

Networked Audio/Video and IT:  
The Key Technologies for Their Development

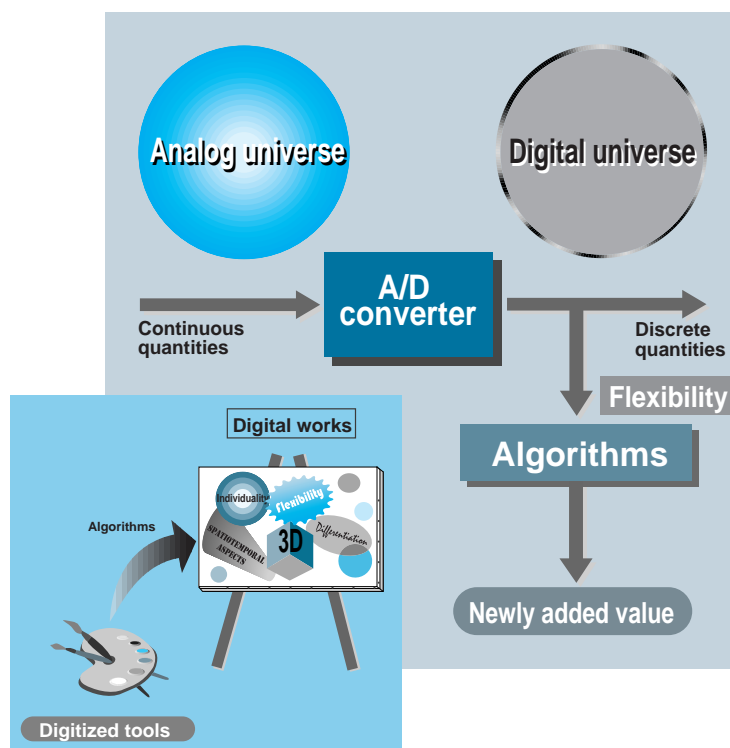
## Consumer Electronics Development in the Digital Age

*Digital technology has entered a golden age.*

*Wherever you go  
you see a multitude of products  
that advertise themselves to be digital:  
cameras, clocks and watches, video and  
audio equipment.*

*However, many experts insist that  
the appearance of a truly epoch-making product,  
a product that represents  
the arrival of a truly digital age,  
is still in the future.*

*Is it really possible for digital technology  
to become an epoch-making technology  
for consumer electronics development,  
since consumer electronics is a mature market?  
We attended the "Sony TechnoWorld '98"  
symposium held earlier this spring  
to look for hints as to  
when a truly digital age will actually arrive.  
What we caught a glimpse of  
there was the outline of a new architecture  
that can flexibly and digitally expand  
time and space.*



Tetsujiro Kondo  
President  
Algorithm Research Center  
Sony Corporation

### Digitized (uniformity) and digital (differentiation)

Since the consumer electronics field has long been said to be a mature field, we must ask what is an appropriate form for product development in a mature period? Today I would like to discuss the future of consumer electronics development from the standpoint of digital technology. First, what is meant by "mature"? There are several aspects, but the following are, perhaps, the most important. First, it is difficult to create product differentiation based on basic performance. Next, the development periods for new devices required to progress to the next phase is long and manufacturers' profit ratios are quite low due to fierce competition. Finally, it is difficult to aim at creating a fad or fashion, since the period is characterized by fierce competition on a world-wide scale. Since the world is changing rapidly and it is no longer possible to take the time to develop new products leisurely, we are now in an age that is

problematic for companies in the consumer electronics field. Can digital technology really act a savior in this situation? Although it is certainly true that there are now many more products that claim to be "digital" than there were just a few years ago, it is doubtful that any new proposals or techniques for achieving product differentiation that can truly be said to represent the dawn of a new era have appeared. We need to reevaluate the positioning of "digital" products with respect to the earlier analog age so that we can provide an answer to the question "Why is being digital significant?" What is important here is recognizing that there are two phases implicit in "being digital", namely the "digitized" phase (uniformity) and the "digital" phase (differentiation), and the both their meanings and their associated development strategies are complete opposites. The first phase, the digitized phase, consists of converting continuous quantities expressed as analog signals to discrete quantities via A/D converter and thus acquiring stability, robustness, and reproducibility. However, all of these involve a tradeoff in which improvements in the characteristics of the analog signal are acquired at the expense

of increases in the amount of information that must be handled. The next phase, which is the main theme of this talk, is the world of achieving product differentiation through being digital. Although the process up to the point where the analog signal is converted to digital by an A/D converter is the same as in earlier systems, flexibility appears at the point the analog signal is broken up into bits and re-expressed as a digital signal. This is the first point. Since these are flexible information sources that can be handled in any manner whatsoever in space or time, it becomes possible, by applying algorithms, to provide new types of added value that would be impossible in a purely analog system.

**An age in which works of art can be created on the three-dimensional canvass of spatiotemporal freedom**

Here, I would like to explain the difference between "digitized" and "digital" with a metaphor from the world of painting. In the analog age, that is, the period when the artists' paints were created by individual craftsmen, it was extremely difficult to consistently produce the same color. However, if this process is digitized, all the know-how concerning artists' paints becomes uniform and equal, and can be provided in a packaged product. This means that anyone can use paints of exactly the same color. That is, the digital age is an age of extremely high reproducibility and uniformity. This means that under the same "digital" approach, since all systems are "digitized," the degree of uniformity between products increases, and it becomes even more difficult to create product differentiation. Meanwhile, the age we are about to enter is one in which we, while using these paints made uniform by digitization, use the flexibility of digital systems to paint our works on the three-dimensional canvass of spatiotemporal freedom, a freedom that was unavailable in the analog age. That is, once we have passed through the phase of creating uniformity and equality through digitization, we enter the three-dimensional digital phase where product differentiation in its true meaning occurs due to the individuality of the painter. This is also the reason that, in the digital world today, there is so much attention focussed on product differentiation created by algorithms.

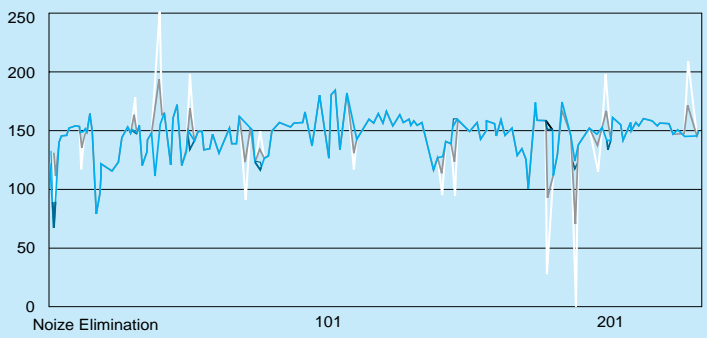
Here, I would like to unravel the thread of history. The process of progressing from uniformity to differentiation in digital systems occurred in radar systems before it occurred in consumer electronics. With the arrival of radar, a device that shows the direction and distance to objects in the vicinity, it became possible to pilot ships or fly planes at night or in the rain. The early history of radar development was charac-

terized by competition to create systems with higher measurement precision, which is the basic performance parameter in radar systems. However, radar systems finally were developed that provided better performance than was required by their users, and thus the market entered its mature period. Then the process of differentiation began and high value added radar systems, such as animate object detectors that only detect objects that move, began to appear. Finally, products, such as the microwave landing system (MLS), which allows automatic piloting by using the spatiotemporal freedom provided by digital systems, appeared. That is, integrated systems with new functionality were born by differentiation created by combining added value with the flexibility of digital systems.

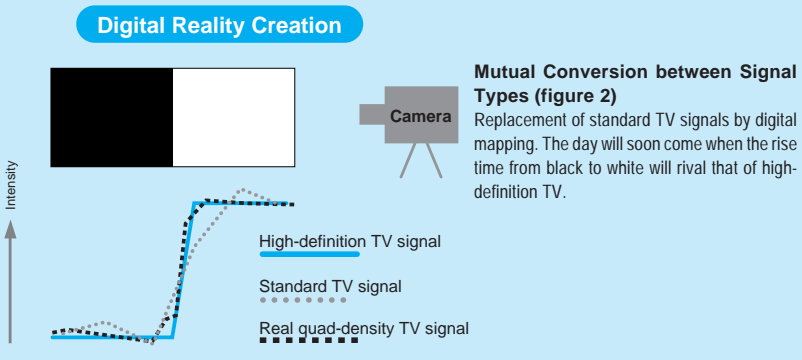
This same process is about to happen in the field of consumer electronics. It is possible that in the near future added value can be created and amplified in consumer electron-

ics development by the integration of a wide range of media through improvements in digital signal processing and the mutual conversion between a wide range of signal types. This will lead to the creation of new added functionality. At that point there will be three basic elements that will bring about new added value. I have named these the "three holy vessels." The first is digital representation (of the signals themselves), the second is computers (the architecture that moves the representation), and the third and final is signal processing (the algorithms that are the basic principles of operations). Added value can be created when these three are combined into a single unified whole. The approach taken towards determining what picture to paint will, of course, differ for each painter. Perhaps a novel work that overturns our analog value system will be painted on this three-dimensional digital canvass. The future of consumer electronics is bright. Thank you.

### Examples of Differentiation Using Digital Technology

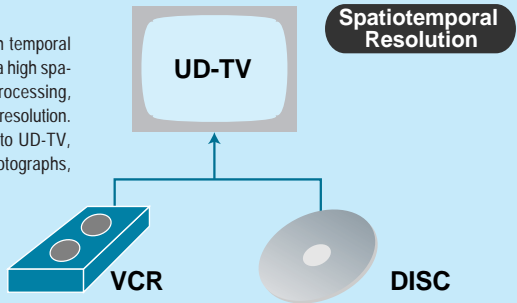


**Noise Elimination (figure 1)**  
From digitized filters in which signal degradation remains to digital filters with no degradation. A signal (light blue) that is essentially identical to the original signal (dark blue) can be acquired by noise elimination techniques that take advantage of the spatiotemporal flexibility of digital technology.



**Digital Reality Creation**

**Mutual Conversion between Signal Types (figure 2)**  
Replacement of standard TV signals by digital mapping. The day will soon come when the rise time from black to white will rival that of high-definition TV.



**Media Integration (figure 3)**  
Integration of VCRs, which require a high temporal resolution with video discs, which require a high spatial resolution, is performed by digital processing, which provides superlative spatiotemporal resolution. In the future, this area will progress first to UD-TV, which provides higher resolution than photographs, and then to AV + IT integration.