

INTERVIEW WITH PROFESSOR JON CROWCROFT

The future of our communication system worldwide lies in the development of the wireless Internet.

Jon Crowcroft, a leading international researcher in network technology, is a Visiting Researcher at IMDEA Networks and member of the Institute's Scientific Council. Jon holds an MSc and a PhD in Computer Sciences from University College London and is the **Marconi Professor of Networked Systems** in the Computer Laboratory of the **University of Cambridge**.

He is also Principle Investigator in the Computer Lab for the EU Huggle Project in DTN, and the EU Social Networks project, the EPSRC TINA project on location sensors and wireless networking of airports, and the ITA project in next generation wireless networks.

- 1. Your main areas of interest are communications and multimedia systems. When and why did you decide to focus your interest on the development of the Internet?**

That's a good question!

I was studying for a Masters and, at the end of the degree, somebody came up to me from a faculty, and offered me a job. I was actually sitting in front of a computer programming... a router, in fact, and this colleague who was on the faculty in London University came up to me and said, hey! We've got this job, do you want it? And I replied, yes! So it was a completely accidental thing. This happened in University College London, which is very famous. It is the third oldest university in England, which is not that old, but it is a very good University, and they did a lot Internet and multimedia research there from before most places. So it was kind of interesting. But it was quite lucky, because I didn't really choose to work there, I was literally sitting there working on something and this person came up to me and offered me a job.

And so you made the right choice.

Yes, I did. And I was lucky!

- 2. The Internet is so prevalent in our lives that we sometimes forget its origins are not so far back in time. When did you first become aware of the existence of the Internet? Do you recall your first experiences using it?**

Yes, absolutely. It's very weird. I got this job..., and I guess we had been using the Internet inside the Masters course, but it had only just started that year; it was really new. But this was about 1981, so nobody else I talked to in Europe had any idea of what we were doing. We didn't even realise that it might be important. I mean, we were doing stuff and we just thought, OK, we are connecting some networking computers, and some of them are in America, and some of them are in Norway, some in Italy, and I used to put some of my own programs on these computers: in Pisa, in a place called Canuche, which is where the Italian National Research Lab is, and also for a Norwegian Telecom Research Centre in Oslo. And I used to program these from London, but I did not use to think this was anything clever. We would just have this network and I was just programming. Occasionally, for example, I'd go out for dinner with some people and I'd try to explain what I was doing, and they'd reply, what's that? And they would not know what it was. Nobody could understand outside Engineering research what we were doing, until probably after the world wide, which was initiated in 1992. So for about ten years I was doing this work and it would be like talking about, I don't know, what was going on in another star, or in some weird piece of cell biology, and it would be considered really boring. You could talk about films and music, but before the World Wide Web, you couldn't talk about the internet because nobody understood anything.

And now we cannot understand the world without it!

That's right. Now everybody has pretty much got the idea.

3. How do you envisage the future of the Internet?

Well, actually for me there are two really interesting actions to attempt: one is that we need to have completely ubiquitous Wireless Internet access, so, literally, if you are standing in the middle of the desert, of the Sahara desert, or the Gobi desert, or you are in a boat in the middle of the Pacific, you should be able to just have very fast Wireless Internet access. There should be no problem and there is no physical reason not to do that. It will take a while, but we need to do more research on how to develop faster wireless access, and longer distances, and also make it affordable outside of cities and rich countries, but that is already happening.

So, you believe this is possible.

Yes, and there are big activities in this area. We are trying to get rid of a thing which in English we call "the digital divide". We are trying to make sure there aren't rich and poor, so that people in India or South-East Asia, or in extreme rural distance areas, have good access. And it is definitely possible. And the good thing is that if we achieve that, it's just cheaper for everyone anyway; it's more affordable. Maybe at the moment we have the top 20% of the wealthy in the world with Internet access, rather more have cell phones. Actually, it is more like 30% of the world now. If we could make better phones with Internet access, in which the battery lasted longer, then, in the end, we could eventually reach everyone. And that could be good. It would be excellent for education and the information transfer which helps the development of any society. So that's a big goal: that's today's Internet for everyone and not just for rich Europeans and Americans.

A second goal that is really important is that even in North America and Europe, even in Japan and Korea, we do not really have as fast a net as we could have, and some things we want to make possible for any Internet user, for example having virtual presence with your family wherever they are, would be difficult with the current Internet infrastructure. So it'd be cool if - for example, take my mother, who is 96 years old and lives on her own- I could have a window on the wall in my house and I could just look and see if she is there in her kitchen and make sure she is alright, and such window it's just there anytime, without having to do a complicated videocall. And we could do that, but right now you have to go and buy a couple of hundred thousand Euros in technology and then you have to pay high ratings per month for your network access. It works in a couple of labs, but you should be able to do that affordably for anyone. Therefore, that goal is useful, and not only for family connections, but for other spheres, like education, and health care. It'd be useful to be able to see your doctor virtually. If you can't travel easily, you can see a remote doctor. People have done lots of work on this for the last 10 to 15 years, so now we should be figuring out how to make it more affordable, and that aspect still needs more research. But that is where we should go next.

4. Could you predict what the main technological breakthroughs might be in the area of communications over the next few years?

The key is not just high speed Wireless; we also need to improve in other fields. We need to replace a lot of the copper used in cabling and provide telephone network with fiber in everyone's home and offices, together with the high speed Wireless everywhere. That combination implies partly just the business of deployment, but it also needs some research to make it less expensive.

5. In your opinion, how can we best promote interest and involvement in Science among the general public?

That's a really hard problem. Across all of Europe and North America, we have a falling interest in Science, whilst in India and China they have an increase. And it may just be that there is a way from being poor to being rich or middle class in India or China by being a Scientist or an Engineer, whereas in Europe, you don't have to be a Scientist or an Engineer, you can choose other careers and have a perfectly good standard of living. What is more, it's hard to study Science and Engineering, so people kind of think at school -they start to think- well, I could be on TV or become a writer, or I could be an entertainer or all kinds of things, I could even be a doctor, that could even be easier than being an Engineer or a Computing person. So people get put off, and, at the same time, there are lots of things which are obviously cool about Engineering.

Once upon a time, Engineering and Computing were seen as really boring, but nowadays you can say, well, look we've got all this digital animation in movies, which are really fun, we've got

all these games that are fun, you've got objects in everyday life, like cellphones, which are "kind of useful", so we could explain to the general public how those work and why they don't work as well as they should, and that we need to attract people to do research to make them better. And maybe they'd think that would be an interesting career option.

One of the really cool developments recently, over the last few years, was these building bricks made by a company from Denmark called Lego. They built an educational system called "Mindstorms", which is robotic, and schools use those to program robots made of the plastic lego bricks, which is really nice. They now have a really big project to apply this to virtual online systems as well. And that's great, because it just shows how Science is not so hard and you don't have to learn all these Mathematics and Theory. And if you do that with kids, who are about 8 or 10 years old, they then get hooked, and some of them are more likely to then pay attention and consider learning the Maths and the other topics that they need to, and that will get them in. Whereas before, at schools, they'd start learning the Maths and the subject just wouldn't look very interesting. Thus, if you show them how there is a connection the results will be positive. And I know the area where people do see the connection is in Biomedical Science, thus kids increasingly go into degrees like Life Science in University, because they can see why it's useful: you can make people better, you can fix diseases, improve agriculture, all these actions which are obvious. And then, these are really hard subjects, but still they are being very successful at getting more students in that area of knowledge. My conclusion is that in other Engineering and Science areas we should just make a similar connection, i.e., that these are useful, interesting and fun disciplines to study, and then, maybe, we'd get some more people working on these subjects and understanding what we do as well.

6. What is your opinion on the extent and quality of scientific and technological research in Networks carried out in the Madrid Region in comparison with the rest of Europe?

Actually, it's really good. Obviously, I've been visiting Carlos III University of Madrid through my connection with IMDEA Networks, and also I went to Telefónica Research, so I've seen these three places in Madrid. I'm aware these are only three and there are other institutions around the area as well. But the work I've seen, combined with having been working with people that are actually very good, and the fact that they are connecting with developments taking place all over the world, that as whole is what's been so positive.

Because some labs in Europe have a tendency to be disconnected from the rest of the world what is better here is that that is definitely not the case. What's happening here is that there is a definite awareness of what's happening in other places, and therefore researchers are not following what others are doing, rather they are getting involved and also leading some trends. That is a strong indication that an institution is operating in the right kind of global way for research: that is the right way to undertake research. I think that, in the past, in some places around Europe, one could see some labs, which had very clever people, but they were kind of acting in isolation, which can be bad, but this is not true here, where the international links are very strong.

7. What do you think about the IMDEA Networks initiative? How has your experience at IMDEA enhanced your research?

Well, obviously I am here because of IMDEA Networks, and that has been good. Actually, working with three different projects and with the people here has been really interesting. Like I say, actually in two of them, I got back into doing some research on next generation internet, which I hadn't been doing in my work in Cambridge. That has been quite a positive experience. Initially, I didn't think I'd do that, but actually because the people here were dealing with issues that are both interesting and useful, I also got involved, which was rewarding for me.

8. What would you say to encourage a student who is considering undertaking a career in research? What does IMDEA Networks have to offer him or her?

That links to what I have just commented upon. What I would say to someone who wants to come and do research in IMDEA Networks is that Madrid is an interesting place to be. The quality of life is nice. Also if the student is Spanish or Spanish speaking he is going to feel at home here. Besides, these students are also going to have these global links, which are very important for someone undertaking a research career. Whether they go back into being academic in faculty or they go into industry, having that awareness is really crucial to achieve really high quality research, so I think that's definitely a very positive aspect of the Institute. Whereas somebody going into some other place -and they might hear about some old

university in some obscure place where there are some very clever people- they run the risk of never being heard of ever again, because they kind of vanish into this ancient history.

ABOUT IMDEA NETWORKS

IMDEA Networks is an international research institute supported by the Regional Government of Madrid and the European Commission. The Institute brings together distinguished and young scientific researchers to develop cutting-edge science and technology in the field of networking. In order to ensure a truly international outlook, the Institute's main language is English. Promoting interdisciplinary collaboration, the Madrid-based Institute works in partnership with leading businesses and scientists from around the globe. By generating new knowledge and understanding through its activities, the Institute supports the continued development of Madrid and Spain as a reference point for international scientific and technological research.

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