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How digital coding led to the development of the CD

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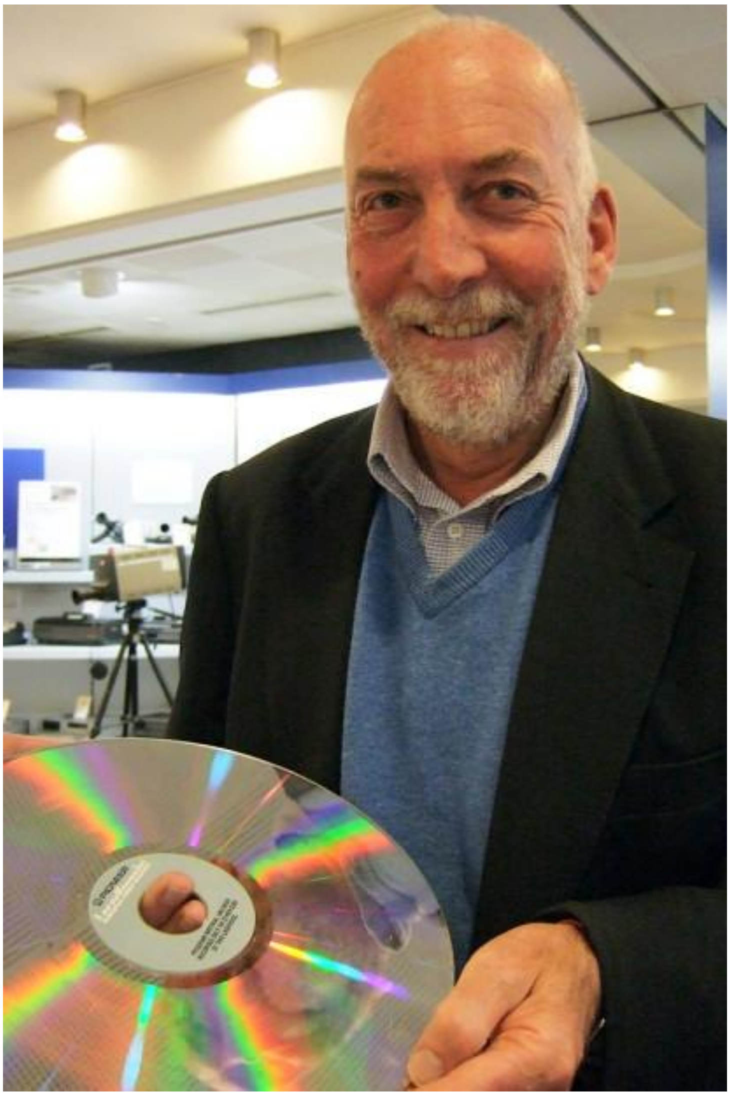
Hans van de Groenendaal, features editor, EngineerIT in conversation with Prof. Kees Imminck, engineer, scientist and inventor.



Prof. Kees Immink – father of the compact disc.

In my conversations for this regular feature in *EngineerIT* I have met some very interesting people. Such a one was Prof. Kees Immink, on the eve of the conferral of an honorary doctoral degree by the University of Johannesburg faculty of Engineering and the Built Environment, thus recognizing him as one of the world's most prolific inventors of consumer electronics in the late 20th century. Prof. Immink can truly be called the father of the compact disc.

"I conducted my first experiments on digital recording using optical disks in 1976. The pressure for the development of a better, hi-fidelity audio storage facility came from artists in the recording industry who were dissatisfied with the relatively poor sound quality from the vinyl records of the time. Little could I have ever imagined that the CD would become such a great hit."

"I am an engineer because I have a sincere passion for science and engineering. I already had this passion as a young boy – I loved everything that moved; I mean machines like steam engines, bicycles, locomotives, sailing boats, airplanes, etc. I would have loved to work side-by-side with James Watt on the design of a new steam engine. Or imagine working with Michael Faraday, developing the first electrical motor. You may see all these beautiful creations in the Science Museum in London; they are fascinating products of daring engineers."

Prof. Immink said that when he decided to study electronics, the field as we now know it was still in its infancy. The term "digital" was associated with very expensive and big mainframe computers. He joined Philips Research Labs in 1968, concentrating on basic research with a possible application aspect. There were no financial constraints, no teaching obligations, and the term research project was an oxymoron. In short: the Philips laboratory was a veritable playground for scientists and engineers.

In 1975 Prof. Immink moved to the optical group. Times were changing at Philips Research. "For the first time I was working on a very definite product, the laser videodisc. It was a beautiful machine full of mechanics and electronics. "The videodisc was very accurately scanned by a laser beam, and could play an hour of video plus audio. Because no stylus touched the disc surface, there was no disc wear, no matter how often the disc was played.

The videodisc was a daring and long-in-the-making product costing around half a billion dollars. The final product reached the market after the launch of the video cassette player. "Although a technical success, it was a big market failure and the greatest blooper I have ever seen in my life," said Prof. Immink.

This was however not the end of the story. "Two engineers started experimenting with audio-only discs using analogue FM modulation, essentially the same as used in the videodisc. The approach failed, as the new optical audio disc was sensitive to fingerprints and the sound crackled just like the old black vinyl discs."

In the mid-seventies Thomas Stockham made the first digital hi-fi audio recordings in the USA, using mini-computers and data tape drives. Digital audio techniques were known for quite some time, but usually used in low-quality voice communications. "The time seemed to be right for hi-fi digital sound, and we said to each other "let us try digital audio on an optical disc instead of the analogue FM so that we can get rid of the clicks by using digital error correcting codes.”

Digital coding was at that time only used in NASA space satellite links to Mars and Venus. The task Prof. Immink and his team faced was formidable. “We had to learn how to apply a very abstract theory full of nebulous mathematics to a practical situation. It was in fact the overlap between the physics of the optical disc and the digital code that was difficult to understand. The experiments with early digital optical discs revealed that due to everyday handling damage, such as dust, fingerprints, and tiny scratches on the disc, the servos are prone to malfunctioning, and may skip tracks or get stuck. The barriers related to playability issues formed the major obstacle to launching the digital optical audio disc. Many experiments were needed to understand the best solutions, and eventually the team learned how to apply coding theory to optical discs.”

“There were many other technical challenges at that time: for example the digital-analogue converter cost around US $10 000 per unit (and for stereo you needed two). Small solid-state lasers were not available and the gas laser used in the videodisc player was around 20 cm long. Clearly, the envisaged digital audio player was not a standard off-the-shelf consumer product in the mid-seventies.

“Our research was accelerated when we worked together withs Sony engineers, and within a year of joint work we were able to publish the Compact Disc Standard, and so finally the product engineers could start their work on the production of both disc and player.”

The compact disc came to the market in 1982, bringing the world’s first fully digital device into people’s living rooms.

“The CD became the catalyst for further innovation in digital audio and video technology, and it created a multi-billion mass consumer industry.”

But how did it happen that the development of the CD escaped having multiple standards like the video tape with its two streams:

Betacam and VHS? “I believe that Phillips took a wise decision not to develop a product on its own but to invite other players to join the development. That is why, I believe, we have one international CD and DVD standard today.”