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United States Patent [19]
Cioffi

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[54] **DISCRETE MULTI-TONE DATA TRANSMISSION SYSTEM USING AN OVERHEAD BUS FOR SYNCHRONIZING MULTIPLE REMOTE UNITS**

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[21] Appl. No.: **252,829**

[22] Filed: **Jun. 2, 1994**

[51] **Int. Cl.⁶** **H04L 7/00**

[52] **U.S. Cl.** **375/354; 375/222; 375/260; 375/340; 375/356; 375/362; 370/506; 455/54.2; 455/56.1; 340/825.2**

[58] **Field of Search** 370/71, 124, 185.1, 370/100.1, 103, 105, 105.1, 105.2, 108, 118; 375/354, 356-358, 362, 371, 373, 219-222, 260, 340; 455/51.1, 51.2, 53.1, 54.1, 56.1, 69, 70, 54.2; 340/825.14, 825.2, 825.21

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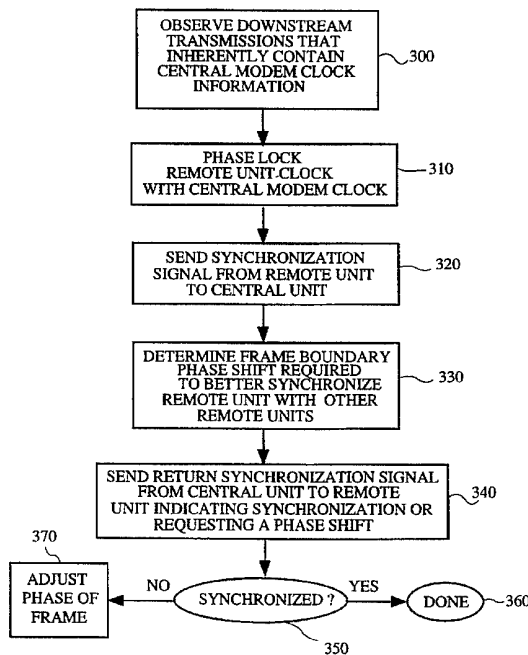
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Attorney, Agent, or Firm—Hickman Beyer & Weaver

[57] **ABSTRACT**

A bi-directional data transmission system that facilitates communications between a central unit and a plurality of remote units using a frame based discrete multi-tone (DMT) transmission scheme is disclosed. The discrete multi-tone data transmission system has a multiplicity of discrete subchannels including an overhead bus. In a method aspect of the invention, frames transmitted from the plurality of remote units are synchronized at the central unit. When a selected remote desires to initiate communications, it loops times it own clock to the clock of the central unit and transmits a remote initiated synchronization signal to the central unit over a dedicated overhead subchannel in the overhead bus. The central unit responds with a centrally initiated synchronization signal that contains information indicative of a frame boundary phase shift required to synchronize the selected first remote unit with other remote units that are currently communicating with the central unit. The remote responds by shifting the phase of the frames it outputs by an amount indicated by the centrally initiated synchronization signal. This synchronizes the frame boundaries of the frames outputted by the selected remote unit with frame boundaries of frames output by the other remote units that are currently communicating with the central unit. The synchronization is arranged to occur such that the frame boundaries from the various remotes substantially coincide when they are received at the central unit. Specific central and remote modem designs suitable for implementing such a system are also described.

15 Claims, 7 Drawing Sheets



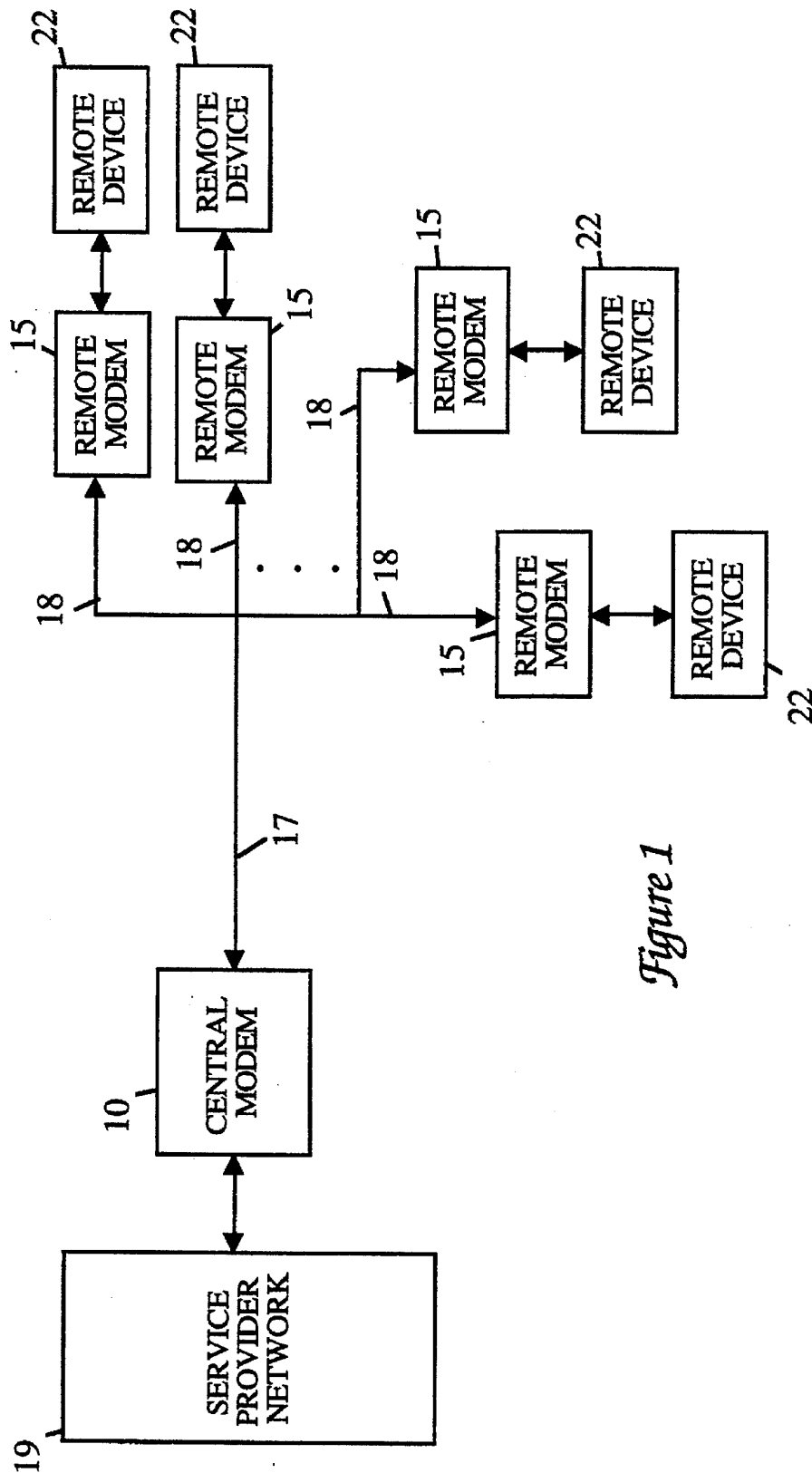


Figure 1

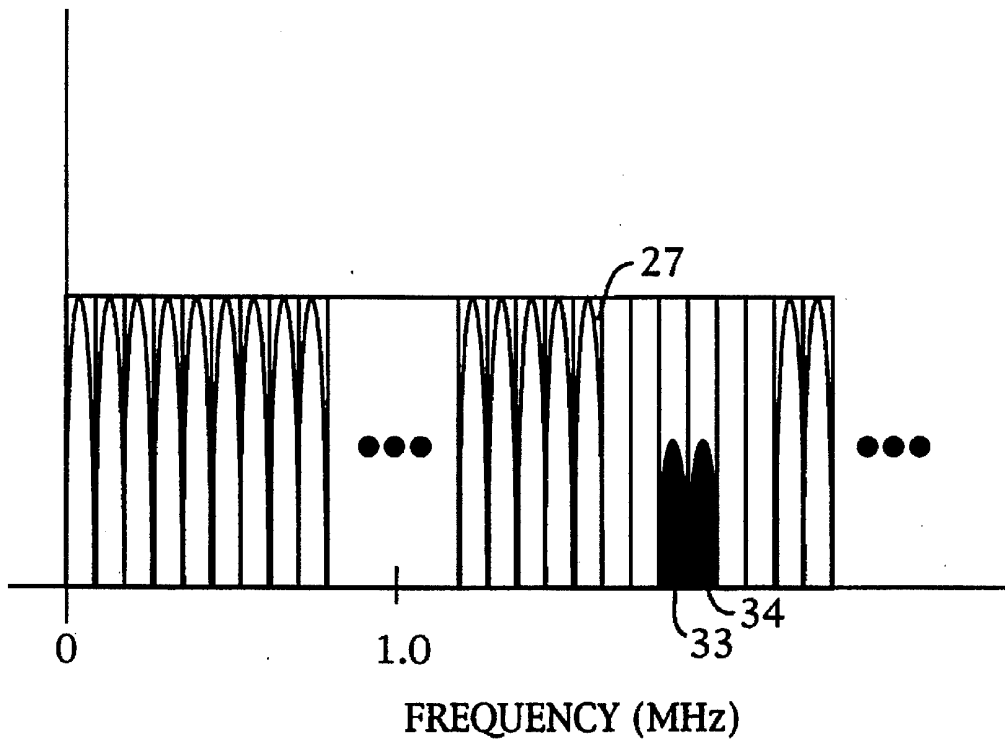


Figure 2

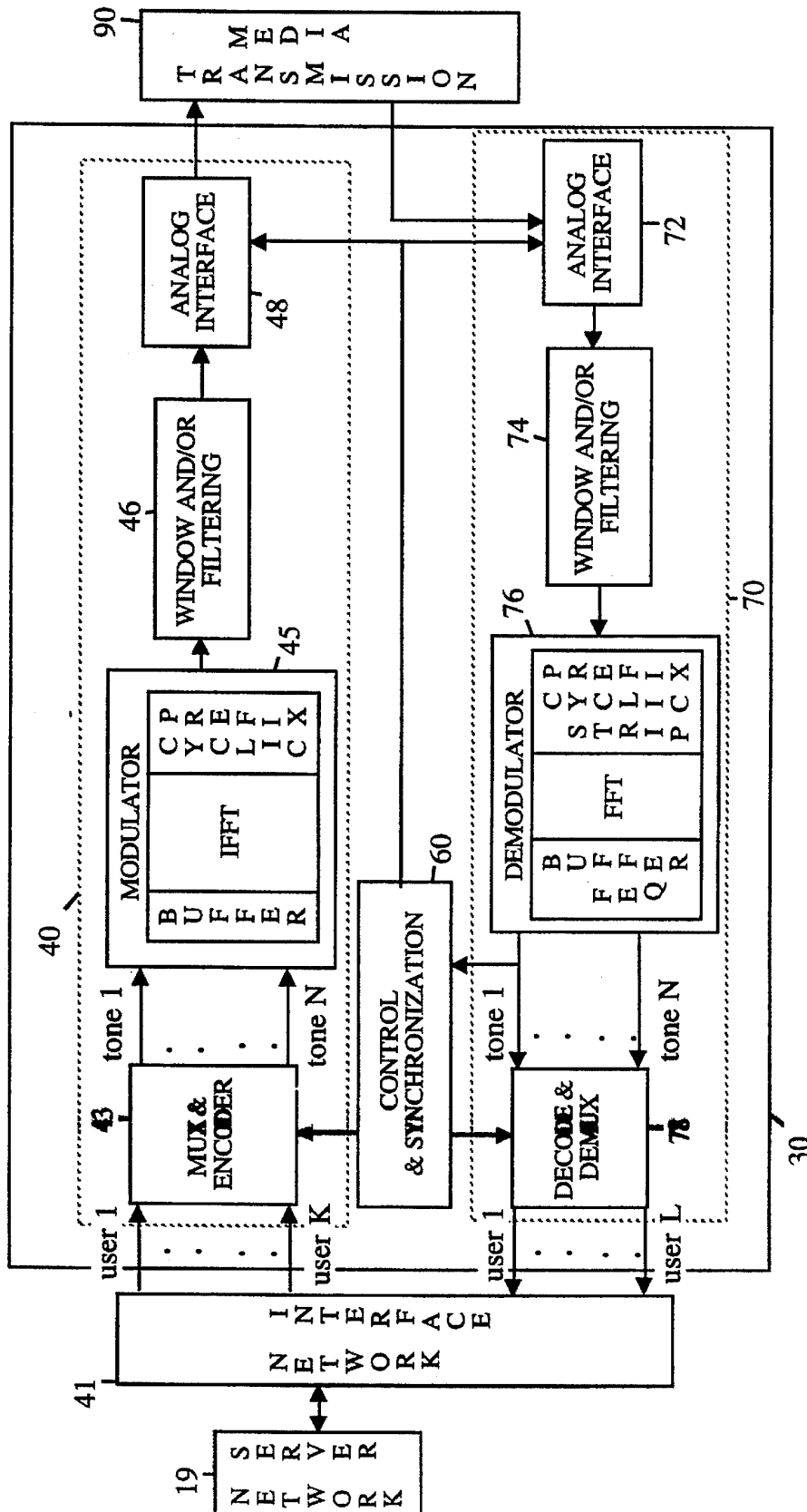


Figure 3

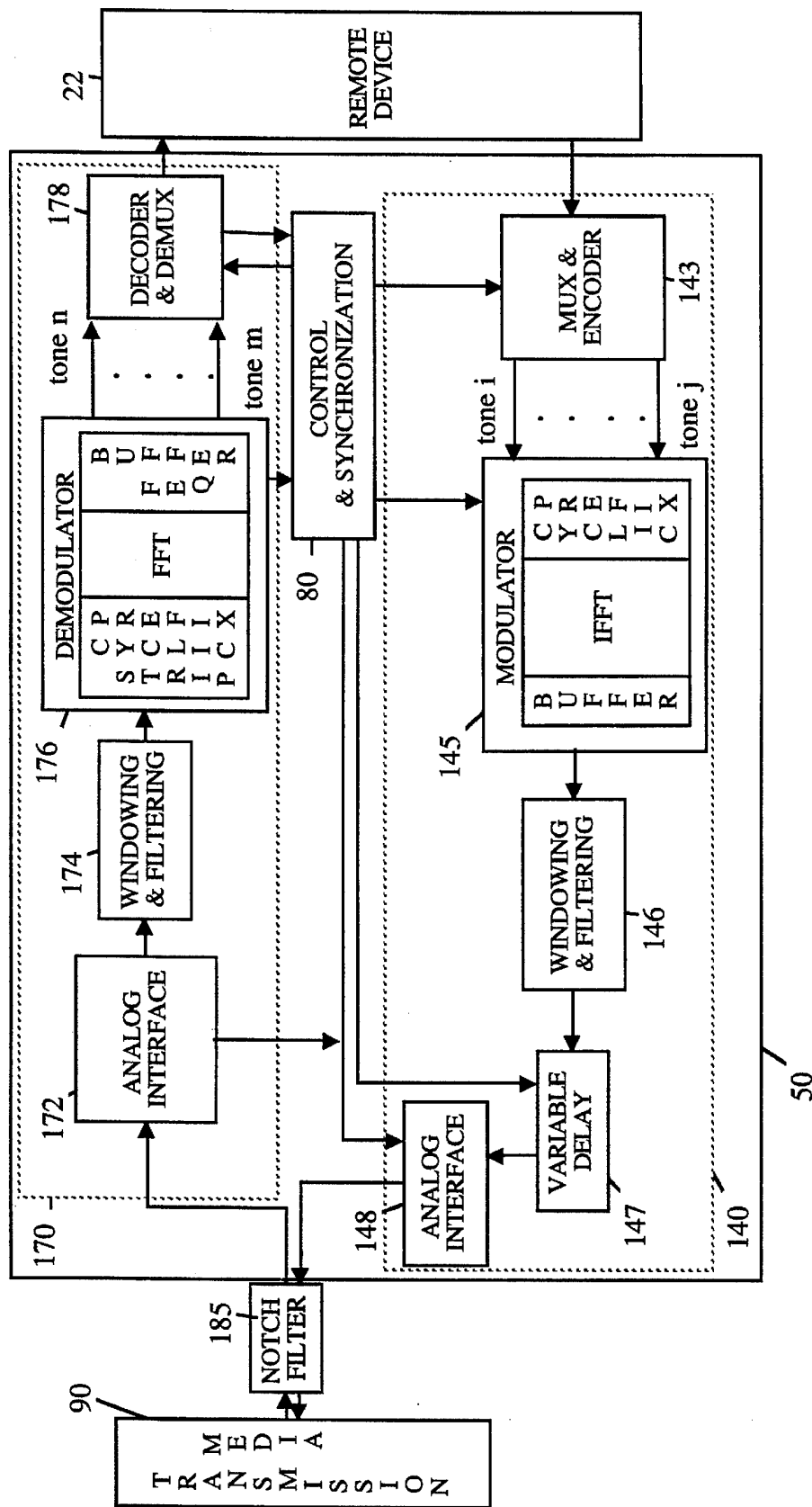


Figure 4

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