Corporate Description, Who We Are at Signal Edge

Principals of Signal Edge have been involved in researching and developing software products for over 30 years that emphasized computer process and network transmission efficiency. A higher regard for software efficiency was born out of significant mainframe experience where functionality had to be achieved with very limited resources. Many in the industry in the beginning designed software algorithms with equal regard. All worked off of the same basic equation:

Capacity X Efficiency = Capability.

Unfortunately, in the 1990's a divergence occurred between hardware and software where hardware continued to refine efficiency and software ignored it. Software was able to disregard the equation because rapid hardware advancements quickly compensated for algorithmic inefficiency. Many used the term "Moore's Law" in reference to the continued doubling of hardware capacity every few years. Using these hardware advances, software algorithms which are systematic methods for performing calculations and problem-solving achieved capability without efficiency. By disregarding the basic equation for so many years, poorly designed software has spiraled out of control. The result is an industry that displays a total lack of regard for software efficiency and energy usage.

It was always the belief of Signal Edge's principals that by reintroducing efficiency back into the software equation, computers would be able to complete their respective functions at dramatically reduced, by magnitudes, operational costs. If the algorithmic aberration allowed by Moore's Law could be corrected, it would produce an entire new generation of advanced network and computer capability. Vast amounts of data could be processed instantly creating a platform for real-time analytics. This was relevant at the time because many large-scale projects were failing, e.g., the failure of Bordernet back in 2011, because their networks and computer systems could not cost-effectively scale to satisfy the exponential growth in computer data. Basically, data growth was escalating faster than hardware capacity could compensate. We felt that by recapturing software efficiency into the equation, it would provide a way around this growing problem.

The origin of the problem turned out to be that computers were originally developed to replace paper processes. So, all current data processing techniques are descended from a "Paper Paradigm". Within that paradigm, all data is processed and exchanged one page at a time, e.g., faxes, forms, transactions, records. Since the physical exchange of paper is by definition a "legacy system", it is not surprising that the first step was merely an automation of that system. Unfortunately, this type of solution does not work well for large volumes of data, especially sensor data that is communicated on a constant basis from a multitude of disparate devices. As the volume of data increases, the amount of energy required to sustain the paper-based process is neither scalable, nor cost-effective.

Worsening Situation

IoT Sensor Processing

The biggest issue in sensory processing and the long-time focus of Signal Edge Principals has been the network bottleneck. Network resources are the most limited, failure prone, and expensive operational component within a distributed computer process. For many years, the industry relied on hardware upgrades to solve their capacity and reliability problems. Unfortunately, the exponential growth of IoT

devices has pushed network data capacity beyond its limit and the result has been escalating costs, slower response times, reduced functionality, low scalability, and higher error rates.

Customers have attempted to solve the bottleneck problem using a variety of techniques. The most common method is compression. A compression algorithm removes repeated byte patterns from the data payload. While compression may reduce individual payloads by 10% to 40%, it does nothing to reduce the number of data packets. So, "10,000 sensors still send 10,000 packets, just slightly smaller ones". Failure to solve the problem has forced the industry to adopt the following mitigations:

Upgrade Capacity

Upgrading capacity was centered on networks upgrades where many industry players put their faith in 5G and faster routers to solve the problem. These systems while sufficient for solving bandwidth issues for applications such as streaming video, did nothing for large-scale data transactions. The sheer volume of sensory data creates a capacity problem that no simple network upgrade is going to solve. Also, network hardware upgrades are very expensive and take significant time to implement.

One solution that the industry has gravitated towards is Edge Computing. Edge Computing involves deploying a large hardware server to process sensory data at the network edge. Unfortunately, this goes against the business trend to move all IT operations towards Cloud Services. The Cloud allows corporations to eliminate the increasingly excessive costs of remote data centers. Customers are going to be highly resistant to paying the high price of going backwards.

Downgrade Capability

Failure to solve the bottleneck problem and the costs of Edge computers have driven many customers to significantly limit a system's capability. For example, utility companies place severe data restrictions on their Smart Meters. These meters which are capable of producing hundreds of sensory readings per second are restrained to one or two measurements a day because of the millions of meters used in a standard network. They, like many others, suppress data production to manage IT costs. Costs that would reach prohibitive points, beyond the business budgets ability to handle it, in order to gain full IoT implementation.

Unfortunately, by doing this, much of the application's capability is lost. Smart meters are relegated to billing as opposed to real-time diagnostics where meter issues and dangerous data trends, indicating risk to life, property, assets, could be immediately identified and remedied. All this functionality lost because there is just too much sensory data for existing IT capacity. We have seen similar issues in mining, transportation, and security where the infrequency of the measurements actually compromises functionality, projecting a false sense of well-being.

While data bottlenecks have existed since the inception of computers and computer networks, the requirements of sensor processing are the elephant that broke the camel's back. Where companies may have 2,000 human users producing transactions every couple of minutes for 8 hours a day, now they have 10,000 sensors producing transactions every few seconds for 24 hours a day. The human users produce 480,000 transactions, while the sensor system produces 432,000,000 transactions. World-wide computer/network capacity is not currently or near-term capable of satisfying such escalation requirements.

Artificial Intelligence

When we examine the current industry initiatives to produce artificial intelligence (AI) from machine intelligence to deep-learning, all suffer from the same recognized problem. They are manifestations of "narrow intelligence." These systems are only capable of solving specific problems where all the variables are known. For example, Machine Learning is where computers use a statistician's toolset, such as regression analysis, to examine large data sets. This is to draw inferences over the long term for the human supervisor to act on. Deep Learning, an expansion of Machine Learning, is where apps are capable of scanning unstructured data input, like images, text docs, and speech patterns, to perform basic recognition and then action.

The entire AI industry recognizes the shortcomings of these approaches and theorizes that the solution can only be found in what is called "Artificial General Intelligence" (AGI). Unfortunately, the industry has no clue on how such a system should be designed or constructed. So, the industry continues to dump more hardware capacity into "narrow intelligence" in a mistaken belief that all data patterns can be preprogramed and General Intelligence can somehow emerge. Attempting solutions in this manner runs into the same bottleneck problem identified above except with frightening capacity escalation requirements. The results speak for themselves, a multimillion-dollar computer with the energy signature of a building that exhibits less intelligence than a fruit-fly.

The artificial intelligence industry has for many years been fixated on duplicating human-level decision-making and marketing products that provide full automation, such as robots. The problem with full automation solutions is they are fraught with regulatory issues. These regulatory issues are best exemplified by examining the automated vehicle development being conducted by Tesla and others. Even if Tesla had the solution tomorrow, it would not be commercially viable. The problem rest in the fact that insurance liability definitions and rates are based on humans or groups of humans (businesses). This fact is exemplified by the Tesla requirement that drivers must keep their hands on the steering wheel at all times. The driver assumes the liability through this prerequisite. The same problem is seen with Ford's rollout of robotaxis which requires a human backup driver.

The human responsibility requirement can also be seen in Department of Defense Directive (DoDD) 3000.09, Autonomy in Weapon Systems, and DoD's Artificial Intelligence (AI) Principles. DOD requires a human in the loop of all fire systems. Somebody, not a computer, must be responsible. These initial indicators show that fully automated products face serious regulatory hurdles and this is the least of their problems. Full automation represents catastrophic risk because it removes responsibility from the user and transfers liability directly to the software manufacturer. So, if the automated car kills hundreds of people causing millions of dollars in damage, the AI vendor is directly responsible. To put that in context, an AI company maybe only one bad software update away from bankruptcy.

The final consideration in artificial intelligence is understanding the difference between scientific fancy and commercial viability. Artificial intelligence requires significant research and seldom delivers a commercial sales practice. Spending billions of dollars teaching a computer to solve a Rubik's cube or win a 40-year-old Atari video game has no commercial product path and will never recoup its investment. Many of the larger companies such as Google have begun to figure this out. They are currently shifting much of their AI research away from full automation into more capable post-analysis duties that have direct commercial impact.

The Signal Edge Solution

While the problem described above was identified in Computer Science, the solution would have to be drawn from neurology, quantum physics, psychology, and philosophy. All play a role in understanding the human brain. The needed solution was found by identifying the brain's process algorithm and duplicating its functionality. The human brain is two liters in size, maxes out on about 21 watts of power, processes millions of sensory signals of minute, solves the bottleneck problem, produces natural intelligence, and adapts to the unknown.

To decipher the problem, Signal Edge researched neural data transfer methods that could break the bounds of our paper processing prison. We discovered that the solution was buried in the brain's subconscious process which systematically performs all sensory measurements to fulfil its basic survival function. The subconscious scans the data arriving from our senses and compares all currently obtained sensory readings with the previously collected sensory data to determine what has changed. This change represents sensory Motion and can be extracted. It turns out that transferring Motion between the brain's various components requires significantly less resources/energy than transferring raw sensory readings.

Energy savings is achieved because Motion can be classified as either Predictable or Unpredictable. The subconscious maintains a single synchronous state amongst its components when performing sensory measurements. In the brain, when transmitting data between two synchronous points, Prediction is used as an energy-saving technique that allows information to travel throughout the subconscious process using NO resources. Since the prediction exists within a synchronous state, the knowledge of that prediction exists within all connected points of that synchronous state. As each component of the subconscious process fires, the prediction knowledge is already available for processing. As a result, Predictable Motion requires no transmission, no conscious thought, and no energy requirements to automatically be processed by the brain. Processing is only needed for Unpredictable Motion.

Testing the theory that the subconscious framework of the brain is based on a motion-reaction-prediction model, the principals of Signal Edge decided to construct a prototype where IIoT sensor input was to be used to simulate human sensory input. To simulate the brain's lowest level of sensory processing required two network devices. The first was the Motion Decimator which duplicates the function of the lateral geniculate nucleus (LGN). The LGN measures raw sensory data, extracts sensory Motion, and classifies its Predictability. The second device is a Motion Reactor that triggers real-time reactions based on the Motion received from the Decimator. The first reaction programmed was a Replicator. The Replicator processes the Motion received reproducing the original data stream.

The results of the prototype far exceeded expectations with a 99.9% reduction in network packet usage. In other words, for every 1000 packets used in traditional data processing, our system only needed 1 packet to move the same data. The two devices establish a synchronous state where sensory data can be transferred using Motion. All Predictable Motion is removed from the encoding and the remaining Unpredictable Motion is compressed down into a single network packet. The highly condensed packet is then synchronized between the devices. What was even more amazing was that the system exchanged data instantaneously. We call the process Neural Synchronization and it transmits information through motion which solves once and for all the network bottleneck problem.

Neural Synchronization is also the foundation block for an artificial subconscious process. A self-perpetuating system for automating real-time reactions. Within this process, sensory data is measured

to discern Motion to produce Awareness to generate Reactions to produce Predictions. The subconscious framework is used in the production of Natural Intelligence. This is general form of intelligence that when mixed with symbolic intelligence can produce various forms of consciousness and process automation. All life is based on the principles of natural intelligence which is a system designed to be greater than the sum of its parts.

Natural Intelligence

Signal Edge has discovered and duplicated the brain's formula for eliminating data bottlenecks and reproducing natural intelligence. By starting at the bottom, we deciphered the brain's communication framework that synchronizes all the pieces together. From that, the two levels of the brain, conscious and subconscious, are knit together into one system. By following the path of efficiency, we found the brain's algorithm and the new science of Artificial Subconscious Intelligence™ will solve the computer industry's problems in both sensor processing and artificial intelligence.

It is Signal Edge's intention to continue to work our way up in the brain's process stack and in so doing, unravel the mysteries of intelligence and life which we discovered are intrinsically linked. Our creation of an artificial brain is not just possible, it's inevitable. We plan to use the knowledge acquired through the process to spawn commercial applications that significantly impact the marketplace, such as our ByteWise^{IoT} Gateway and our Cognitive Object Interface (COI). We will use our brain-based technology to create market changing solutions that propel industry capability to an entire new level. Also, since the brain's entire design is based on energy conservation, it becomes the ultimate expression of "Green Power".

Signal Edge does not see our role as competitive in the sensor processing marketplace. The ByteWise^{IoT} product is positioned as a simple network enhancement that can be easily attached to any existing sensor deployment. With our knowledge of the brain's algorithm, we can apply its efficiency through a pair of low-cost devices that reduces network packet requirements by more than 99.9% and effectively eliminates the bottleneck problem. By using brain inspired technology, companies will be able to deploy fully functional sensor-based solutions at a fraction of the price on their existing infrastructure.

Signal Edge believes that the most commercially acceptable artificial intelligence products at this time should be centered on human integrated solutions that create a force-multiplication effect. In other words, don't replace humans, focus on multiplying human capability. Instead of teaching a computer to understand millions of sensory signals, Signal Edge will use our technology to generate the awareness necessary for human comprehension. Artificial Subconscious Intelligence™ technology will make possible affordable real-time situational analysis, a place where none of the current artificial intelligence products can go.

Understanding the brain's algorithm for natural intelligence has significant implications far beyond Computer Science. It provides a foundation for the mind-based sciences where many will experience a renaissance as existing research is reevaluated and the true cause-and-effect process can be seen. All their theories and conjectures will have a factual basis for validation and study. The knowledge this produces will revolutionize treatments for physical brain disorders and by integrating a human consciousness with an artificial subconscious, an entire new generation of psychology tools for treating behavioral disorders will be available. Signal Edge will establish a framework for others to unite the sciences to solve the biggest problems facing our world. More importantly, we will finally be able to understand who and what we are. In that revelation, we will be changed forever.