

## SOME SOURCES OF TIMING FOR COMMUNICATION SYSTEMS

J.L. JESPERSEN and D.W. HANSON  
NBS, Boulder Colorado 80303 USA

One of the important applications for accurate time is in digital communication systems. Here the applications range from code alignment in code division multiple access systems--spread spectrum modulation is an example--to decoding information that has been stream enciphered. An important problem in all these applications is how does one initially establish the necessary timing throughout a communication network, and, once it is established, how can it be maintained?

Generally speaking, two approaches are possible. In the first the communication network itself is used to establish and maintain network timing. In the case of television, for example, timing is provided by synchronization pulses which are incorporated into the TV signal itself. Thus in the "international" approach part of the communication capacity of the TV system itself is reserved for network timing. In the other approach, the "external approach", network timing is provided by some time source external to the communication network. For example, one could use LORAN-C to provide the necessary time information at major nodes in a communication network. In many cases there is a mix of both internal and external sources of time information.

Much of the network that is now carrying wideband digital communication traffic was in fact built and used earlier for analog communication. Here the communication system itself, where the emphasis was on frequency coordination, syntonization, rather than synchronization, was sufficient to distribute the necessary timing information. But with the more stringent timing requirements of digital communication, the essentially analog system is often not a viable option for providing the necessary timing.

NBS has for some time now been participating with various industry wide telecommunication associations in their efforts at evaluating and solving the timing needs of future and evolving communication systems. Both internal and external time sources are being considered. In particular external sources such as GPS and two-way satellite time coordination techniques are being examined for possible use in future operational systems.