

The dawn of Rec. 601 ... 25 years on

David Wood interviews the European 4:2:2 pathfinder — Peter Rainger
(Chairman of the joint EBU-SMPTE Task Force in 1981)



David Wood from the EBU's Technical Department interviews Peter Rainger (ex-BBC, and shown on the left) on his major contribution to the standardization of 4:2:2 digital video, aka ITU Recommendation BT.601

DW: *Peter, though many people contributed to the ideas in the 4:2:2 standard, you were for us in Europe the main driving force that made it happen. To understand what was driving you, tell us about your career.*

PR: I began working for the BBC in 1951 in the Research and Designs Departments. I spent most of my early years working on television. I started in Designs Department and in due course was promoted to Head of Department. Then, as this struggle for international standards reached its climax, I became Head of BBC

Research Department. Later, I moved into general management as Deputy Head of Engineering in the BBC.

DW: *Before digital came along, in the 1960s, you led the teams that made the world's first NTSC-to-PAL standards converters ... This is a great story in itself.*

PR: The first major challenge was to make a Line Store Converter. It was this that made practical the change of the UK television system from 405- to 625-line standards. We then used this technology to convert 625-line pictures to 525-line standards. I led a good team in Designs Department and we had many successes. Then BBC Research Department added their contribution so that a much superior machine could be made. It was clear that if international standards like the 4:2:2 were agreed, we could do better. Although it looked a long way off, Eric Rout in BBC Research Department was already working on digital television techniques. Here then was our opportunity to create new and better standards.

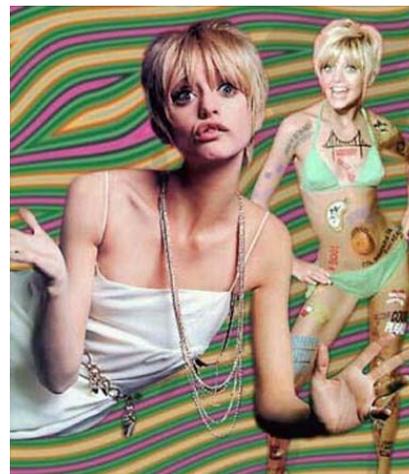
DW: *Can you let us share the behind-the-scenes background?*

PR: On several occasions in my career I approached the then Director of BBC Engineering, Sir Francis Maclean, suggesting that the (separate) Research and Designs Departments of the BBC should cooperate. This was rejected: it was said that competition would benefit the Corporation and provide insurance cover against the many technical problems that lay ahead. The situation was

complicated by my appointment firstly as Head of Designs Department then Head of Research Department. Naturally I knew both departments well and appreciated there were good people in both of them.

Chronologically, the Designs Department work on Line Store Converters was the first to deal with pictures electronically, pixel by pixel. Research Department took up the idea and, in line with the policy to compete, they then produced a standards converter. Both machines were demonstrated "head to head". They both worked but had different virtues and, after the demonstration, Sir Francis Maclean decided to use the Designs Department machine.

It was clear to both departments that Field Store Converters would also be necessary. Research Department was making a converter which used a large array of quartz delay lines. Unfortunately, the delivery of delay lines of sufficient quality was proving difficult. Furthermore, at that time, the converting of colours was also a problem. Both departments realized that the principles involved in the Line Store Converter would help, so the two Line Store designs found a use.



The BBC Designs Department Field Store Converter found early service in the landmark TV series, Rowan & Martin Laugh-In

Designs Department went on to build a Field Store Converter which was colour capable and it was used for the exchange of programmes: it was duly recognized as a "first" by the technical world. However it had defects. It changed the size of the picture. After a few months, the Research team completed their converter and although it too changed the size of the picture, it was only by a tiny amount. It was a great step forward and it too was recognized as a milestone in the development of standards converters. You know there have since been many milestones in the production of digital converters with better and better qualities, but the Research Department machine was the first "high quality" electronic standards converter.

Of course "firsts" are prized in the technical world and many capable engineers have made important contributions. Many have had their contribution recognized but there are many more that have not received their just reward. A major part of my roll as Head of Department was to make sure that these people all cooperated in an environment designed to promote competition. The same problem existed in the EBU. Laboratories that were in competition had to cooperate. My answer is to be sure to fully recognize the contributions of all concerned.

DW: *In the mid 1970s, you encouraged the EBU to reorganize its technical structure to be "ready" for this digital wave.*

PR: In 1977, after we had a momentous EBU Technical Committee meeting in Venice, with great technical demonstrations primarily arranged by our friend and colleague Howard Steele of the IBA, we were all convinced that we were on the threshold of a digital revolution and we agreed to design the Technical Committee around this concept. The idea was to have the work led by the Heads of the Research and Development departments of EBU Members, in a new Working Party (Working Party V). They were to develop digital standards for all parts of the broadcasting chain. They were organized in three sub-groups led by Yves Guinet, Mario Comminetti and Andre Keller. A Specialist Group – V1-VID, led by Howard Jones – was the main engine for the digital coding work.

DW: *The first proposal from Howard's group was called 12:4:4, but this was superseded?*

PR: A worldwide digital standard would be better than a European-only one and when it was clear that our US friends would not accept the 12:4:4 format, we reopened the matter at the 1980 Technical Committee meeting in London, and began the search for a format acceptable to everyone. We

formed a joint Committee with the SMPTE.

DW: *Which you chaired, along with your task as Chair of Working Party V ...*

PR: Yes, that's right ... with you, David, as our young secretary.

DW: *What is the next episode in the story of 4:2:2?*

PR: There were several landmarks – a major meeting of all the relevant EBU Groups in Winchester in January 1981, a meeting of the EBU Technical Committee in San Francisco in February 1981 and a Joint Meeting of the EBU and SMPTE in Brussels in March 1981. This last meeting was the one where champagne was drunk because of our final agreement on what became “Rec. 601”.

At the meeting in San Francisco, there were three options on the table, on show from the SMPTE, each using different luminance sampling frequencies. These were 12 MHz, 13.5 MHz and 14.3 MHz. We looked at the quality available with these, the cost of equipment using them, the prospects for compressing them and the quality of colour (chroma) keying and picture expansion using them. There was frankly a political element too ... no-one was going to accept a set which unduly favoured either the 50 Hz or the 60 Hz worlds.

DW: *So, there was a compromise?*

PR: Yes, I felt the only set that everyone would ever agree on was the middle one, 13.5MHz, so after San Francisco I contacted all the Members of the *Bureau* of the EBU Technical Committee with this message. The last to be convinced was Herbert Fix, then the head of the IRT in Germany. Eventually he was able to persuade the Chief Engineers in Germany to agree, and then we had a deal. 13.5 MHz is a good value technically, because it allows a stationary sampling pattern for both 525 and 625 grids, but it has the double advantage of not favouring either to the exclusion of the other. It was an “equal goodness” solution – this is what made it.

DW: *Did you think at the time that this decision would be one of the main shaping factors for the next 25 years of television technology?*

PR: Only the bravest would have foreseen the extent of the revolution but we knew that digital techniques were the future, and that there was a job to do.

DW: *Do you think there are lessons for today about the way to achieve common standards?*

PR: Well, we started with a commitment to cooperate. This allowed us to spend a lot of time and energy behind the scenes, listening to their arguments, gathering facts. When we came to the meeting there was a broad basis of agreement. The main thing is therefore to do your homework. Only stage a meeting when you have a reasonable prospect of making some progress.

DW: *Peter, you have the thanks of the world's technical community, so good luck in your continued retirement ...*