Technical Note: SET™ (Supercomputing Engine Technology™) is No Rubber Band

Abstract

Sometimes it is not easy to recognize true innovation, but Advanced Cluster Systems clearly has unique technologies that place it well ahead of its time. A star in its portfolio is Supercomputing Engine Technology (SET), whose intellectual property takes the form of both a working, multiplatform implementation and an extensive patent family*.

Too many patents, such as the "rubber banding" patent owned by a famous company, embarrass the community because they are merely trivial enhancements on older ideas. Nonetheless if a "rubber banding" patent can change the phone industry and have enormous weight in court, surely a patent that is truly innovative is overwhelmingly valuable. We at ACS can definitely say SET is no "rubber band", and here is why - ***The SET design expresses the most fundamental, the simplest, and most efficient way to make use of a parallel computer from a client device.*** All the essential components necessary for correct operation are present in SET, and no more. Removing anything will cause the system to either perform poorly or fail, nullifying any benefit from using a parallel computer.

Necessary Types of Components for a Client Device to Properly use Parallel Computing

We can identify three necessary types of components for a client Device to properly use parallel computing - necessary hardware components, necessary software components and necessary component behaviors.

Necessary hardware components include:

1. The client device (mobile device, laptop, etc.)
2. A computing service containing multiple compute units (cluster, supercomputer, cloud)
3. A bidirectional means of communications from the client device to one compute unit of the parallel computing service (Wireless such as 3G, LTE, Wifi, and wired such as DSL, Cable or Gigabit Internet, etc. The faster the better)
4. A bidirectional means of communications between compute units inside the parallel computing service (Ethernet, Infiniband, Shared Medium, etc.)

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Necessary software components include:

1. On the client device: a Front End (FE)
2. On the parallel computing service: numerous Back Ends (BEs), one for each compute unit.

SET takes many forms. Figures 1 and 2 below show couple of them:

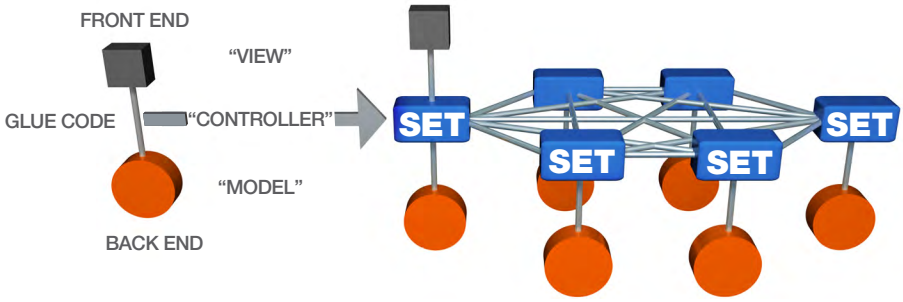

Figure 1. MVC (Left) and how SET is integrated into MVC (Right)

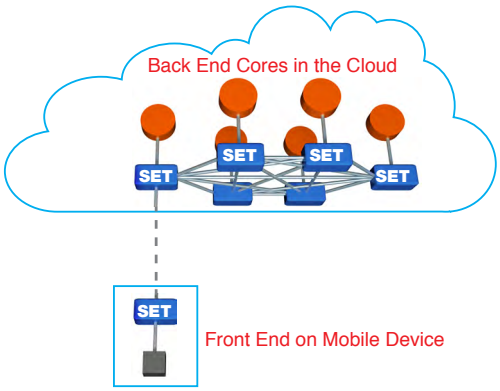

Figure 2. SET in the Cloud

Necessary component behaviors include:

1. The FE accepts and interprets commands from the user and communicate these commands with the parallel computing service. The FE displays the result of the computation once received.
2. One component (Back End #0) on one compute unit in the parallel computing service that accepts commands from the FE and relays them to other similar com-

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ponents (other Back Ends) on the other compute units. These Back Ends (BEs) compute and communicate with one another to accomplish the task. Then the BE #0 sends the result back to the FE.

SET Implementation of a Parallel System (PS)

Now that we have identified the necessary components, we can "assemble" them together as an integrated infrastructure, a SET implementation of a Parallel System (PS). In this system, the Front End (FE) connects to one Back End (BE) which then connects to many other BEs, and all those BEs are connected to each other. The number of BEs must be two or more.

Before analyzing what happens when we remove any necessary hardware component, software component or a necessary behavior, we need to understand that the SET implementation itself has important characteristics and behaviors as well.

SET Important Behaviors and Characteristics

The SET behaviors include:

1. The FE accepts a command from a user, which passes said command to the first BE which passes said command to all other BEs.
2. These BEs cooperate with each other to process and communicate as necessary to accomplish that command.
3. These BEs send a result of this processing, as specified by that command, back through the first BE and on to the FE for use by the user.

The SET implementation's important characteristics include:

1. Many processors compute simultaneously
2. Many processors communicate with each other to support said computations
3. The FE initiates the processing performed by the system
4. The command originates from the FE
5. The system's goal is to provide its result for that command to the FE

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Effects of Removing Necessary Component or Behavior

We know that removing a necessary hardware or software component disrupts the SET behavior, and removing a SET behavior from the PS disrupts the PS result. Lets see why.

Removing a necessary software or a necessary hardware component disrupts the SET behavior:

A. Removing the FE: No command is given, nor any result is seen.
B. Removing the connection from the FE to the BE: The BEs cannot receive a command, so they do not act, nor can a result be presented back to the FE.
C. Removing the first BE: The FE has no destination for its command, nor can it receive a result.
D. Removing a connection from the first BE to any other BE: that other BE will not get the command, so it cannot carry out its portion of work.
E. Removing a connection between BEs: Other BEs need data from the other BEs otherwise they cannot complete their work.
F. Removing a connection between BEs while rerouting that data via fewer connections: This change causes network congestion, a bottleneck, slowing the arrival of needed data, delaying the overall computation (Direct communication between BEs is necessary for the highest performance). This alternative design (sometimes known as a “grid” approach) is proven by the HPC industry to be slow for general tasks, and therefore not practical, resulting in a poor, uneconomical product.

If any one of components A through E is missing, the system fails and is indistinguishable from an inert object, and therefore is not useful.

Removing a SET behavior disrupts the system’s result:

A. Without SET behavior 1, the system will not act.
B. Without SET behavior 2, the system will not compute.
C. Without SET behavior 3, the system cannot report anything to the user.

If any one of those steps is missing, the system is indistinguishable from an inert object, and therefore is not useful.

In Conclusion

In conclusion, all the essential components necessary for correct operation are present in the SET implementation, and no more. Removing anything (which may be inherent to different implementation models) will cause the PS to either perform poorly or fail, nullifying any benefit from using a parallel computer.

Furthermore, the design of SET is a major quantum leap beyond what came before. A PS design cannot evolve to SET from previous forms of parallel computing, therefore no conglomeration of "rubber band"-class patents can add to SET. It is a exemplary instance of non-obviousness, and ACS would rather aim for where the puck will be rather than merely build on the past.

The above description lays out the fundamental tenets of SET, and a product that is missing any of these will be deficient, based on the three-decade experience of high-performance computing industry. These characteristics make SET very valuable to a modern industry where parallel computing is ubiquitous, seen in multicore, GPUs, cloud, and beyond. ACS has a clear and pioneering stake in a technology that is highly valuable in the computer industry.

More Information

For more information, please contact us at info@advclustersys.com or visit us at http://www.advclustersys.com

*U.S. Patents 8082289, 8140612, 8402083, 8676877, Japan patent 4995902 and Patents Pending.