Ericsson Research — 10 years of shaping change

In radio, networks and multimedia, Ericsson Research has established itself as a central force in the way the world communicates. On the 10th anniversary of this institution's founding, some central figures in the history of Ericsson Research look back on its legacy.

DAVID CALLAHAN
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When Ericsson Research was formed on November 1, 1998, the organization inherited a significant legacy of achievement in telecommunications. Ericsson had already driven the standardization of Global Systems for Mobile Communication (GSM) and Wideband Code Division Multiple Access (WCDMA).

Those breakthroughs hinted at the advances to come. Ericsson Research would take digital voice and data to new heights and lay the groundwork for a revolution in TV and personal communications.

Ericsson Research was formed by then-CTO Jan Uddenfeldt by merging the Radio Core Unit Research (RCUR) section of Business Area Radio with a number of research labs within Business Area Switching. The centralized organization was structured into six research areas (RA), headed by future head of Group Function Technology & Portfolio Management, Håkan Eriksson.

Ulf Wahlberg, former head of Ericsson Research, says Eriksson was a natural to take on the task of consolidating the Radio and Switching research centers into one organization. "Håkan has always been a strong force in Ericsson Research in looking into the strategy areas and where we're going."

The structure for Ericsson Research was modelled after RCUR, which maintained independence from business and development units but at the same time worked with a centralized strategic vision. Unlike the research centers in Ericsson's Business Area Switching, RCUR's budget was guaranteed and the unit could devote itself fully to research, rather than spend time and energy seeking funding.


Jan Uddenfeldt


Håkan Eriksson


Ulf Wahlberg


Jan Färjh

The research centers in Business Area Radio showed that research with a clear directive from management can deliver impressive results: in addition to conducting the first mobile broadband test bed, RCUR led such technologies as GPRS, Bluetooth and WAP to standardization. "It was a great thing to create Ericssson Research back in 1998," Uddenfeldt says. "RCUR had been such a good way of conducting research within Business Area Radio and now we could raise that within the total Ericsson Group."

As evidence of Ericsson Research's

BOX A 10 milestones in Ericsson Research 1998–2008 (in chronological order)

1. **Bluetooth:** A large portion of the basic technical development and specification of the Bluetooth standard was done by Ericsson Research in Lund from 1994, resulting in the first standard release in 1998. A second version with improved performance was released in 2004.
2. **WCDMA** Release 99 was approved 1999 as the first specification of this new global standard in 3GPP. Ericsson Research played a dominant role during the standardization.
3. **Adaptive Multi-Rate Codec (AMR)** approved in February 1999 in 3GPP as the mandatory speech codec for the speech service in GSM and WCDMA. Ericsson holds a substantial amount of standard essential IPR that is the basis for a strong licensing offering.
4. **EDGE** approved year 2000 in 3GPP as the evolution of GSM with major contributions from Ericsson Research.
5. **HSPA:** Ericsson Research started activities on HSPA in the beginning of 2000. Mobile broadband took off in 2007 when the service was commercially launched.
6. **Broadband Transport:** The development of an optical fibre interface between a main unit and a remote radio unit in 2001. The work led to the standardized Common Public Radio Interface (CPRI) currently used in Ericsson's main-remote products.
7. **LTE:** The development and standardization of LTE commenced in 2004. Global agreement was reached on LTE FDD/TDD in 2007. Ericsson performed the first demonstration of an LTE-enabled mobile terminal by streaming video at the Mobile World Congress in February 2008.
8. **The System Architecture Evolution (SAE)** was developed as the new core network architecture of LTE being able to handle multiple access technologies including 2G/3G legacy. 3GPP work on SAE started in 2004 and Ericsson Research was the driver behind the Evolved Policy-based QoS solution.
9. **Internet Protocol Television:** the architecture of an IMS-based IPTV system developed in Ericsson Research was presented to the Open IPTV Forum in Sept 2006, and the specification was approved in late 2008.
10. **labs.ericsson.com:** IMS enablers including development tools publically available on the internet for web developers in September 2008. The solution includes a commercial IMS system operated by Business Unit Ericsson Test Environments (BETE) on behalf of Ericsson, which provides IMS support for services independent of operators.

effectiveness, Eriksson points out two important distinctions: Ericsson Research has the most standards contributions in 3GPP as well as the highest rate of acceptance. "If you have everyone heading in the same direction, it is much easier to make a big impact on the world," Eriksson says.

Jan Färjh, current head of Ericsson Research, says while Ericsson Research maintains independence as an organization within Ericsson, it also retains a close dialog with development units. As an ambition, 30 percent of the Ericsson Research work is directly used (and steered) by the company's business units. "We have an organization that can work with cutting-edge technology and look into the future, and we combine that vision with the ambition to develop profitable products and solutions," Färjh says. "We can continue with or have long-term research that is not interrupted by short-term priorities."

"We have one foot in reality and one foot in the future," Eriksson notes. As he explains, the coordination of product development and research continues even beyond the standardization process. Ericsson is one of the few companies in which researchers take ownership of their research and shepherd it through the product development process.

"The research we do must reach business or it's not worth anything," Eriksson says. "So we transfer competence to development. You don't stay in Ericsson Research and spend your career there. You develop a technology, then follow it into the development unit, develop it, and bring it to market."

From telephony to mobile broadband

As with the organization itself, Ericsson Research's dominance in the Third Generation Partnership Project (3GPP) standardization track has roots that reach back some 25 years or more. Technologies such as Enhanced Data Rates for GSM Evolution (EDGE), High Speed Packet Access (HSPA) and Long Term Evolution (LTE) trace their origins to work that began in the 1980s and 1990s under Uddenfeldt's leadership.

Färjh describes Uddenfeldt as "a visionary who started the research into digital communication in the early 1980s." This legacy includes not only mobile telephony but mobile broadband, a core subject in Ericsson Research and a technology that is believed to have revolutionary potential.

Mobile broadband development can be traced at least as far back as the WCDMA studies in 1992 and 1993 and the world's first Wide Band Test Bed in 1995-1996, which showed voice, video and data traffic on the same radio link, using 5MHz of spectrum. Video and internet data rates peaked at 128kbps.

Touring in a demo bus, the Wide Band Test Bed showed the new technology to hundreds of customers and industry stakeholders that year, including Microsoft founder Bill Gates. "At that time it was not obvious that you could use those bandwidths. That was the first time we showed mobile broadband, so it was quite a milestone in our history," Färjh says.

This project provided the input needed for the 3GPP to adopt WCDMA as a third generation technology the following year.

Soon afterward Ericsson Research also contributed significantly to the development of EDGE, as the evolution of GSM. The standard was frozen in year 2000. First studies of Multiple-Input Multiple-Output (MIMO) technologies for EDGE followed.

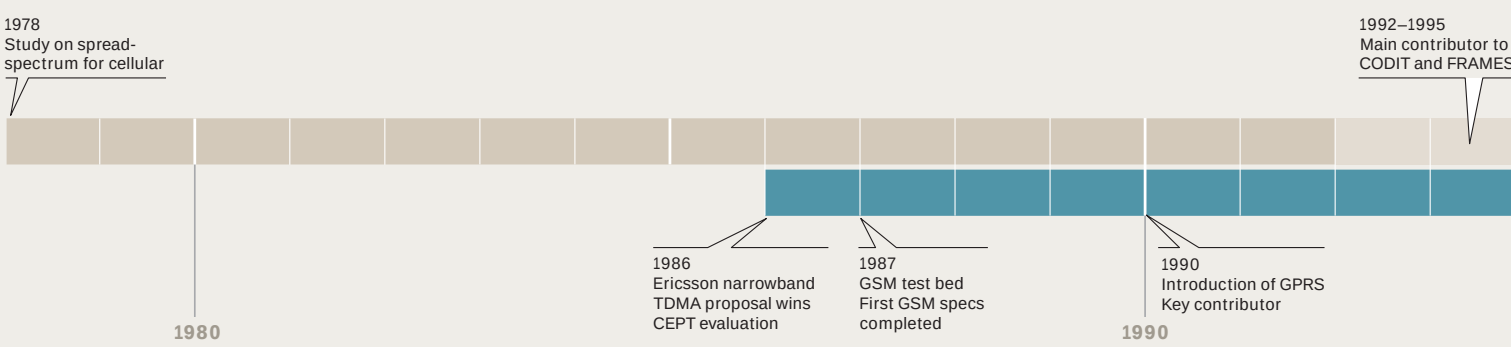
Seeking an answer to Qualcomm's High Data Rate (HDR) technology, Ericsson Research's discussions with Nokia and Motorola in 2000 centered on WCDMA-E. In September, they released a vision statement that targeted high-speed downlink packet data rates of 20Mbps by 2005, along with overall reduction of round-trip delay targeting 10–50 ms. By November 2000, the term HSDPA had entered the picture as the Work Item in 3GPP for WCDMA-E.

An HSDPA test bed was developed and showed 5Mbps over cable in a lab environment in December 2003. Six months later, the HSDPA test bed began running in the demo bus for the first time, showing 1–5Mbps. Downlink speeds had reached 8–10Mbps by February 2005, when the HSDPA test bed was shown at 3GSM in Cannes.

Around the same time 3G was launched, Ericsson Research started looking into 4G access with a workshop in October 2001. A draft of a downlink 4G access scheme had been developed by March 2004, at which point uplink concept work commenced.

Wahlberg remembers: "When I came

FIGURE 1 **Ericsson Research, a main contributor to global standards.**



in we had just launched 3G. But beyond 3G and HSPA, it was a blank roadmap. From a research point of view, it was time to define the next step, but we didn't want to be too specific because we wanted everyone to be focused on introducing the 3G system."

Discussions were initiated with DoCoMo around the concept of Super 3G in April 2004. By the time a Super 3G test bed — which was developed jointly with Development Unit Radio in December 2005 — demonstrated 46Mbps downlink, the focus had begun shifting to what would be known as LTE. One year later, 146Mbps downlink was achieved over cable in the LTE/MIMO test bed. At 3GSM in Barcelona, in February 2007, Ericsson Research and DU Radio's LTE test bed was shown with applications of HDTV and video conferencing, as well as streaming HDTV content.

Global agreement was reached on LTE FDD/TDD in 2007. Ericsson performed the first demonstration of an LTE-enabled mobile terminal by streaming video at the Mobile World Congress in February 2008.

Wahlberg calls LTE a major achievement. "It's now the acknowledged standard. Everybody's heading in that direction. Operators in the US with CDMA have a path into LTE, as do those in China with the TD-SCDMA track."

FIGURE 2 **HSDPA demo bus September 2005**

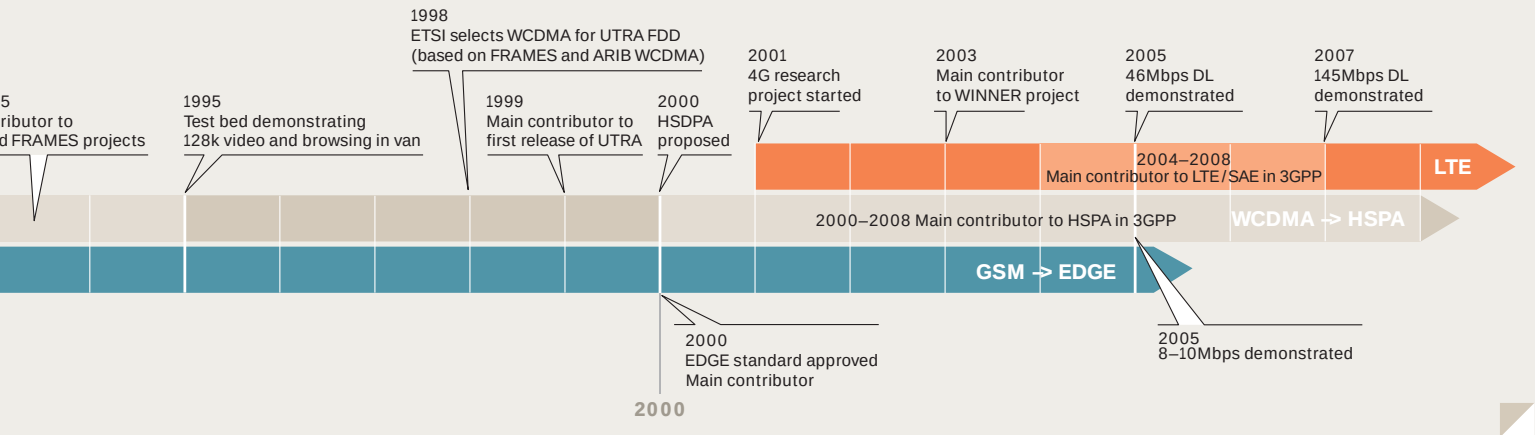
Widening the scope

But Ericsson Research is about more than radio. Eriksson credits Wahlberg with building up the non-radio areas of Ericsson Research. "He has been quite inspirational for the group," Eriksson says. "Ulf helped in widening Ericsson Research's perspective and furthering the balance between radio and non-radio."

In the area of core networks, Ericsson Research has been part of the standardization of the System Architecture Evolution (SAE) in parallel with LTE. SAE was developed as the new core network architecture of LTE, being able to handle multiple access technologies including 2G/3G legacy. 3GPP work on SAE started in 2004 and Ericsson Research was the driver behind the Evolved Policy-based QoS solution.

Multimedia is another area where Ericsson is establishing leadership. In 1998, Ericsson Research embarked on a project to develop a solution to support real-time Voice Over IP (VoIP) over the packet access in WCDMA. The first mobile VoIP was demonstrated in June 1999. In 2006, standardization work began on Multimedia Telephony (MMTel or MTSI), which includes VoIP. The access-agnostic MMTel specification was approved in 3GPP in March 2007.

Ericsson Research took a leading role in the standardization of two other groundbreaking multimedia technologies: IPTV and Mobile TV. In September 2006 Ericsson Research developed



the architecture of an IMS-based IPTV system. The first prototype was demonstrated two months later, featuring switching between a broadcast stream and a stream with personalized content. It also demonstrated video on demand service interacting with resource management for controlling limited bandwidth. In November 2007, Ericsson Research showed a three-screen (TV, laptop and mobile) IMS-based IPTV demonstrator at AT&T Labs.

The Open IPTV Forum approved the first specification for IPTV in 2008, opening the way for a completely new business area that will drive huge amounts of traffic.

In Mobile TV, Ericsson Research drove the standardization of the Packet-Switched Streaming Services (PSS) standard in 3GPP in 2001. At the Milia TV conference in April 2005, Ericsson Research demonstrated Java-based Mobile TV with fast channel switching of 4 seconds. And in December 2005, a Mobile TV demonstration showed IMS-based authentication, channel switching over multiple channels, and voting on a Sony Ericsson Z800 phone.

The road ahead

Färjh says that in the future Ericsson Research will address the challenge of performance in networks, radio technologies, applications and terminals. It will seek to improve networks' ability to support an increasing number of users who employ bandwidth-heavy services, and to make sure that new applications function effectively and are sufficiently attractive.

"That's where Ericsson Labs (labs.ericsson.com) comes in," Färjh says of the recently-launched prototype portal for applications and internet enablers, which is expected to stimulate external collaboration and generate instant feedback.

"We can get early end-user feedback from developers, applications and services," Färjh says. "When you commercially launch a service, it should be attractive with the right price and functionality. You cannot jump the gun.

"Labs.ericsson.com enables us to attract application developers, improve our knowledge of user requirements and strengthen the potential for successful services and applications."

With the rapid advance of technology and the ever-changing business environment, staying on top of the trends is a central concern for Ericsson Research. Today, Wahlberg works in Group Function Technology as "sort of an ambassador for research and development outside of the company," lobbying governments and working with research institutes and universities to ensure that investment is directed toward areas of interest to Ericsson.

"Guiding research into areas of our own interest allows us to make use of that research and to probe what is going to be the technology, what are going to be the trends, in 5 to 10 years," Wahlberg says.

By working closely with academia worldwide, Ericsson ensures that universities produce candidates for recruitment who have the latest ICT training and that this competence is distributed around the globe.

"We need to be able to hire people who have the right competence, and we need to make sure there are people in different parts of the world with the competence we require," Wahlberg explains. The results are clear. "If you look at telephony and mobile broadband we have been the leader in driving standardization. We have some really bright people in Ericsson Research that we can be proud of."

Eriksson agrees. "We've been able to utilize the competence of the best people, who are educated in the right areas. Ericsson Research is a truly rewarding group of people to work with. Every meeting is educational because there is so much talent and knowledge in that group. "These people are among the best."

FIGURE 3 **HSDPA testbed (Terminal) 2005**

BOX B

About Ericsson Research

Research centers are located in Canada (Montreal), China (Beijing), Finland (Helsinki), Germany (Aachen), Hungary (Budapest), Italy (Pisa), Japan (Tokyo), Spain (Madrid), Sweden (Gothenburg, Kista, Linköping, Luleå, Lund, Mölndal) and the USA (Research Triangle Park (RTP), Silicon Valley).

Ericsson Research is active in a wide variety of standardization bodies covering the areas of strategic interest to Ericsson. Examples are 3GPP, ARIB, Bluetooth-SIG, Ethernet Forum, ETSI, IEEE, IETF, ISO, ITU-R, ITU-T, JPEG, Khronos, MPEG, OMA, Open IPTV Forum, TIA and W3C.

Hans Hermansson

Joined Ericsson in 1982 to work with speech coding research and was heavily involved in the standardization and specification of GSM speech services until its first release in 1987. He has worked with research and the standardization of speech and multimedia services for TDMA, PDC and WCDMA and, since 1995, has served as Director of Multimedia Technologies within RCUR and Ericsson Research. Hans hold an M.Sc. in electrical engineering from the Royal Institute of Technology in Stockholm, Sweden.