probabilities of certain pattern types are desired. Each of n processors can examine a signal or image in parallel where each examination is essentially testing an hypothesis concerning a particular pattern. The result of each individual process is a probability of a particular pattern being present. Combining the results in the Bayesian manner yields the most probable pattern along with its absolute probability within the population of patterns being searched.

[0522] The invention provides advantages in the context of database searching where each processor has access to a different database or a different part of a particular database. A machine with n nodes optically connected as in the broadcast method allows such a search to proceed in parallel, effectively speeding up a database search by the number of processors available.

[0523] The invention provides advantages in the context of pattern recognition, where data from a subset of sensors, such as a random grouping of pixel information from an imaging device, is sent by broadcast to specific partial-image processors. The entire set of image-processing nodes (modules) can then identify particular pieces of the pattern in parallel. Individual pattern elements are then recognized as belonging to certain patterns. The results are assembled in a coordinating element and the most probable pattern is identified with the presented image. The paper by W. W. Bledsoe and I. Browning, "Pattern Recognition and Reading by Machine" in the 1959 *proceedings of the Eastern Joint Computer Conference* presents a particular example of pattern recognition that would benefit by the broadcast method disclosed herein.

[0524] More generally, in the usual interconnection methods, typically either optical or electrical (crossbar, electrical multiplexing with fan-out, etc), broadcast is achieved by increased complexity or simply not attempted other than by relaying messages between processors or serially between levels of the interconnect hardware. Optical fan-out is both inexpensive and simple to accomplish. Electrical fan-out, on the other hand, is slow, expensive, and difficult to accomplish, introducing latencies and delays in the message paths. The optical broadcast method uses optical fan-out, allowing light energy to reach all parts of the system from each optical emitter. An added feature of using light for broadcast is that light from various emitters does not interfere in the free-space region where the fan-out is taking place. That is, multiple light channels can occupy the same physical space.

[0525] The broadcast model of optical communication within a backplane allows efficient multiple-instruction, multiple-data (MIMD) operation as well as the usual single-instruction, multiple-data (SIMD) operation. Broadcast allows parallel database searching. This can be achieved by broadcasting a query to a distributed database where each portion of the database is interfaced to a processing node (module) of the system.

[0526] The broadcast model of optical communication within a backplane allows asynchronous operations and data-flow architectures. Synchronization can be efficiently achieved and maintained by broadcasting short messages concerning global system status and reporting local processor or cluster status. Data-flow computations can be easily coordinated by such short broadcast messages.

[0527] The broadcast model of optical communication within a backplane allows both large-grained and fined-grained problems to run simultaneously. In this case, destination codes can be assigned to groups of nodes and such nodes are not constrained to be near neighbors. Dynamic "local" groups are may be formed where "local" has a purely logical connotation and not constrained by physical nearness.

[0528] The broadcast model of optical communication within a backplane allows high-throughput transaction processing. For instance, by allowing each processing node (module) in a large lightcube array to communicate with several transaction stations, a lightcube can handle a large number of distributed and local transactions. Coordination between the transactions and a central data repository can be accomplished by broadcasting necessary information to coordinating processors as the transactions occur.

[0529] The broadcast model of optical communication within a backplane allows efficient semaphore use and management. Semaphores can be used to control computing resources by preempting them for in certain situations and allowing access in others. Semaphore management can become efficient and practical in a broadcast model.

[0530] The broadcast model of optical communication within a backplane allows multiple hypothesis testing on a single system (e.g., Bayesian parallel processing). Bayesian hypothesis concatenation and the particular application of Bayesian signal processing are the most consistent techniques for dealing with data of all kinds. Although preferred by many, these computationally intensive activities are often approximated by faster but less accurate methods. A parallel-processing system that allows broadcast of data to multiple hypothesis-testing nodes will allow the more accurate Bayesian methods to find wider application.

[0531] The broadcast model of optical communication within a backplane enables distributed memory access. A significant advantage of a low-latency, message-broadcast model is improved memory access in a distributed memory system. For example, in a cache-coherent, uniform memory model, the addition of a new node would not be a problem as the new node would simply announce its presence and any reference to the new node would be simply a reference at large, broadcast to all.

[0532] The invention is scalable and cost effective. The invention is inherently tolerant to misalignment with no feed-back recovery system necessary. The invention facilitates efficient optical communication and/or computing within and between core switches, terabit routers and cross-connect equipment, especially in central office environments.

Practical Applications of the Invention

[0533] There are many practical uses for the communications power provided by the invention that have substantial value within the technological arts. A central result achieved by the invention is that of intrinsic information broadcast to the entire set of processing nodes (modules). As a computing or data-processing technique, broadcast allows multiple receiving nodes, simultaneously and without necessity of intervening and delaying relaying steps, to receive coordinating information as well as allowing data to be processed in parallel. Practical uses of broadcast include synchronizing computing activities, efficient communication of system