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Authors	Spyros Denazis (UoP), Nikolaos Efthymiopoulos (UoP), Luigi Mori (ADBB), Mu Mu (ULANC), Omar Niamut (TNO), Stephen Phillips (ITInnov), Jacco Taal (BTN)
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Executive Summary

STEER envisages a ***community-centric digitally-based ecosystem*** which it refers to as "***Social Telemedia***" as a cross-breeding of social networks and networked media. According to STEER, the Future Social Telemedia Lifecycle will revolve around media services that user communities can both autonomously build and enjoy exploiting smart tools and specific networking facilities. Hence, the project will investigate the possibilities opened by the creation of an ecosystem where these elements are coordinated to enhance the experiences of their members.

To lay the foundation for this work, the present deliverable will introduce a real-life use case that describe the experiences of people that find themselves involved as "producers" and "consumers" of a social telemedia ecosystem. The use case concerns geographically distributed communities of people that automatically gather around an "event", about which the community members share, retrieve, exchange, and integrate networked media objects that they produce to tell stories from each individual's perspective.

Through this use case, we will be able to show how technologies developed in STEER can facilitate the assessment of the nature of the Future Social Telemedia Lifecycle that revolves around communities, reveal new properties and patterns, create new insights, and explore the synergy between Social Informatics and Networked Media delivery, and its impact on user experiences.

While the use case reflects STEER's vision on future community media service, it is not within the project's objectives to fully implement the whole set of tools that can make the use case happen in all its aspects. While many of the STEER technologies will provide essential functionalities to the use case, there are also topics that will remain out of the scope of the STEER. For such topics, STEER will however provide outlooks, recommendations and links to related EC projects.

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STEER use case

1.1. Rationale

STEER envisages a ***community-centric digitally-based ecosystem*** which it refers to as "***Social Telemedia***", as a cross-breeding of social networks and networked media. Within this ecosystem, communities of people contribute and "consumes" media objects that relate to interests and experiences they are happy to share in various circumstances of their lives. STEER believes that examples of this behaviour which are of particular relevance in real life involve people contributing to produce, share and spread narrations of live "events" which they are part of as actors or witnesses. In such cases, that the project will take as the paradigm for the investigations and developments it will carry on within its lifespan, media contents that are autonomously produced or gathered from various sources by one or more persons who participate to an event are assembled in real-time, distributed and cached for efficient access in key network nodes, with the help of dedicated smart tools and networking facilities. These contents, that range from video clips taken from personal cameras, with audio and superimposed comments, to segments of live TV broadcast programs, can be organized by their producers to form multi-faceted stories or commentaries for an immediate or delayed enjoyment by groups of people, or communities, that have previously expressed an interest to, or have been notified in real-time of, that event, either directly or through the mediation of a recommendation system.

Due to the disparate nature of the events that can aggregate the interest of such communities, the behaviour and the interactions among the various characters that compose them, or that, more in general, are members of the whole social telemedia ecosystem tend to be complex and dynamic. In its various realizations, the ecosystem will potentially encompass a quite large number of "users", typically spanning wide geographical areas, each of which exploiting different kinds of resources and infrastructures to be involved and act in one or more of a number of possible roles. In particular, as this will be convenient for the formalisms used in the representation of the project functional model, three main such roles have been identified, namely those of "consumers", "producers", and "broadcasters". A consumer gets notifications of the availability of media objects that have been organized in one or more "stories" by producers, with the possible involvement of one or more broadcasters, and retrieves this material from the distributed social telemedia infrastructure, which relies upon a number of tools and applications installed on network nodes and end user devices. The role of producers and broadcasters are respectively played by people who aspire to contribute their experiences of viewers and participants of an event for its narration, and by professionals and organizations which take advantages of the social telemedia framework to open new business opportunities outside their conventional channels. A consumer can as well take the role of a producer (a so called "prosumer") in different occasions and/or timeframes associated to an event.

Within this context, this first project deliverable will try to synthetically capture the various aspects of the social telemedia environment defined above, and highlight the major interactions among the entities involved, through the identification of a typical use case that describes the behaviours that develop around a fictitious event.

The use case will stand as an example of what the STEER approach to social telemedia will enable, and will help to lay the foundations of a framework wherein experiments may be deployed and carried out to evaluate and assess the validity of the underlying concepts. The use case will also guide the identification, design and fine tuning of the technology, mechanism and algorithmic components that will be developed or refined within the project.

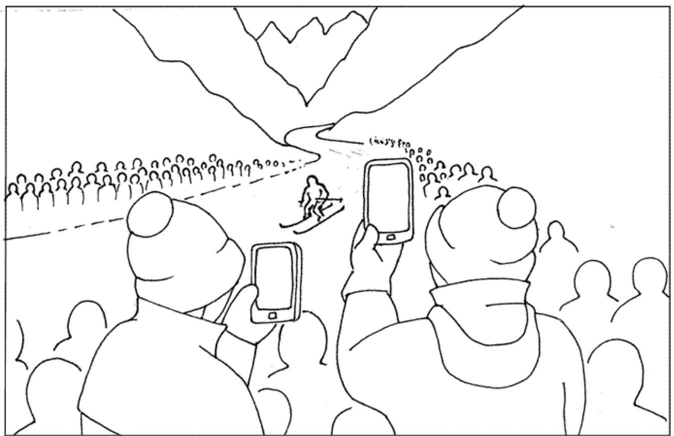
Finally, the framework defined by the use case will help clarifying the mechanisms that underlie the engagement and aggregation of people in communities around an event. The determination of such mechanisms is of particular interest for answering questions such as under which circumstances are these players willing to join and actively participate to communities, whether the offered application and the contents or their social ties influence the user behaviour and provide motivations for the involved actors, how does the quality of service (i.e., the amount of resources and proper infrastructure) impact user reactions, and so on.

The description of the use case has been structured in three parts. The first part (Section 1.2) focuses on all features that the particular social telemedia system considered in the project, and conventionally referred to as the "STEER system", provides in order to augment the user experience beyond existing ways of covering an event, e.g. through TV broadcasting or textual instant messages. The second and third parts focus on two applications that have been identified as being particularly representative of the possible ways of exploiting the STEER system: a "storytelling" application (Section 1.3), used in the aftermath of an event to revisit and further elaborate the live contents produced by people that attended its development, and an application for "augmented broadcast" (Section 1.4), where materials produced by professionals and amateurs are synchronized and combined in a same, multiple view watching experience.

As described in the next sections, the particular event considered for the use case is the ski championship competition happening annually in Schladming.

1.2. STEER use scenario

Mu and his friend Nick travel from Lancaster to Schladming to attend the annual ski championship. Their friends Steven, Craig and Craig's housemate Matt couldn't make the trip. However, as skiing fans, they are interested in watching the live broadcast of the skiing championship though the event is not officially covered by any commercial broadcaster in the UK. Furthermore, watching live broadcast on TV or PC never matches the actual experience of attending the event: the friends of Mu and Nick are therefore also eager to hear reports of their Schladming trip directly from them.



Nick and Mu arrive at the Schladming ski championship. To share their experience with others at the event and friends at home, they use smartphones to capture short video clips of their trip.

At the ski resort in Schladming, joined by other skiing fans and tourists, Mu and Nick use their mobile phones and camcorders to record many short video clips that tell pieces of moments of the event.

Mu and Nick have both previously subscribed to "STEER", a social framework that enables the sharing of multimedia contents within a community of users on a cloud-based, distributed infrastructure. Through a STEER application running on their devices, Mu and Nick are then able to upload their clips to the STEER system.

Video clips shot by Mu and Nick are uploaded to the STEER Story-telling application by STEER-assisted distribution networks for sharing in STEER communities .

Spyros and Nikos, who are members of another group of skiing fans who travelled from Patras to Schladming, are excited to experiment with another feature of STEER, which allows TV broadcasters that have been assigned the exclusivity for the coverage of scheduled events to contribute part of their material to the community, on a free or reasonable cost basis. The system provides synchronization tools for coordinating the view on a same screen of such material with the clips generated by the community members. Both types of streams may therefore be received live and watched side by side at the homes or hotel rooms served by the broadcaster, with the assistance of a stream ranking or recommendation facility that helps in selecting and assembling the available material. The composite view can as well be announced on the official event site and displayed live on the broadcaster channels.

Knowing that, unlike the UK case, the event is being covered by a local commercial broadcasting centre in Schladming and delivered to homes in The Netherlands by Dutch IPTV provider KPN, Spyros and Nikos take still pictures and register video streams from their mobile phones and camcorders, and post comments and reports with the intention of complementing the "official" live footage with their own perspectives of the ongoing competition. For example, Spyros is a huge fan of the Dutch female skiing champion Nicolien Sauerbreij and he tries to capture all of the disciplines in which she competes. Nikos, on the other hand, is more interested in capturing the whole atmosphere and surroundings of the live skiing event.

The friends of Nick and Mu back in Lancaster, as well as Spyros and Nikos friends Frank, Hans and Hans' housemate Omar living in The Netherlands, had expressed, as STEER subscribers, an interest in skiing or, more in general, a curiosity for their friends' public activities. As such, when they connect to the STEER system they are automatically notified of the availability of the various composite views of the Schladming competition.

Thanks to STEER algorithms, therefore, the various groups of people present at the event, who don't necessary know each other, are dynamically joined together without any explicit human intervention into a community that builds around the ski competition event and quickly expands to involve members that are located far from the event itself, possibly exploiting the "aggregation" facilities offered by other social networks they can be part of.

The group of Spyros and Nikos friends in Holland, for example, can see tweets and Facebook messages related to the event popping up next to the video frame where the broadcast channel is displayed, annotated with "sentiments", discussion topics and other media objects. The STEER system provides indications about the availability of media object streams related to the broadcast program, as well as a ranking of their relevance, through a semantic analysis of messages exchanged on social networks, so that each user of the system friends gets meaningful recommendations on what additional user-generated content they can watch next to the regular broadcast of the live vent.

The members of the community are also able to augment the set material produced by their friends with other videos or personal comments or annotations, which they can then contribute back to enrich the shared contents, therefore further increasing the possibilities of involving other interested people in the group.

Thanks to the fact that STEER supports both real-time content streaming and a caching repository for delayed content view, each user can enjoy the multimedia contents in their homes at their best convenience during the same day of the event or later on in the week.

Nick and Mu's friends can for example additionally recommend some of the clips to their friend Omar in the Netherlands who also loves skiing. At the time Omar gets these recommendations, he is at home playing with his kids with its laptop so he tags the clips in order to watch them the next morning on his mobile phone, when he would be in the train going to work.

1.3. STEER on demand storytelling application

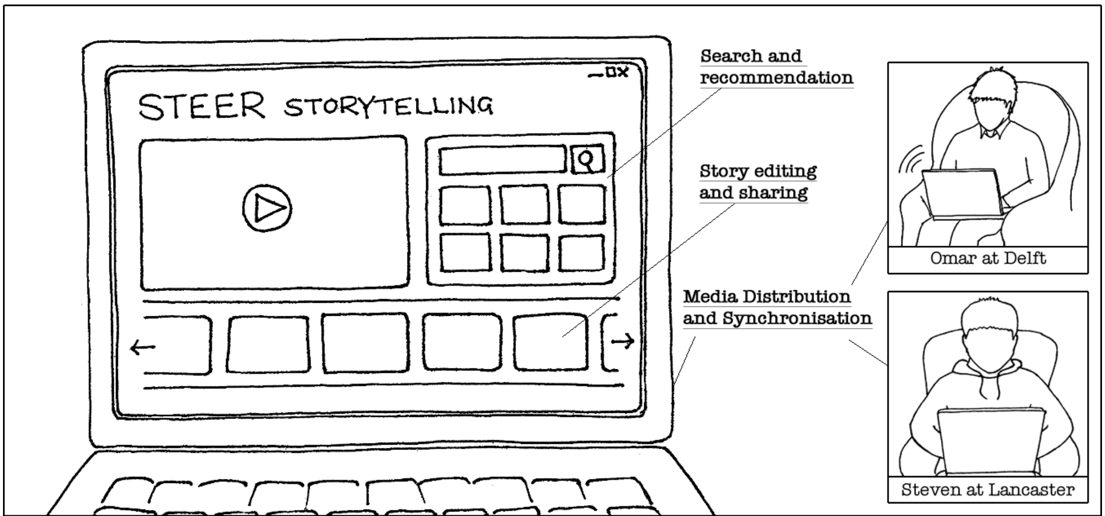
Back in his hotel room, Nick enjoys all the videos shared by the STEER community and makes a video story of his day using his own videos and shared videos.

When Mu returns to his hotel room, he is able to search all the videos he and Nick uploaded from their mobile phone earlier in the day. Using a STEER "Storytelling" application, Mu selects a few video clips that best tell the great moments of the day, downloads them temporarily on the shared network storage system accessible locally through the hotel access gateway which his laptop is connected to, and assembles them to form a single, cross-linked "story". The story shows his day far more vividly than he could have ever done using only text and photos.

The network side of the Storytelling application then detects Mu's editing activities at the ski resort and intelligently recommends his new stories to other members of the "Schladming" STEER community.

Back in Lancaster, Steven, Craig and Matt, because of their social connections, are therefore notified of all the stories created and shared by Mu. Craig and Matt are busy at that moment, and decide to come back and check Mu's work the day after. On the other hand, Steven chooses to immediately watch the stories. While doing so, his STEER-assisted smart home gateway also caches the downloaded media objects that compose the video story, all of high quality, on a local storage device. This allows the same contents to be retrieved from the device when Craig and Matt look at the story later on, minimizing the network bandwidth occupation thanks to the proximity of Steven and his friends' households in Lancaster.

Unfortunately, when the day after Craig connects to Steven's home network and initiates the streaming the stories from the storage device attached to the gateway, the access network starts experiencing congestion that reduces the end to end bandwidth below the bit-rate at which the video clips of Mu's stories have been encoded. Luckily enough however, Steven's gateway hosts a STEER application that has been downloaded and recently updated from a STEER Service Portal and that is capable of estimating in real-time the available upstream bandwidth on the ADSL link. Based on this information, the transcoding function which is also incorporated in the gateway automatically decreases the video resolution of the clips while streaming them on the fly, without modifying the original stored data. This in turn allows Craig to keep watching the story, albeit with a (temporary) lower quality. Since Steven's gateway also supports differentiated Quality of Service (QoS), it will as well be able to reserve suitable bandwidth resources to the value-added services that Steven subscribed to from his telco provider, which include VoIP telephony and an automatic network-based remote backup service. The combination of QoS enforcing and transcoding capability therefore ensures the nice coexistence of STEER data exchanges with Steven's paid services in all usage conditions.



Using a number of STEER technologies enabled in the Storytelling application, Nick and Mu share their stories with their friends at Delft and Lancaster.

The gateway transcoding capability is also exploited when Matt, who visits Steven at a later time that day, starts watching Mu's video clips on his smartphone, which Steven has granted access to his home Wi-Fi network. This time the transcoding is activated, with suitable configuration parameters, because the Wi-Fi link has temporarily a limited capacity, as again determined by the gateway bandwidth estimation application now applied to the home network, and at the same time the smartphone display has a resolution which is lower than the resolution which the clips have been recorded at. As for the case when Craig accessed the contents on Steven's local storage from his home, Steven can for example place a VoIP call at the same time as Matt is watching STEER content without any impact on the voice quality even if the home bandwidth resources become congested.

Back in Schladming: when Mu and Nick return to their hotel room at one night after the Championship, they notice that Steven and Matt are available online and eager to listen again to their stories. Mu and Nick immediately open up a live story telling session so they can show the video story they made earlier and add synchronized voice comments to the moments recorded in the story. The session is maintained so that Mu and Nick's shared story and voice are synchronised at all their friends' locations. This facilitates interactive discussions between all members in the story telling session. Steven is also able to add to the story the videos he made from his previous visit to the ski championship.

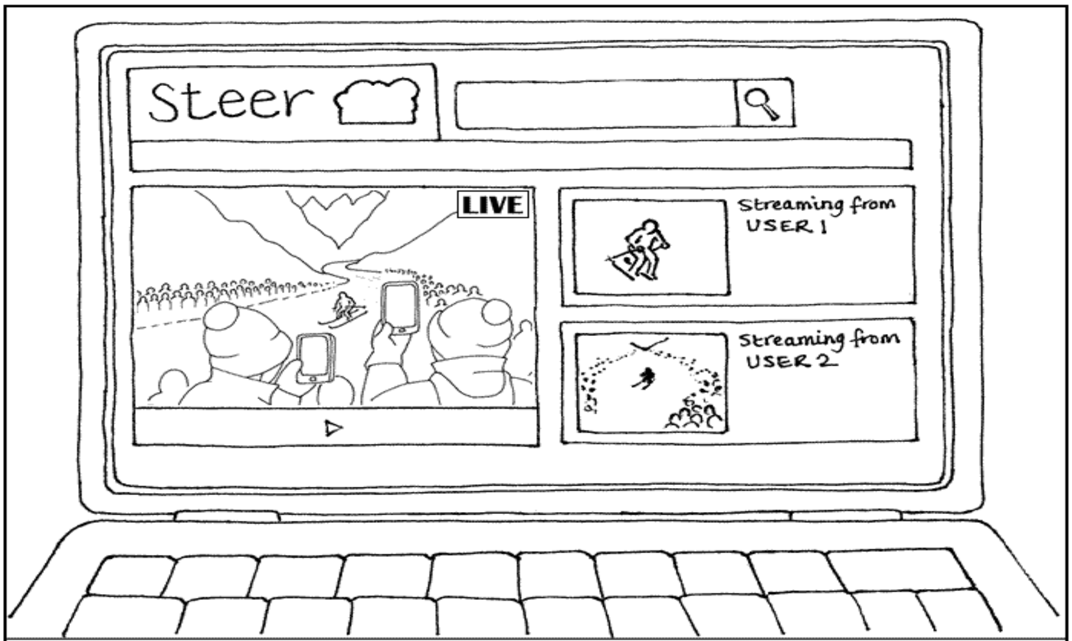
Based on records of the previous activity of all friends around Schladming stories, the STEER system had also been able to determine that all or part of the contents produced so far should be conveniently proactively cached either on network nodes closed to friends' houses, or one or more of their home gateways, at a time when the distribution network was relatively unloaded. The relative "closeness" of storage elements and end users of the system is derived from a suitable metric that is able to account for the amount of resources involved and available in the network on the associated links.

The effectiveness of this way of sharing media is optimized, and the amount of resources required is minimized, thanks to a novel social-aware Peer-to-Peer (P2P) live streaming infrastructure that STEER has architected to make the best usage of the distributed facilities (computing, local storage, upload bandwidth, transcoding capability) and made available by the STEER users involved in a community. A better insight of the capabilities of the access network links and home networks of the various STEER users that employ a STEER home gateway can be gained thanks to the periodic collection of statistics indicators performed by the STEER portal.

1.4. STEER augmented broadcast (live) application

Back in The Netherlands, Omar is now interested in watching the live event broadcast. Since he registered himself as a STEER Community Member, he is able to augment his viewing of the live broadcast with the additional live streams that his friends Spyros and Nikos are generating at the event. Through the STEER system, many additional live video streams are available to Omar, even from people that he does not know. However, through the analysis of data about the event, communicated on social networks, the STEER system can detect what video streams may be relevant to Omar, and present additional options to him. The analysis of Tweets and Facebook messages allows the STEER system to detect which video streams are rapidly becoming popular. Also, the STEER system can detect if people like or dislike video streams, or if sub-events occurring give rise to positive or negative feelings.

Since Omar can see the various video streams side-by-side, it is important that the videos show the same event in a synchronized manner. Fortunately, the STEER system provides heterogeneous media synchronization, which allows for synchronizing media streams from different origins, transported over different delivery networks. Omar can even see the additional streams on his tablet, fully synchronized. The same holds for any social network messages that Omar likes to see, next to the videos.



STEER users watch live streams from broadcaster and other users at the venue side by side.

The STEER system has detected that one particular video stream is becoming very popular. The person providing this stream has a track record of providing semi-professional capture of events and is already a trusted identity in the STEER community. However, his most recent live stream is becoming so popular, that additional measures are required to handle the efficient distribution of his particular stream towards many interested viewers.

2. STEER functional model

2.1. Definitions

STEER defines a functional model that encompasses all the facilities that make possible the use case presented in the previous sections. To formally introduce this model, some of the key terms used are defined below.

Event:

An event is characterised by a combination of time and location. For instance, “New York, Great Central Station, 12.22h” is an event.

An event can be scheduled and publicly announced, such as in cases that event is foreseen to be covered by a live or registered TV or radio programme. The “Schladming Alpine Ski World Championship” is one example of this type of event.

Other events are implicitly defined by persons witnessing circumstances that they believe are of some interest to people they know or can establish relations with: in this context, the event materializes around the personal views and media contents captured on the fly using mobile devices, which are shared through a social network infrastructure. A “sub event” of the main Schladming event, which may e.g. concern a competition for amateurs that happens at the margins of the main ski slope and that the broadcaster cannot cover, may represent events of this class.

Finally, an event can be identified in retrospect, by analysing logs and statistics of the storytelling application (see below) and/or clusters of activities happened at a certain time and referring to a given location.

For all these kinds of events, STEER provides means for dynamically forming and advertising communities, and an infrastructure where the information can be exchanged and enjoyed efficiently

Community:

A community is a group of people that is formed in a social media framework, or cross-linked frameworks, either explicitly or implicitly, by a system-assisted aggregation of a group of friends and/or people with share a common interest in an event (e.g., “Schladming Championship”) or “sub event” (the collateral amateur competition).

“Implicit” communities are therefore defined by the criteria used by selecting their members; rather than be constrained to explicitly specify a membership list. Such criteria may be dynamic, evolving in time to better reflect matching interests.

Communities may eventually dissolve, when no more activity is taking place around the interests that originated it.

(online) Social Network:

A social network is an online service where users can register or become members and are able to connect to other users. Online social network offers functionalities to share content with other users, groups or with the entire network. Many different social networks exist, offering their own specialized functionalities. Besides the more generic Facebook and Google+, examples of specialized networks are LinkedIn, Pinterest and Instagram.

(STEER) User:

A STEER user has registered with the STEER services for logging in. STEER users are often connected to users within the STEER community, or in other social networks.

Media Object:

Media objects can be any type of multimedia content, for instance video, audio, text messages or a combination of these.

Media objects can be created by members (or future members) of a community, for instance using smartphones, tablets or PCs or originated within the context of a professional activity, such as the production of TV programs. Media objects may be conveniently indexed by a unique identifier or a hash, which help referring to them in a synthetic way, and have associated metadata, which convey information such as their title, description, taking location, time, and other specific tags.

Media objects may be "live", e.g. in cases where they are broadcasted from a central point, or be recorded and stored for delayed retrieving and playback.

Story:

A story is a composition of media objects that, together, and when seen in a specific order or placement, forms a narrative of what a user has experienced in an event, or an overview of the live experience at the event A story can also be the result of the effort of a group of people, or even a community, when more people have collaborated or collaborate to aggregate and order media object components.

Storytelling:

A "storytelling" application offers a variety of tools to a user to tell a story about an event. Since a story is a logically ordered collection of multimedia objects, the storytelling application supports a number of functions to retrieve, index, annotate and forward media objects for story building and sharing.

Augmented Broadcast:

An "augmented broadcast" application offers a variety of tools to a user to experience a live view about an event. It can present the user with a number of video streams, some from a professional broadcast, some user-generated. The augmented broadcast can be interpreted as story where the live video streams are logically ordered into a spatial collection of multimedia objects. The augmented broadcast application supports a number of functions to detect, retrieve, synchronize and deliver media objects for story building and sharing.

2.2. The STEER model

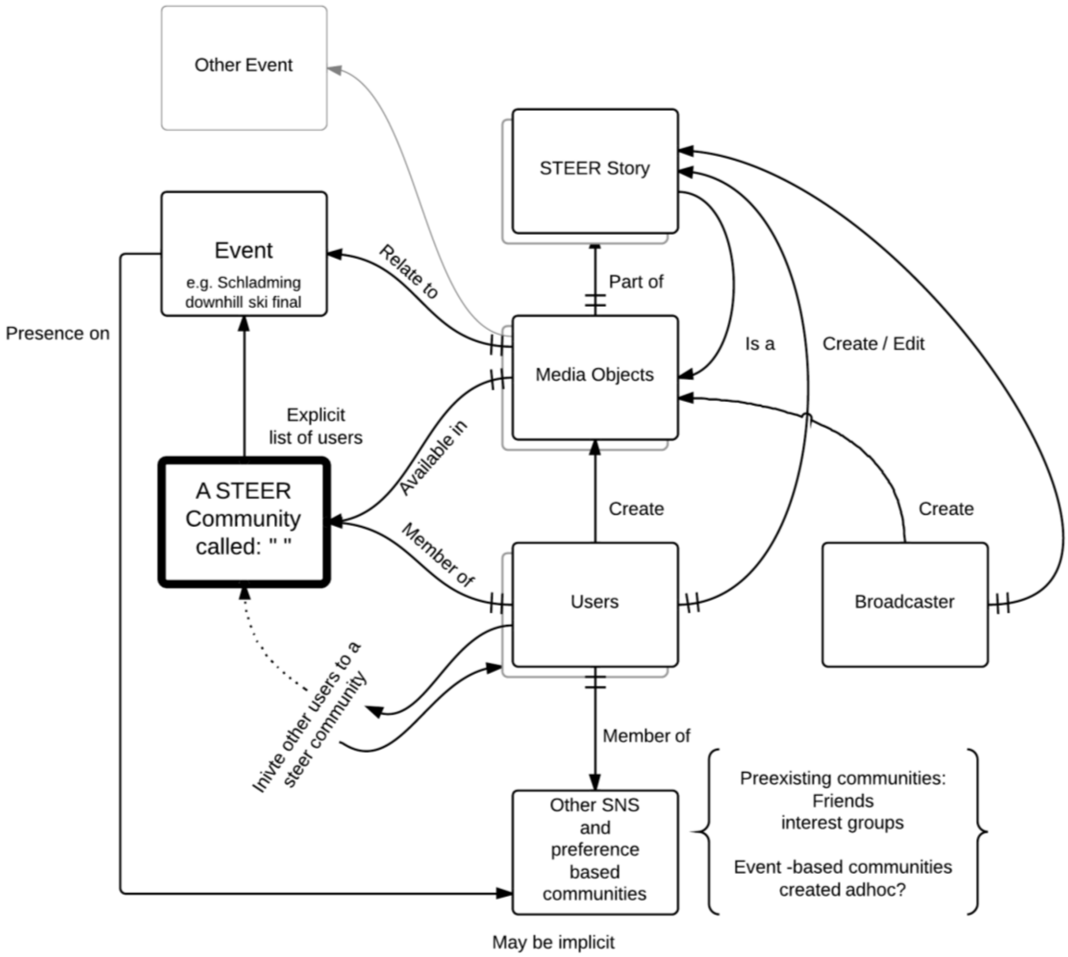


Figure 1 STEER Model.

Figure 1. represents the mutual, multi-faceted, dynamic relationships among the various functional entities that compose the STEER system.

The most central role is played by the **STEER Community**. Each STEER Community, either explicitly or implicitly defined, is represented in a central database to be exploited by relevant STEER technologies. A STEER Community is related to one specific **Event** and includes multiple **Users** as its members.

Users can create new **Media Objects** by uploading or up-streaming their media content. Media Objects are processed and stored in a media object database, or delivered directly towards other members of the STEER Community.

Each Media Object is related to a specific Event (or a set of Events), through which the Media Object can be searched or linked. The STEER system supports multiple types of media objects, including live and on-demand video, audio, photo, and aggregated types.

A STEER **Story** is a special composite media object, which contains other media objects. Through a ***storytelling*** application, members of a Community can collaboratively compose and edit STEER stories to share the experience of a community.

An ***augmented broadcast*** application allows members to directly view streams from other members as part of a composite Story that also contains live broadcasts from the event. In a broadcast-centric scenario, a **Broadcaster** becomes a member of the STEER Community and may host elements of the STEER system. In a user-centric scenario, a Broadcaster only provides additional Media Objects that can be consumed or incorporated in Stories, next to Media Object contributed by members of the STEER community.

While being members of a STEER Community, Users are often also members of other social networks such as Facebook, with which they maintain unique sets of relationships. Events often also have representations on these other social networks through "groups", "communities", or event organisers creating their own account for the event. Through this presence, STEER Communities and Stories have the means to manifest themselves on existing social networks, leveraging such social connections in a way that would otherwise not be possible.

It must be noted that the one-to-one mapping shown in Figure 1 between a STEER Community and an Event is not in any way restrictive, since multiple child events, or "sub events', can be derived from an event when the system users feel an opportunity for that. For instance, the Schladming World Ski Championship event referred to in Section 0 may have originated sub events that relate to e.g., a specific discipline, a side-event, or just even a visit of a group of friends.

2.3. Additional details of the STEER model

The following sections provide a further insight into the various elements of the STEER model, its underlying functionalities, and some of the implications that the implementation of this architecture will have on the project organization.

2.3.1. Event boundaries

Most events are characterised by the fact that their reach goes beyond the borders of the location where they happen and involve a larger group of people that those physically present in that place. Television, social media, news, etc. stretch the virtual boundaries to wherever people are interested.

How such perimeter is extended is largely dependent on the social infrastructure that the event can amalgamate, i.e. the way people with alike interests aggregate around it and aid spreading the related contents by recommending them to persons they are acquainted with or can get in contact with, possibly exploiting the knowledge of their attitudes and tastes.

Social informatics helps improving this content discovery activity by providing automatic tools for mining data interspersed or even hidden in the social networks.

In particular, the STEER system builds user profiles with information of their social connections, tastes, view history, etc, which it complements with attributes about media content they have been interested in, including for example related keywords, location and time of production: the system then uses these components to feed its recommendation algorithms and to further expand discovery of linked content.

2.3.2. Detecting relevant media objects

Intelligent social informatics modules in STEER operate in the background within the network data space produced by users of the STEER system, or on other social networks linked to it, to extract "sentiments" referring to entities such as sub-events, media objects or other "elements", like a person, a company, or a location.

The analysis is done with the aim of inferring a correlation between entities and a main event, either already existing, or being potentially discovered as the result of the analysis itself.

The social informatics algorithms measure an entity novelty, importance and potential impact based on its statistical characteristics inside the networks it propagates within, as well as any associated metadata and correlated factors such as references on the Internet in press web sites, databases, etc. The algorithms also automatically evaluate the reputation and authority of the users involved in the production and handling of the entity, which are other factors that determine their importance and relevance.

The social informatics modules eventually construct an importance-weighted entity-graph, which, being continuously updated, is exploited to aggregate user groups, or communities, around events associated with entities, and enrich the live viewing experience of the members of communities that have been already formed.

In this way, for example, STEER users watching online a live footage about an event can access a dynamic list of entities provided by the STEER social informatics modules, ranked by their importance with respect to the event and visually scored according to their popularity (e.g. using hues within a colour gamut). When a user clicks on one element of such list, he can then obtain a collection of the most important media objects linked to the concerned entity.

2.3.3. Community formation and identification

Communities can get associated to an event in various forms. For instance, for scheduled events, an organising committee could explicitly create an "official" community. Alternatively, communities can be created directly by STEER users, often in relation to a specific interest branched from an existing event (for instance, the community of Schladming personnel interested in the event conduct).

Communities may also be formed automatically, by the event/media object -detection algorithms in the previous section, relying upon a semantic analysis of the metadata associated to materials such as user-uploaded or professional video clips, and other forms of feeds. As soon as a new event is detected which is not yet known by the system, a new community can be formed. Users who happen to be at the event are recommended to join this community, in order to follow what is happening at the event. More specific sub-communities related to special topics can also be suggested.

Communities can then be possibly linked to communities on other social networks such as Facebook and Twitter.

Since communities are linked to events and events are linked to location and time, existing communities can be found by users on an event timeline (as in Twitter or Facebook), or on a map or by other location-based services.

2.3.4. Story composing and sharing

Users can compose a story by connecting a series of audio-visual media objects characterised by their temporal, spatial, event, or social relations. When a media object is shared by a user or a professional content provider, a wide range of metadata types is typically associated with it. The metadata are either provided by the uploader explicitly, or are generated by the tool that ingests the object in the system. Metadata can then be exploited by any user to retrieve media objects that conform to the user's specific search criteria.

The search function is provided by one or more web servers, which also support a virtual space, or "storyboard", available to users for storing and cross-linking the selected media objects. A story in the storyboard can be saved on the server for editing at a different time or on a different user device.

A user can also share his story with other users or the entire community by either manually adding a known user to his viewer group or setting up an auto-sharing function using his friend list. Permission can also be granted by the original story creator to other users so that multiple users can edit a story collaboratively.

2.3.5. Live story telling through augmented broadcast

Bigger events are often on-going events, spanning multiple hours or even days. Many different types of media give live (TV, radio, streaming video) and delayed (TV, web video) coverage of the event.

Especially for live coverage, media synchronization is an important issue. Maximum acceptable propagation delays for live television are in the order of 7-10 seconds, but in practice these figures should be decreased to prevent the "neighbour-yelling phenomenon", where a viewer hears his neighbours yelling for something happening on their screen (a goal, an important guest appearing) while he is still seconds behind that same event. More than being just annoying, this destroys the experience of watching live, of being part of the moment. Particularly when media from different sources, or using different channels, are combined, this also imposes an even bigger challenge for synchronizing different media, since there are additional constraints to the possibility of achieving a correct result.

2.3.6. Synchronizing and sharing the experience

The STEER system enables heterogeneous media synchronization by developing and incorporating inter-media, inter–device and inter-destination media synchronization, for shared media experiences such as live augmented broadcasting.

Examples of the need for media synchronization are:

- chatting on the viewed content between users live at the event location and users at home, where chatting is seen as user generated content rather than real-time communication;
- interactive quiz or betting, as part of a shared experience where each user can join the game at his or her own location and no substantial advantage must be given to any of the players;
- when a group of dispersed friends watch and comment on an existing video story at the same time (such as in a group call), there is a requirement for a storyteller to alter the playback of story which results in synchronised changes on all participating user devices.

There are a number of major challenges for providing these synchronization features, which will be explored in the STEER experimentations:

- Proper timestamping of different sources: live event broadcast material should be timestamped with a real-world time bases during capturing, and these timestamps should be kept as they are in relation to the content during its distribution. Content generated by users at the live event should also be timestamped with real-world time. Content generated by users at home should be timestamped with the real-world-timestamp of the content currently playing at home.
- Clock synchronization: if ensuring a common clock among all relevant streams is not possible, clock synchronization is required to accommodate inter-clock differences and the clock drift.

2.3.7. Media object distribution

Besides supporting the conventional methods of exchanging media on the network, the STEER system incorporates a novel P2P live streaming architecture, which develops on the social relationships of the producers of live contents, discovered through STEER communities. This architecture will hopefully be able to efficiently exploit the resources that, as further explained in Section 4, may be locally available to STEER users, especially in terms of upload bandwidth and processing capabilities for on-the-fly transcoding.

Tied to this approach there are two major challenges whose assessment will be covered in the STEER experiments:

- The feeding of P2P overlays with the network addresses of STEER user devices that are in their homes and are socially connected with the STEER users that participate in a media event, as the former will (potentially) consume the media objects that the latter will generate: therefore, resources of home users can be effectively exploited in order to increase the efficiency of the live distribution of generated media objects.
- A novel congestion control algorithm suitable for P2P live streaming that will be "friendly" to the other TCP flows of the underlying network, will exhibit low delay and high stability as required by live distribution, and will interact efficiently with the synchronization algorithms that STEER will also develop.

2.3.8. Broadcaster-centric and user-centric augmented broadcast

As mentioned in Section 2.3.5, STEER envisages that users participating in events will have the capability to broadcast media objects by ingesting the streams they produce into a local broadcast facility, therefore contributing to the services that such facility provides.

Depending on specific situations, the broadcast facility may or may not have a central role in feeding and timestamping (see Section 2.3.6) the P2P overlays.

In the latter case, defined as "user-centric" augmented broadcast (as opposed to "broadcast-centric" augmented broadcast, which refers to the other possibility) the STEER users will be able to take over, in part, the role and the services of the broadcast facility to preserve the overall Quality of Service (QoS) and Quality of Experience (QoE) (in terms of stability and efficiency) of live distribution.

Towards this goal, the critical research challenges and the experimentation objectives for STEER will be:

- the coordination of a decentralised timestamping scheme that can replace the one otherwise provided by the broadcasting infrastructure;
- the provision of the means for ensuring the stability of the social aware P2P overlay architecture mentioned in Section 2.3.7 without the assistance of media servers;
- the highest possible exploitation of the overall upload bandwidth, distributed among the users that cooperate for the live sharing of each media object.

The achievement of the latter two objectives can be facilitated by implementing a scalable and accurate real time monitoring of the total upload bandwidth of the involved users and, in case such bandwidth is shown to be insufficient, the exploitation of the real time transcoding capability that STEER envisages should be available on the users' home gateways (as will be further elaborated in Section 4.4). Albeit this may cause a temporary degradation in the quality of the retrieved media object, the overall impact on the user experience is believed to be much more acceptable than that caused by an abrupt interruption of the media streaming.

3. Major STEER functionalities

This chapter elaborates on the major innovative functionalities that STEER has to develop in order to support the aforementioned scenarios and perform experiments in a real system according to research objectives established for the project's work-packages number 3 and 4.

3.1. Creation and management of STEER communities

3.1.1. Creation of an event

As discussed in the Section 2, each STEER community is directly mapped to an event. Therefore "event" and "STEER community" can be used interchangeably.

There are two possible ways for the creation of an event that STEER will examine during the experimentation phase:

1. **Explicitly defined event**: A user who creates a media object explicitly assigns a newly created event to the media object as part of its metadata. An event can be defined by a geographic location, a timestamp and, if available, an event name. Alternatively, an event can be announced in advance, and any related media object connected to it at a later time.
2. **Implicitly defined event**: An event detection algorithm, which resides on a STEER background server, defines new events based on multiple analysis criteria. For instance, when parsing media creation logs, a new event is recognised by the time clusters of media object recordings taking place within a small time span and at more or less the same location. All objects in the cluster are automatically attached to the same event.

A centralized event database will be employed to store event information and also host the event detection algorithm. The database can be queried for lists of events and for lists of media objects belonging to a specified event.

3.1.2. How STEER employs communities

A user can explicitly define a community by creating a community ID and assigning descriptive information to it. Upon creation of a community, a number of users can be associated (invited) and an event can be specified. The community can also be defined and maintained by a social analysis system, which will be realised using STEER technologies. The system exploits social analysis toolsets to analyse social networks and extract relevant social information, which will be subsequently used to constitute social context, detect social events and recognise social communities. The communities may be defined implicitly by the analysis system or explicitly by users or broadcasters that participate in STEER. The method (implicit/explicit) according to which communities are created will depend on the purpose that each community has to serve. Users define a community mainly for the purpose of communication while a STEER social system may favour forming *virtual* communities of implicitly related users and events to facilitate a range of social activities, such as content searching and recommendation. Such a purpose-built virtual community is usually constructed dynamically and may not be persistent.

Although there are a number of existing tools such as the Facebook API and Twitter API to facilitate data mining from social networks, there is currently lack of research on dynamically formation of community using key metrics to enhance social activities. There are clearly challenges in defining models and algorithms to extract a user's social context and detect social events.

STEER also links to the concept of a community of other social media, such as Facebook groups, or people following the Twitter account made by the event organisers. Many social-network users already create or join groups and share content on these groups. As depicted in Figure 1, friends on other social media can be invited by users to join a STEER community.

3.1.3. Recommendation of communities to users

Using a number of relevant social metrics such as geographical location, social graphs in social networks and user preferences, the STEER system quantitatively evaluates the match between any user and a number of candidate communities in multiple dimensions Based on such evaluation, the STEER system recommends a number of communities to the user with companion information such as the reason for any recommendation and recent activities in the recommended communities. User's decision to accept or ignore a recommendation will also be exploited by the STEER system to fine-tune metrics and algorithms for future recommendations.

The STEER system keeps track of which users are present at events, and their media activity (recording / watching videos). Based on the knowledge of history, consolidated in the social graph and information about user tastes, the system may then recommend communities related to the event.

Several problems have to be solved for this and should be answered during the project:

1. Event discovery, i.e. how to detect the existence of event at a certain location and time.
2. Event – community correlation, i.e. how to associate a specific event with communities that may spring into existence contextually with the users of the storytelling system. This could be a heuristics based system or explicitly defined by the user who creates a community.

3.1.4. User search for a community

Besides the ability for "automatic" recommendation of relevant communities, each user can search for a community using a number of keywords. The STEER system will process user's inputs and parse given keywords to semantically comprehend the search request. The results will be passed on to a STEER search engine, which will return a number of relevant communities. Meanwhile, implicit search terms (such as social context and location) will also be examined by the community recommendation system to adjust the search results for individual preferences.

3.1.5. Correlation of a community with a Facebook group

STEER storytelling communities are formed by the people who contribute to a story and by the people who consume the story. It is up the users to disseminate the story and other media objects to related social networks such as Facebook and Twitter. Whether or not this process can be supported and/or automated will depend on the accessibility to, and the quality of, tools that crawl Facebook and other social networks.

3.1.6. Targeted advertisements within a community

It will be free to anybody to provide media objects to the storytelling system. Commercial organisations having an interest in a specific event may provide professional media objects free of charge, or provide media objects containing commercials (clearly tagged as such). Commercial organisations may even endeavour to create their own stories in cooperation with "normal" users. As long as these organisations communicate their intentions clearly, we expect fruitful cooperation between commercial organisations and normal users.

3.2. User services within each community

This section depicts the functionalities available within a community and that will allow users to search, recommend, compose and distribute media objects in a social aware, scalable, low cost and stable way.

3.2.1. Uploading a media object to the community

Each user will be capable to upload media objects, which will be indexed in the STEER media object database. These media objects could be used by STEER users for operations such as media object consumption, media object search and media object recommendation.

The use case described in Section 0 considers media objects that are generated by multiple "media actors" exploiting the STEER system. These actors are:

- Professional full event coverage providers that own the rights to the event (e.g., music gigs, major sport events).
- Professional event coverage providers that support an event that where the rights are not protected (e.g. small gigs, ceremonies, local sport events, a car accident, a demonstration, a celestial phenomenon, etc.)
- Users that partially cover a scene of any type of event and want to share it with their "friends" (social relationships and/or other people with similar interests).

3.2.2. Consuming a media object from a community

All the aforementioned media distribution scenarios could be categorized and served by two services namely Live Media Object Distribution and On Demand Media Object Distribution.

Live Media Object Distribution concerns cases where a media stream is generated in a network node (usually in the event location). A set of users, who with high probability are socially connected, consume this object in real time in order to be informed about what is happening in the event.

On Demand Object Distribution has to do with consumption of a part of a media stream that has been generated at an earlier time. Users can consume this stream when they like, and in some cases a set of users (social group) may watch at it together for commenting and/or discussing it.

One of the major objectives of STEER with respect to these two services is to examine how they can take advantage of knowledge about social relationships and user resources, assessing how social sharing of resources can be beneficial for users, network and service providers. These objectives will be analysed in more detail in the next section.

3.2.3. Searching for a media object within a community

A conventional search function takes a number of keywords specified by a user and returns an ordered list of content whose attributes (such as metadata, text and hyper-text) best match the list of keywords. The STEER system will enhance such a search function by intelligently correlating the keywords and metadata with 'hidden' social information provided by other STEER functions, such as the knowledge of the user current geographic location and the record of events he has been involved with.

The STEER search function also exploits social information to organise the search results, through grouping and ranking, using a range of "social indicators" including the communities (and event) that the user is connected to, the popularities (hit rate) of media objects in linked community, and the user preferences as determined by the STEER system. Some of the signals are also exposed in the search results as companion metadata of the returned media objects, to improve user experience and refine future search results. One example of companion metadata may be "Hot in Schladming Now".

3.2.4. Recommending a media object to a user

A user can manually recommend any media object or story to other members in the linked community. When the receiver of the *user recommendation* is a particular user, an explicit notification is triggered. When the recommendation is made to all users, then the target media object receives an increment in its "vote" metadata. This is then exploited by the STEER systems for the search function and to provide (e.g. through the storytelling application) its own recommendations about the most popular media objects, with the aim of facilitating social interactions between implicitly connected users and to improve user experience in social sharing within a community.

3.2.5. Creating a story

A story is initialised by a user (owner), which results in an empty storyboard and a unique identifier for the story. The owner of the story can then add other users or an entire community to the storytelling group, which can therefore end up to be as small as one user or as large as the entire public. In the latter case, people are able to contribute their own video clips to a shared story shown on a display unit in a public place. Any group member can add or change media objects in the storyboard. It is also possible to finalise a story by disabling the editing functionalities.

3.2.6. Consuming a story

A user can explore and consume all media objects and stories that he/she has access to. The access can be manually configured by an invitation, or inherited from trust in social networks. When stories are consumed on user devices with different capabilities, video streaming of specific quality levels and selected distribution mechanisms are enabled to optimise the user experience. A story can be consumed either in an offline or a live fashion. In the offline fashion, a story is watched by anyone at any time of his/her own convenience. In the live fashion, a presenter tells a story to one or multiple parties by triggering the synchronised playback of the story on multiple (local and remote) screens. Everyone in the party can add (voice) comments while the story is being shown.

4. STEER media distribution system

This section provides hints on how and why the STEER system exemplifies an innovative real time media distribution architecture that, by exploiting social informatics to optimize the resources of participating users, can realize a more scalable, lower cost and more stable infrastructure for delivering media objects with higher quality.

4.1. QoE, low cost and social aware live media object distribution

Today, video streaming systems account for a considerable percentage of the Internet traffic, which according to Cisco will exceed 90% of the globally exchanged Internet traffic by 2015. On the other hand, major video on demand service providers, such as YouTube, suffer from high bandwidth costs. Many efficient content distribution architectures like peer-to-peer (P2P), adaptive HTTP streaming and caching have therefore recently received a lot of research focus, as they aim at achieving a better trade-off between bandwidth costs and quality of the transmitted video, while increasing the overall system scalability. Major requirements for such kind of systems are:

- **Efficiency** of the video distribution, which aims at achieving the highest possible utilization of the upload bandwidth of participating peers in order to reduce the usage of more expensive, networked media servers to the minimum extent required to deliver a media object with the desired (or anyway acceptable) quality. This will of course have a beneficial impact on the trade-off between bandwidth costs and video quality.
- **Stability** of the system against factors that exhibit a great degree of variability, such as the heterogeneity of the bandwidth resources contributed by the participating peers and the associated aggregate bandwidth, the dynamic underlying network conditions, and the batch arrivals and departures of peers. These conditions have a serious impact on the QoS and consequently the QoE that the system can provide. An efficient P2P video on demand algorithm must therefore be able to react immediately to these dynamic conditions in order to reduce the bandwidth requested to the media servers (and hence the cost) without affecting the overall QoS.
- **Scalability** of the system, as determined by the amount of bandwidth and processing overhead that media servers have to contribute when the number of participating peers grows. For the design of a scalable system, distributed and real-time management and control architectures are required. In this way, as opposed to centralized architectures, it would be possible to obtain both a low bandwidth overhead from media servers, as control algorithms are based on the direct exchange of information among the participating peers, and low processing overhead, as peers execute these algorithms by themselves. Additionally, the system is able to execute algorithms in real time even if the number of the participating peers is very high.

By exploiting peer resources and by connecting them according to relationships derived from social informatics an even more efficient, scalable and stable media distribution systems can be obtained.

4.2. Social aware caching for on demand media object distribution

The storytelling application can cache a video story to be shared among STEER users on a compatible user device, such as a smart home gateway equipped with networked storage. In this way, future requests from users in a same household can be served directly from the gateway with very little start-up delay and minimal external network traffic.

Stories can also be proactively placed on storage points, prior to any user request, in network nodes that are close to the users who are likely to consume them. Storage points could be service-caching facilities or user's local storages. The estimation of story consumption is based on user preference as well as the corresponding relationships between users in social graphs. This guarantees that a story can be consumed with the least impact from network impairment especially during peak hours.

4.3. Bandwidth monitoring

In previous sections, the necessary bandwidth in relation to QoE or QoS is mentioned. Bandwidth in this concept is the maximum available or necessary data capacity in an end-to-end chain between the service located somewhere in the cloud or network and the application that the user is running from a device at his home. Generally speaking the "cloud" is composed of networks that are closely monitored by companies such as hosting companies, Internet Service Providers etc. where access bandwidth is not an issue anymore due to Gigabit networking technologies and high speed access technologies like VDSL (Very high speed Digital Subscriber Line) and FttH (Fiber to the Home). The expected bottlenecks for available bandwidth will be found more and more in the users' home networks. The home network nowadays, from a monitoring point of view, is becoming more complex due to a multitude of devices such as tablets, smartphones, smart TVs, media players, PC's etc. The way the devices are connected to the home network varies greatly due to a multitude of possible connection techniques like Ethernet, Wi-Fi, POF (Plastic Optical Fiber), PLC (PowerLine Communication) etc. that can be used. In most cases the user has no knowledge about how his device is connected to the internet and generally does not care as long as the applications and services work as expected. If the application or service does not work as expected because of insufficient bandwidth the customer may get annoyed and stop using the service. Bandwidth monitoring, especially for the home networking domain, can detect and alleviate these issues and will therefore be a part of the STEER system. The main aim is to improve the end user experience while using the STEER applications at home.

4.4. The role of the home gateway

This section briefly describes the characteristics of recent high-end Home Gateways (HGs), how such devices will play an important role in the use case addressed by STEER, and the functionalities that, more particularly, will be object of study and development for exploitation in the project.

4.4.1. The home gateway as an "open" platform

Traditionally the HG has provided routing and NAT/firewall functions to end-user devices in the home, attached to simple or heterogeneous (and frequently coexisting) networking technologies (such as Wi-Fi, Power Line Communication, Bluetooth, Zigbee, Ethernet, MoCA (Multimedia over Coax Alliance), ...), possibly with support for Voice over IP and additional capabilities such as in-house shared storage and printer server.

More recently, the inclusion of a standardized and secure execution environment on top of the HG software stack, a representative example of which being the standardized Java-based framework defined by the Open Services Gateway Initiative (now OSGi Alliance), is introducing the possibility for handling dynamic software modularity, making it possible to exploit HG processing resources for executing applications that enhance, or even go beyond, the traditional HG networking functionalities.

Whereas in customary scenarios the HG has largely been provided at a subsidized cost to customers as a pure enabler for connectivity services, the availability of an execution environment would let the telecommunication operator, or Broadband Service Provider (BSP) as it is also referred to, or even other Application Service Providers (ASPs) using the BSP as broker, to flexibly deploy, on a per-subscriber basis, value added services such as remote surveillance, tele-health / telemedicine, parental control, energy monitoring, energy saving, etc. These applications may reside entirely on the HG, or use the HG as a gateway to reach other devices in the home which a particular service can rely upon (e.g., the energy meter, telemedicine equipment and sensors, surveillance cameras, etc.).

In this context, the usage of an efficient and scalable infrastructure for the remote management of the HG and home devices assumes an increased importance, to cover the needs for customer-specific device configuration, control, monitoring, application lifetime management (download, upgrade, verification, activation, start, stop, removal of SW modules) and service accounting.

Such a role can be played by the interplaying of networked servers which, together, encompass the more traditional role of remote device management (Auto-Configuration Server - ACS - using BroadBand Forum terminology) and a "service (or application) portal", where the latter function provides a web-based, user-friendly interface for customers to discover, install and activate value-added applications such those mentioned beforehand.

Especially in cases where these applications are more efficiently implemented with some form of a cloud-based support, the service portal will also exchange data with the HG or the user devices, for example to perform time-consuming, centralised post-processing of collected measure samples when this cannot be efficiently executed by the HG CPU, or to maintain large, service-specific databases.

The interest in this type of solution is testified by the wide support that recent activities on the standardization of the relevant network architectures, protocols and APIs (such as ETSI M2M, or Home Gateway Initiative) are receiving by the main players in this market segment.

Once consolidated, the new capabilities will turn the HG into a catalyst for interaction among devices in diverse technology ecosystems, realising a framework of "controlled openness" through which operators can engage with third parties to build valuable business partnerships, while always maintaining the benefits of a controlled, managed environment.

4.4.2. The home gateway as a "media gateway"

On a parallel but related ground, with the broadening of the variety and number of multimedia, fixed and mobile consumer electronics devices used in the home, such as video enabled smartphones, tablets and connected TVs, the opportunity of, and the request for storing and transferring large amounts of data both locally and across the external network is steadily increasing. Media content can be produced, exchanged and consumed in many ways, among family members, friends and larger communities. Data can be moved across personal devices (cameras, digital media players, PC, tablets, etc.) when staying at home or travelling (through suitable forms of secure remote access), downloaded from, or sent to the Internet, or received as broadcast or pay-per-view high-quality, high-value material from BSPs.

Data from the internet can be streamed for real-time viewing, or downloaded for time-shifted or repeated presentation, relying in both cases upon traditional internet routing or peer-to-peer overlay networks. The amount of data is potentially huge, due to the availability of high-quality audio, video and still picture material, including user-generated content.

Under the push of this trend, the HG is currently undergoing a further shift of its role in the home network to include the function of a so-called "media gateway", adding tasks that have been so far more typical of a set-top box, such as media acquisition, media protection, and media rendering. At the same time, the importance of the HG networked (and therefore shared) media storage capability is increasing. Many usage scenarios become possible in this context such as:

- premium content delivery to end-user rendering devices;
- centralized PVR with time-shifted displaying;
- "follow-me" playback (where on-going content streaming is suspended and resumed at a later time on a different device, either within or outside the home);
- extended remote control; and
- location-agnostic home content service.

4.4.3. The home gateway in STEER

The production, assembling and exchange of multimedia flows promoted by the enhanced usage patterns of social network and peer-to-peer infrastructures explored and developed by STEER enrich this picture and present new challenges and opportunities to the evolving HG.

One key advantage of using an HG augmented with all the capabilities described so far is that, by retaining its role as a hub for the entire home network and demarcation point between the home and the external network domains, the device is in the best position to perform the usage configuration of bandwidth resources, and enforce its control. This is facilitated by the fact that the HG is typically an always-on device (albeit possibly operating in a low-power mode), as opposed to other equipment that, by their nature or because of the increasing pushes or enforceable regulations for energy saving and power consumption optimisation, can spend significant time in a power-off or standby state.

As discussed previously, the BSP that owns the HG has increased opportunities of directly selling or mediating the offer of services on top of pure connectivity. In these cases, the operator is bounded by some more or less explicit form of Service Level Agreement with the customer, above the undifferentiated guarantee on the access link bandwidth. The BSP has therefore a key interest in trying to enforce, or at least control the QoE of the offered services, which in turn depends on the QoS that can be ensured for the relevant data flows on an end-to-end basis, along all the network segments including the home network.

This asks for an effective and dynamic, service-oriented bandwidth optimisation scheme, which is capable of preserving the quality expected from "basic" services, such as voice calls, and services for which the user pays a subscription (where such quality is also sometimes regulated by contracts between the owners of content and distribution systems), while fully exploiting the residual resources for all the other free, "best-effort" services, which may even have the same perceived importance as premium services by part of the family members, or in general during the time periods when the premium services are not used.

Using devices that can support this capability is obviously of particular importance for the STEER use case, which focuses on network usage patterns that BSPs have normally no straightforward interest to be involved with, notwithstanding their general willingness of preserving user satisfaction and minimizing the churn rate. While this is not a problem for basic access contracts, it can lead to some form of "self-defence" against a way of using resources that may be perceived as a threat, unless a clean and effective way of guaranteeing the interests of all the involved actors is available.

This goal can be obtained with the simultaneous integration of:

- the capability of distinguishing and classifying the various flows associated to specific services, and treat them differently in terms of allocated bandwidth and maximum delay and jitter;
- the capability of configuring service policies that guarantee service-specific QoE / QoS for premium and/or provisioned services;
- the capability of monitoring and estimating the available bandwidth for best-effort services with a sufficiently fine time granularity, both on the access and the home network sides; this can be extended to cover e.g., load balancing on multiple access network physical links and the automated discovery of local network topology; and
- the capability of tuning the bandwidth usage patterns of those services for which this is not in contrast with the achievement of a satisfactory QoE.

Based on the elements discussed so far, it should be clear that many aspects would need to be considered to obtain efficient and cost effective designs for supporting the various usage scenarios, which take into account networking technologies and protocols, as well as equipment functionality and implementation architectures.

Within STEER, however, only a limited number of specific areas can be reasonably addressed, possibly dealing with functional and physical building blocks that cannot yet be considered as mature. Bearing in mind that the assessment of technical solutions in this field is generally in a still relatively early stage, starting from the lack of availability of really cost effective hardware solutions, this is nevertheless expected to provide important elements for evaluating the effectiveness of the tools employed or developed in the project.

In this respect, it has been determined that, among the items mentioned in the bullet list above, the last two could fit well the overall focus of the project. In particular, effort will be spent on the integration in the HG of a transcoding capability that can be applied to audiovisual streams, whose real-time configuration is driven by information derived from other STEER components that can infer or estimate the most suitable video format (in terms of resolution and bit-rate) needed to represent the content on the target displaying device, considering the possible constraints on the available bandwidth due to the various factors considered above.

On-the-fly transcoding of digital multimedia streams generally refers to the operation of converting the encoding format of digital audio and video flows into another format while the streams are distributed from a content source (e.g., a storage device, or a live feed facility) to a content sink (a display, or target storage device), typically across a network link. The modified format may differ from the original in terms of various parameters including video resolution and frame rate, audio quality and component or overall bit rates. The stream format can be modified either at the source or destination device, as well by equipment traversed by the communication link connecting the two, e.g., a network node performing traffic bridging and/or routing.

Considering the previous discussion, it should be clear that this functionality, when performed on the HG, can become increasingly interesting in real application environments that, as those described above, involve the exchange of content across wide area and local networks, thanks to the fact that it can be used to both dynamically optimize the channel bandwidth utilization and allow end user devices with different capabilities (e.g., computation and rendering speed, display resolution) to share heterogeneous contents while limiting the quality loss.

As seen before, the home gateway is a very convenient point at which to perform transcoding, whose functionality can in this way be potentially shared among all involved devices. However, this is going to raise a number of issues related to the increased HG complexity and the relevant cost affordability (which are normally very sensitive aspects for this kind of equipment), and the best way of integrating the functionality with other service protocols.

Live and on demand real time media object distribution will exploit the capabilities that HGs now offer in order to enhance their features. Caching, transcoding and real time communication are the major functionalities that will be used towards this goal.

5. Conclusions

In this document we have presented a real-life use case and two derived user applications, namely the Storytelling application and the Augmented Live Broadcast application. Together they form a vision for a future ***community-centric digitally-based ecosystem*** (coined a “Social Telemedia”) system.

While this use case reflects STEER’s vision, it is not within the project’s objectives to fully implement the complete system needed to enable this use case. STEER rather wants to lay the foundations for such a system by providing key technologies and knowledge.

This use case will guide project members to proceed in the next project steps, namely: the definition of the overall system architecture, in whose framework research activities aimed at clarifying the mechanisms that underlie the engagement and aggregation of people in communities around events will be carried on; the development of applications enabling the key features of the system; and the set-up of the platforms where those applications will be experimented and the project goals assessed.

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