

RealFusion/CET

Cloud Enablement Technology



Protecting your investment in IT Infrastructure and Applications Development

- Optimising Server (processor) usage
- Extending the life of existing applications
- Improving applications scalability and performance
- Delivering a Greener IT environment

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The purpose of this document is to provide an appreciation of an enabling technology that unlocks a potentially vast business advancement capability in multicore hardware. It provides a business level introduction to a product that enables businesses to enhance their software applications to access the benefits and economies of high performance computing based on multi-core hardware.

Further in-depth documentation can be provided on agreement with ClearFalls.

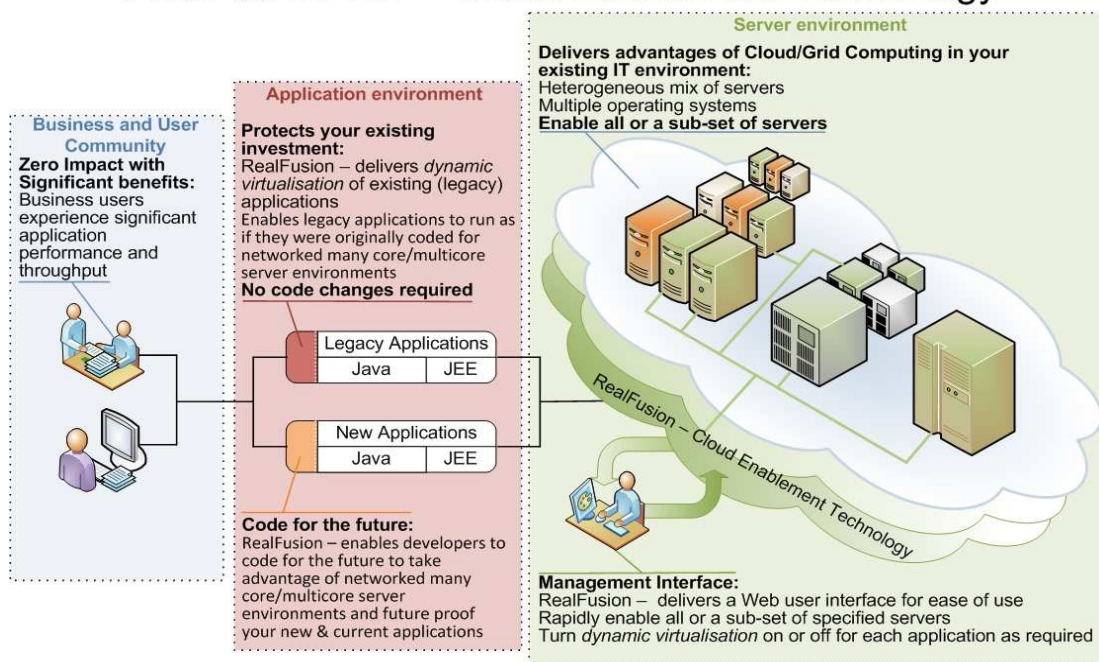
1 Introduction

RealFusion™ is a market leading virtualisation solution and development platform that dramatically improves the scalability, sustainability and flexibility of computing, in a low risk, cost effective manner.

RealFusion has been developed to address pressing issues affecting the areas of cost effectiveness, processing speed and the need for increased infrastructure utilisation encountered in every IT installation from large multi-national enterprises and, government agencies to small-medium businesses and universities. Businesses need RealFusion because:

- Businesses need to protect their existing investment in IT infrastructure and applications development
- business systems need to be better, faster AND cheaper
- years of creeping IT complexity in enterprises needs to be simplified
- under-utilization of existing IT infrastructure needs to be addressed
- businesses are being compelled to gain green efficiencies to satisfy governments and customers expectations
- businesses need to be able to aggressively seize new opportunities and defend against threats from competitors and other external forces
- businesses are focused on minimizing costs and controlling risk to survive tough times and reposition to be ready to expand in good times
- flexibility and agility is essential to the success of any business.

RealFusion/CET – Cloud Enablement Technology



1.1 Technology Conundrum

Hardware innovation is about 5 years ahead of software. The majority of today's existing applications were never designed to operate in multi-core/multi-socket server environments. This is a well established conundrum being faced by IT vendors and users alike. Hardware manufacturers are developing and deploying systems with the goal of providing more speed per processor, on smaller form factor chips, with greater numbers of processor cores in a race to have the smallest and fastest, similar to the arms race of the 1950's to 1990's. This "Chipset Arms Race" is great news in keeping prices low, and giving buyers more capability in their servers than ever before, but to-date software has been unable to keep pace.

So the big problem remains that in order to actually make use of the new speeds/capabilities delivered by these new servers, the software needs to be able to make use of these new parallel processing resources. Because most software is “thread limited” meaning the operation cannot be easily split into parallel streams, the software will only get to use a minute portion of the new capabilities.

VMware, and other server virtualisation tools, help to get the new hardware devices “sliced and diced” into many virtual environments for applications to exist in, but they still don’t enable the applications themselves to gain the benefits of more compute resources suddenly being available.

RealFusion changes all this in the way it “helps” old and new software to see more than one processor core and spreading the applications threads of execution across many of these cores to be processed in parallel, without requiring the vendor/software owner to change any lines of code.

1.2 How does RealFusion address the Technology Conundrum

RealFusion/CET (Cloud Enablement Technology) is a real solution for optimising existing (legacy, thread-limited) software applications and for new applications being developed to benefit from multi-core processing capabilities. By utilising tools and technology designed specifically for enabling the parallelisation of new and old applications there is an opportunity for businesses to ensure scalability, increase the speed of operation and service persistence of their applications, enabling more orders, requests and other transactions to be processed in parallel, giving the ability to increase delivery of product to their end customers.

RealFusion is a solution focused on the optimisation of existing, and development of new, software applications to run on –multi-core/multi-socket servers. RealFusion utilizes a process called ‘Reactive Coordination’ developed and patented by ClearFalls.

Reactive Coordination is the foundation of the hardware independent RealFusion/CET framework for the optimisation of existing applications - and the development of new applications. The patented Reactive Coordination paradigm enables these applications to become highly concurrent distributed information systems, which can more effectively leverage current IT infrastructure and execute more efficiently on new multi-core/multi-socket server platforms.

Through the ‘dynamic virtualization’ of applications to leverage more compute capability in an IT environment, the business can plan to reduce their total server count and maintain the same levels of service, or retain their server numbers and provide vastly improved services at lower cost.

This means that a business can provide their services more cost effectively. Users of RealFusion will achieve greater usage of existing and new IT infrastructure, delivering long-term sustainability of application services.

Over time, this will allow businesses to dramatically reduce their IT carbon footprint, through consolidation of their IT infrastructure (server) farms, thereby delivering a greener, more sustainable and cost effective IT environment.

RealFusion achieves this by providing a capability for existing applications to operate as though they were designed to execute in a parallelised manner and utilise more cores than they were originally designed for. RealFusion also enables applications to embrace the advantages of newer faster multiple-core devices, and emerging ‘massively-scalable’ multi-core devices, along with commonly available standard technology, including:

1. Greater processing throughput, by performing ordinarily sequential processing tasks in parallel on multiple processor cores
2. Faster processing speeds through the more processing threads operating at the same time, rather than waiting for their turn in sequential order,
3. Greater ability to use multiple processor cores in parallel without experiencing “drop offs” in speed and efficiency by using these,

Additional associated benefits include:

1. Lower power needs (directly at the server level)
2. Lower heat generation, resulting in lower power needs within the hosting environment, and

RealFusion enables enterprise businesses, ASP’s and other Hosting providers, and software vendor organizations to quickly and confidently optimise their legacy applications to become multicore enabled and to build new safe,

reliable, and sustainable applications. These applications will be able to fully utilise the multiple processor cores available within the existing and planned IT environment. Furthermore, RealFusion enabled applications will automatically scale to use additional cores across future multi-core processors.

1.3 Scalability, Sustainability, Flexibility

Scalability of computing is a major issue for most organisations as the needs of the business can alter dramatically day to day and hour to hour. In many instances this issue is dealt with through the addition of more hardware (processor cores) into the environment to provide additional compute power. Through server-level virtualization, data centres often provide this service that can be “dialed” up and down in a monolithic hardware sense, but this approach does not provide the ability to enable the software itself to seamlessly scale horizontally, across ‘unused’ processing capacity.

RealFusion requires no change to application code to enable the application to scale beyond the original physical server it was designed to run on, and thereby achieve the benefit of increased processing throughput, potential application speed increases, and greater utilisation of existing hardware resources.

Sustainability, in regards to hardware utilisation, failover and power usage, is addressed to some degree by the prevalent ‘server-level’ virtualisation technologies currently available, but they still limit an application to a single physical server. Products like VMware, Xen and others provide solid solutions to install more applications on the one server, but they do not provide the ability for the application to grasp more compute resources ‘on-demand’, and then release those resources when not needed. This limits their capability to provide comprehensive flexibility in a true ‘Grid’ or ‘Cloud’ compute environment, and limits the economies of scale through greater utilisation of available resources.

Flexibility, RealFusion provides the ability for all available processing capacity (within the whole compute environment), to be “seen” by an application as a single virtual environment where the physical location of available compute power (processor cores) is no longer an issue.

Once RealFusion has been installed onto a server, it allows any available core to be used by enabled application, if the processor core is free. If a core is in use RealFusion will simply find another available processor core to complete the transaction. Once the transaction is complete the core is again freed to be used by another application’s transaction. If a failure happens the transaction is re-performed on another available core to complete the needs of the application, resulting in failover being at a transaction level rather than at an application/environment level. RealFusion aggregates the applications results through its Reactive Coordination layer.

RealFusion has been built using industry standard software development languages and tools, enabling users involved in either in optimising and supporting existing applications, or building new ones, to utilise their IT infrastructure better and extend the life of existing software, without the need for expensive retraining.

1.4 What does RealFusion do

RealFusion is a business focused solution designed to increase the utilisation of existing (and new) IT server hardware through ‘dynamic virtualization’ of applications, old and new. The key characteristics of RealFusion are:

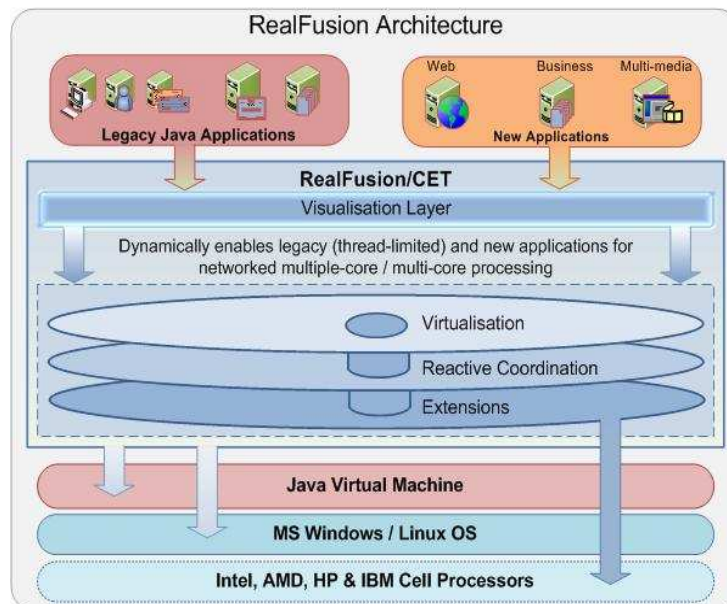
- RealFusion is purposely designed to sustain a broad spectrum of business applications, in comparison to specialized products
- RealFusion ‘virtualizes’ applications without major code changes
- RealFusion allows for the enhancement, development and integration of Java Business Applications that require performance increases for the modern business
- RealFusion allows for the enhancement, development and integration of Java Business Applications that demand the full-performance benefits of multi-core technology
- RealFusion transparently coordinates application work-load for the application across available processor cores
- RealFusion requires minimal alterations to existing execution scripts and no source code changes
- RealFusion’s operation and performance is independent of fixed or Virtual Machine
- RealFusion is an Application-level solution, that executes exclusively above the Virtual Machine
- RealFusion does not subvert or change the Virtual Machine, Operating System or Hardware

- RealFusion does not rely on specific OS thread management policies
- RealFusion is not a Java or C/C++ native plug-in custom thread management library Architecture and Performance

2 RealFusion Architecture

RealFusion is a three tiered solution consisting of the primary components, illustrated below:

- **Visualisation Layer** consisting of a Graphical User Interface (GUI) and Management Server: This layer provides the interface and control for a Systems Administrator to determine which servers and applications are enabled to use RealFusion. This is also the access point for a Systems Administrator, Architect or Senior Developer to “analyse” applications to determine hotspots of sub-optimal performance and either manually or automatically enable RealFusion to optimise these areas. Reporting of application performance, monitoring resource utilisation is also provided through this interface. The Management Interface is designed to complement, not replace, existing NMS’s.
- **Virtualisation Layer:** This layer is where the interactions between RealFusion and the applications take place. In this layer processing requests from the application are transformed in real-time - and are presented to the next layer (Reactive Coordination) for distribution to any available processor cores. Here the results are also reconstituted for presentation back to the application and subsequently the user. In this layer the transformation of code is only temporary, and does not impact the applications IP or source code.
- **Reactive Coordination Layer:** In this layer the packages of data relayed from the virtualisation layer are sent to available cores for processing. This ‘engine’ sends the work to any available processor core. There are no restrictions on the individual core specifications - and then repackages the responses together for presentation back to the virtualisation layer for reconstituting into the original applications. By having this ability to utilise processor cores of different specification means a business can continue to take a pragmatic approach to retaining older equipment and purchase of upgrades in tighter financial times, while still retaining the ability to improve the performance of their applications through ‘dynamic virtualization’.
- **Extensions:** This is a sub-layer containing some specific application extensions for better utilisation of specialised hardware like the IBM CellBE processors. The extensions are built and deployed specifically to enable the full engagement of specific localized capabilities for any RealFusion enabled application.



2.1 RealFusion Provides Increased Performance

Users of RealFusion will achieve increased application processing speeds and greater reliability of application services.

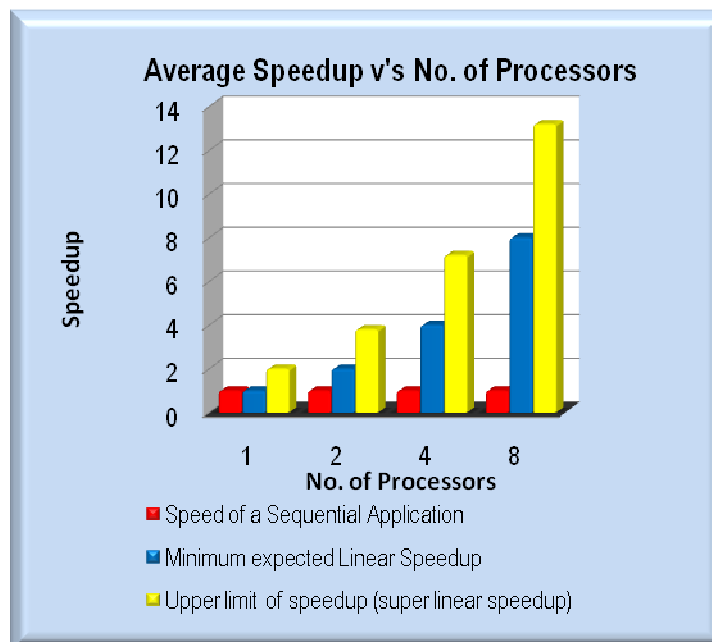
Even in IT environments with older existing server platforms, with fewer processor cores and lower processing power – users of RealFusion will gain the associated benefit, -, of enabling their business to decrease the environmental impact of their IT systems, while maintaining at least the same processing capabilities, and in the great majority of cases vastly improve their processing speeds.

To date, most of our current business applications are designed and constructed for sequential execution, and therefore have limited concurrency capabilities. This means that no matter how many processor cores are available on the servers, if an application is predominantly sequential the potential concurrency gains possible through the multiple cores will never be realised. The result is that additional threads of execution running on the processor cores will remain idle, waiting for their respective inputs.

RealFusion allows older, sequentially designed (thread-limited) applications to leverage the full processing concurrency available in the server(s). This means that depending on the number of processor cores available, RealFusion can increase the speed of processing for software applications significantly. In addition, in some instances, RealFusion may be able to improve the applications execution speed by a factor greater than the number of processors available, referred to as super-linear speedup.

In addition, users who may have existing applications that were designed for multi-threaded processing – can also use RealFusion as a Integration plug-in, with these existing sequential applications, and in many cases, also have these applications benefit from the full available concurrency processing capabilities of the servers.

The graph shows the expected utilisation of a sequential application operating on different hardware configurations in red. The bar in blue shows the minimum expected linear speed up (scales with number of processors) for an application using RealFusion as a plug-in or as the base framework for a newly developed application. The yellow bars show the upper limit of speedup, or super-linear speedup possible using RealFusion. Such performance improvements open up vast opportunities for businesses to renew or transform themselves cost effectively and with far less risk than using specialized programming languages.



NOTE: A sequential application running on a multicore device *may* achieve some processing speedup, but this is variable and unable to be relied upon as it is a function of inherent Instruction Level Parallelism rather than application-level design.

3 Benefits of RealFusion

3.1 Benefits for Businesses, CEO's, CFO's and CIO's

RealFusion provides businesses with the ability to easily achieve application performance optimisation and increased server hardware utilisation which will deliver substantial savings and a broad range of benefits including:

- The ability to embrace the next generation of server hardware technology cost effectively for both existing and new applications, using industry standard familiar tool sets and practices.
- Extending the useful life of existing server hardware and software assets - speeding up applications on older technology gives businesses breathing space to consider and safely defer major IT purchases until new technologies are more settled and price competitive.
- Providing a cost effective upgrade path for newer multi-core/multi-socket server hardware, as applications will be able to automatically scale to the number of available processor cores, thus maximizing server usage and delivering greater ROI.
- The ability to pursue performance benefits independently of day-to-day work provides a valuable avenue to achieve significant results without risk or disruption to existing / planned programs of work. Existing administrative resources can be allocated to optimising all of your existing applications, rather than focus on a small number of systems..
- The potential for improvements in ongoing operating costs through a single homogeneous technology suite,
- The ability to leverage reductions in energy consumption for existing servers and new multi-core equipment operation, resulting in measureable savings in energy consumption for cooling of data centres, which also aids businesses to achieve and their overall goal of a greener IT environment.
- Increase the capital productivity of IT investments, and
- Significantly increase the asset utilisation of IT infrastructure.

Utilising RealFusion, a business can cost effectively extend the life of legacy, sequentially- architected applications and older server hardware, through enabling applications to operate effectively across more available processor cores. There are no proprietary programming languages or mysterious new concepts to master, meaning this solution is low risk and cost effective over the long term.

3.2 Benefits for Application Vendors, Architect, Developer and Consultants

Software vendors, wanting to remain competitive, currently face the prospect of very substantial and costly rewriting of their current applications to run on the parallel processing environment created by the introduction of multi-core processors, particularly the new generation chips due for release over the next three to five years.

If the clients of these vendors are provided with RealFusion (either through embedding into the vendors product, or standalone licence) - they can continue using the current versions of the vendor software plus enjoy very substantial increases in application performance. This outcome can save vendors vast sums on rewriting software while delivering impressive performance gains and related benefits to their clients.

In today's business climate agility is essential to survival and prosperity. RealFusion contributes to this by providing developers with graphical workflow tools in a familiar environment and enabling faster delivery of high performance and scalable products with less risk and lower development costs. RealFusion enables new systems to be built in one language such as Java or Microsoft .NET, rather than forcing developers into using multiple languages and plug-ins based on things like C or C++ to gain further performance benefits. This means risk is reduced in optimisation, development and support, and lower long term cost.

3.3 Benefits for ISP's, Hardware Vendors and Data Center Operators

Large-scale operators of hardware, particularly large ISPs and hosting corporations and data centre operators, can readily deploy RealFusion on existing servers and new multi-core/multi-socket equipment, enabling their existing applications and clients to easily migrate across to this new equipment.

As RealFusion delivers optimised utilisation of all processor cores it can facilitate a substantial reduction in the hardware infrastructure requirement, based on using multi-core hardware. The potential for a facility to dramatically cut the number of servers, and thereby reducing their hardware costs and power consumption provides substantial

savings on capital expenditure, maintenance costs, accommodation infrastructure footprint and operating costs, and greatly reduced energy consumption for equipment operation and cooling. The resulting environmental benefits in particular address a major problem currently facing the data centre industry globally.

RealFusion provides a cost effective method of improving the performance and flexibility of a business's application fleet through the ability for an application to utilise more than one specific piece of hardware to conduct its processing, without the requirement for expensive application redevelopment or re-factoring.

4 Summary

The pace of change in server processor technology is far outstripping applications development, leaving it further and further behind. Current software architectures do not have the ability to utilise the increased capabilities of the new hardware types to take full advantage of the true processing capabilities inherent in these servers, resulting in businesses being unable to maximize their ROI in new technologies.

Businesses and software vendors need an easy to use product that enables their older applications to be optimised for the new hardware, and for new software applications to be specifically built to operate to the maximum benefit on new technologies. Businesses need to be able to increase their IT asset utilisation by having software that can operate more effectively on both older (existing) server hardware and on the new server platforms.

RealFusion provides the solution to these problems by enabling the optimisation of older, legacy software to run across multiple processor cores, and the ability to use it as a foundation framework to build new applications that are able to fully utilise the full capabilities of the new processors. This means that businesses can now be assured that the capital productivity of their IT investment remains high, while their investment in older legacy software and server hardware remains current.

RealFusion is a reliable and an easy to use product to optimise existing applications without code change, and also incorporates a suite of tools that developers can use to build highly concurrent applications. This suite is easy to use as it does not require developers to learn new programming languages or obscure development processes.

Businesses using RealFusion will be able to gain greater utilisation of resources, reducing operational costs and associated expenditure, and will begin to gain improved IT services capabilities, through greater application scalability and flexibility, along with better Green IT credentials.

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