COntent Mediator architecture for content-aware nETworks

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3rd Year Progress Report on Dissemination and Standardization

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1 Executive Summary

This deliverable summarizes the consortium's dissemination and standardization efforts during the 3rd year of the project. Our efforts were based on the 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, WP5 and WP6 and are classified into 4 main categories, which constitute the sections of this document: 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 3rd Year Progress Reports

2.1 Concertation

2.1.1 Activities

SESERV 2012 - Interplay of economics and technology for the Future Internet, Athens, Greece, 31st January 2012

Sergios Soursos attended the "Interplay of economics and technology for the Future Internet" Workshop, 31 Jan. 2012, organized by the SESERV Support Action. The objective of the workshop was to discuss, through a number of invited talks, the economic and business impacts of the Future Internet. In this context, Sergios Soursos attended the plenary session and then joined the parallel session that dealt with *"Content and service delivery architectures for the Future Internet"*. There were two presentations, from the PURSUIT and SAIL projects, and then there was a discussion about the possible new stakeholders and the business models related to the introduction of ICN networks. Sergios represented the COMET approach and raised all the competing/conflicting issues between the ICNs and existing stakeholders, such as the CDN provider and the Search Engine provider, related to the two major functionalities of the ICNs, namely the name/content resolution and the content delivery. There was also a dicussion about possible tussles between the stakeholders under various business models.

Future Internet Assembly, Aalborg,10th – 11th May 2012

David Flórez from TID and Andrzej Bęben from WUT attended the FIA meeting held in Aalborg on the 10th and 11th of May, where they represented the COMET Project.
Apart from the plenary sessions that opened and closed the event, COMET representatives also attended the following sessions:

- Novel Networking and Relationship with applications. Hot topics:
  - How to harmonize Network Neutrality and Application Cooperation
  - How to reimbourse intermediate operators for prioritized flows crossing their infraestructures.
  - How these forms of improved networking relate to CDNs. Will they be able to coexist?
- Internet of Things (IoT) and Future Internet (FI) Architectures. Hot topics included:
  - How to identify and certify contents without reference to the hosting machines.
  - Paradigm change in the concept of personal privacy inside an Internet were users are willing to advertise their personal data.
  - In IoT, users' data can be captured/processed without users being aware of it.
- Games Networks and Clouds. What are the requirements?
  - Trends in Games are moving to Built-in caching (content and application), global QoS, P2P for distribution and servers virtualisation.
  - CDNs are adopting a more and more important role in gaming services.
  - Conflicts between gaming requirements and telcos' benefits, unless network neutrality is tweaked somehow.

Future Internet Cluster Meeting, Brussels, Belgium, 10th – 11th October 2012

David Flórez, in his role of COMET project co-ordinator, attended the Future Networks 10th Concertation Meeting and the Future Internet Cluster Meeting in Brussels on the 10th and 11th of October 2012.

After the disbandment of the Media Networks Unit and the subsequent reorganization, COMET was assigned to the Future Networks Unit and invited to the session of the 10th Future Network Concertation Meeting, where David Flórez briefly presented the COMET project's aims and outcomes to the members of the Future Internet Cluster.

NEM Summit, Istanbul, Turkey, 16th - 18th October 2012

Sergios Soursos, as a representative of Intracom Telecom, attended the General Assembly meeting on October 16, since Intracom Telecom is a member of NEM's GA. During the NEM summit, 17-18 October, Sergios Soursos attended a number of sessions in the research areas of Digital Media Content and Connected Media Worlds, which closely related with the activities in the COMET project. During those sessions, as well as in the exhibition area, Sergios had the chance to discuss with other participants on issues regarding content/media-centric approaches.

Joint COMET-PURSUIT Workshop, UCL, London, UK,30th – 31st October 2012

The COMET consortium has organised a common workshop with the FP7 PURSUIT project, which is also looking into transforming the current Internet into an Information-Centric platform using the publish-subscribe paradigm. All partners from both projects have attended the workshop with UCL leading the organization and the technical program. The workshop's theme was: *"Information-Centric Networking: Open Issues, Challenges and Ways Forward"*; the programme can be found here: http://www.comet-project.org/event-comet-pursuit-2012.html

The workshop has attracted researchers from the FP7 ENVISION and the FP7 Univerself projects. The presentations have triggered a lot of questions which led to fruitful discussions regarding the future of ICN architectures, deployment and related research challenges.

Spiros Spirou gave a talk to an audience of about 40 people about the potential of ICN deployment. The talk examined the incentives of the main stakeholders (End User, Network Service Provider, Content Service Provider) in ICN deployment. It also presented CDNI as a related technology to ICN. The conclusion was that incentives for ICN deployment are currently unclear and weak. The talk stirred a lot of discussion, even during the presentation. The general feeling was that ICN should not be pegged against incumbent technologies for content distribution, like CDNs. Instead, ICN deployment can be promoted if ICN can be positioned as an enabler of new applications and services. However, at the moment, those application and services are not obvious. Dr. Ning Wang from University of Surrey also gave a technical presentation on the resilience issues for protecting against potential failures of content resolution infrastructure in the context of the coupled approach that has been developed during the project.

COMET Demo during COMET-PURSUIT Workshop, UCL, London, UK, 30th – 31st October 2012

David Flórez, in his role of COMET project co-ordinator, presented a demo of the COMET decoupled approach during the COMET-PURSUIT workshop held in UCL premises, London, on October 30th.

The demo was based on the COMET federated testbed built by connecting three testbeds located at WUT (Poland), PTL (Cyprus) and TID (Spain) premises, respectively. Using the external access to the COMET federated testbed, which allows to connect a content client to the testbed from almost anywhere in the world, the demo essentially showed how users at TID with different COMET CoS could retrieve contents from servers deployed at TID, WUT, PTL. Transmission of contents was done according to the user Class of Service (CoS), the server load and its respective characteristics (CoS and QoS) and path characteristics (again CoS and QoS). These contents were retrieved by using a single unique name, hiding the connection parameters, such as the server location, and the retrieval method (Streaming, VoD, etc).

4th COMET-ENVISION liaison meeting, UCL, London, UK, 30th October 2012

The meeting was held during the Joint COMET-PURSUIT Workshop, on the 30th of October 2012. From ENVISION's side the attendants were Dr David Griffin (project co-ordinator of ENVISION), Dr Eleni Mikonyati, Raul Landa all of UCL. The COMET project was represented by David Flórez and Ignacio Conde of TID, Dr Andrzej Beben of WUT and Dr Michael Georgiades of PTL.

This meeting dealt with the finalisation of the COMET-ENVISION Integration activity and the definition of the related COMET-ENVISION Demo Cases. Two use cases were finally agreed upon: how to sway COMET path selection by including ENVISION cost function in the decision algorithm and how to do it likewise for server selection.

2.1.2 Summary

During the third 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 and information-centric networking. We have attended all the FIA and NEM events and have also liaised with the FP7 PURSUIT Project. In particular, we have organised a joint workshop, where participants of both projects have presented open research issues with regard to the future of ICN.

The organization of these events fulfill 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 meeting (Aalborg) throughout 2012, fulfilling *Objective 7a: To participate in all Future Internet Assembly plenary meetings*.

2.2 Academic Dissemination

2.2.1 Activities

4th EU-Japan Symposium, Tokyo, Japan, 19th January 2012

Dr George Kamel of University of Surrey gave a presentation at the 4th EU-Japan Symposium in Tokyo, which covered the decoupled and coupled approaches developed by COMET, and briefly overviewed some of the work related to energy-efficiency for ICNs being carried out. The work presented on content caching generated particular interest amongst attendees, with a number requesting and receiving references to seminal COMET publications on the topic. The sessions were very well-attended, with a large number of NICT researchers present.

IEEE Consumer Communications and Networking Conference (CCNC) 2012, Las Vegas, NV, USA, January 14th - 17th 2012

Sergios Soursos attended the 9th Annual IEEE Consumer Communications & Networking Conference, Jan. 14-17, 2012. On the first day, he joined the 4th IEEE International Workshop on Future Mutlimedia Networking, where he presented an idea on the convergence of broadcast (TV) and broadband (Internet) content, taking advantage of the underlying ICN infrastructure. The paper was entitled *"Connected TV and Beyond"* [1]. On the discussions that followed specific details of the ICN approaches were discussed, and the COMET approach was also discussed extensively. During the next days, Sergios Soursos attended the main event and joined several sessions where topics related to the wider area of Media Networks and Content-Centric Networks were presented.

Talk at King's College London, London, UK, 18th April 2012

Dr Ioannis Psaras has given a talk at King's College London, Centre for Telecommunications Research on the research undertaken in COMET. Specifically, the talk has focused on the investigations and results on in-network caching. The presentation was very well-attended by researchers and academic staff at King's College with a lot of interest and questions both in the general area of ICN and in particular in the COMET project's approach.

Flexible Networks Workshop, University of Surrey, UK, 25thApril 2012

Prof. Pavlou, Dr Ioannis Psaras from UCL and Dr George Kamel of the University of Surrey have participated and presented COMET in the Flexible Networks Workshop under the auspices of the Engineering and Physical Sciences Research Council (EPSRC), UK. Extensive discussion followed with leading scientists in the UK on the general concepts of COMET and on the caching and delivery approaches that the project is investigating.

Paper Presentation at IFIP Networking 2012, Prague, Czech Republic, 21st – 25th May 2012

The paper *"Cache 'Less for More' in Information-Centric Networks"* [2] has been accepted, published and presented in the IFIP Networking 2012 conference, which took place on the 21st-25th May in Prague. The paper was presented by Prof. George Pavlou of UCL and received the BEST PAPER AWARD. Prof. Pavlou received positive comments by the audience and a lot of discussion took place during the coffee breaks.

Paper Presentation at IEEE International Conference on Communications (ICC), Ottawa, Canada, 10th - 15th June 2012

Professor Zhili Sun from University of Surrey presented the technical paper titled *"Optimizing Server Power Consumption in Cross-domain Content Distribution Infrastructures"* at IEEE ICC Conference held in Ottawa, Canada in June 2012 [3]. A number of interesting questions were raised after the presentation regarding operational issues related to the proposed content server sleeping optimisation scheme.

Paper Presentation at IEEE International Symposium on Computers and Communications (ISCC), Cappadocia, Turkey, 1st - 4th July 2012

Mr. Ali Norouzi from University of Surrey presented the technical paper titled "*An ISP and End-User Cooperative IntradomainRouing Algorithm*" at IEEE ISCC Symposium that was held in Cappadocia, Turkey [4]. After the presentation, a few interesting questions were raised on the possible interaction scenarios between user behaviours and the network response.

Paper presentation ACM SIGCOMM ICN Workshop, Helsinki, Finland, 17th August 2012

The paper titled *"Probabilistic In-Network Caching for Information-Centric Networks"* [5] has been accepted at the ICN workshop, which is organised together with ACM SIGCOMM. The acceptance rate was 25% (16 of 63 papers accepted). The workshop included very interesting and high-quality presentations. The paper was presented by Dr Ioannis Psaras of UCL on the 17th of August in Helsinki, Finland. The audience asked very interesting questions regarding the concept behind the probabilistic caching algorithm and the paper received many good comments.

Paper Publication, Springer Annals of Telecommunications Journal, August 2012

The paper titled *"Multicriteria Decision Algorithm for Efficient Content Delivery in Content Networks"*has been published on-line on 29 August 2012 and in the printed form in Issue Network Digital Media, vol. 68, no 3-4, March/April 2013 [6]. The paper is available with an open access at: http://link.springer.com/article/10.1007%2Fs12243-012-0321-z.

Paper Publication, Springer Annals of Telecommunications Journal, August 2012

The final version of the paper titled *"Internet Scale Content Mediation in Information-Centric Networks"*, which was an invited paper in the Springer Annals of Telecommunications Special Issue on Networked Digital Media has been published in vol. 68, no. 3-4 [7].

Keynote at the 24th International Teletraffic Congress 2012, Krakow, Poland, 6th September 2012

Prof. George Pavlou has given a keynote speech at the International Teletraffic Congress, which was held in Krakow, Poland on 5-7 September 2012. The keynote took place on the 6th of September and received great attention from the audience with a lot of questions and related discussion on ICN issues, as well as on how does COMET deal with the open research issues. The keynote was titled: *"Information-Centric Networking and In-Network Caching"* and the related link to the conference is: http://www.itc24.net/keynote-speakers/

Tutorial at the 24th International Teletraffic Congress 2012, Krakow, Poland, 7th September 2012

Dr Ioannis Psaras of UCL (together with Dr Dirk Trossen of the University of Cambridge – technical leader of EU FP7 PURSUIT project) has given a tutorial at the 24th International Teletraffic Congress (ITC-24) on the 7th of September. The title of the tutorial was *"The Information-Centric Networking Challenge: Background, Open Issues and Research Directions"*. The tutorial attracted around 20 attendees, who participated very actively throughout the tutorial and triggered extensive discussions. The concepts of our COMET architecture as well as of specific algorithms have been presented and explained in detail. The reading material provided to the audience can be found here in [8].

Keynote talk at Polish ICT conference 2012, Warsaw, Poland, 12th – 14th September 2012

Dr Andrzej Bęben has given a keynote talk about ICN/CAN network at Polish ICT conference. This talk presented some general ICN concepts and briefly introduced the COMET approach. This talk initiated debate about the role, assumptions key research directions related to ICN approaches in Polish ICT society. The paper was published in Special Issue of Journal Telecommunication Review and Telecommunication News (Przegląd Telekomunikacyjnyi Wiadomościtelekomunikacyjne- in polish), pp. 622-625, No. 8-9, September 2012, ISSN 1230-3496).

COMET stand at exhibition co-organised with Polish ICT conference 2012, Warsaw, Poland, 12th – 14th September 2012

Dr Andrzej Bęben has organised the stand and demonstration of the COMET prototype at exhibition co-organised with the Polish ICT conference. This demonstration shows key features of the COMET system covering content naming, resolution process, decision process, and content forwarding.

Paper Presentation at Polish ICT conference 2012, Warsaw, Poland, 12th – 14th September 2012

Dr Andrzej Bęben has presented the paper titled *"The Content Mediator Architecture for Content-Aware Networks"* about the COMET architecture, designed mechanism and algorithms, developed COMET prototype, deployed federated testbed and performed tests [12]. The presentation has stimulated discussion about resolution and content delivery mechanisms (especially between people involved in COMET and ALICANTE projects). The paper was also published in the Special Issue of the Journal Telecommunication Review and Telecommunication News (Przegląd Telekomunikacyjnyi Wiadomości Telekomunikacyjne - in polish), pp. 1192-1203, No. 8-9, September 2012, ISSN 1230-3496 [12].

Paper Presentation at IEEE Networks conference, Rome, Italy, 15th – 18th October 2012

Dr Andrzej Bęben presented the joint COMET-ALICANTE paper entitled *"Optimization of the Decision Process in Network and Server-aware Algorithms"*at IEEE Network conference [9]. The paper focuses on optimisation of multicriteria decision algorithm that was proposed in COMET. After the IEEE Networking conference, the paper has been selected as one of the best papers so we were invited to submit its enhanced version of the Journal of Telecommunication Systems (Springer).

Presentation at PURSUIT Workshop Essex, Colchester, Essex, UK, 23rd of January 2013

Dr Ioannis Psaras was invited to present the major findings of the COMET project in the PURSUIT Workshop, which was organised at the University of Essex on the 23rd of January 2013. As mentioned earlier, the FP7 PURSUIT project is an ICN project and therefore, all presentations were focused on ICN-related issues. The presentation received wide attention and several questions, which highlighted the novelty of the COMET concepts, as well as individual findings on content resolution and in-network caching.

Paper Submission and Presentation at SIMUTOOLS, Cannes, France, 5th – 7th March 2013

UCL has built a simulation platform called Fast Network Simulation Setup (FNSS), which is helpful for setting up simulations using several different topologies and metrics. The work on this simulation tool has been submitted to SIMUTOOLS 2013 conference, where it has been accepted and presented. Mr Lorenzo Saino of UCL attended the conference, which took place on 5-7 March 2013 and presented the paper. The paper is titled *"A Toolchain for Simplifying Network Simulation Setup"* [10].

Paper Publication, Elsevier Computer Communications Journal, Special Issue on Information-Centric Networking, April 2013

The IFIP Networking 2012 best paper is extended, accepted and published at the Elsevier Computer Communications Journal, Special Issue on Information-Centric Neworking in vol. 36, no. 7, April 2013 [16]. The paper is titled "Cache 'Less for More' in Information-Centric Networks (Extended Version)".

Paper submission: IEEE International Conference on Communications (ICC) 2013, Budapest, Hungary, 9th – 13th June 2013

UCL has designed a receiver-driven transport mechanism for Information-Centric Networks. The protocol was implemented and evaluated through simulations. The paper was submitted and accepted at the IEEE International Conference on Communications (ICC) 2013, where it will be presented in June 2013. The title of the paper is: *"CCTCP: A Scalable Receiver-driven Congestion Control Protocol for Content Centric Networking"* [11].

2.2.2 Summary

The COMET partners continued their research effort during the third year of the project and submitted several papers in top-class conferences and journals, some of them still pending for acceptance. Among the key academic dissemination activities of Year 3, were the paper publications/presentations of accepted papers in the dedicated ACM SIGCOMM Workshop on ICN, the Special Issue of Elsevier Computer Communications on Information-Centric Networking and the two papers in the Springer Annals of Telecommunications Special Issue on Networked Digital Media. Pending publications include papers in the Elsevier Computer Networks Special Issue on ICN, the submission on IEEE Transactions on Parallel and Distributed Systems, and the submission for Springer Journal of Telecommunication Systems. Those papers that have been submitted within the duration of the project, but for which the final decision has not been made yet have been in included in the Appendix (see Section 4). Finally, our work in ICN caching published in IFIP Networking 2012 has been recognised for its excellence and received the Best Paper Award among 225 submissions and 64 accepted papers.

2.3 Industrial Dissemination

2.3.1 Activities

TID Press Release, 7th December 2012

A proposal for a press release was submitted to the corresponding department in Telefónica in December 7th 2012, The Press release is currently being reviewed by the PR department in Telefonica, which will assess its compliance with Telefonica's policies and, if approved, when and where it will be published.

TID White Paper, 13th of December 2012

A White Paper was submitted to the strategy department of Telefonica in December 13th 2012 making a comparison between CDNs and CCNs, summing up the advantages and disadvantages of each technical approach to content distribution (e.g., known benefits in the case of CDN vs. better resource utilisation in the case of CCNs).

People from the strategy department were interested and thankful about the new concepts that were presented, but also concerned about the inexistence of manufacturers distributing CCN equipment, which would certainly delay the deployment of CCN solution within Telefonica's network till hardware solutions are available in the market.

INTRACOM TELECOM Press Release, 1st March 2013

INTRACOM TELECOM submitted a second press release in Greek and English aiming to attract favorable media attention and provide publicity to the COMET project in Greek and foreign media. The press release summarizes the project's results and impact in Internet users, the funding fromthe E.C., as well as defines the members of the COMET consortium. The press release is currently reviewed by the PR department of INTRACOM TELECOM.

TID Workshop on CCN, Madrid, 21st March 2013

Workshop performed in TID on the 21st of March 2013, called "The CCN Paradigm" about the CCN Concept, and its relation with the CDN business. The main attendees were Telefonica's employees as a mean to make them aware of the concepts, advantages and future of a potential Content-Information-Centric Network. The Workshop also included a demo of the COMET outcomes, so the audience could experience the concept they have learnt in a real implementation.

Most of the audience was unaware of the CCN concepts and was quite impressed of the soundness of the concept, embodied in its simplicity. The main concern, though, was that the effort and the investment needed in order to deploy such revolutionary solutions inside an operator's network might outweight the benefits brought by Information-Centric Networking architectures.

Primetime Magazine, March Issue, March 2013

Primetel included an article on the finalisation of the COMET project and the succesful outcomes in its national (Cyprus) magazine which is also available internationally trhough its online website. The magazine article discusses the importance of the COMET approaches and its benefits for Content Provisioning based on the R&D project's results. Moreover it highlights how the ICN paradigm is an alternative approach to CDNs and why it should be considered in the near future by operators. It also references some of the important COMET publications for further reading.

2.3.2 **Summary**

The initial plan for the third year dissemination was based on using the COMET Federated Testbed for demonstrating COMET outcome. However, the infrastructure and configuration problems which plagued the set-up of the federated testbed, and which delayed D6.2 submission till late February 2013, prevented the consortium to have a stable demo till early November 2012. This, along with the need of keeping the federated testbed stable for the performance evaluation included in D6.2, made the consortium miss the most appropriate occasions for industrial dissemination, like the October 2012 NEM Summit held in Istanbul.

In spite of these difficulties, the COMET Federated Testbed and its associated demos have been instrumental in presenting COMET outcomes during the COMET-PURSUIT joint workshop held in London, late October 2012, and the mainstay in TID's continual internal dissemination, as illustrated in the demonstration efforts held for the TID's Strategy Department, late December 2012, and for the internal Workshop held in late March 2013.

In addition, all industrial partners issued press releases to their PR departments, aiming to attract media attention to the COMET project and its results by national and foreign media, fulfilling *Objective 7.1.g. Production by the industrial partners (TID, PrimeTel and INTRACOM TELECOM) of two notes for press releases, the first one at the beginning of the project (no later than M3) and the second one at the end of the project (no later than M36).* Primetel's press release was approved and published in its national magazine, PrimeTime, in March issue.

2.4 Standardization

2.4.1 **Activities**

CDN Interconnection, use cases and requirements, Media Content Distribution - Content Delivery Networks Interconnection Working Group, European Telecommunications Standards Institute, 31 March 2012

Spiros Spirou had previously edited a document, summarizing COMET's viewpoint on the relation between CDNs and ICN. This document was eventually published as part of draft-fmn-cdni-advanced-use-cases and was presented at IETF-82. Following this presentation, COMET was invited to submit that work to ETSI MCD CDN-I work group as well. S. Spirou re-edited and adapted the work, which was finally published as Annex D.3 of Technical Specification ETSI TS 102 990 - CDN Interconnection, use cases and requirements. The focus of contributions to that TS was then shifted on architecture, procedures and data models for CDN interconnection.

IRTF ICNRG Meeting, Stockholm, Sweden, 13th – 15th February 2013

Dr Ioannis Psaras attended the interim meeting of the ICNRG group [13] which took place in Stockholm on the 13th-15th of February 2013. Dr Ioannis Psaras has contributed to the ICN Research Challenges document produced by the group as an Internet Draft [14]. The document is an ongoing effort. During the meeting in Stockholm several directions for the next versions of the draft have been discussed and documented. The next version is expected during June-July, before the next IRTF meeting at IETF 87 in Berlin in July-August 2013.

ICN Baseline Scenarios Document, IRTF ICNRG Meeting, Stockholm, Sweden, 13th – 15th February 2013

During the IRTF ICNRG interim meeting in Kista, Sweden on the 14th of February 2013, Spiros Spirou paricipated at the break-away meeting about the Internet Draft on ICN Baseline Scenarios [15]. The purpose of this document is to "to define reference baseline scenarios to enable performance comparisons between different approaches". Following the discussion at the meeting, S. Spirou was invited by the draft editor to contribute. The contribution was eventually focused on traffic and system metrics for comparing a given ICN approach to an earlier version of that approach, to another approach or to the incubent TCP/IP networking technology. The IETF IPPM was proposed as a basis. The contribution will be integrated to the draft in time for IETF 87.

Presentation at IRTF ICNRG Meeting, Stockholm, Sweden, 14th February 2013

Spiros Spirou participated in the discussion during the IRTF ICNRG interim meeting and gave a talk about the deployment potential of ICN. The title of the presentation was *"Is ICN going to make it to deployment?"* and identified the main stakeholders and analysed their incentives. The main message was that given the current state of ICN research the are only minimal incentives for ICN deployment. A similar message was given the previous day by Dave Oran, one of the ICNRG chairs, at the co-located SAIL/EFRAIM workshop. The discussion that followed S. Spirou's presentation seemed to confirm that ICN needs to come up with novel scenarios and use cases in order to increase chances of deployment.

2.4.2 **Summary**

The IRTF ICNRG group has finally been formed and, as discussed in previous deliverables, the COMET consortium considers that this is the most relevant working group to be involved in, in order to disseminate our results and contribute to standardisation efforts in the area. We have therefore, attended most of the group's meetings as detailed above and have also contributed to

two (out of the three) main documents to be produced.COMET's research outputs (e.g., the coupled approach architecture and COMET's ICN caching mechanisms) have now been included as baseline material for the group. The COMET partners will continue their contribution to the group even after the end of the project and will follow the developments within the group.

3 Summary and Conclusions

During the third 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 a joint workshop with one of the projects in the area (PURSUIT), contribution to the related standardisation group of IRTF and publication of several papers in ICN-specific venues. COMET partners have also continued to be 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 both the industrial and academic partners focused on the standardization of the project's results in the most relevant standardization working group, namely the ICNRG group of the IRTF. Towards this direction, two of the COMET partners have been co-authoring two out of the three main documents/drafts of the group, as detailed earlier in the related section.

All COMET partners have been committed to continue their research, implementation and exploitation efforts, as well as disseminate project's progress and developments during Year 3, aiming to increase project's impact to the community. The project has become one of the flagship projects in the area with most of the research community being fully aware of our results. This is evident from the high number of citations to our papers already within less than three years of publication, several invitations for keynote speeches and invited talks in related events and invitations to contribute to the first documents of the related ICN research group at IRTF.

4 Appendix

In this appendix, we list the papers that have been submitted during the final months of the project (including the 3-month extension period), but we have not yet received the (final) decision letter.

Paper submission: IEEE Transactions on Parallel and Distributed Systems (IEEE TPDS), November 2012

UCL submitted the paper *"In-network cache management and resource allocation for Information-Centric Networks"* to the IEEE Transactions on Parallel and Distributed Systems journal (IEEE TPDS). The paper is an extension of the ICN Sigcomm Workshop paper *"Probabilistic In-Network Caching for Information-Centric Networks"*. This extended version elaborates on issues related to resource allocation in ICN environments. The paper has received the first round of reviews and the editor commented that the paper will be published after the reviewers' suggested revisions. The final outcome will come later in 2013.

Paper submission: Elsevier Computer Networks (COMNET), Special Issue on Information Centric Networks, January 2013

UCL submitted the paper *"In-Cache Time Calculation for Information-Centric Networks"* to the Elsevier Computer Networks journal, Special Issue on Information-Centric Networks. This paper is an extension of the earlier IFIP Networking 2011 paper *"Modelling and evaluation of CCN caching trees"*. In this extension we have proved that our theoretical model applies not only to CCN environments, where contents are cached in every cache they traverse, but also to a wider spectrum of algorithms and techniques for in-network caching. The decision is expected during May 2013.

Paper Submission: Springer Journal of Telecommunication Systems (Springer), 16th January 2013

The enhanced version of the paper from IEEE Network Conference, entitled *"Optimized decision algorithm for Information Centric Networks"*, was submitted to the Springer Journal fo Telecommunication Systems [9]. The enhancements are focused on dynamic adaptation of reference levels used in the decision algorithm. The dynamic adaptation allows avoiding problems with appropriate tuning of reference values. The effect is especially important for ALICANTE system. The decision of paper acceptance is expected during May 2013.

5 References

[1] Soursos, S.; Doulamis, N., "Connected TV and beyond," *Consumer Communications and Networking Conference (CCNC), 2012 IEEE*, vol., no., pp.582,586, 14-17 Jan. 2012 doi: 10.1109/CCNC.2012.6181009

[2] W. K. Chai, Dilliang He, Ioannis Psaras and George Pavlou, "Cache 'Less for More' in Information-Centric Networks", IFIP Networking 2012, Prague, May 2012 – BEST PAPER AWARD

[3] C. Ge, N. Wang, Z. Sun, "Optimizing Server Power Consumption in Cross-Domain Content Distribution Infrastructures", Proc. of the IEEE ICC, Ottawa, Canada, 10-15 June 2012.

[4] Ali Norouzi, Michael P. Howarth, Ning Wang: An ISP and end-user cooperative intradomain routing algorithm. Proc. of the IEEE ISCC 2012: pp. 289-294

[5] I. Psaras, W. K. Chai, G. Pavlou, "Probabilistic In-Network Caching for Information-Centric Networks", Proc. of the 2nd ACM SIGCOMM Workshop on Information-Centric Networking (ICN'2012), Helsinki, Finland, August 2012.

[6] A. Bęben, J. Mongay Batalla, W. K. Chai and J. Śliwiński, "Multi-criteria Decision Algorithms for Efficient Content Delivery in Content Networks", Annals of Telecommunications, Special Issue on Networked Digital Media, vol. 68, no. 3-4, pp. 153-165, April 2013, (DOI) 10.1007/s12243-012-0321-z.

[7] G. Pavlou, N. Wang, W. K. Chai and I. Psaras, "Internet-scale Content Mediation in Information-centric Networks", Annals of Telecommunications, Special Issue on Networked Digital Media, vol. 68, no. 3-4, pp. 167-177, April 2013, (DOI) 10.1007/s12243-012-0333-8.

[8] Reading Material for Tutorial at ITC-24, Krakow, Poland, September 2012 http://www.ee.ucl.ac.uk/~uceeips/itc-reading-material.pdf

[9] J. MongayBatalla, A. Bęben, Y. Chen, "Optimization of the Decision Process in Network and Server-aware Algorithms", Proc. of IEEE Networks 2012, Rome, Italy, October 2012.

[10] L. Saino, C. Cocora, G. Pavlou, "A Toolchain for Simplifying Network Simulation Setup", in Proceedings of the 6th International ICST Conference on Simulation Tools and Techniques (SIMUTOOLS '13), Cannes, France, Mar. 2013

[11] L. Saino, C. Cocora, G. Pavlou, "CCTCP: A Scalable Receiver-driven Congestion Control Protocol for Content Centric Networking", In IEEE ICC 2013 - Next-Generation Networking Symposium (ICC'13 NGN), Budapest, Hungary, June 2013 (to appear).

[12] A. Bęben, J. MongayBatalla, D. Florez, W. K. Chai, S. Spirou, N. Wang and M. Georgiades, "The Content Mediator Architecture for Content-Aware Networks", Special Issue of Journal Telecommunication Review and Telecommunication News (PrzegladTelekomunikacyjnyiWiadomościtelekomunikacyjne), pp. 1192-1203, No. 8-9, September 2012, ISSN 1230-3496.

[13] Information-Centric Networking Research Group (ICNRG) charter. Available at http://irtf.org/icnrg.

[14] D. Kutscher, S. Eum, K. Pentikousis, I. Psaras, D. Corujo, D. Saucez, "ICN Research Challenges", draft-kutscher-icnrg-challenges-00, IRTF ICNRG, http://tools.ietf.org/html/draft-kutscher-icnrg-challenges-00, February 10, 2013.

[15] K. Pentikousis et al., "ICN Baseline Scenarios", draft-pentikousis-baseline-scenarios-02, http://datatracker.ietf.org/doc/draft-pentikousis-icn-scenarios/, March 11, 2013.

[16] W. K. Chai, D. He, I. Psaras and G. Pavlou "Cache "Less for More" in Information-Centric Networks (Extended Version)", Elsevier Computer Communications, Special Issue on Information-Centric Networking, vol. 36, no. 7, pp. 758-770, 1 April 2013, (DOI) 10.1016/j.comcom.2013.01.007.

6 Abbreviations

ALICANTE	MediA Ecosystem Deployment through Ubiquitous Content-Aware Network Environments
CCNC	Consumer Communications and Networking Conference
CDN	Content Delivery Networks
CDNi	Content Delivery Networks interconnection
COMET	COntent Mediator architecture for content-aware nETworks
COMNET	Elsevier Computer Networks
CoS	Class of Service
DOI	Digital object identifier
EFRAIM	Eco system for future media distribution
ENVSION	Co-optimisation of overlay applications and underlying networks
EPSRC	Engineering and Physical Sciences Research Council
ETSI	European Telecommunications Standards Institute
FI	Future Internet
FIA	Future Internet Assembly
GA	General Assembly
ICC	International Conference on Communications
ICN	Information Centric Networks
ICNRG	Information-Centric Networking Research Group
ICT	Information and Communications Technology
IEEE	Institute of Electrical and Electronics Engineers
IETF	Internet Engineering Task Force
IFIP	International Federation for Information Processing
IoT	Internet of Things
IP	Internet Protocol
IPPM	Internet Protocol Performance Metrics
IRTF	Internet Research Task Force
ISCC	International Symposium on Computers and Communications
ISSN	International Standard Serial Number
MCD	Media Content Distribution
NEM	Networked and Electronic Media
NICT	National Institute of Information and Communications Technology
P2P	Peer to Peer
PR	Public Relations
PTL	Primetel
PURSUIT	Publish Subscribe Internet Technology

QoS	Quality of Service
R&D	Research and Development
SAIL	Scalable and Adaptive Internet Solutions
SIGCOMM	Special Interest Group on Data Communication
SESERV	Socio-Economics Service for European Research Projects
SIMUTOOLS	Simulation Tools and Techniques
STREP	Specific Targeted Research Project
TCP	Transport Class Protocol
TPDS	Transactions on Parallel and Distributed Systems
TS	Technical Specification
TV	Television
UCL	University College London
VoD	Video on Demand

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