

## ***Dinosaur Concepts - why are we always so conservative?***

**By Nils Schiffhauer**



**The digital short-wave world: the SDR-14 is the size of a book**

The Icom IC-R9500 has received enough praise by now. The demand can barely be satisfied - surprising enough, considering the price of around 12000 Euro. Everybody wants one. And for the one who does not yet have it, his piggy-bank still needs a little feeding. It is high time that Nils Schiffhauer should look at it from another perspective - an interruption, a "Not so fast!"

The history of receivers for the radio hobby field ran alongside the history of professional receivers for many years: Professional technologies showed up in slimmed-down form with Yaesu, Icom & Co. after a time-delay of some years. Of course, far too few manufacturers of professional devices practised what is today known as line extension. But at least firms such as Watkins-Johnson and JRC took the initiative and modified their professional designs for the high-end hobby market, at the same time addressing governmental purchasers in the Third World. However, it was with the advent of DSP that the professional and hobby spheres began to drift apart - ever so gradually at first.

From a technological viewpoint, when we stand in front of dinosaur concepts such as the IC-R9500 [1] or a Hilberling PT8000 transceiver [2] this certainly becomes clear to everyone. (Clearly, if parenthetically: These radios are wonderful and highly desirable. But they portray the past, if admittedly on a very exalted plane!)



**The Icom IC-R9500. Photo: Christoph Ratzer**

### **The parting of the ways began in the 1950's.**

The split with the professional camp took place in several stages, and actually began in the analogue era. This became most apparent in the area of strong-signal performance and above all, in the means by which it was attained. Without doubt, the high point of this early development - separation of incoming RF signals prior to any amplification - was the Collins R-390A/URR with its built-in tracking preselector. The R-390A was introduced on 24 February 1954; over 57 000 units were built. Fowler Industries delivered the last five units in 1984.

The tracking preselector was the ultimate refinement. It was ganged with tuneable IF stages, and protected the active (tube) circuits not only from strong adjacent signals, but also from noise. The cost was so enormous that it intimidated not only the competition, but others too.

Thus, National Radio Co. simply equipped their all-solid-state HRO-500 professional communications receiver (1964) [3] with a manually-tuned RF preselector. This became quite commonplace in the amateur market; Drake receivers from the 2- and 4-lines all the way to the SPR-4 were typical examples. By contrast, professional radio users saw even the autotracking preselector as an emergency measure. The rapid growth of microprocessor control, and above all the frequency-hopping system with its requirements for fast frequency changes, saw the preselector as a serious handicap. The ultimate solution: a broadband receiver. Already 20 years ago, the broadband front-end architecture reached its mature form in the Telefunken E1800, whose receive performance can hardly be improved upon even today.

## **Perhaps it didn't have to be like that.**

However, the radio hobby industry perseveres with narrow-band design concepts even to the present day - usually with automatically-switched front-end BPF's, the rare exception being the tracking preselectors in the pioneering JRC NRD-545 (1998). For cost reasons, filter selection and tracking were almost always implemented with switching diodes and varactors; this led to strong-signal problems. In this manner, the actual receive performance of the top-level receivers has hardly improved - except for "high-tech" models such as the IC-R9500, which employ relay-switched front-end filters.

Let's stay focused on summing up the comparison between professional and hobby receivers as regards RF preselection: what the professionals began to phase out in favour of better-performing designs in the mid-1980's is still welcomed as "state of the art" for hams and SWL's! And this is by no means the worst of it. Radio amateurs in particular repeatedly resisted attempts to bring modern technologies into their hobby. The very slow disappearance of AM in favour of SSB is a rather historic example nowadays; doubtless, some of us recall the scepticism of amateur radio organisations towards packet radio. The battle over the abolition of the Morse test is fresh in our minds, as is the initial widespread ignorance of efficient digital modes as used on HF. The keyword here is PSK31, not to mention such professional standards as STANAG 4539 or digital speech codecs.

## **The "Digital Revolution" is not quite getting through...**

As the shift from narrowband to wideband designs was evolutionary, the transition from analogue to digital radio architecture is revolutionary. Here, we are not referring to mere digital frequency displays, first implemented with Nixie tubes at the end of the 1960's (Telefunken E724, but also in 1971 on the Drake DSR-1.) Rather, we are considering digital signal processing (DSP) with its striking inherent advantage of replacing electronic components and filters with software which need be written only once. This concept is so cost-effective and flexible that as far back as 1984, the professionals at Rockwell-Collins already implemented IF-level DSP in the HF-2050 receiver! We should remember that 1984 was also the year in which the last R-390A/URR tube monsters rolled off the assembly line...In the HF-2050 double-conversion superhet, manufactured until 1991, the analogue/digital conversion took place at the 3 MHz 2nd IF, which set a requirement for very fast A/D converters (ADC's). [4] Hobby listeners were still soldiering on with analogue designs, even in the post-demodulation audio chain. Even so, audio filters such as the Datong are still fondly remembered. Some of these even offered an auto-notch feature to suppress interfering tones.

Digitisation of signals requires a new way of thinking. The manufacturers had to fight all the problems of triple- and quadruple-conversion superhets so as to arrive at a final IF in the range of some 30 kHz at most. This allowed the use of relatively slow and inexpensive ADC's. Notwithstanding this, convincing hobby listeners to accept DSP's new capabilities such as continuously-variable IF bandwidth was an uphill battle. The field was new for everyone; the customers subsidised the industry's R&D. Actually, this development process is by no means ended, when one considers the enormous difference between potential DSP features (e.g. synchronous demodulators or AFC even for SSB) and what today's receivers offer us.

## The Professionals: broadband and digital from the antenna input on...

In the early 1990's, the two "professional" trends - broadband and DSP - were brought together in the Rockwell-Collins 95S-1. In this 0 - 2 GHz receiver, the developers revived a trick from the earliest days of broadcasting: the homodyne concept. The mixer down-converts directly to baseband (audio). I tested this receiver thoroughly; on HF, this design, simple and inexpensive (at least in principle) as it was, could compete effortlessly with the JRC receivers of that era.

But these signals were heard exclusively by professional users. The manufacturers of hobby receivers have not visibly involved themselves with this concept. *[Translator's note: FlexRadio and SoftRock are notable exceptions to this statement.]* Even the newest "black box" radios from Icom or Winradio are following the traditional path, more (Icom) or less (Winradio). However, this appears to suit the conservative tastes of radio amateurs above all, whose potential market demand also sets the pace for innovation in the field of pure receivers targeting the high-end market.

Thus, we can ask: Is the hesitancy [in introducing new technology] a result of intelligent market research, perhaps? Such research certainly appears all but non-existent in the ham market. Or do the developers not know any better? And yet, DSP has been a part of university curricula for over a quarter-century. Or will the receivers become too cheap, when software replaces their expensive hardware? The Rohde & Schwarz EM510, a professional [direct-sampling] receiver, is considered a good deal by professional users at 20 000 Euro, but is clearly more costly than its hybrid [analogue/DSP] predecessors. Is it possible that hobby listeners feel they do not even need the possibilities which digital broadband receivers offer? It is certain thus far, that not even the test engineers of the world-wide leader among radio amateur periodicals, the ARRL's QST, recognise or even present [to the reader] the possibilities [offered by direct RF sampling].

And when they do not do this, who else shall? The ARRL test of the SDR-14 [direct-sampling receiver] oozes with ignorance, and by the same token what remains of the German radio press piles on test "numbers" ad nauseam rather than illustrating the fundamentally new possibilities and exciting listening experiences these technologies offer.

Thus, the SDR-14 - which as a leading receiver unites broadband and digital technologies at the antenna socket - has at last created a visible niche market incorporating professional design concepts (at press time, nobody has yet reviewed the Perseus with its even greater potential.) As does the abovementioned EM510, the [Perseus] links broadband operation and digitisation right at the antenna socket. The mixer, with all its problems, is no more. One can display a spectrum as wide as 30 MHz on a PC if one wishes. And one can capture a frequency range almost 200 kHz wide for subsequent tuning and monitoring. This concept will be developed still further this year [2007] under the keyword "Perseus". Not in Japan, but in Italy, whose Geloso receivers, [drive units] and transceivers we admired decades ago.

These new products are still niche products in a niche market. Even the admittedly narrowband, but fully-digital designs lead a marginal existence - even when they offer receive performance as good as that of Rudolf Illes' new DRB32. [6] Hans Zahnd will certainly advance this product category in the autumn with his ADT-200A transceiver, which will be available also in a receive-only configuration [7].

It is probable that for some considerable time we have been at a dead point in [receiver] development, characterised by uncertainty on the part of the designers as well as the SWL and ham customer base: the developers regard the bulk of their rapidly-ageing customers as arch-conservative even from a technical standpoint. Thus, they are reluctant to frighten their clientele with new concepts, the more so as these design ideas (being software-based) are much more cost-effective and would thus erode their thin profit margins even further.

The customers, on their part, have little knowledge of the performance quality offered by broadband digital concepts, as the technical press comes across to them as a rather helpless intermediary lacking in creative imagination. Thus, the [degenerative] loop is closed.

We cannot praise highly enough those companies and private individuals who - ever more vigorously in the past two years - are putting modern and very affordable design ideas on the [shack] table of the listener and radio amateur alike. They stand to endanger the dinosaurs of the classical receiver era. It is only to be hoped that the customers have not already proved to be dinosaurs too!

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First published in [Radio-Kurier](#), October 2007

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