The year 2010 to 2011 has seen the completion of BBC Research & Development’s main property moves; the South Lab is operating fully, and by the time you read this, around 35 staff will be established in the North Lab in the BBC’s new MediaCityUK campus in Salford. In addition, the Central Lab has new space in the BBC’s Central London campus. These new facilities give a foundation for BBC R&D to continue to have a significant impact, along with BBC, industrial and academic colleagues, as the BBC evolves into a new kind of broadcasting organisation.

In March 2010, I was privileged to be invited to give the Barlow Memorial Lecture at University College London. This gave me the opportunity to consider how the BBC is moving into the emerging Information Age, and the vision that BBC R&D has for a new broadcasting system to support this transition.
In 2005, the BBC identified the key trends shaping broadcasters in the new environment as the development of on-demand and time-shifted consumption, increased choice for audiences, the advent of user generated content and the rise of new competitors. Since then, we have been able to observe how these trends have developed, some as expected and some in more surprising directions.

We have seen an explosion in choice of content, but the BBC’s content has remained highly valued and widely used. We are seeing new ways of watching and listening with a proliferation of devices, both fixed and mobile, and with more users ‘multi-tasking’ – consuming more than one type of media at a time. The relationship with the audience is changing, particularly with the growth of social media. User-generated content is becoming more important, particularly for News, and has a complimentary relationship with traditionally generated content. The BBC needs to maintain its quality and breadth of output to address all licence fee payers; but it also needs to evolve its technology systems to integrate traditional technologies alongside new platforms to support is mission to inform educate and entertain.

In order to be the BBC in the new Information Age, we will need to build a new broadcasting system that supports our reinterpreted role and the new context that we operate in. Such a system covers the whole chain from capture to audience.

Production, the capture of content, will move to increasingly high fidelity capture. There will be multi-sensor arrays capturing audio and video, but also other data sets, such as location, camera settings, ambient noise, which can be used later – even years in the future – to be manipulated in software further on in the production process to create high quality content.

The next element is media management, including moving material around inside and between the BBC and its partners, increasingly exploring the use of cloud technology. We also need to store material for the future in the archives maintaining a digital memory for the nation. We not only need to be able to store the material, but to be able to use new techniques to search for and retrieve material broadening access and allowing new forms of content to be created.

Distribution is the process of getting material to the audiences, and this is being changed by the advent of IP distribution. We are developing a hybrid model, where broadcast and internet delivery technologies sit alongside each other, making the most of the advantages of each to give a system far more exciting than using either in isolation. This raises issues such as synchronising material delivered over different paths and how to engineer in a new kind of resilience. It also leads us to consider innovative uses of both RF spectrum and Internet infrastructure in the future.

The final stage of the new broadcasting system is the audience experience – how the material is presented to and used by the audience. This includes ensuring accessibility to the whole population and the enabling of new editorial formats such as the use of dual screens. It also considers how to present content which can be used on such a wide range of devices, from mobile phones through to 3D and Super Hi-Vision.

The whole system is under-pinned by the desire for it to be ‘IP end-to-end’, so that each part of the system uses internet protocol and can be ‘joined up’. It is a change that has already begun within the BBC, but we are working to complete the chain so that our programme makers do not need to consider how content is moved, just how to make the very best output.

As we develop these ideas alongside colleagues from across the organisation, the department continues to present and publish our work. BBC R&D staff presented 27 conference papers in 2010-11, and published 22 other papers. Naturally a number of these are published on our website. In addition we filed six new patents in 2010, and continue to maintain a portfolio of around 120 patents.

It is an exciting time for the development of the broadcast industry. The term broadcasting itself is in the process of being re-interpreted for the Information Age so that organisations such as the BBC can continue to offer the social and economic benefits we achieved during the industrial age. Looking forward, BBC R&D will be working with groups from across the media industry and academia to build this future.
HIGHLIGHTS OF THE YEAR

BBC R&D South Lab
The BBC R&D South Lab is now fully up and running, including a research studio in Television Centre.

IBC Innovation Award
The IBC Innovation Award for Content Delivery was won by the DVB-T2 study group led by BBC R&D.

IEEE Award
Dr Nick Wells was awarded the IEEE Consumer Electronics Society Engineering Excellence Award 2010, on the occasion of the 14th IEEE International Symposium on Consumer Electronics (ISCE).

Per Erik Selemark Award
Lindsay Cornell was awarded the Per Erik Selemark Award for services to DAB 2010 at the 16th WorldDMB General Assembly, Belfast, 27 October 2010.

Augmented Reality Film
Augmented reality film was launched in the Natural History Museum’s David Attenborough Studio, in conjunction with the BBC’s Natural History Unit.

Interactive Audio-Visual
Nine BBC R&D engineers, mainly trainees, collaborated with artists Charlesworth Lewandowski & Mann to create an interactive audio-visual installation named ‘The Cut Up’ which was exhibited for the duration of the 2010 Anti-Design Festival and after this it was nominated and jointly won the NEMarts prize.

Trials of Technologies
Trials of technologies which will be used for the London 2012 Olympics were held, including live delivery, via the internet, of Super Hi-Vision content from our research studio to NHK in Japan.

Free-Viewpoint Video
Our Free-Viewpoint Video system was used on air for the first time for Blue Peter’s world record ski quarter pipe item.

MyMedia
The MyMedia collaborative project won the Context-aware Movie Recommendation Challenge at RecSys 2010 and the Professional Video Tagging Task at MediaEval 2010.

Infax and Redux
We deployed a simple system for all BBC staff that allowed them to search the rich internal archive metadata system (Infax) then watch that content from the last four years (from an internal online archive, Redux) in the same browser window.

Ingex
Ingex is in use for HD production of EastEnders. Our tablet-based portable production tool has been tested on a BBC comedy series.

Production Labs
The new Production Labs facility allows projects to test their work in a realistic production environment. The first labs have focussed on logging and surround video.

Web Standards
We drove new standards as part of various key W3C working groups and led the BBC’s input into future Web research.

RadioDNS
We worked on the RadioDNS project with a number of commercial broadcasters and receiver manufacturers to deliver service information for hybrid DAB/IP Radios. We demonstrated this with RadioTAG where we helped devise a protocol by which you can share information with a broadcaster about what you’re listening to by pushing a button on your IP-enabled radio.

P2P-Next
We created key interactive technologies as part of the P2P-Next collaborative project – demonstrated at IBC in Amsterdam.

Second Screen
We created second screen demonstrators which were adopted by the Autumnwatch TV team, and were trialled around a live broadcast with fans of the show.

Technology Strategy Board
As part of a Technology Strategy Board funded project, we began research into automated tagging of broadcast audio, in order to easily find content within the archive by people, places or topics.
FREE-VIEWPOINT VIDEO

Free-Viewpoint Video allows someone to watch an event or programme with free, interactive choice of the viewpoint. This enables viewers to watch and observe action from any angle and is of particular interest for visualising events that are over very quickly. In a previous project called iView this work has looked into capture and replay of sport events, like football or rugby for post-match analysis. We continued this work in a recent Technology Strategy Board project called i3DLive, which finished earlier this year. As part of this project a number of production tests have been made. In September 2010 a Taekwondo fight was captured in the experimental R&D studio in London alongside NHK’s Super Hi-Vision camera. We captured the action with a set of 12 additional locked-off HD cameras and could demonstrate computational stereoscopic 3D in Super Hi-Vision resolution and Free-Viewpoint Video in HD quality.

In another production trial we captured a dry-slope skiing event at Ski Rossendale, north of Manchester. This was part of a high jump Guinness World Record attempt on a quarter pipe and was used in a BBC Children’s Blue Peter programme broadcast on 1 March 2010. BBC R&D took along 16 high definition cameras to capture the jumps of nine different athletes. After the on location recording, Free-Viewpoint Video render techniques were then used to visualise the skiers’ jumps from different angles, and to observe their performance.

PRODUCTION

Our Production research is primarily concerned with delivering benefits on screen to the audience. Projects are clustered around the image analysis, computer vision and tracking technology areas. Our production work also includes 3D audio and advice on the latest HD production technology. The section collaborates extensively with industrial and academic partners, including through the new BBC Audio Research Partnership. As well as delivering high quality, innovative services to BBC audiences much of the work here can be used to drive revenue opportunities for the BBC through technology licensing. Licensing our techniques to manufacturers and service providers creates useful products which they can develop and provide to the production industry from which fellow broadcasters as well as the BBC can derive benefit. This year we had six Production projects at various stages of development which are all designed to be licensed to third parties.

For more information see www.bbc.co.uk/rd/projects
PORTABLE PRODUCTION TOOL

One of the aims of our work on Production Automation is to provide teams with tools for flexible access to production content and sharing of information, without the need to be at a particular location. Although portable media players have found niche usage in productions in the past, recent advances in smartphone and tablet computing offer an opportunity to provide programme-makers with something genuinely helpful, and potentially to reduce the number of desktop computers needed for a production. The Portable Production Tool is a tablet-based application (currently for the Apple iPad), which has been designed for professional production use. It allows a user to view content shortly after it is acquired into the production, and to add comments about the content and share these within the team, so that they automatically appear on each member’s tablet screen. The user can select the best parts of the content and assemble and view a rough-cut edit on the tablet to try out ideas in preparation for subsequent editing.

The Portable Production Tool has attracted much interest around the BBC production community, and has recently been used during recording of the BBC’s Mongrels comedy at Twickenham Studios to let the editors and producer view their rushes when away from the production office. We are currently working with several production and technology teams to identify new requirements and opportunities for the business to exploit the tool.

MEDIA MANAGEMENT

Our Media Management research focuses on production processes (such as the Ingex tapeless production technology), archive analysis – including quality analysis – and retrieval. Better systems and processes improve internal efficiencies, drive costs down, make adopters more competitive, and enable producers to work more creatively.

We currently have 18 Media Management projects each of which could deliver benefits not just to the BBC but also across the industry.

For more information see www.bbc.co.uk/rd/projects
USE AND PROTECTION OF THE SPECTRUM

Several of our projects are targeting the efficient use of spectrum, but at the same time aiming to protect existing services from the effects of interference. We contributed to a high power field trial of the digital radio system DRM+ in Scotland, which showed that this system is capable of providing excellent coverage at reduced power levels compared with FM. We are also participating in two trials of white space devices, which make efficient use of TV spectrum for local data transmissions, using channels that are not allocated to TV transmitters in the local area. An important part of this work is to ensure that such devices can operate without causing interference to the reception of the existing television services.

A further potential source of interference arises from the proposed introduction of 4th generation mobile broadband services into the UHF spectrum released by digital switchover. We are working with the rest of the broadcasting industry to understand the potential impact of this, and how best to mitigate its effects. Similarly, we published the results of experiments showing the potential for interference to radio that can be caused by certain types of power line communication devices, and we are trying to ensure that appropriate regulations are introduced to limit these effects.

DISTRIBUTION

Our Distribution research directs its energies on 12 ongoing projects that centre on the strategic development, implementation and adoption of industry standards right along the different broadcast and IP chains. We aim to work in a horizontal market where different players can share the same technology through open standards but use it for their own bespoke business purposes.

For example, work within the Digital Video Broadcasting project focuses on digital TV transmission technologies and continues to develop global specifications to improve transmission efficiency and ruggedness to enable terrestrial delivery of HDTV within the increased demands upon spectrum.

We also work closely with the international standards bodies for digital radio transmission – WorldDMB and DRM – protecting and enhancing the radio experience.

For more information see www.bbc.co.uk/rd
DUAL-SCREEN

BBC R&D are working to research and enable dual-screen services by devising APIs and prototypes that enable communication and synchronisation between the television and a tablet, PC or mobile device.

Our Universal Control application programming interface (API) is an open specification for how a television or set-top-box can provide a web service to enable both native and web applications to control it over a home network. The API allows for the creation of new user experiences unconstrained by the user interface of the television. Using it we have created a mobile phone ‘remote control’ application with support for blind users, shown how websites can dynamically change to reflect what you are watching and worked with the Autumnwatch production team to create an interactive companion slide-show that follows the programme. We have worked within the P2P-Next EU-funded collaborative project to enable co-ordinated dual-screen experiences alongside video and audio on demand.

INTELLIGIBILITY OF SOUND

For the last 18 months BBC R&D has been contributing engineering and user testing expertise to BBC Vision’s television audibility research project, alongside investigating technical solutions for improving the intelligibility of TV sound and delivering alternative soundtracks for broadcast TV via IP.

The project is the BBC’s deepest ever piece of research into the factors that cause audibility problems.

BBC R&D provided advice on the testing of alternative audio mixes with representative audience groups. In addition, we carried out an in depth piece of work in our specialist User Testing Laboratory where the mixes were presented to members of the Royal National Institute for the Deaf (RNID) with mild to moderate hearing loss. This work provided valuable insight into the experiences of those with hearing loss when watching and listening to a variety of programme genres.

As a result, some programme soundtracks were remixed to improve intelligibility; best practice guidelines for audio production have been made available publicly on the BBC Academy’s College of Production website and editorial guidance for hearing has been revised.

AUDIENCE EXPERIENCE

BBC R&D was founded in 1930 to look into the variety of ways that BBC audiences, and then audiences everywhere, could have a better broadcast experience. Today, audiences remain central to BBC R&D’s thinking.

Our Audience Experience research, through 15 projects, continues to investigate all aspects of accessibility, interfaces, navigation and new content on behalf of ALL audiences and in partnership with a range of stakeholders, establishing new standards and ways of working to encourage their adoption on behalf of both mass audience groups and more niche communities. We work closely with other areas of the BBC to explore the opportunities provided by new technology to give innovative audience experiences.

For more information see www.bbc.co.uk/rd
### BBC R&D Achievements Over the Years

#### Some Highlights of BBC R&D’s Innovation Over the Years

**1930s**
- Research mainly concerned with short-wave broadcasting, studio developments, developing the Simultaneous Broadcast system, and television:
  - **1930** BBC Research Department formed in April
  - **1936** First regular high definition television service launches
  - **1937** First close-talking noise-cancelling ribbon microphone giving broadcast speech, the L1.

**1940s**
- The start of FM radio; colour television started to look viable; and new magnetic recording techniques started coming into operation:
  - **1945** First VHF/FM transmission tests from Alexandra Palace; Type D disk recorder brought into service
  - **1947** Early measurements on the magnetic properties of recording tape
  - **1949** Work starts on smaller, light, higher sensitivity commentator’s microphone, the L2, to replace the L1. Simple colour channel set up.

**1950s**
- The start of work on stereo radio; first transatlantic signals (and so need for standards conversion); transistors being used in commercial equipment:
  - **1953** Suppressed-frame telerecording equipment designed, and used at Coronation
  - **1958** VERA (Vision Electronic Recording Apparatus), first video tape machine used by the BBC
  - **1959** First transatlantic television transmission by R&D’s ‘Cablefilm’, stereophonic tests using EMI-Percival system; investigations into TV picture storage begin.

**1960s**
- Satellite communications used for the first time in broadcasting; digital techniques transform sound and picture communication:
  - **1962** First transatlantic colour TV link by satellite, using BBC R&D’s slide scanner
  - **1963** NTSC, SECAM and PAL colour demonstrations to EBU and OIRT
  - **1964** First studies into digital techniques for television
  - **1967** BBC Two transmits first regular colour television service in Europe.

**1970s**
- Latest integrated circuits used for signal processing:
  - **1970** Digital line-store standards converter work commences
  - **1972** Teletext experiments begin
  - **1974** BBC R&D demonstrates world’s first digital television recorder
  - **1975** Successful transmission of digital television signals
  - **1976** First transmissions of digital television over INTELSAT satellite; CARFAX road traffic information service principle demonstrated
  - **1978** First digital stereophonic sound broadcast experiments – leading to NICAM stereo sound.

**1980s**
- Decade of debate: stick with analogue systems, wait for digital, or a hybrid?:
  - **1982** BBC Microcomputer, from Acorn, released
  - **1982** HDTV studies commence in earnest
  - **1984** Video watermarking – electronically labelling television pictures – devised
  - **1985** LF Radio Teleswitching service commences enables the Electricity Supply Industry to optimise power distribution at peak demand times
  - **1986** BBC’s NICAM 728 system for digital stereo sound accepted as British Standard
  - **1987** Join Eureka 147 collaborative group, which developed the DAB standard.

**1990s**
- Start of digital radio and television broadcasting, and launch of BBC Online. Virtual production techniques evolving to provide powerful production tools:
  - **1990** First DAB trials
  - **1995** The new Digital Radio service started in September
  - **1996** First fully compliant test of the new DVB transmission standard
  - **1997** BBC internet services start
  - **1998** BBC launches digital satellite and terrestrial television services
  - **1999** Digital Text service (replacement for analogue Teletext) successfully launched on DTT.

**2000s**
- Upgrades and enhancements across the board:
  - **2000** R&D’s handheld digital radio camera used for live broadcasts
  - **2001** Speech recognition used as an aid to provide subtitles
  - **2002** Freeview launched
  - **2006** World’s first end-to-end MIMO broadcast system tested
  - **2008** Freesat service launched. Dirac Pro used by BBC to deliver Beijing Olympics in HD
  - **2009** Freeview HD service launched using DVB-T2 transmission standard.
MANAGEMENT TEAM

Matthew Postgate
Controller, Research & Development

From left to right:
- **Stephen Baily** General Manager
- **Brandon Butterworth** Chief Scientist
- **Daniel Pike** Head of Technology Transfer
- **Conrad Franklin** Head of Business & Operations
- **Adrian Woolard** Project Director, R&D North Lab
- **George Wright** Head of Prototyping, R&D Central Labs
- **Caroline Green** Business Manager

LEADERSHIP TEAM

Top row, from left to right:
- **Graham Thomas** Production Magic
- **Phil Tudor** Automated Production & Media Management
- **John Zubrzycki** Archives Research
- **Richard Wright** Archives Research
- **Chris Nokes** Distribution Core Technologies
- **Phil Layton** Digital Service Development
- **Jeff Hunter** Distribution Application Layer
- **Nick Wells** Research Fellow
- **Lindsay Cornell** Principal Technologist

Second row, from left to right:
- **Justin Mitchell** Lead Technologist
- **Andrew McParland** Audience Experience
- **Andy Bower** Head of External Relations
- **David Rayers** Principal Technologist
- **Judy Parnall** Knowledge Management & Communications
- **Samantha Chadwick** Strategic Partnerships Executive
- **Chris Chambers** Media Network Integration Lab
- **Justin King** Head of Research Platforms
CONTACT DETAILS

For more information about BBC R&D, who we are and what we do – including regular updates on our current projects – please check out our website at www.bbc.co.uk/rd

For media enquiries please contact BBC Press Office on 020 8576 1865 or email at press.office@bbc.co.uk