the media content distribution (MCD) matters with the primarily goal of identifying standardization needs not covered or not correctly covered at the present stage of development. This set of documents will cover at least the activities and areas better specified in part 1 of this set of documents.

The present document is part 2 of the set of documents and collects, lists and discusses the Content Providers needs and opinions falling within the wide scope of this set of documents.

2 References

References are either specific (identified by date of publication and/or edition number or version number) or non-specific.

- For a specific reference, subsequent revisions do not apply.
- Non-specific reference may be made only to a complete document or a part thereof and only in the following cases:
  - if it is accepted that it will be possible to use all future changes of the referenced document for the purposes of the referring document;
  - for informative references.

Referenced documents which are not found to be publicly available in the expected location might be found at http://docbox.etsi.org/Reference.

NOTE: While any hyperlinks included in this clause were valid at the time of publication ETSI cannot guarantee their long term validity.

2.1 Normative references

The following referenced documents are indispensable for the application of the present document. For dated references, only the edition cited applies. For non-specific references, the latest edition of the referenced document (including any amendments) applies.

Not applicable.

2.2 Informative references

The following referenced documents are not essential to the use of the present document but they assist the user with regard to a particular subject area. For non-specific references, the latest version of the referenced document (including any amendments) applies.

[i.1] IETF RFC 959: "File Transfer Protocol".

[i.2] Secure File Transfer Protocol, Internet-Draft, Secsh working group of the IETF.

[i.3] IETF RFC 2616: "HyperText Transfer Protocol".

[i.4] IETF RFC 2818: "HyperText Transfer Protocol Secure".

[i.5] W3C, eXtensible Markup Language, XML 1.0.

[i.6] SMPTE 0377: "Material Exchange Format (MXF) - File Format Specification".

NOTE: For SMPTE documents see http://store.smpte.org/category-s/1.htm and use the Search engine.

[i.7] EBU Tech 3264: "Subtitling data exchange format" (EBU-STL).

NOTE: See http://tech.ebu.ch/webdav/site/tech/shared/tech/tech3264.pdf.

[i.8] ETSI TS 102 796: "Hybrid Broadcast Broadband TV".

[i.9] SMPTE 0259M : "Television - SDTI Digital Signal/Data - Serial Digital Interface".

[i.10] SMPTE 292: "1.5 Gb/s Signal/Data Serial Interface".

[i.11] Open Mobile Alliance, OMA DRM 1.0.

[i.12] OpenCable, OCAP 2.0.

[i.13] Electronic Industries Alliance, EIA-608/CEA-708.

[i.14] W3C, Distribution Format Exchange Profile.

[i.15] SMPTE Metadata Dictionary: SMPTE RP 0210 ("Metadata Dictionary Registry of Metadata Element Descriptions") and SMPTE RP 0224 ("SMPTE Labels Register").

[i.16] ITU-T Recommendation Q.6/SG16, H263.

[i.17] ISO/IEC 14496-2: "MPEG-4".

[i.18] ISO/IEC 14496-10: "MPEG-4 AVC".

[i.19] ETSI TS 102 825: "Digital Video Broadcasting (DVB); Content Protection and Copy Management (DVB-CPCM)".

[i.20] Marlin, Marlin Developer Community.

[i.21] SMPTE 0421M : "Standard for Television - VC-1 Compressed Video Bitstream Format and Decoding Process".

[i.22] ISO/IEC 13818-2: "MPEG-2".

[i.23] ATSC A/52B.

[i.24] ISO/IEC 11172-3: "MPEG-1 layer II".

[i.25] ISO/IEC 13818-7: "Advanced Audio Coding".

[i.26] ETSI EN 300 472: "Digital Video Broadcasting (DVB); Specification for conveying ITU-R System B Teletext in DVB bitstreams".

[i.27] ETSI EN 300 743: "Digital Video Broadcasting (DVB); Subtitling systems".

[i.28] Adobe, Real-Time Messaging Protocol.

[i.29] IETF RFC 3550: "Real-time Transport Protocol".

[i.30] IETF RFC 2326: "Real-Time Streaming Protocol".

[i.31] IETF RFC 768: "User Datagram Protocol".

[i.32] ISO/IEC 13818-1: "MPEG-2 Transport Stream".

[i.33] W3C, Scalable Vector Graphics.

[i.34] ISO/IEC 13522-5: "Multimedia and Hypermedia Experts Group, MHEG-5".

[i.35] ETSI TS 102 590: "Multimedia Home Platform".

[i.36] Cineform.

NOTE: See http://www.cineform.com/technology.php.

[i.37] Microsoft, Microsoft Media Server.

[i.38] ETSI EN 300 468: "Digital Video Broadcasting (DVB); Specification for Service Information (SI) in DVB systems".

[i.39] ISO/IEC14496-3: "Advanced Audio Coding".

3 Definitions and abbreviations

3.1 Definitions

For the purposes of the present document, the following terms and definitions apply:

adaptive streaming: process that adjusts the quality of a video based on changing network conditions to ensure the best possible viewer experience

advertising agency: service business dedicated to creating, planning and handling advertising

catchup TV: video on demand service delivering content for a short period after its broadcasting on a television channel

content: information and experiences that may provide value for a viewer

content delivery network: system of computers containing copies of a content, placed at various nodes of the Internet so as to shorten the path and lower the network congestion between the server and the client

content provider: any actor distributing content through a content delivery network

digital rights management: access control technology imposing limitations on the usage of digital content

mezzanine file: high-quality file acting as the reference file from which lower-quality copies are derived

operator: organization that provides network services through wired or wireless connections

peer to peer: distributed system of end-user computers providing content delivery services

progressive download: method for transmitting non-live video to the user for immediate playback, using buffers to avoid network congestion

streaming: process of transmitting content in real-time over the Internet without local buffering

trick play: functionality allowing to pause, change the speed of playing and seek in a given content

watermarking: process of embedding unperceivable information in a video or audio signal, for instance in order to identify the source of the content

3.2 Abbreviations

For the purposes of the present document, the following abbreviations apply:

API	Application Program Interface
CDN	Content Delivery Network
CP	Content Provider
DRM	Digital Rights Management
DTD	Document Type Definition (XML)
DTT	Digital Terrestrial TV
EITp/f	Event Information Table, present and following (DVB)
EPG	Electronic Programme Guide
HD	High Definition
IP	Internet Protocol
IPTV	Internet Protocol TeleVision

NOTE: Based on ITU definition and TISPAN work.

MCD	Media Content Distribution
MMS	Microsoft Media Services
QoS	Quality of Service
RTP	Real-time Transport Protocol
RTSP	Real Time Streaming Protocol
SDO	Standards Development Organization
STB	Set-Top Box
TDF	Télédiffusion de France (company)
TMP	Télévision Mobile Personnelle (DVB-H project in France)
TS	MPEG-2 Transport Stream
VOD	Video On Demand

4 Methodology

Content providers are traditionally under-represented in standard organizations. Nevertheless they regularly submit presentations and templates to the governments, regulators, or local industry forums. At first we have gathered a number of them, and tried to draw common lines of actions. This has proved an uneasy task. Furthermore, it also hides a lot of smaller issues, which content providers do not necessarily think of bringing to the public attention.

We have therefore decided to take a proactive approach, and organize series of interviews with selected content providers. We have thought important that:

- Though a questionnaire has been developed in the MCD group, the questions were not closed. The questionnaire was designed to make sure no topic was forgotten during the discussion, but the interviewees had full liberty to talk about what comes to mind first.
- The interviews had to be done one at a time, to make sure that a CP would not influence the others. It has put into focus a lot of drifts or full disagreements between interviewees, but it has also taken an awful lot of time, which explains the limited number of interviews.
- The choice of interviewees should include personalities well known among CP for their insight, but representing very different types of content providers. For instance:
  - Large public broadcaster;
  - Large commercial broadcaster;
  - Small commercial broadcaster;
  - Large VOD provider;
  - Small VOD provider;
  - And lots of hybrid models.

The present document is the abstract of the series of interviews we have done. For confidentiality reasons, the names of the interviewees and companies have been removed.

5 Ecosystem

5.1 The "content provider" cloud

When first trying to define with the CP the ecosystem they imagine, we have stumbled across major divergences between the interviewees. These can be traced back to the fact that the "content provider" term is much harder to define than we imagined, and may regroup - or not - different roles such as:

- broadcast channels;
- aggregators (live or on-demand);

- distributors;
- content producers;
- advertising agencies.

All the broadcast channels we have talked to view themselves as "aggregators"; for some of their contents, they can also be distributors or content producers. Also they can have an internal advertising agency, competing with the agencies of the Internet or of telecom operators.

VOD portals are also, in a more obvious way, "aggregators". At some point there can be several levels of aggregation. Many companies have a hybrid business model.

We have long considered whether and how to include those roles in an analytical view of the CP ecosystem. In the end, one question prevailed: if we chose to make those roles appear, would TC-MCD have anything to do in these areas? From the discussions with the interviewees, it appeared very clear that the interfaces between those "roles" or actors (in case they are born by different companies) had a strong link with the contractual side of the relationship; implying that how the content is distributed is very much dictated by the terms of the contracts that bound the actors, or internal processes (for that matter, juxtaposing several roles in the same company does not seem to simplify the processes). Also in most cases the number of actors is fairly small. Practically content providers do not automatize any task in that area, and though it would sometimes be needed, they fail to see how it could be feasible.

As a conclusion, we have decided to promote a very simple definition of the term "Content Provider":

content provider: any actor distributing content through a content delivery network.

5.2 Relationships with other actors

We have proposed the following schematic to interviewees, as a basis for discussion.

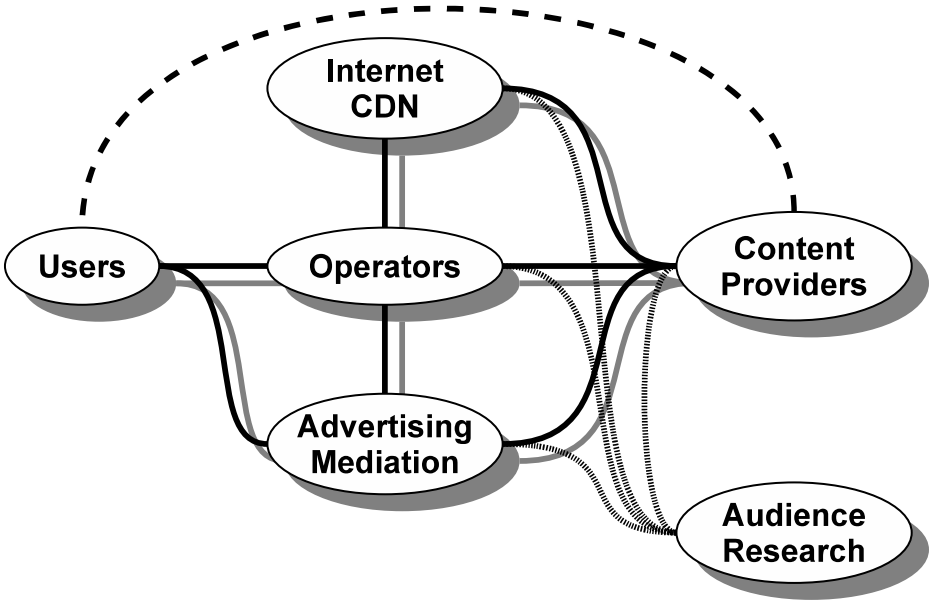


Figure 5.1: The Content Provider Ecosystem

Some interviewees would like to add the traditional broadcast operators in the schematic, in a symmetrical position with the network operators. We believe that the interfaces and roles between CPs and broadcast operators are already well-defined elsewhere and out of the scope of TC-MCD.

Some want to draw a link between the users and the content providers. They argue that CPs are represented as a brand to the users, and take responsibility for the selection and presentation of contents. As such, they get user feedback and recognition. However these are not technical relationships and are out of the scope of TC-MCD.

For some CPs, the "Internet CDN" is seen as a technical subcontractor of the content provider, and should not be placed on the same level as the network operators. It belongs then to the "content provider cloud". It can also be noted that some CPs have a very aggressive strategy towards IPTV, and tend to create their own internal Internet CDN. That's one of the reasons why several interviewees have asked for a direct connection between the Content Provider and the User.

Finally, most interviewees put a lot of emphasis on audience measurement. They distinguish two different ways of measuring audience:

- qualified audience: it is very important for advertisers;
- raw numbers of viewers: they can be consolidated to repay royalties to content owners or societies of authors.

CPs stress the fact that network operators do not release their figures: it would indirectly give information to their competitors about their user base. In some cases (TMP, or mobile TV in France) operators are forced by contract to communicate the audience of the channels. Some interviewees call for the development of an "audience mediator" role between the operators and the CP, which would consolidate the figures of the operators while enforcing privacy and confidentiality constraints.

6 Non-technical constraints

6.1 Business model choices

There can be a lot of differences in the technical architecture and constraints, depending on the choice of business model of the company. First come to mind the live vs. on-demand services. Most VOD services use progressive download, so that they can work around the lack of QoS and poor network conditions. Some are looking at streaming, or adaptive streaming.

VOD interfaces are well-defined (based on media file + meta-data exchanges) and widely used. Stream interfaces are mostly ad-hoc solutions; in some cases the captation of the stream is completely subcontracted to a CDN, often by traditional broadcast means (DTT or satellite).

Another important choice is the number of subcontractors the CP has. Some choose to have only one CDN distributing the content to the Internet; others multiply the supported platforms and the operators (e.g. IPTV STB networks). In the latter case, CPs are exhausted by the lack of standardised interfaces and have to redevelop everything for each platform.

Billing interfaces can also be impacted: the CP can choose to charge the client directly with credit card, charged calls or text messages. Or it relies on the telecom operators in-between and their internal billing system, with which they have to communicate.

6.2 Contractual constraints

A few common points stand out from the contracts of the content owners:

- contents are bought for a defined territory; geolocking needs to be enforced;
- contents have a window of availability;
- CP needs to have the ability to remove very quickly a content.

Also in some cases, the contract defines the platforms (network operators) and ways of reception (STB/TV, PC, mobile, etc.). If a platform or a way is to be added, the contract needs to be renegotiated, and it costs money.

Except in the case of a broadcaster publishing its own internally-produced contents, the contracts also require content protection measures to be enforced. The simplest one is watermarking. Some interviewees have told us that the contracts specified a precise DRM system to be applied to the files (specified by vendor + product name). Even using a different, more recent product by the same vendor was submitted to approval by the content owners. Sometimes the contract places restrictions on the resolution of the content (e.g. no HD on open networks and PCs).

However in most cases the contracts are only mentioning that reasonable efforts needs to be taken to prevent piracy. It also depends on the type of content (the moving pictures industry is more sensitive). Some contracts place limits on the content redistribution, once it is on the customer's PC: it is then forbidden to retransmit it using the Internet. This kind of contract forbids some business models related to out-of-home access.

It may be of interest to notice that the nationality of the content owner rarely makes a difference. In particular it is wrong to believe that U.S. content owners could be more restrictive than European ones.

6.3 Convergent models

The interviewees considered the convergence of their services towards multiple platforms and distribution means, as a dream scenario. Some do not see it happening in the near future, and also consider session transfers between different appliances to be a fantasy; it would not be a request from the customers.

First of all, a lot of business models are based on a non-convergent ecosystem: as seen in the previous paragraph, content owners earn more money by selling restricted rights for each platform than by selling a global license. An interviewee told us that when he wanted to broadcast his channel on the PC, the content owners have asked for more money; this is not understandable to him, because in the end he still has the same number of viewers. Some just shifted their usage towards the PC. Also, operators are not inclined to let their customers wander on other networks. Locking the distribution to a specific network allows to keep a captive customer base.

Another problem is that content shot for TV are not necessarily suited for mobile use. Landscape views are particularly prohibited on mobile due to the lack of details. Some events, such as sport events, have to be shot independently for the mobile, so that the action be more visible. Mobile users are also consuming shorter contents.

However, some CPs state that business agreements will necessarily be reached in the short term; the market pressure is strong. It is remarkable that the closer the interviewee is from the content producers, the more optimistic he appears. In the long run, session transfers will be possible, but in the short term, for practical reasons it will only be available inside the same operator.

6.4 Advertising constraints

When asked whether targeted advertising is of interest to them (when applicable), all interviewees answered yes. But they want such a solution to be completely managed by the content provider; intermediates such as the telecom operators should not be allowed to tamper with the content (and it is often forbidden by contract). Content integrity is a major issue: CPs oppose the "widgets" strategy of CE vendors.

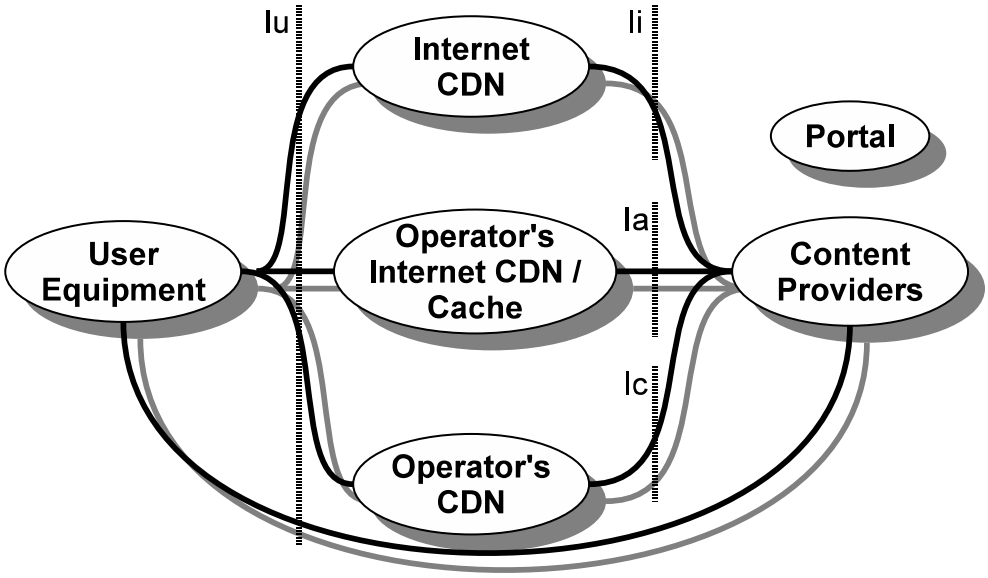
Information such as "what the customer is already buying from us" or "where the customer is located" is of interest. CPs are willing to share their targeted advertising revenues with operators, if and only if they can make targeting more efficient.

Some players plan to achieve it using interactivity middleware, such as OCAP [i.12] in the U.S.A. or HbbTV [i.8]. A targeted pop-up could be displayed with HbbTV-enabled receiver. Some others are already including advertisements embedded in the content flow, or via a playlist system in the player. However in the case of on-demand services, there is no standardised way to prevent the user to skip the ad or play the next item. This impedes the development of advertising in VOD and catch-up services.

Targeting could be made on a voluntary basis to avoid privacy concerns.

7 Interfaces positions and roles

7.1 Block diagram



Iu: content pull.
Ii: content push, reporting push or pull.
Ia: content pull, reporting pull (push could be more optimal).
Ic: content push or pull, reporting push or pull.

Figure 7.1: Interfaces between actors

It first stroke us during the interviews, how much of a "transformation industry" a content provider was. On every interface, it is getting data in whatever formats, transforms/transcodes/transtypes them and outputs them in several different formats.

7.2 Content flow

We have proposed four ways of conveying the content to the final user:

- Directly over the Internet (Iu): for instance the content is a media file stored on the same web server as the portal. This case seems quite marginal: it lacks a lot of technical features such as QoS, the ability to view the content before it is fully downloaded, content protection.

- Through an operator's CDN (Ic): this is the case when the CP pours VOD or broadcast content to a telecom operator's IPTV service. Though the interfaces are functionally equivalent for VOD or live, we will see that they are technically quite different, and managed by different teams.

- Through an Internet CDN (Ii): this is the traditional way to provide the open Internet with content. Though there are several independent company offering this service (to name but a few, Akamai, Yacast, Limelight, etc.), a CP usually only contracts with one or two of them. This makes a difference when having to consider the burden of supporting non-standard, divergent interfaces from diverse providers.

- Through an operator's Internet CDN acting as a cache: this actor does not currently exist as such. It is merely our suggestion; the goal would be to cache at the operator's level the most accessed contents, in order to avoid network congestion. Some consider the CP should not have to deal with it: QoS is the problem of the Internet CDN, who should negotiate it with the operators; the recurrent fee covers that task. Others have balanced it with other technical solutions to avoid congestion, such as multicast.

Generally speaking, though CP are concerned with QoS problems affecting the user, they are not willing to play an active part in it. For them, it is part of the contract they have with the Internet CDN. Some could make separate contracts with operators to ensure that their contents are properly carried (in particular when the CP is bound to a certain territory, holding a finite number of operators); such an extra cost could be bounced back to the user; however in some countries this could be illegal (infringement of the net neutrality). Finally, some go as far as saying that the construction of the networks should be financed by the state, and enforce a certain level of quality, like a public service (comparison with highways).

7.3 Content portal

Interviewees have encouraged us to display the portal on the block diagram, because it seems an important part of the offer of the CP. It is indeed the way to access the content, and therefore as much a part of the editorial choices as the content itself.

Some CPs choose to develop and/or host their own portal to access the contents. Others completely rely on the infrastructure of the telecom operators they are dealing with. Developing one's own portal can be very demanding in the case of set-top-boxes because of the lack of a standardised middleware in the STB, and of a standardised API for streaming from the network operator's facilities, but the content providers ask for more freedom in the way their content are presented, and whenever possible (i.e. when allowed by the telecom operator) they prefer to control the portal.

International corporations have the tendency to create their own portal in their home land, but leave this task to their local distributors abroad.

7.4 Reporting flow

In return of the content flow toward the different CDN structures, content providers expect logs of usage. They are mandatory to repay the content owners and/or societies of authors, but they can also serve as a basic audience measurement tool. Some CPs expect those measurements to counter-balance in the future the traditional, often monopolistic, audience measurement agencies. It can be noted that, since reports of the CDNs are sometimes too slow, some CPs use the logs of the web portal to deduce basic audience information; hence the importance of controlling the portal.

The Internet audience of contents should not be neglected: one CP told us that on some programs, Internet accounted for a fourth of the total audience. Content providers are thus insistent about getting those figures as quickly and as reliably as possible. Consolidated audience reports are mandatory to attract advertisers.

Some CPs said that ideally, audience should have granularity of 1 second. That way, programs could be dynamically modified to maximize the audience. Currently the granularity for live contents is 5 minutes or 15 minutes, and figures are only available the following day.

On-demand programs generally have fewer requirements. Most of the time they consist of a monthly report of the consumption of each content item, including: number of views, number of different viewers, mean number of views per viewer. For hot contents, or ad-supported VOD, the report may become daily, and include the peak number of concurrent users. Some CDNs provide a way to query, in pull-mode, the audience for a definite period of time.

Also sometimes the CDN provides functionalities allowing to track the user's behaviour; some kind of profiling can be done, like proposing similar contents. Some CPs ask for the raw logs (session start and end), and consolidate the audience measurements themselves.

8 Interface formats and protocols

8.1 Interface with the user equipment

The CDN/User interface is probably the best known interface, in both domains of standards and proprietary software. The first choice to make for this interface is the Digital Rights Management system. Most content owners require their content to be protected against piracy.

Operator's internal CDNs manage a defined park of set-top-boxes, generally with a broadcast-like conditional access system, such as Nagra Kernel or Verimatrix. In that case the contents are protected by the system of the operator, and the entirety of the task is devoted to the operator. Mobile operators are in the same case: the content provider's task consists in providing streams encoded in the appropriate format, generally H.263 [i.16], MPEG-4 [i.17] or MPEG-4 AVC [i.18], and applying OMA DRM [i.11].

In the open Internet however, the content provider plays a more active part. CDNs merely have a choice between two concurrent DRM systems: Microsoft DRM and Flash. Some also use Magic Box for the Playstation Portable. Apple QuickTime is too closed. Some CPs are dissatisfied with the existing systems for several reasons: lack of support for non-Microsoft operating systems, incompatibility between versions; also the current systems do not allow to delete the downloaded files when the entitlements have expired, or during black-holes in windows of availability (for instance some contents being exclusive during Christmas) though the contracts specify it. Furthermore they fail to properly enforce output protection, both digital and analog.

When asked about more open systems like DVB-CPCM [i.19] or Marlin [i.20], the interviewees state that the main problem with them is the lack of support in case of problem. With its DRM, Microsoft controls the entire flow, and can ensure that in case a flaw is found in the system, it will remedy to it within a given time. Also, Microsoft is already approved by the major studios, so the content provider does not have to prove the content owner that the conditional access system is working. Marlin however is gaining support, in particular in Japan, but the interoperability feature is a non-issue: CPs can offer the same file in multiple DRM formats.

An interviewee gives her definition for the choice of a good codec: it's a trade-off between quality, acceptance by the industry, and amount of royalty fees. There is indeed a large abundance of codecs. Though all interviewees call for the generalization of MPEG-4 AVC as the video codec for the Iu interface, some DRM systems impose another codec; for instance, Microsoft's WM10 DRM imposes VC-1 [i.21]. The next generation of Microsoft's software, PlayReady, will only support MPEG-4 AVC mid-2010. On the set-top-boxes, most of them already support MPEG-4 AVC; there is still a small park for legacy MPEG-2 [i.22]. When asked about MPEG-4 SVC [i.18], the interviewees have not shown any enthusiasm, though it is now included in the ATSC specifications; it seems too far away from actual deployment, and it is not backed by DRM vendors (though it could be solved by scrambling the base layer only). There are already technologies such as adaptive streaming (SilverLight) which fulfil the same requirement on the Iu interface.

Audio codecs are simpler: the choice is generally between the legacy MPEG-1 layer II [i.24], and various flavours of AAC [i.25] and [i.39]. For high quality content, Dolby Digital or Dolby Digital+ [i.23] can be used for 5.1 coding. Subtitles, when needed are either the legacy CEEFAX (embedded in TS) [i.26], or DVB subtitles [i.27].

The container format is, again, imposed by the protocol of distribution. Some interviewees see the soar of Flash (RTMP [i.28]), embedding MPEG-4 AVC. Microsoft DRMs impose the use of Microsoft's container. The only reason to use standard RTP [i.29] and RTSP [i.30] is trick play. In the balance between progressive download and live streaming, progressive download is currently favoured because it allows to work around network congestion; however this is highly debated, and deeply depends on the business model: some content owners forbid progressive download because they want to prevent files to be stored on the user's PC. Others encourage operators to use pre-caching to avoid congestions, but it requires the use of a DRM system.

Of course in the managed networks, operators use the same technologies as for the rest of IPTV: multicast or unicast UDP [i.31] streams with the legacy MPEG-2 Transport Stream [i.32], and optionally RTP and some FEC. The control interface is generally RTSP, or equivalent. If multicasting were accessible to them, content providers would accept to use it and pay for it, in order to improve the QoS.

Finally we have mentioned Peer To Peer as an alternative to the cost of Internet CDNs. The interviewees were not enthusiastic, mainly because of the lack of control over the distribution of the content (no audience reporting), and because of the hidden costs which some studies have lately highlighted. Also some insist on building a balanced ecosystem: the CP should not jeopardize the business models of the operators, but should work in collaboration with them. Also some CPs insist that the protocols and software needs to be different from the ones used by pirates; otherwise this is would be indirect publicity for illegal uses.

8.2 Interaction with the user

Some content providers have placed a particular emphasis on interactive contents. The PC world has HTML browsers, Flash and SVG [i.33]. However these capabilities are quite limited in the embedded world of the set-top-boxes. A lot of middleware solutions exist, ranging from the full proprietary middleware (OpenTV, MediaHighway) to various HTML flavours, passing by MHEG5 [i.34] and DVB-MHP [i.35]. That is why some French and German content providers have taken the lead in defining the HbbTV [i.8] specification, which describes a common profile of a web browser, with mandatory features. This technology is scheduled for inclusion in lots of TV sets and set-top-boxes.

Some consider it the Holy Grail of interactivity: it allows to embed interactive content into MPEG-2 Transport Streams. It can also be used as a standardization milestone for the portals of the content providers: currently CPs have to redevelop a portal for each operator they distribute content to. It finally solves the parental control requirements: an embedded application could mask the video and ask for a parental credential. Currently this feature is deported into the portal, or the STB's conditional access system. The same mechanism can be used for interactive or targeted advertising.

On the down side, it is remarkable that there is no plan for HbbTV on the mobile phones.

Some interviewees expect the middleware to migrate from the set-top-boxes to displays. This would be the end of proprietary set-top-boxes from DSL or cable operators.

8.3 Feeding the CDN with media files

The interfaces between the content provider and the CDN will grow more obscure as we move forward in the present document. Uploading media files is still relatively intuitive, and though the details of implementation may differ greatly between providers, the idea behind it is straightforward. CDNs usually provide a specification document detailing how the files should be encoded and uploaded.

The upload itself can take advantage of the standard Internet protocols like FTP [i.1], SFTP [i.2] (FTP over an SSH-secured connection), HTTP [i.3] or HTTPS [i.4]. After the transfer, the file enters a provisioning process: it varies between CDNs, but it can include operations such as automated checking, scrambling (especially for operator's CDNs), transcoding (for instance to generate previews), indexing, and of course the actual copying to the streaming platform. The provisioning process can be automatically started at the end of the upload, at certain times of day, or upon uploading a trigger file (which can be the meta-data file itself).

Some content providers have told us that the major problem with their CDNs is that they did not implement an interface to get the list of the uploaded media files. It is sometimes very difficult to get the status of files in the provisioning process, and some get rejected without notice.

Some companies, like SmartJog, also sell all-in-one solutions to transfer files from one point to another. A custom PC is installed at content provider's, laboratories, and operators, and files just have to be transferred to that local PC. The proprietary software is then responsible for transferring the file to the remote PC, with appropriate security and retransmission. The force of this solution is to have as many linked places as possible; then file exchanges become as easy as e-mail, security added.

The next important question is how the file should be encoded. Unfortunately not all CDNs have agreed upon a common encoding format. A first hypothesis would be to send to same high-quality file to all CDNs (called a mezzanine file), and have the CDN do the transcoding to one or several target formats. However this solution does not seem to be favoured by either the CPs or the CDNs. Some content providers show a strong will to control the encoding quality, and the whole process. It is sometimes out of question to delegate this critical part to a CDN. Also CDNs are reluctant to support the additional costs of transcoding mezzanine files. So content providers have to upload target files described at clause 8.1. It is remarkable that mobile operators are an exception: due to the diversity of mobiles available on the market, the transcoding operation is sometimes devoted to the operator. Furthermore, mezzanine files have a great importance inside the "content provider cloud". It is usually the only kind of file that is kept by the CP or the laboratory, since all the target formats can be derived from it. Upon receiving a content from cassette (for instance Digital Betacam or HDCAM), the first operation is to create the mezzanine file with a hardware encoder. A lot of PC software (even freeware or shareware) then specializes in transcoding the mezzanine file to target formats, embedding several audio tracks or subtitles. Some subcontractors are developing this area of activity very quickly.

With the advent of PC files and PC encoders, some have started exchanging mezzanine files. But no standard exist in this domain. Some use MPEG-2 4:2:0@8 Mbi/s or MPEG-2 4:2:2@15 Mbi/s for SD, MPEG-2 4:2:0@60 Mbi/s for HD, embedded in a TS container. Others are trying to standardise MXF@30 Mbi/s [i.6] for SD. Some laboratories are pushing the proprietary codec Cineform [i.36] because it yields less artefacts than MPEG-like codecs.

And mezzanine files are not just about video codec: though the simplest audio codec (MPEG-1 layer II@384 kbi/s) is often the best, subtitles are more problematic. Sometimes they are embedded in the TS file as CEEFAX [i.26] or closed-captioning (EIA-608/CEA-708 [i.13]). More and more often, the subtitle file is provided separately (as it generally comes from another company and process) in the W3C DXFP [i.14] or more frequently EBU-STL [i.7] format, but that choice is sometimes vehemently discussed because it is somewhat outdated (see for instance http://www.sttcr.org/html/technical_note_06.html).

8.4 Feeding the CDN with meta-data

Meta-data is an ambiguous term regrouping two very different concepts: technical meta-data and commercial meta-data. Both types of files are generally formatted with XML [i.5], or more simple text files. The DTD is almost always proprietary for each CDN; some content providers use CableLabs meta-data internally.

Commercial meta-data are only useful for exchanges between the content provider and the portal, whether both are members of the same entity, or separate companies. Commercial information includes pricing, windows of availability, editorial information (title, actors, abstracts, etc.).

Technical meta-data are destined to the CDN's provisioning process, and are often deposited in the same way as the media files themselves. They include low-level data such as PIDs, audio tracks, subtitles tracks, codecs, bit rates, picture format (SD or HD), etc.

No standard is in use currently for exchanging any of these meta-data. One interviewee mentioned SMPTE RP 210 and RP 224 [i.15] efforts, but to our knowledge they are not currently in use in the scope of our study. Most content providers state that it is a difficulty for them because they have to adapt to each CDN; however they do not think CDNs and operators would be willing to change their interfaces: proprietary processes are a way to keep content providers captive. In the balance of forces, content providers do not think they could impose such a decision to them. It greatly depends on the situation of the CP: a big broadcaster having one or two CDNs does not have the same priorities as a small VOD provider with a dozen target platforms with different formats; some content providers are in a great difficulty due to this heterogeneity.

8.5 Feeding the CDN with streams

File formats have been a pain to collect and explain; the streaming world is even worse. Internet CDN have a tendency to use traditional broadcast methods (terrestrial, satellite) to get contribution streams. Some CPs also provide a live stream to their Internet CDN using Windows Media's MMS [i.37] protocol.

Of course operators' CDNs can also use conventional ways as well; probably this is even the most used method of contribution. However, the advent of IPTV has developed a niche market for very small, very low-cost TV channels, which would not afford traditional broadcast otherwise. Even typical contribution video links (SDI [i.9] or HD-SDI [i.10] to fibre optics) are too expensive.

Therefore these channels gather in mutualised control centres, like Cognacq-Jay Image in France (a subsidiary of TDF), which themselves have IP links with multiple IPTV operators. The signal is contributed via IP to the operator's private contribution network.

The transport protocol is MPEG-2 Transport Stream [i.32]. As for the codecs, two approaches are confronted: some operators require the content provider to encode the stream in the target format (MPEG-2 [i.22] or MPEG-4 AVC [i.18]). Others ask for a contribution signal (for instance MPEG-2@8 Mbi/s) which will be transcoded to several targets. Again, the heterogeneity of the solutions imposes additional costs to the content providers, who have to encode their signal several times. Only the biggest media groups have the power to impose their contribution choices to the operators. Some media groups believe it is their responsibility to encode to the target format; others consider it is the broadcaster's problem, and only ask for an audit right.

The meta-data accompanying the streams are the EPG information. Content providers insist on this problem being non-trivial. Most of the time, IPTV operators do not support DVB extensions (EITp/f) [i.38] because the set-top-boxes feature an HTTP-only EPG. This approach has numerous advantages: it reduces the need for streaming bandwidth, allows for more elaborate content, and works around the usual patents on EPG. So there is no way to send the meta-data in-band.

Some operators accept XML [i.5] files from the TV channels. However no DTD has been standardised for this task. This is further complicated by the fact that the EPG service is often subcontracted to independent companies who have no interest in complying with the minor TV channels desires. In other cases the operator develops a proprietary API to provide extra features to the its EPG: it is a differentiator. So the CP are sometimes in the uncomfortable position of having to develop specific processes for the EPG provider, and to pay the said provider. Not being included in the operator's EPG can be a death penalty to smaller channels, which have no other way to promote their programs.

8.6 Reporting from the CDN

Internet CDNs have to regularly report on the consumption of the contents. They send daily reports via e-mail. Depending on the contracts, the raw logs of the web servers can be downloaded from an FTP [i.1]/SFTP [i.2] server at any time. Some CDNs also provide a web portal with advanced statistics tools. Neither the logs or the reports are standardised: each Internet CDN has its own format. Generally, a content provider contracts with only one Internet CDN, so it is not a major problem; it only appears when the CP intends to change its subcontractor. Again, Internet CDNs are not expected to welcome a potential standard, because that would make defections from content providers easier: it would be an incentive to churn. The complexity involved in changing the subcontractor impedes the competition in this sector.

Operator's CDNs have nearly the same processes. In general, at the end of each month an official report file is generated and placed on an FTP/SFTP server, or via a web-service; this file serves as the basis for the billing system between the operator and the content provider. Its content can be cross-checked with the logs of the portal by content providers. It is not unusual to find disparities in the reports, therefore audits are sometimes needed.

There again, each CDN has its own, non-standard ways. Though in this case, operators cannot be suspected of hindering the competition, because anyway content platforms have to be with all major operators, CPs do not think it could be in their power to force the operators to use a common, standardised scheme.

9 Conclusions

The present document shows the large diversity of the content providing industry. The smallest providers have to afford, in every aspect of content delivery, expensive adaptation and transformation costs, and would benefit a lot from standards. However they do not have the resources to participate to SDOs, nor enough weight to influence the operators' strategies. Large providers suffer from this situation as well, but regardless they cope with it quite well due to their industrial structure and strength.

In many cases the use of standards is restricted. Content owner's contracts place a lot of emphasis on content protection, a field in which proprietary solutions are preeminent. These content protection solutions also impose limitations on the choices of codecs and protocols.

The content providers themselves have strategies that limit the possible uses of standards. Those who do not want to delegate the transcoding of media files to target formats impose themselves a heavy burden. Similarly, controlling the portal means having to cope with the diversity of set-top-boxes and middleware.

Standards are often directly in opposition with the interests of the operators or CDNs. Standards would simplify the task of migrating a service to another contractor, so they would encourage competition. The current proprietary protocols are ad-hoc solutions, written to fit exactly the operator's need; sometimes they feature innovations the operator does not wish to share. However, standards could lower the cost of developing new services, so that the content offer could be larger than it is today, and would increase revenues.

The discussions with the content providers have shown that there is a lot of room for potential standards in several areas, listed here by a rough evaluation of both urgency and feasibility:

- Exposing a standard API in middleware, for the purpose of interactivity or targeted advertising: a lot of technologies have been proposed in this domain, the latest of which being HbbTV.
- Providing EPG data to operators: this would define a content (similar to what DVB did for the EIT), a container, and one or several protocols.
- Standardizing meta-data for live streaming or VOD between the CP and the CDN: there are already a number of initiatives in this area and we should avoid re-inventing the wheel. However, analysis and publicity of existing solutions would be helpful.
- Defining the characteristics of mezzanine files: again a number of solutions exist but a more thorough examination of the processes in this area could isolate different features for different uses.
- Creating a common format for reporting: first the exact needs should be assessed, then it can be agreed on a container and a protocol.
- Defining a solution for entitlements and sessions transfer from one output device to another: at first an intra-operator protocol that could be generalized to inter-operator uses.

There is indeed a lot of work in this area; content providers have to be more closely involved in SDOs if they want to support the simplification of their processes.

Annex A:
Content providers' questionnaire

The latest revision of the questionnaire which has served as a support for the discussion with content providers is reproduced here, for informative purposes. It is dated 25th of June, 2009.

A.1 Introduction and Scope

The present document presents a methodology and scope to gather Content Provider requirements and comments on the media content distribution area.

A.2 Questions

A.2.1 Ecosystem and Business Models

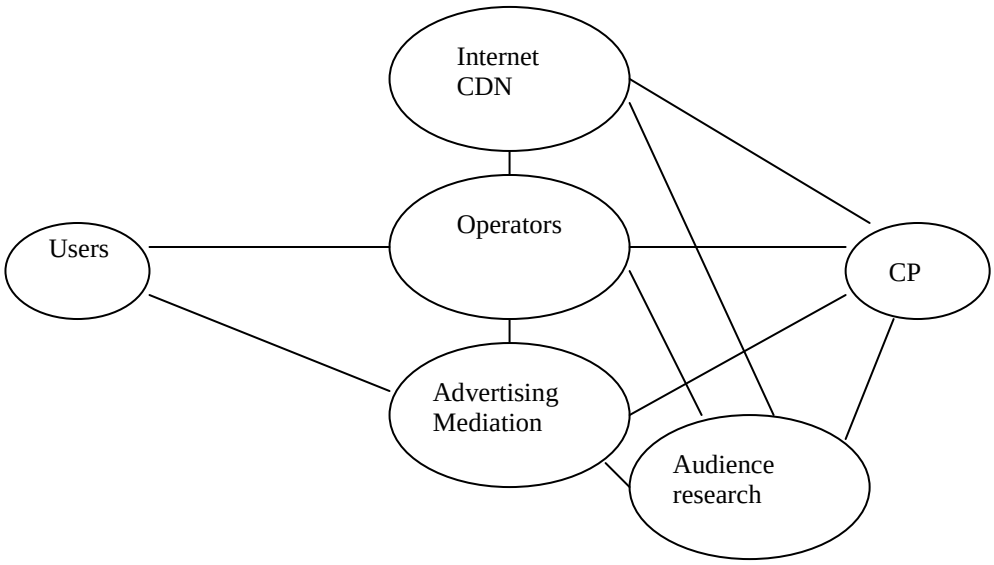


Figure A.1: Draft ecosystem model

- What actors do you see operating in your perimeter (see diagram above)? What relationships between the actors?
- What business models are you concerned with today?
  - Where should there be billing relationships between actors?
- What business models may be of interest to you in the future?
- What are the requirements for publishing content?
  - Requirements on geolocalisation/geolocking?
  - Window of validity?
  - Need to stop/resume the distribution of a piece of content?
  - Requested encryption?

- What other sort of commercial constraints do you see to distribution?

- How important is the requirement for having your own portal (possibly still using CDN capabilities at different levels)? (2 models, operator manages portal, many CP manage their portal)

A.2.2 Advertising

- Do you see a strong link between content distribution, audience measurement and advertising?
  - Do you see a place for multilevel ad placement, targeted advertising? (with associated business models)
  - Is user profiling across wider area than CP own content important for ad sponsored models?

A.2.3 General Content Delivery

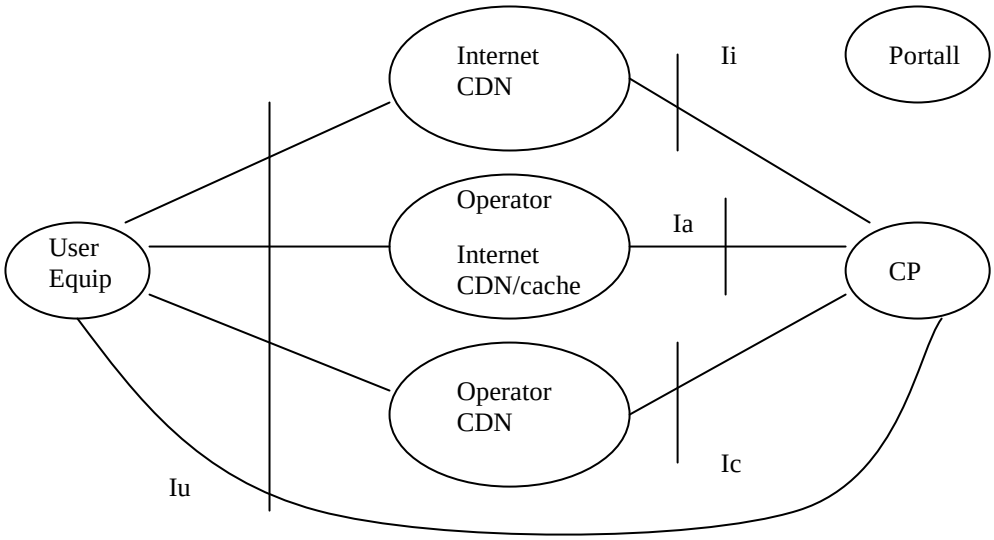


Figure A.2: Draft Interface model

Interfaces between actors:

Iu: content pull

Ii: content push; reporting push or pull

Ia: content pull; reporting pull (push could be more optimal)

Ic: content push or pull; reporting push or pull

- Do you see the need for stream and/or file interfaces?
- What role and means do you see for content metadata?
- How do you see content protection interacting with content distribution?
  - Role and constraints of DRM/CP?
  - Position wrt "common encryption" for mass distribution?
- Do you see requirements on protocol/infrastructure security?
- Role of and position of billing interfaces?
- Do you consider parental control requirements a delivery issue? In-band or control interface?

- How do you judge broadcasting formats profiles and evolution? (existence of codecs/features, metadata)
- What delivery methods do you see required? (http, adaptive streaming, rtp/rtsp streaming, trickle download, live streaming, p2p, etc.)
  - Role of progressive download vs. adaptive streaming vs. live streaming?
  - Role for RTP and RTSP? (including in terminals)
  - MPEG4 SVC as an alternative to adaptive streaming
  - Do you see a role for P2P? (streaming/download)
  - Is there a need for multicast distribution, in what case?
- Do you see a need for out-of-home access for content?
  - On portable device? (streaming/download)
  - At other people's house?
  - When travelling abroad?

A.2.4 CDN

- Do you see a need to place the content in a CDN?
  - Need to pre-define levels of popularity, for resource allocation purposes?
- What role do you see for different types of CDNs:
  - operator VOD CDN?
  - operator internet cache CDN?
  - external internet CDN (akamai, etc.)
  - other types/roles?
- Would you be interested in an interface between CP and network providers to 'announce' and ingest new content?
- What are the requirements for reporting content usage (unique clients, peak consumption, hits on content, etc.)?
  - Periodicity and interval of reporting? How real-time? Push/Pull?
- Do you see other specific requirements for interfaces to the CDN?

A.2.5 Network QoS

- How important do you consider QoS aspects?
- What QoS treatment do you expect from the network providers?
- Do you envisage that QoS guarantees can be a part of your business model and justify extra revenues/costs?

A.2.6 Audience Measurement

- Do you see needs for consolidated audience requirements? (from different operators and broadcasters)
- Should traditional polls and telco reporting be consolidated?
- What granularity of audience measurement is required?
- Does ad tracking (or other commercial constraints) require you to set up independent verification of the actual audience?

A.2.7 Applications Convergence

- What role do you see for convergence? (mobile/fixed, fixed/fixed)
- Do you see a need for streaming session transfer?
- Do you think rights transfer is an important issue?
- Do you consider interactive application part of your content offer?
  - Do you expect it to generate extra revenues?
  - Do you see a need for technical standards?
- What role for transcoding of content for mobile terminals?
- What role for program preloading, especially for mobile?
- Role of precaching hints from UE side?

History

Document history		
V1.1.1	March 2010	Publication