

4 section four

Driving Research into Standards - An I²R Perspective



The role of R&D is becoming increasingly important as Singapore transforms itself to a knowledge-based economy. As a publicly funded research institute, the Institute for Infocomm Research (I²R) not only has to pursue excellence in science, but also be able to translate achievements in the scientific domain to tangible economic benefits. One of the ways that I²R has been approaching this is by driving its research towards industry standards where feasible. The Institute's involvement in standards activities has risen considerably over the last several years and has had some initial successes, most notable of which was the adoption of I²R's intellectual property into the Motion Picture Experts Group's MPEG-4 Scalable Lossless Coding and MPEG-4 Audio Lossless Coding standards. The institute was also able to contribute a significant way in the Wimedia standards, harmonising many different proposals from various companies into a single unified proposal for adoption into the standard.

The article discusses in greater detail I²R's involvement in various standards, as well as how the work in those standards have attracted collaborations with multinational corporations, and the economic spin-offs that have resulted. These early successes are promising signs indeed that Singapore is gaining more prominence in the R&D arena, while at the same time ensuring that research is translated into economic relevance.

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1 Introduction

One of the many challenges for a researcher, and indeed research and development in general, is getting the output of research adopted and used by a sizeable number of people. There are many factors influencing the adoption of technology of course, including the efficacy and performance of technology vis a vis other alternatives, ease of use, business model and pricing etc. One of the important, but less obvious, considerations to universal adoption of technology is compatibility and interoperability. This framework for compatibility, interchangeability and commonality, more commonly termed as the standards framework, help bring about benefits in a competitive marketplace without hurting competition. Standards today determine how mobile phone calls are made, how hazardous materials are to be classified and managed, and even how safety procedures are to be carried out. Even something as simple as our modern 365 day calendar is a standard.

Arguably the most rapidly evolving area of standards development is in the Infocomm Technology arena. The world has evolved from the industrialised age to the Internet age, largely through the advances made possible by advancements and standardisation of technology. More and more companies are resisting proprietary technology which locks in the company to a particular vendor. The whole Internet itself is made up of a large collection of standards that made it possible for web pages to be created, published and viewed universally. Large amounts of research are still under way to further improve the current technologies, and not an inconsequential part of that research effort is channeled at looking at the issues affecting interoperability. Many standards bodies exist in the Infocomm area, both the traditional standards organisations like ISO and ANSI, to the more specifically Infocomm focused W3C, 3GPP, and many other similar organisations.

2 From Research into Standards

Singapore is in the midst of a transformation to a knowledge intensive, knowledge driven economy. In its 2003 report, the Economic Review Committee recommended to strengthen public sector R&D efforts to create and exploit intellectual property. Since then, there have been major changes to the R&D landscape in Singapore. This includes the set up of the National Research Foundation in January 2006, as well as the doubling of public sector R&D spending for the five year period starting from 2006. While public sector research is often looked at as an academic and hence educational pursuit in many places, it is not the case in Singapore. A large part of public sector research is carried out with direct economic development goals in mind, and comes under the auspices of the Ministry of Trade and Industry (MTI) rather than the Ministry of Education.

The Institute for Infocomm Research (I²R) is one of the 14 research institutes funded and managed by the Agency for Science, Technology and Research (A*Star), the statutory body within MTI spearheading public sector research. In the pursuit of economic and industry relevance of its research several years ago, the Institute realised that it too had to get involved in standards work in a consistent and coherent manner. Standardisation activities were included in the portfolio of key strategic initiatives.

There are many compelling reasons why standards activities benefit the research institute. Firstly, standards are industry driven. They exist largely to facilitate interoperation and exchange that is part and parcel of trade. Thus, participating in standards activities help align research to industry. Secondly, having technology accepted as standards and successfully commercialised is one of the fastest ways to get widespread adoption. The financial paybacks are also an added incentive. Globally accepted technologies like MP3 earn its inventor, Fraunhofer Institute in Germany, many millions of dollars a year in royalty. Thirdly, success at getting a technology accepted as a standard is validation of the quality of research that takes place. The standards arena involves competition of technologies against the very best in the world, and the demands on quality are very exacting. The stakes are high for many participants, with everyone trying to gain a competitive edge. Finally, success at the standards arena also raises the profile and visibility of the contributing organisation. As a Singapore entity, I²R demonstrates to the rest of the world the innovativeness and capability of the city state to do cutting edge R&D. Singapore will not be known just as a passive user and adopter of standards, but also a creator of standards that influence the world.

Even though the case for participation in standards activities is strong, yet in reality, there are many barriers that prevent researchers, especially researchers in universities and small companies, from participating seriously in these activities. Participating in standards activities requires commitment, both in time and money. Standards meetings which I²R participate in, like the IEEE meetings, are normally held four times a year in different countries. In addition,

there may be intermediate meetings for specific working group members to resolve issues in between the main standards meetings. Also, major players in standards do not just send one person to attend each standards meeting – they send teams. Many of the meetings are held either in Europe or America. The cost of travel for participants in Asia is much more than the counterparts in Europe or America then. A standard also does not come about in just one or two meetings – it is a long drawn out process. In one of the case studies examined below, the whole process took almost five years from the initial proposal to the final specification document to complete. Thus cost becomes a major factor for participants wishing to play a contributive role in standards. This creates a huge barrier for many, especially small and medium sized companies and university researchers. I²R has overcome many of these barriers and consciously positions itself to be the Singapore flag bearer to influence and make contributions to international standards in its technical arena.

3 I²R's Standards Involvement

Since the formulation of a standards strategy several years ago, I²R has been actively participating in standards activities, always with a view to contribute and influence standards development with its technology and know-how. The institute does not focus on standards where it has insufficient competency to contribute, or when it has started working on the technology considerably later than the other players in the standards. Nevertheless, the institute has made good progress in its goal in influencing and contributing in a wide ranging array of standards. Many of the standards are still work-in-progress, and contributions are at different stages of the cycle, ranging from initial solution proposals, to proposals accepted into draft, to proposal accepted into the specifications. Even amongst proposals that are accepted, some are accepted into the core specification, some accepted into the optional specification, and others accepted into a part of the specification known as the informative part of the specification. The following tables show the more recent standards that the institute has played a part in.

IEEE STANDARD	TECHNOLOGY	CONTRIBUTIONS
IEEE 802.11n	High Speed Wireless LAN	6 proposals incorporated into specifications 3 informative contributions
IEEE 802.15.4a/b	Low Rate Wireless Personal Area Networks	7 proposals incorporated into specifications 16 informative contributions
IEEE 802.16j	Multihop relay for Broadband Access Networks	1 proposal in evaluation
IEEE 802.22	Wireless Regional Area Networks	6 proposals with core patents in evaluation 1 informative contribution

Table 1: I²R contributions to IEEE standards

ISO/IEC STANDARD	TECHNOLOGY	CONTRIBUTIONS
JTC1 SC17	Biometric Match on Card and Quality	1 proposal accepted into draft 1 informative contribution
JTC1 SC37	Biometric Quality	
15444-1	JPEG 2000	1 proposal incorporated into draft 1 informative contribution
MPEG 4 Part 10 and extensions	Video compression standard	1 proposal accepted into draft 3 patents in informative contributions
MPEG 4 SLS	Scalable to lossless audio compression	16 proposals with 7 core patents published as standard
MPEG 4 ALS	Audio lossless coding	2 proposals with 2 core patents published as standard

Table 2: I²R contributions to ISO/IEC standards

STANDARD BODY	TECHNOLOGY	CONTRIBUTIONS
Wimedia (formerly 802.15.3a)	High Rate Wireless Personal Area Networks	1 proposal accepted into draft 6 informative contributions
3GPP LTE	3G cellular technology improvements	1 proposal accepted into draft 5 informative contributions

Table 3: I²R contributions in other standards bodies

In many of these standards activities, besides the researchers directly participating in the standards activities, there are also implementation teams supporting the research that create prototypes of the technology. Through the prototype implementation, the technologies invented are validated. The prototypes also help give the team practical experience with the implementation of technology and the associated difficulties, and give the researchers an edge when working with collaborators to commercialise the technology. In addition, in several cases, implementation patents have been developed in the course of prototype creation which are not reflected in the tables above.

Two cases studies are presented on the evolution of two different technology standards which I²R was involved in and the long and arduous process to get the technologies standardised.

4 Case Study

4.1 WiMedia

I²R started research into Ultra Wide Band (UWB) technology near the turn of the century, and was one of the earlier organisations researching into the practical applications of this technology, even though the technology itself has a history dating back more than 40 years. In 2002, work was started in an IEEE standardisation project known as 802.15.3a, which was to develop specifications for high speed personal area networks. I²R was one of the original authors of the specification, and was the only publicly funded research organisation to take part in the standard development. Competition was intense with 23 proposals submitted. Together with three other companies, I²R was instrumental in putting forward a merged proposal of the 23 submitted proposals that was supported by more than 130 companies, including many of the leading consumer electronics players. This consortium came to be known as the Multiband OFDM Alliance (MBOA). However, a small group of companies, backed by Motorola, had an alternative solution, and the 2 camps were deadlocked, so much so that eventually the decision was to withdraw the project under IEEE in 2006. However the MBOA group surged ahead and merged with WiMedia, and now the WiMedia specification has been accepted as a standard by ISO/IEC in early 2007. The technology has been growing from strength to strength and has been incorporated into the Wireless USB standards as well as the next generation Bluetooth technology. Lenovo and Dell have just launched their first PC's with UWB technology in July 2007. Through all this, I²R has been able to capitalise on its deep understanding of the technology to help add value to its collaborators and give them a headstart in commercialising the technology.

4.2 Case Study – MPEG 4 SLS and ALS

In a radically different standards arena, the story of I²R's contribution to the MPEG 4 Scalable to Lossless System and Audio Lossless System is no less convoluted. In 2002, MPEG issued a call for proposals for a lossless and scalable technology that was backward compatible to existing technology. I²R submitted a proposal shortly after, but at a subsequent meeting, the proposal was split into 2 parts (SLS and ALS) as a compromise. In the subsequent competition, the solution proposed outperformed all other proposals and was subsequently selected as the reference model. After the selection of the reference model, further challenges were made to the proposals lasting more than a year, in which the I²R researchers had to respond and show evidence regarding the robustness of their solution. The researchers also had to fight off new alternative solution proposals from other companies, including solutions from a very powerful and influential industry player. Throughout all this, I²R managed to prevail through their superior technology solution and astute industry partnership. Almost a year and a half after the selection of I²R technology as the reference model, the final amendment proposals were made to the standard by I²R and two other partner organisations, and a further year and a half later, the standard was published. This is a significant achievement as the technology I²R submitted is protected by seven core patents, and it is the first Asian organisation to successfully get substantive technology contributions into the MPEG specifications.

5 Translating Standards and Research into Economic Relevance

Given the achievements so far in standards activities, it begs the question of how these inroads into standards work has been or can be translated to economic benefits for Singapore. If we compare it to a fairly recent technology standard like 3G cellular telephony technology, we see that the standardisation process took three to four years; the first commercial systems took another two years to hit the market, and another three to four years to make a business impact. Another popular technology, MP3, took about two years to be incorporated into the MPEG-1 standard - and another seven years to start gaining widespread popularity. So it is still early days yet to pass judgment as only a handful of efforts have reached the end of the standardisation cycle. Already however, the institute is starting to see the fruits of its standardisation strategy. At least one multinational has selected Singapore to become its worldwide product headquarters for a class of infocomm products after collaborating with the Institute. This involved setting up a R&D team in Singapore of more than 20 members and licensing the Institute's intellectual property developed as part of its standardisation efforts to jumpstart operations here. The prototypes and patents developed within I²R during its standardisation efforts played a key role in the decision to base its product design HQ here. I²R has also managed to secure a large collaboration with an Asian MNC to capitalise on our headstart in the implementation of a standards compliant prototype. In another instance, a new spin-off company has been formed to commercialise technology which has been successfully incorporated into standards. There are also several other projects currently under negotiation, with at least one more organisation looking to base its R&D and operational HQ here in Singapore.

6 Conclusion

Valuable research in the A*Star context is research that makes an impact on society. Of course, the essence of research is venturing into the unknown, or, as I²R's tagline proclaims, going from "Imagination to Reality". So this makes predicting outcomes of research an inexact science. Nevertheless, there are always steps one can take to mitigate risk and improve chances of success. One of the steps that I²R has chosen is to drive its research into standards where applicable, to improve its chances of making an impact on society, and contribute towards the economic development of Singapore. The early signs are encouraging, and the Institute remains committed to its standards strategy.