FUTURE NETWORKS

FROM RESEARCH TO INNOVATION VIA STANDARDISATION

Report of the Future Networks 7th FP7 Concertation Plenary Meeting
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Executive summary

Standards are fundamental to technological progress in the ICT world of today, and the standardisation process is pivotal in the exploitation of technical innovation. Standardisation is important from a policy viewpoint because it supports the internal market and the deployment of pan- European systems and services. Open standards facilitate both competition and consumer protection; they promote global solutions, and support the emergence of EU positions on global issues.

From a research perspective, standards are also very important. They are an instrument to catalyse the exploitation of research results, and are an efficient co-operation platform with other regions of the world. They form a natural link for research into those issues that are system oriented. It is possible, therefore, to incubate research ideas within the traditional standardisation process. From the inception of the Framework Programmes in the 80's, ICT RTD has been systematically encouraged to generate standardisation spin-offs, especially in the networking domains.

The policy context for closing the standardisation gap with research is to maintain a key focus on innovation and smart growth backed by a systematic coupling of RTD with maximum innovation impact from medium to large scales. Facing major societal challenges and frequently uncoordinated European and National level actions, the European Commission (EC) is proposing European Innovation Partnerships (EIPs), frameworks bringing together the main actors, policies and actions at EU and national levels, from research to market, around common objectives and targets. Preparations for the future EU research programme will aim towards a more systematic, proactive, policy driven approach, coupling RTD with standards.

Various Framework projects have demonstrated, and are currently showing, that research contributions to standards are possible, effective, and facilitate the timely development of global technology solutions. Examples include:

- ARTIST4G and Fourth Generation Mobile technology
- EUWB and E^3 with Cognitive Radio technology
- OMEGA with the in-home network of the future
- CARMEN with inhomogeneous, interpretable wireless mesh networks
- TRILOGY with the Future Internet.

The standards bodies are becoming more "research friendly" in welcoming the input of research where appropriate. They are creating organisational structures by which research can participate in the standardisation processes, for example:

- ETSI Industry Study Groups and new research-orientated Technical Committees
- IETF with its innovation-focussed organisational structure
- ITU-T, where Study Group 13 has a broad, futuristic remit for work on network evolution.

Nonetheless, there remain barriers to the efficient participation of research where appropriate in the standardisation processes. As the European Commission prepares its proposals for the future Framework Research Programme, it will be addressing a number of questions and issues to ensure a more systematic policy driven approach, coupling RTD with standards.

The policy perspective

Standardisation is most important from a policy viewpoint because it supports the internal market and the deployment of pan-European systems and services. Open standards facilitate both competition and consumer protection; they promote global solutions, and support the emergence of EU positions on global issues.

Standards are fundamental to technological progress in the ICT world of today, and the standardisation process is pivotal in the exploitation of technical innovation. In a networked world, new products must be able to work with one another and fit into existing infrastructure. Technical innovation can only contribute to societal goals if consumers can obtain new technology at affordable prices, yet suppliers can only offer new products when they have confidence that there is a sizeable market waiting. Standardisation may, indeed, be a pre-condition for turning research results into products.

From a research perspective, standards are also very important. They are an instrument to catalyse the exploitation of research results, and are an efficient co-operation platform with other regions of the world. They form a natural link for research into those issues that are system oriented. It is possible, therefore, to incubate research ideas within the traditional standardisation process. From the inception of the Framework Programmes in the 80's, ICT RTD has been systematically encouraged to generate standardisation spin-offs, especially in the networking domains.

Research is growing in importance within the standardisation process. This was not the case in the past, when typically standardisation activity began after a technological innovation had established itself. In the old world, research had little business in the standards arena, and companies often placed research and standardisation in the hands of different people in different departments. Nowadays the innovation to exploitation cycle runs much faster, and research activity needs efficiently and proactively to engage with the generation of standards.

The policy context for closing the standardisation gap with research is to maintain a key focus on innovation and smart growth backed by a systematic coupling of RTD with maximum innovation impact from medium to large scales. To do this it is necessary to strengthen partnerships between the academic world and industry, and to strengthen cross sectoral partnerships, maintaining a medium versus long term balance with research in an (eco)system context. Public sector leverage of ICT take up is most important with standardisation as a key tool.

Facing major societal challenges and frequently uncoordinated European and National level actions, the EC is proposing European Innovation Partnerships (EIPs), frameworks bringing together the main actors, policies and actions at EU and national levels, from research to market, around common objectives and targets. The first of these, on Ageing, has been launched; there will be communications on additional EIPs in May 2011. It is planned to promote EU competitiveness in the "digital society" through faster access to information and new ways of trustworthy communication, enabled notably by the Internet of the future.

Preparations for the future EU research programmes will aim towards a more systematic, proactive, policy driven approach, coupling RTD with standards. A Green Paper consultation proposing a Common Strategic Framework for Research and Innovation (CSF) is in hand between February and May 2011. The upcoming orientations will be formed in spring of 2011, and the next research programme proposal will emerge at the year-end. DG-INFSO wishes to develop innovation friendly tools and add R&D capacity and infrastructure to support the standardisation processes.

Questions to be addressed include the following.

- What are the precise roles for research in the context of standardisation (validating, influencing, early detection etc.)?
- What organisations and structures are appropriate?
- What is the role of the public sector that is the relative positions of policy-driven versus industry-driven initiatives?
- Is research a valid tool towards international co-operation, global standards and interoperability?

Some examples

Mobile communications: long term evolution

Long Term Evolution (LTE) technology, formerly known as Fourth Generation Mobile, is an excellent example where effective research input to the standardisation process has helped the exploitation of the technology. The technical baseline was established in August of 2010, and commercial rollout has begun in Germany and Sweden. The first rollout is not the end of the story, as further refinements are needed in the areas of Co-operative Multipoint (COMP) for interference avoidance and relaying for small, cost-efficient cells with self-backhaul.

The results of the ARTIST4G integrated project must benefit customers in Europe and strengthen companies based in Europe, so results need to be transferred to commercial products. Therefore, standards and products are of key importance. So far, only the transmitter and protocols are standardized, and a lot of innovation is required also in implementation, architecture and deployment. Projects that have made a strong impact on LTE standards are ARTIST4G, the predecessor project WINNER, and EASY-C (a German National project). Members of the ARTIST4G consortium who were members of the Next Generation Mobile Networks (NGMN) alliance have fed project results to that body, strengthening their requirements adoption, while industry partners have contributed to the ETSI Third Generation Partnership Project (3GPP).

The timing of standards contributions is critical. At first, a consensus should be established between key players before a topic is officially studied and options are narrowed from a wide range of possible approaches. At this stage, inputs of scenarios, requirements and assumptions can have a huge impact on the development of technical concepts. Research can inform, motivate and convince corporate players. Contribution of technical concepts themselves may in practice be highly political and the responsibility of a different part of a participant's company, maybe even in a different country.

ARTIST4G members are currently active on the standardisation of COMP in 3GPP, working on the evaluation methodology, scenario prioritisation and simulation assumptions. The main benefit of the ARTIST4G work here is to avoid fragmentation and to drive common goals between members. An "official" ARTIST4G input would have been highly counterproductive.

Research projects can be very successful in driving the development of standards. Usually, the input will be successful when individual partners form a collaborative nucleus, contribute on a voluntary basis and are ready to involve other partners not in the project where necessary and appropriate. Even when a project is very successful in helping the standardisation process, there may well be no formal or visible project contribution, and the project may receive no official acknowledgment. There can be a variety of good reasons for this. For example, only certain participating members may have access through membership to (for example) 3GPP, or different company departments may head the process and provide the delegates. A less happy reason may be that some research project managers may view standards contribution as a dissemination activity that is of lower value than the research itself.

Detect and avoid: Cognitive Radio

It can take a long time for standardisation work to come to fruition. It is quite common for this time to exceed the three-year lifetime of a typical framework project. The exact time varies with the technical area: some are relatively near-term in coming to the market. An example of a very long gestation period is that of Cognitive Radio, explored in project EUWB. Cognitive Radio systems, aimed at very short-range applications, make efficient use of radio spectrum by sensing the level of radio signal around and then automatically choosing frequencies that are quiet in the locality. These are sometimes known as "detect and avoid" systems, a domain where Europe currently leads. Standardisation is especially slow because this technology is a new use of radio spectrum that has to convince not only standards committees in ETSI but also regulators in CEPT. EUWB partners are active on various Technical Committees (TCs) of ETSI and Working Groups (WGs) of CEPT. One of these is ETSI TC Reconfigurable Radio Systems (RRS), an example of an ETSI TC specifically aiming to welcome and incorporate research results in its deliberations. Project E^3 is also working in this area, contributing to ETSI TC RRS, to IEEE WG P1900.4 and to the IEEE international DySPAN symposium.

The home network

If one were to imagine a work area where the need for standardisation was most obvious, it would surely be the components for consumer networks in the home. Project OMEGA determined that standardisation would be necessary to engage a broad development community in an open process, leading to a larger market of interoperable and exchangeable products from different vendors. This was a multi-technology research project, making innovations in the areas of wireless radio communication, power line communication and wireless optics (visible light). This led to contributions to existing standardisation efforts for WiFi (IEEE 802.11 ac/ad), PowerLine (ETSI TC PLT and ITU-T G.hn), visible light (IEEE 802.15.7), mesh networks (IEEE 802.11s) and various multi-technology standards. There being no existing work on the inter-working of Media Access Control (MAC), consortium members promoted a new working group, IEEE P1905.1, in November 2011. This is labelled the Convergent Digital Home Network (CDHN) WG.

Wireless mesh networks

A wireless mesh network is a group of wireless nodes that sense one anothers' presence and autonomously locate the best means to communicate between one another, using intermediate nodes where necessary. This makes possible efficient self-organising networks. It is, of course, desirable for heterogeneous networks to be formed from different vendors' nodes, and this inevitably implies standardisation of their inter-working. The CARMEN project discovered that it would be possible and productive to work within an existing standardisation initiative, IEEE 802.21, on media-independent handover services. Nonetheless, they needed to generate some new functionality for self-description of interface properties, neighbour discovery, radio interface configuration and resource management. A Study Group (SG) to analyse Heterogeneous Wireless Networks Management was created in November 2009. The project confirms that the time to influence and create successful standards is quite likely to exceed a typical FP7 project lifetime. They comment that while academic contributors are extremely valuable when contributing to the development of standards, they need to advise or work alongside industrial partners since they can make little impression on their own.

Re-architecting the Internet

The FP7 Integrated Project TRILOGY is researching the architecture of the Future Internet, so the Internet Engineering Task Force (IETF) was the natural place to aim its results. Members of the TRILOGY integrated project designed the Multipath Transport Control Protocol (MPTCP), proposed the MPTCP Bird of a Feather (BOF) as a result of which the MPTCP Working Group (WG) was formed. One of the MPTCP WG co-chairs is from TRILOGY, while all the four drafts of the WG have TRILOGY authors. Two of these have reached the Request for Comment (RFC) stage. Members of TRILOGY likewise initiated the BOF for the Congestion Exposure (CONEX) WG; one is its co-chairs is from the project and the two WG documents have TRILOGY authors.

The standardisation processes in action

Closing the standards gap

Various activities are being deployed to close the "standards gap", i.e. gap between research activities and the standardisation process. These include the standards bodies themselves, about which more follows below. Additionally, there are specifically directed pre-standardisation initiatives such as the Future Internet Architecture (FIA) Forum.

EU-supported initiatives include:

- FP7 projects set up for the purpose
- Project clusters
- European Technology Platforms (ETPs).

Among the standards bodies, ETSI accepts research and futuristic inputs through its Industry Steering Groups (ISGs), and is deliberately orienting some of its Technical Committees (TCs) so that these, too, may where appropriate address, consider and incorporate research input. The Internet Engineering Task Force (IETF) has a specifically designed process for absorbing new proposals from the world of research. The International Telecommunications Union Standards Organisation (ITU-T) has set up the Study Group 13 (SG13), "Future Networks including Mobile and Next Generation Networks (NGN)", with a broad and futuristic remit.

European Telecommunications Standards Institute (ETSI)

ETSI is developing new structures and methods of working alongside traditional organisations, as ETSI realises that engagement with research questions is more necessary in a fast-moving, networked world. The ETSI structure includes four types of organisation: the Project, the semi-permanent Technical Committee (TC), the Partnership Project (e.g. 3GPP) and the Industry Study Group (ISG). The TCs produce the main output of standards (ETSI standards, technical specifications and technical reports), while the ISGs concentrate on pre-standardisation activities. One such ISG (though there are many) is the ISG on Autonomic networking engineering for the Future Internet (AFI); this clearly functions as a pre-standardisation ISG working as part of an existing TC. There may be a potential conflict in the functional division of TCs and ISGs, since pre-standardisation work may not necessarily percolate quickly enough to the TCs for effective standardisation work. The ETSI TC on Reconfigurable Radio Systems (RRS) was created in 2008 with specific orientation to the uptake of FP7 results, and to facilitate consensus making between projects. ETSI TC RRS with its four working groups has become a centre of competence for Configurable Radio (CR) and Software Defined Radio (SDR). ETSI TTC RRS is open to liaise with different bodies and has prepared the ground for efficient involvement of EC research projects at TC level in the standardisation process. Naturally, engagement with research is not appropriate for near-time standardisation activities, though it is increasingly necessary for medium and longer-term work.

Internet Engineering Task Force (IETF)

The Internet Engineering Task Force (IETF) is the established forum for addressing the shortcomings and evolution of the current TCP/IP based Internet. Draft Internet standards appear as Request for Comment (RFC) documents, which are input to an approval process. The IETF is open to any interested individual; one can contribute to work already planned or in progress, or one can try to influence the agenda and open a new area of work. The starting point is usually to attend meetings, and the next step to submit an Individual Internet Draft. These are open and not peer-reviewed inputs, so it is a substantial achievement to convince a Working Group (WG) chairman that it is worth the presentation time in a meeting. The next major accomplishments are to be invited to prepare a WG Internet Draft, in due course to prepare an RFC and to chair or present at a Technical Plenary meeting. To initiate the formation of a WG, a proposer launches a BOF (literally “Birds of a Feather”) proposal in concert with others.

International Telecommunications Union – Standardisation (ITU-T)

The ITU-T regards pre-standardisation work as a necessary part of its development of standards for future networks. Study Group 13 (SG13), “Future Networks including Mobile and Next Generation Networks (NGN)”, is inviting research participation and indeed regards its own operating process and methodology as research issues. SG13’s Question 21 provides an explicit link between research and the standard-setting process, seeking a clean-slate design for providing futuristic functionalities beyond the limitations of existing networks including the Internet. Future Network (FN) documents will include:

- Objectives and Design Goals
- Terminology
- Framework for Virtualisation
- Identification Schemes
- Energy Saving in networks
- Project descriptions

A new standard and vision of future networks, ITU-T Y.3001, “Future Networks: Objectives and Design Goals”, has a target date in the range 2015 – 2020. Its four objectives will be environment awareness, service awareness, data awareness, and socio-economic awareness, and these lead to twelve design goals for promising technologies. A standard of such breathtaking extent will entail wide collaboration outside the traditional ICT domain. It is also clear that this standard will present a roadmap for ongoing technology and standards development.

Conclusions

Standards are fundamental to technological progress in the ICT world of today, and the standardisation process is pivotal in the exploitation of technical innovation. Standardisation may, indeed, be a pre-condition for turning research results into products. From a research perspective, standards are also very important, and it is possible to incubate research ideas within the traditional standardisation process. From the inception of the Framework Programmes in the 80's, ICT RTD has therefore been systematically encouraged to generate standardisation spin-offs, especially in the networking domains.

Framework projects have been very successful in making contributions to standards and so enabling earlier take-up of results and exploitation of technology.

- ARTIST4G members have actively contributed and are contributing to LTE (Fourth generation Mobile) standards, leading to commercial roll-out of LTE.
- EUWB and E^3 members are working in ETSI and CEPT to drive the necessary standardisation and regulatory consensus needed for the deployment of cognitive radio systems.
- OMEGA members are engaging with different fora for the innovative technology and multi-technology platforms of home networking.
- CARMEN members are participating in standardisation work that will enable inhomogeneous mesh networks consisting of interoperable and exchangeable equipment from different vendors to function and organise themselves.
- TRILOGY members are taking an active role at the IETF as the design and standards of the Future Internet evolve.

The standards bodies are welcoming the input of research where appropriate, and are creating organisational structures by which research can participate in the standardisation processes.

- ETSI has its ISGs and is developing research-aware TCs such as ETSI TC RRS.
- IETF has an innovation-oriented basic method of operating.
- ITU-T has designated the futuristic SG-13 and formulated the project Y.3001, "Future Networks: Objectives and Design Goals."

There remain barriers, however, to the effective participation of research projects in the standards activities.

- It is normally necessary for project participants to contribute in the capacities of their separate companies, and on a voluntary basis.
- The standards cycle is normally slower than the typical project lifetime.
- Some research managements still view contributions to standards as a dissemination activity of less value than the research itself.

Accordingly, the European Commissions preparations for FP8 will aim to facilitate a more systematic, policy-driven approach, coupling RTD with standards.

List of speakers

The ideas in this report reflect presentations and discussions among participants in the Future Networks 7th FP7 Concertation Plenary Meeting that took place in Brussels on 10 February 2011.

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The opinions expressed in this document are drawn from consensus views of the participants to the event and may not always be represented as the exact opinion of an individual participant or their employer.

This work does not necessarily reflect the view of the European Commission.

Acronym list

3GPP	Third Generation Partnership Project (a mobile communications pre-standardisation body)
AFI	Autonomic networking engineering for the Future Internet (a ISG of ETSI)
CDHN	Convergent Digital Home Network (a WG of the IEEE)
CEPT	European Conference of Postal and Telecommunications Administrations
CONEX	Congestion Exposure (a WG of the IETF)
CR	Configurable Radio
DG-INFSO	Directorate General (of the European Commission): the Information Society
DySPAN	Dynamic Spectrum Access Networks (an international symposium promoted by the IEEE)
EC	European Commission
EIP	European Innovation Partnership (an EC innovation framework addressing particular topics of interest e.g. the Ageing Society)
ETP	European Technology Platform
ETSI	European Telecommunications Standards Institute
EU	European Union
FN	Future Network
FP6	Sixth Framework (of EU-supported RTD)
FP7	Seventh Framework (of EU-supported RTD)
FP8	Eighth Framework (of EU-supported RTD)
G.hn	An ITU-T global standard for the fully networked home
ICT	Information and Communication Technologies
IEEE	Institute of Electrical and Electronic Engineers
IETF	Internet Engineering Task Force (a global standardisation body for the Internet)
IP	Internet Protocol (a core network layer protocol of the Internet)
ISG	Industry Study Group (of ETSI)
ITU-T	International Telecommunications Union – Standardisation
LTE	Long Term Evolution (“fourth generation” mobile communications standards)
MAC	Media Access Control
MPTCP	Multipath TCP (a WG of the IETF)
NEM	Networked and Electronic Media. (An EC-funded ETP)
NESSI	Networked European Software and Services Initiative. A community with a common Strategic Research Agenda. (An EC-funded ETP)
NGMN	Next Generation Mobile Networks (a global industry alliance)
NGN	Next Generation Networks
PLT	Power Line Telecommunications (a TC of ETSI)
R&D	Research and Development
RFC	Request for Comments, a draft standard within the IETF
RRS	Reconfigurable Radio Systems (a TC of ETSI)
RTD	Research and Technology Development
SDR	Software Defined Radio
SG	Study Group (within the IEEE Standards Association, also of ITU-T)
SG13	Study Group 13 (of ITU-T) on Future networks including mobile and next generation networks
TC	Technical Committee (of ETSI)
TCP	Transport Control Protocol (a core transport layer protocol of the Internet)
WG	Working Group (of the IETF, also of CEPT, also of the IEEE Standards Association)

Project list

ARTIST4G	Advanced Radio Interface TechnologIes for 4G SysTems (FP7 integrated project)
CARMEN	CARrier grade MEsh Networks (FP7 project)
E^3	End-to-End Efficiency (FP7 integrated project)
EASY-C	Enablers of Ambient Services and systems – Part C, Wide Area Coverage (a German national research project)
ECODE	Experimental COgnitive Distributed Engine (FP7 project)
ETICS	Economics and Technologies for Inter-Carrier Services (FP7 project)
EUWB	Existing Ultra-Wide Band radio technology (FP7 integrated project)
MEDIEVAL	MultimEDia transport for mobIlE Video AppLications (FP7 project)
OMEGA	OMEGA is an FP7 integrated project, the Home Gigabit Access project
TRILOGY	Re-architecting the Internet (FP7 integrated project)
UniverSelf	UniverSelf, realizing autonomics for Future Networks (FP7 project)
WINNER	Wireless World Initiative New Radio (FP6 project)

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Find out more about Future Networks Projects Portfolio and Research Roadmaps in FP7:

Future Networks – The Way Ahead!
FP7-ICT-Call5 Project Portfolio
FP7-ICT-Call4 Project Portfolio
FP7-ICT-Call1 Project Portfolio
http://cordis.europa.eu/fp7/ict/future-networks/publications/

Find your way to the right EU funding scheme:

Practical Guide to EU funding opportunities for Research and Innovation
http://cordis.europa.eu/eu-funding-guide/home_en.html
Understanding the Seventh Framework Programme
http://cordis.europa.eu/fp7/home_en.html
EU funding for the advancement of ICT
http://cordis.europa.eu/fp7/ict/home_en.html

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