COntent Mediator architecture for content-aware nETworks

European Seventh Framework Project FP7-2010-ICT-248784-STREP

Deliverable D7.2
2nd Year Progress Report

The COMET Consortium

Telefónica Investigación y Desarollo, TID, Spain
University College London, UCL, United Kingdom
University of Surrey, UniS, United Kingdom
PrimeTel PLC, PRIMETEL, Cyprus
Warsaw University of Technology, WUT, Poland
Intracom SA Telecom Solutions, INTRACOM TELECOM, Greece

For more information on this document or the COMET project, please contact:

Mr. Spiros Spirou
INTRACOM TELECOM, spis@intracom.com

Document Control

Title: 2nd Year Progress Report

Type: Public

Editor(s): George Petropoulos

E-mail: geopet@intracom.com

Author(s): George Petropoulos, Sergios Soursos, Spiros Spirou (INTRACOM TELECOM), David Florez Rodriguez (TID), Ioannis Psarras (UCL), Ning Wang (UniS), Andrzej Beben (WUT), Michael Georgiades (PrimeTel)

Doc ID: comet_d7.2_v0.3.docx

AMENDMENT HISTORY

Version	Date	Author	Description/Comments
v0.1	07/12/2011	George Petropoulos	First version, ToC
v0.1.1	14/12/2011	George Petropoulos	Updated contributions, summary and conclusions
v0.2	16/12/2011	George Petropoulos	Integrated contribution by UCL and WUT
v0.3	22/12/2011	George Petropoulos	Final version

Legal Notices

The information in this document is subject to change without notice.

The Members of the COMET Consortium make no warranty of any kind with regard to this document, including, but not limited to, the implied warranties of merchantability and fitness for a particular purpose. The Members of the COMET Consortium shall not be held liable for errors contained herein or direct, indirect, special, incidental or consequential damages in connection with the furnishing, performance, or use of this material.

Table of Contents

Commercial in Confidence

(This page is left blank intentionally.)

1 Executive Summary

This deliverable summarizes the consortium's dissemination and standardization efforts to disseminate project's output in high-quality conferences, journals and fora, aiming to fulfil the required smart-objectives and targets of the dissemination and standardization plan. These dissemination and standardization activities mainly derive from the project's research and implementation efforts in WP3, WP4 and WP5 and are classified into 4 main categories: Concertation, Academic Dissemination, Industrial Dissemination and Standardization. Every section consists of the activities' reports, as well as a brief summary, highlighting the major benefits and objectives fulfilled.

2 2ⁿᵈ Year Progress Reports

2.1 Concertation

2.1.1 Activities

- **7ᵗʰ FP7 Networked Media Concertation Meeting, Trento, Italy, 14ᵗʰ – 15ᵗʰ April 2011**

  Gerardo García of TID presented an update of the COMET project and its future plans during the Networked Media 7ᵗʰ FP7 Concertation Meeting held in Trento, Italy from 14th to 15th April 2011.

  An additional presentation was made on 14ᵗʰ April 2011 in the Networked Media 7ᵗʰ FP7 Concertation Meeting as part of the Workshop on Overlay Architectures for Content Delivery, in which Ioannis Psaras of UCL presented the COMET Architecture and Gerardo García showed in a demo the main functionalities and benefits of the project.

- **Future Internet Assembly (FIA), Budapest, Hungary, 18ᵗʰ May 2011**

  o Francisco Javier Ramón and Gerardo García of TID, Prof. George Pavlou of UCL, Andrzej Beben and Prof. Wojciech Burakowski of WUT and Spiros Spirou of INTRACOM TELECOM attended the Future Internet Assembly on behalf of COMET project, held in Budapest, Hungary, on 18ᵗʰ May 2011. They participated in Information-centric Networking (ICN) session, organized by COMET, as well as other relevant sessions and events.

  o **COMET Information-Centric Networking (ICN) Session**

    Organisers: George Pavlou (University College London), Spiros Spirou (Intracom Telecom)

    Session summary

    The information-centric networking (ICN) session attracted about 100 people; four experts and six projects provided statements and contributed to the discussion with the audience. Each statement focused on content naming/identification, content delivery and business models. It seems that the session successfully brought together most projects working on ICN in Europe.

    George Pavlou identified peer-to-peer (P2P) overlays and content delivery networks (CDNs) as the "first step in ICN" in his introductory speech. He further suggested that the key issues in ICN are content naming, name resolution and content routing.

    Torsten Braun (University of Bern) made a point that in ICN "content should encompass services" and that ICN should facilitate "the composition of services". Prof. Ebroul Izquierdo (Queen Mary, University of London) suggested that in ICN the network should be aware of content encoding – particularly, layered encoding – and should "help in content distribution by prioritising different layers". Bruno Kauffmann (Orange, France Telecom) questioned whether "there are ICN incentives for players apart from network operators". Finally, Börje Ohlman (Ericsson) proposed that in ICN business models "compensation for content and transport [services should be] totally independent".

    Project representatives gave their statements as part of the discussion moderated by Spiros Spirou. Evangelos Markakis (ALICANTE project) explained how content access and delivery can be through a proxy, namely the "Home-Box". Francisco Javier Ramón (COMET) proposed a global content naming scheme based on a hierarchy of namespaces and emphasised on stateless content routing for scalability

purposes. Andrea Detti (CONVERGENCE) suggested two different content naming schemes optimised for the application and network levels respectively; he identified source routing as the mechanism for content delivery. Miguel Río (ENVISION) noted that the application should be primarily responsible for content naming and content routing; the network provides information to assist in routing decisions. Arto Karila (PURSUIT) described the use of separate content identifiers at the application, control and data planes; he supported a disruptive data plane based on the publish/subscribe concept. Finally Victor Souza (SAIL) advocated a content naming scheme in a URI format, coupled with a name resolution system that also records the content location.

The session concluded that ICN should essentially make P2P and CDN mechanisms part of the network, but deployment should be incremental. Incentives for content service providers and network operators are adequate but it is not yet clear how end users will benefit from ICN. Finally, the main research challenges are still in content naming and content routing.

Questions

- Why don't we just stay with existing P2P overlays and CDNs?
- What are the incentives for each stakeholder in ICN?
- Is in-network caching at the backbone necessary?
- Are content-based service policies compatible with net neutrality?
- Does the network really need to become something more than a bit-pipe?
- Can a content identifier refer to more than one content objects?
- How do content naming schemes deal with dynamic content?
- Is cooperation between network operators, as suggested by ICN business models, possible?
- Are networked operators convinced that ICN deployment can be incremental?
- What is the benefit of ICN to the end user?

Links and info
Session description: http://www.fi-budapest.eu/down/SDI1.pdf
Session presentations available: http://www.future-internet.eu/home/future-internet-assembly/budapest-may-2011/session-i1-information-centric-networking-icn.html

- **3rd FIA PPP Usage Workshop, Brussels, Belgium, 28th June 2011**

Sergios Soursos of INTRACOM TELECOM attended the 3rd Future Internet Usage Areas Workshop in Brussels, 28-29 June, organized by the FIA PPP, ExFI and CONCORD Project. In this two-day workshop potential use cases that should expand the current ones considered by the PPP were discussed. There were several discussions around the networked media area.

- **COMET architecture presentation to MMLab, AUEB, Athens, Greece, 6th July 2011**

Sergios Soursos of INTRACOM TELECOM was invited to the Mobile Multimedia Lab (MMlab) of Athens University of Economics and Business to give a talk about COMET. MMLab is a partner in the PURSUIT project which has similar objectives with COMET. In this context, Sergios Soursos gave a high-level presentation of COMET's objectives, architecture and approaches. Several discussions were raised with respect to the naming/addressing issues (e.g. global registry system), the relation of search providers (e.g. Google) and existing CDN providers (e.g. Akamai), the similarities of the coupled approach with DONA/CCN, the complexity of the decoupled approach, as well as whether content providers will open interfaces to their content servers for server load monitoring.

Commercial in Confidence

A follow-up was scheduled for MMlab to present the PURSUIT project to INTRACOM TELECOM, so as to have a better understanding of the commonalities between the two projects.

- **COMET project achievements presentation to FP7 EVANS project, 20th July 2011**

Dr. Ning Wang of UniS presented the COMET project achievements to the FP7 IRSES EVANS (End-to-end Virtual Resource Management Across Heterogeneous Networks and Services) project on July 20th 2011. The EVANS Project covers the general topics of network virtualisation and network resource management/optimisation, with content-centric network (CCN) being a candidate use case to be investigated. During the talk Dr. Wang introduced the overall COMET architecture and the coupled approach. Follow-up discussions were carried out with FP7 PURSUIT partners involved in the EVANS Project.

- **PURSUIT Summer School on Information-Centric Networks, Cambridge University, UK, 29th August 2011**

Dr Ioannis Psaras of UCL participated in the PURSUIT Summer School on Information-Centric Networks at Cambridge University, Computer Laboratory. COMET project was briefly presented and discussed with colleagues from the PURSUIT project. The respective link to the summer school is: http://www.fp7-pursuit.eu/PursuitWeb/?page_id=463

- **2nd COMET-ENVISION liaison meeting, Limassol, Cyprus, 15th September 2011**

The 2nd COMET-ENVISION liaison meeting was held during the 7th COMET plenary in Limassol, on September 15th 2011.

Attendants:
  o David Griffin (UCL) and partners from the ENVISION project
  o David Flórez, Francisco Javier Hernández (TID), George Kamel and Michael Howarth (UniS), Ioannis Psaras, Wei Chai, George Pavlou (UCL), Andrzej Beben (WUT), Michael Georgiades and Eugene Ciur (PRIMETEL) from the COMET Project

This meeting consisted of:

  o COMET and ENVISION presentations
  o Discussion on COMET-ENVISION interface.
  o COMET - ENVISION Joint Workshop

David Flórez, from TID, presented an overview of the Decoupled Approach of COMET project.

- **PURSUIT Plenary meeting, AUEB, Athens, Greece, 20th September 2011**

Sergios Soursos of INTRACOM TELECOM was invited by the Athens University of Economics and Business (AUEB) to participate in the opening day of the PURSUIT plenary meeting in Athens. In the opening sessions, the PURSUIT architecture was presented as well as the COMET one (by Prof. G. Pavlou of UCL) and there were discussions around the different perspectives of each project.

- **2011 NEM Summit, Turin, Italy, 27th September 2011**

Sergios Soursos of INTRACOM TELECOM attended the 2011 NEM Summit in Turin, 27-29 September 2011. He joined the sessions that directly or indirectly dealt with networked media. He also discussed with other participants about their views on content-aware networking approaches, due to either their involvement in relative projects or their commercial activities, thus getting informed about the state of the art in this research area.

- **Meeting with Alcatel-Lucent Bell Labs, Belgium, 18th October 2011**

Prof. George Pavlou of UCL, together with Dr Ning Wang of University of Surrey visited Alcatel-Lucent Bell Labs in Belgium on the 18th of October and presented the main ideas investigated in the COMET project, within the general framework of Information-Centric Networks. Colleagues at ALU gave feedback on the importance of ICN research and the role of the COMET project in the area.

- **Future Internet Assembly (FIA), Poznan, Poland, 24th – 25th October 2011**

David Flórez of TID and Andrzej Beben of WUT, attended to the FIA held in Poznan in October 24th - 25th on behalf of the COMET project. Apart from the plenary sessions that opened and closed the event, David Flórez attended to the following parallel sessions:

  o Media roadmap

  o Research roadmap

  o When infrastructure meets the user

- **Meeting with Jim Roberts of INRIA, 9th November 2011**

Dr Ioannis Psaras of UCL had a private meeting on the 9th of November with Jim Roberts of INRIA, France, a leading expert in Internet traffic engineering, who is very active in ICN research and participates in the French national ANR CONNECT project. ANR CONNECT is focusing on content-centric networks with the starting point being PARC's approach to ubiquitous caching, hierarchical naming etc. Therefore, the two projects are in the same area and focus on similar topics. During the meeting, the main ideas of the COMET and the ANR CONNECT project on traffic engineering, in-network caching and content resolution were presented and discussed. Feedback was given from both sides.

- **3rd COMET-ENVISION liaison meeting, London, UK, 9th November 2011**

3rd COMET-ENVISION liaison meeting was held during COMET's 8th plenary, meeting on November 9th 2011.

Attendants:

  o David Griffin (UCL) and partners from the ENVISION project

  o David Flórez, (TID), George Kamel and Ning Wang (UniS), Ioannis Psaras, Wei Chai, George Pavlou (UCL), Andrzej Beben and Jordi Mongay (WUT), Michael Georgiades and Lenos Andreou (PRIMETEL).

The first part of this meeting summed up the results of the offline analysis and assessment of the proposals sent by UCL after the 2nd COMET-ENVISION meeting.

The only sensible solution, after consulting with projects partners, was that ENVISION's tool for providing path costs were installed in TID's testbed and that the CINA interface was implemented in COMET's CME to refine the paths decision processes carried out by that element.

The second part of this meeting dealt with the final preparation for the joint COMET - ENVISION workshop that was due to be held one day later in O2's premises, Slough, UK. The chair people for each session were assigned, as well as the individuals in charge of the welcome talks, closure and chairing of the open discussion.

- **COMET-ENVISION Joint Workshop, Slough, UK, 10th – 11th November 2011**

During November 10th and 11th, the workshop Future Media Distribution Networks was held in O2's Premises at Slough, UK. This event was co-organised by COMET and ENVISION projects, with TID in charge of the logistics of the event.

The workshop lasted one and a half days, including opening keynotes each day, three full sessions on the first day and two sessions on the second, while both days ended with open discussions.

During the First day, the following talks and sessions were held:

o Keynote presentation, "Content Networks: Market Insights": Santiago Rouco from Telefonica I+D, summarized the perspectives of a Network Operator on the need, opportunity, feasibility and expected revenues of future ICNs.

o First Session on "Content Distribution Networks for Media Delivery", presenting Overview of different network approaches for Media delivery in the context of present CDNs. The talks during this session were:

  ▪ "New Generation Open Content Delivery Network" by Yannick Le Louedec from Orange Labs, presenting a summary of the results of the Ocean Project in regards to CDN interconnection and MultiCDN systems.

  ▪ CANCELLED: "The CDN interconnection use case" by Philip Eardley and Bob Briscoe, from British Telecom and Olivier Dugeon, Orange Labs. This talk was cancelled because the speakers could not finally attend the meeting.

  ▪ "Control plane uses for content delivery in future networks" by Manuel Núñez, from Telefonica I+D, who explained the use of network's intelligence capabilities in the case of CDNs from the point of view of a Network operator.

o A Second Session on "Information-centric Networking I (Evolutionary Solutions)" or ICN solutions that could be deployed on the existing Internet without disrupting its operations, which comprises the following presentations:

  ▪ "SAIL's NetInf: from Content Distribution to the Network of Information" by Pedro Aranda from Telefonica I+D, summarizing the results of the SAIL project on content retrieval over ICNs.

  ▪ "COMET, the Decoupled Approach: Mediating between Content Producers and Consumers" by David Flórez from Telefonica I+D and Andrzej Beben from Warsaw University of Technology, offering an overview of the network architecture proposed for COMET's decoupled approach.

  ▪ "Future Content Networks: Content-aware Searching, Retrieval and Streaming" by Theodore Zahariadis from Synelixis summarising the results of the COAST project, using CURL for unique identification of contents.

o A third Session called "Future Video Adaptation and Delivery on the challenges and solutions for Video Coding and Transmission over next networks", comprised of the following two talks:

  ▪ "Scalable Video Coding in Content-Aware Networks" by Michael Grafl, from Universität Klagenfurt presenting the results of the Alicante Project on the topic of video coding/transmission over ICNs.

  ▪ "P2P-Next: Future Internet Media Delivery to CE Devices" by Mark Stuart, from Pioneer Digital Design Centre UK, summarizing Results of P2P-Next on the topic of video transmission over P2P.

During the Second day, the following talks and sessions were held:

o Keynote presentation: "Centric Networking: Overview, Current State and Key Challenges" by Prof. George Pavlou from UCL, who enumerated different trends and dangers in the evolution of the current Internet and how ICN could help to solve them.

- o A first session about "Network-application Cooperation" or how the cooperation and sharing of information between Network and applications could contribute to increase the performance of the current internet, comprising the following presentations:

  - "Toward network aware P2P streaming applications: The NAPA-WINE approach" by Prof. Emilio Leonardi and Marco Mellia, from Politecnico di Torino, commenting on the results of the NAPA-WINE project.

  - "CINA: The Collaboration Interface between Network and Applications" by Bertrand Mathieu from Orange Labs, describing the CINA interface developed in the ENVISION project for communicating the network with the applications and vice versa.

  - "Multimedia Transport for Mobile Video Applications" by Bo Fu from DOCOMO Communications Laboratories Europe summarizing the Results of the Medieval Project about Mobile Video transmission with cross layer capabilities.

- o A last session focusing on "Information-centric Networking Clean-slate Approaches" or those ICN approaches that would constitute the seed of a new Internet, segregated from the current one and finally substituting it, where the following talks were given:

  - "Bandwidth and memory sharing in CCN: an introduction to the French project ANR CONNECT" by Jim Roberts from INRIA. The talk summarised results of the ANR CONNECT project and in particular, focused on flow-aware CCNs.

  - "CURLING: Content-Ubiquitous Resolution and Delivery Infrastructure for Next Generation Services" by Ioannis Psaras from UCL presented the Coupled content resolution and delivery approach of the COMET project for the mediation of contents.

  - CANCELLED: "The Publish-subscribe Internet Routing Paradigm" by Dirk Trossen, from University of Cambridge. This presentation was cancelled on account of speaker's illness.

Conclusions:

- o The main problem of these different approaches is whether there is a real possibility to be deployed in the real network, in terms not of technological excellence, but cost.

- o It seems clear that there is some sort of overlapping between the goals of the CDN and ICN. The open question is whether this overlapping will lead to cooperation or conflict.

- o The widespread success of P2P technologies makes them a perfect choice for complementing the functionalities of both ICNs and CDNs.

- o Last but not least, a wide variety of technical solutions exist, serving the same means and, most importantly, being equally valid in principle, so the final choice, if any, will depend on other matters than the technical ones.

- **Meeting with BT Research Unit, London, UK, 24th November 2011**

The UCL COMET team held a meeting with two chief scientists from the BT Research Unit, at UCL premises on the 24th of November. The UCL COMET team presented our on-going efforts on Information-Centric Networks, and in particular the efforts within COMET in order to get feedback from industrial people on the validity and viability of our proposed solutions and research directions.

- **ALICANTE Plenary meeting, Tel-Aviv, Israel, 6th – 8th December 2011**

  Jordi Mongay Batalla from Warsaw University of Technology participated in the seventh plenary meeting of the ALICANTE project held by OPTEC and BandWD in Tel-Aviv, Israel on December 6-8, 2011.

- **FMN Cluster Concertation meeting, Brussels, Belgium, 14th - 15th December 2011**

  David Flórez of TID attended the FMN Cluster Concertation meeting in Brussels on the 14th and 15th of December, where he presented:

  o A presentation about the project's status, and

  o A summary of the joint COMET-ENVISION workshop held in Slough, UK, on November 10th - 11th.

  On request of the PO, Isidro Laso, George Kamel from UniS volunteered to give a talk in the forthcoming Joint EU-Japan call on Green and Content-centric Networks, to be held on January 19th 2012.

2.1.2 Summary

During the second year of the project, the COMET consortium has actively participated and contributed to relevant project clusters and FIA meetings and liaised with related research projects in the field of content-aware networking. However, the second year's highlights have been the organisation of the ICN session in FIA Budapest and the co-organization of the Future Media Distribution Networks workshop in Slough, UK, together with the ENVISION project, aiming to discuss and address certain questions and issues in the field of information-centric networking and media distribution overlay networks, with research-related EU projects.

The organization of the 2 events fulfills 2 of the smart-objectives related to Concertation (*Objective 7c: To organize ideally 3 workshop or sessions on Content-based Networking*). Besides, COMET representatives attended all FIA meetings (Budapest and Poznan) throughout 2011, fulfilling *Objective 7a: To participate in all Future Internet Assembly plenary meetings*. Other notable activities were the attendance and demo presentations in the FP7 Networked Media Concertation meeting in Trento, the NEM Summit, as well as the close collaboration of COMET with ENVISION project.

2.2 Academic Dissemination

2.2.1 Activities

- **IFIP Networking 2011, Valencia, Spain, 10th – 13th May**

  Ioannis Psaras of UCL attended the IFIP Networking 2011 conference at Valencia, Spain, on the 10th -13th of May. He presented COMET's "Modelling and Evaluation of CCN Caching Trees" accepted paper.

  The conference acceptance rate was 21.5% which guaranteed high quality of papers and presentations. The COMET paper presentation attracted a large audience and received very good comments. The paper is available at: http://www.ee.ucl.ac.uk/~uceeips/ccn-caching-networking11-ipsaras.pdf [1]

  During the same conference, Richard Clegg of UCL presented the second accepted COMET paper with title: Balancing by PREFLEX: Congestion Aware Traffic Engineering, available at: http://www.ee.ucl.ac.uk/~uceejoa/files/networking.pdf [2]

- **IEEE/IFIP IM 2011, Dublin, Ireland, 23rd May 2011**

  Prof. George Pavlou of UCL gave a keynote speech on Information-Centric Networks in IEEE/IFIP IM 2011. The title of the presentation is "Information-Centric Networking: Overview, Current State and Key Challenges."

- **Future Network & Mobile Summit 2011, Warsaw, Poland, 15th – 17th June 2011**

  Dr Andrzej Beben from Warsaw University of Technology attended Future Network & Mobile Summit 2011. This conference was held on the 15-17 June 2011 in Warsaw, Poland. He presented the common paper entitled "COMET: Content mediator architecture for content-aware networks" [3]. This paper presents the overall COMET architecture, describes main processes and implementation issues as well as QoS engineering and content-aware forwarding concepts.

- **IEEE WoWMoM 2011, Tucca, Italy, 20th June 2011**

  Prof. George Pavlou of UCL gave a keynote speech on Information-Centric Networks in IEEE WoWMoM 2011. The title of the presentation is "Information-Centric Networking: Overview, Current State and Key Challenges."

- **IEEE ISCC 2011, Corfu, Greece, 28th June 2011**

  Prof. George Pavlou of UCL gave a keynote speech on Information-Centric Networks in IEEE ISCC 2011. The title of the presentation is "Information-Centric Networking: Overview, Current State and Key Challenges."

- **Wei Koong Chai, Michael Georgiades, Spiros Spirou, "Chapter 9 - Towards Information-Centric Networking: Research, Standardisation, Business and Migration Challenges", part of the book on "Media Networks: Architectures, Applications, and Standards", Editors: Hassna Moustafa, Sherali Zeadally, CRC Press, May 2012.**

  COMET has provided a chapter contribution to the book "Media Networks: Architectures, Applications, and Standards", which is to be published in May 3, 2012 by CRC Press. The book editors are: Hassnaa Moustafa, France Telecom Research and Development; and Sherali Zeadally, University of the District of Columbia, Washington, DC, USA. The chapter is entitled: "Towards Information-Centric Networking: Research, Standardisation, Business and Migration Challenges" and is written by Wei Koong Chai, Michael Georgiades and Spiros Spirou.

This chapter gives an introduction to Information Centric Networking and Information Centic Internet. It discusses open research issues, the business impact and incentives as well as related research and standardization activities in the area. Content resolution approaches like the lookup-based resolution approach and hop-by-hop discovery approach are described. Moreover, caching, information object security, mobility support, anycast and multicast are all discussed in the context of ICN. The final two sections of the chapter analyse the business incentives and migration challenges as well as the latest research and standardization activities in the area of ICN.

- **IEEE CNSM conference, Paris, France, 26th October 2011**

   Prof. George Pavlou was invited and participated in the panel discussion during the IEEE CNSM conference in Paris, France on the 26th of October 2011 (http://cnsm.loria.fr/program.html). During the discussion Prof. Pavlou discussed the COMET ideas on how Bandwidth and Storage Management can be better dealt with through the ICN paradigm, and in particular through the COMET solution space.

- **Paper submissions**

   During Year 2, COMET partners submitted the following papers:

   o "An Integrated Framework for Inter-domain QoS-enabled Content Access and Delivery Services" to the IEEE Communications Magazine, Special Issue on Convergence of Application Services in Next Generation Networks [Coordination by UCL, contribution by TID, UniS, WUT, PrimeTel, INTRACOM TELECOM]

   o "To Cache Or Not To Cache: Probabilistic In-Network Caching for Information-Centric Networks" to the IEEE INFOCOM 2012 NOMEN workshop (http://www.ieee-infocom.org/2012/nomen) [Coordination and contribution by UCL],

   o "Cache "Less for More" in Information-Centric Networks" to the IFIP Networking conference 2012 (http://networking2012.cvut.cz) [Coordination and contribution by UCL],

   o "Multi-criteria decision algorithms for efficient content delivery in information-centric networks", Annals of Telecommunications, Special Issue on Networked digital media Digital content (r)evolution: towards communication/information/knowledge convergence, Springer [Coordination and contribution by WUT, UCL]

   Results for the above submissions are expected in early 2012.

2.2.2 Summary

COMET partners continued their research effort during the second year of the project and submitted several papers in top-class conferences and journals, still pending for acceptance. Besides, the consortium contributed to the "Media Networks; Architectures, Applications, and Standards" book with a chapter related to information-centric networking. Among the key academic dissemination activities of Year 2, were the paper presentations of accepted papers in IFIP Networking and FNMS 2011, as well as the several keynote speeches of Prof. George Pavlou in ICN-related conferences.

2.3   Industrial Dissemination

2.3.1 Activities

- **IEEE Signal Processing Society, UKRI, De Montfort University, Leicester, UK, 18th January 2011**

  Spiros Spirou of INTRACOM TELECOM was invited by DMU Professor Raouf Hamzaoui to give a talk on Information-Centric Networking at a meeting of the IEEE Signal Processing Society, United Kingdom & Republic of Ireland Chapter. The invitation was extended in recognition of ICN's rise as an important research topic and INTRACOM TELECOM's related work in COMET. The talk covered content naming, resolution and routing in a style accessible to a non-expert audience. COMET was portrayed as one of the first few projects worldwide working on ICN. About 30 people attended the meeting, many of which were postgraduate students interested in the area. An interesting discussion with DMU research staff after the meeting revolved around what is known in COMET as 'edge-controlled routing'. A few students requested and received references to some seminal ICN publications.

- **Project Impact Factsheet, 7th August 2011**

  In August 2011, the industrial partners of the COMET project (INTRACOM TELECOM, TID and PrimeTel) produced the Impact Factsheet, in order to present the current problems and the expected project's impact on the stakeholders of the content value chain.

2.3.2 Summary

During Year 2, the COMET consortium focused on the implementation and integration of the COMET prototype; hence, the industrial partners of the COMET consortium did not contribute or demonstrate project's results in any industrial dissemination fora or exhibitions, which is expected to happen during the third year. However, they have produced the Project Impact Factsheet, briefly identifying the project's expected benefits on the content value chain actors. The creation of the Impact Factsheet was one of the smart-objectives related to industrial dissemination.

2.4   Standardization

2.4.1 Activities

- **Catalogue of Advanced Use Cases for Content Delivery Network Interconnection, Content Delivery Networks Interconnection Working Group, Internet Engineering Task Force, 24th October 2011**

  Spiros Spirou of INTRACOM TELECOM coordinated a discussion within COMET about the relation between CDNs and ICN. This discussion was eventually edited by S. Spirou as a chapter of draft-fmn-cdni-advanced-use-cases-00. This Internet Draft (I-D) complements "the current CDNi WG use-cases with a catalogue of advanced, longer-term CDN interconnection use cases" and includes contributions from the ALICANTE, COAST, COMET, ENVISION, NEXTMEDIA and OCEAN projects. The document was produced by the Future Media Networks (FMN) cluster of the Networked Media Systems FP7 projects with the support of Mr. Isidro Laso, Scientific Officer at DG INFSO, EC. COMET's contribution discusses similarities and differences between CDNs and ICN in terms of objectives, technical approach, deployment and business models. It also explores the possibility of interaction and coexistence of ICN and CDN in a future Internet. The I-D was presented at IETF 82 in Taipei, Taiwan. The CDNI WG members have decided to keep the I-D as a standalone document, separate from draft-ietf-cdni-use-cases, with a possible update in the beginning of 2012. Following the presentation at IETF 82 the I-D authors have been invited to submit this work at ETSI.

2.4.2 Summary

During the second year of the project, the COMET consortium aimed to identify possible standardization organizations and groups, in which it could be actively involved and contribute to. The most relevant one ICNRG group of IRTF, which, however, is not yet formed and discussions are on-going as to whether the topic of Information-Centric Networks is mature-enough in order to justify an RG group of its own or not. We hope that the decision is going to be made during the next IETF meeting in Paris at the end of March. Depending on the outcome, COMET will make decisions as to whether it is going to focus its standardization efforts from now on. For the time being we have focused on the Content Delivery Networks interconnection (CDNi) working group, in which COMET has contributed a chapter to the "the current CDNi WG use-cases with a catalogue of advanced, longer-term CDN interconnection use cases" Internet Draft, eventually published and presented during IETF 82 in Taipei, Taiwan. Publication of the I-D fulfils one of the COMET SMART objectives (Objective 7d: To submit at least 1 draft to a standardization body.).

3 Summary and Conclusions

During the second year of the project, we have made efforts to highlight the project's progress and results in high-quality concertation, academic dissemination and standardization events and fora. Key activities have been the organization of 2 major concertation events, the ICN session in FIA Budapest and the joint COMET-ENVISION workshop on Media Distribution Networks in Slough, UK. In addition, COMET partners have been highly active in related project clusters and FIA meetings, through liaising and closely collaborating with ENVISION and other research-related projects.

The academic partners of the project have continued their research effort, through submitting several papers in high-quality conferences and journals, while the industrial partners focused on the standardization of project's results in relevant standardization bodies' working groups. Towards this direction, COMET contributed to the published and presented "The current CDNi WG use-cases with a catalogue of advanced, longer-term CDN interconnection use cases" Internet Draft.

All COMET partners are committed to continue their research and implementation efforts, as well as disseminate project's progress and developments in Year 3, aiming to increase project's impact to the community. Upon the successful implementation and testing of the COMET prototype, the consortium will focus on disseminating results to relevant conferences and exhibitions, as well as releasing its exploitation plans.

Commercial in Confidence

4 References

[1] I. Psaras, R. G. Clegg, R. Landa, W. K. Chai, G. Pavlou, *"Modelling and Evaluation of CCN-Caching Trees"*, Proc. IFIP Networking 2011, Valencia, Spain, 9-13 May 2011.

[2] J. Araujo, R. G. Clegg, I. Grandi, M. Rio, G. Pavlou, *"Balancing by PREFLEX: Congestion Aware Traffic Engineering"*, Proc. IFIP Networking 2011, Valencia, Spain, 9-13 May 2011.

[3] Gerardo García, Andrzej Beben, Francisco J. Ramón, Adrián Maeso, Ioannis Psaras, George Pavlou, Ning Wang, Jaroslaw Sliwinski, Spiros Spirou, Sergios Soursos, Eleftheria Hadjioannou, "COMET: Content mediator architecture for content-aware networks", Future Network & Mobile Summit 2011, 15 - 17 June 2011, Warsaw, Poland

5 Abbreviations

CDNi	Content Delivery Networks interconnection
COMET	COntent Mediator architecture for content-aware nETworks
IETF	Internet Engineering Task Force
STREP	Specific Targeted Research Project

6 Acknowledgements

This deliverable was made possible due to the large and open help of the WP7 team of the COMET project within this STREP, which includes besides the deliverable authors as indicated in the document control. Many thanks to all of them.