

a JPR Workstation Report Bulletin

JPR's workstation round-up and reviews: a triangle of three very different approaches to workstation computing

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JPR Workstation Report: Special Bulletin

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JPR's workstation round-up and reviews: a triangle of three very different approaches to workstation computing

November and December tend to be quieter times in our business. Behind are the hectic days of September and October — when marketing machines are peaking to crank out as much news and as many events as possible, before the holidays grab everyone's attention. Ironically, once Thanksgiving comes around, we actually find time to get to things we hadn't been able to for a while. One of those things was reviewing new workstation models, especially timely since the third quarter had seen myriad new machines pumped out on the tail of Intel's release of both Haswell and Ivy Bridge-E processors.

So we put out the call to the OEMs, initially with the hope we'd get several similar machines in house, where we could do some comprehensive side-by-side, apples-to-apples comparison. It didn't end up turning out like that, however ... much to the contrary. Instead of getting our hands on three similarly outfitted machines, we got three that represented very different takes on what a workstation can be. In fact, if we went out of our way and consciously tried to get three machines representing different points on the workstation spectrum, we couldn't do any better.

And in the end, that proved more interesting than our original plan. The differences in the build, capabilities, and performances of these three machines do a great job showcasing the breadth of what today's workstation industry provides and OEMs' abilities to tailor machines to fit a wide range of budgets and meet very specific demands.

Apples and oranges ... three very different takes on a workstation

Boxx sent us its new, Haswell-powered, liquid-cooled 3DBoxx 4150 Xtreme, priced (as configured) at \$5,261, making it a high-end desktside machine by JPR metrics. It's middle of the road (intentionally) in size and capacity, but with its top-end CPU and GPU, along with high-performance memory and storage, it's designed to deliver the ultimate in single-socket performance.

Then there's the other end of the desktside spectrum, represented by our Lenovo ThinkStation E32 small form factor (SFF) workstation. At \$1,149, its price tag pales in comparison to those of our other two machines and puts it in the entry-class (or better put, sub-entry). It's designed to deliver basic workstation functionality at a PC price and minimal footprint.

And finally there's the Eurocom Panther 5D, a machine like virtually (if not literally!) no other. Calling it a mobile workstation is somewhat accurate, but it's better described as a high-performance desktside that's been squeezed into a portable package. It's far heavier and bulkier than any conventional mobile workstation, with virtually no ability to run off AC power. But it also delivers performance that no other conventional mobile workstation can match ... not even close, as we demonstrate ahead in our benchmarking.

| | 3DBoxx 4150 XT | Eurocom Panther | Lenovo E32 SFF |
|--------------------------------|---|---|--|
| | The ultimate in mini-tower performance | Top-end workstation performance ... that can travel | Workstation functionality at a PC price and size |
| CPU SKU | Intel Core i7-4770K ("Haswell") over-clocked and liquid-cooled to 4.3 GHz | Intel Xeon E5-2697 v2 ("Ivy Bridge-EP") @ 2.7 GHz | Intel Xeon E3-1240 v3 ("Haswell") @ 3.4 GHz |
| # CPU cores (physical/logical) | 4/8 | 12/24 | 4/8 |
| Memory | 16 GB DDR3-1600 (4 x 4 GB DIMMs) | 32 GB DDR3-1333 (4 x 8 GB DIMMs) | 8 GB DDR3-1600 (1 x 8 GB DIMM) |
| Disk (primary) | 240 GB SATA SSD (Intel SSDSC2BW24) | 480 GB SATA SSD (Intel S3500) | 1 TB 7200 RPM SATA HDD (Seagate Barracuda ST1000DM003) |
| Graphics | Nvidia Quadro K5000 with 4 GB | Nvidia Quadro K5100M with 4 GB | Quadro K600 with 1 GB (low-profile/half-length) |
| OS | Windows 7 Professional (64-bit) | Windows 8.1 Professional (64-bit) | Windows 7 Professional (64-bit) |
| MSRP | \$2,800 (base) \$5,261 (as configured) | \$8,547 (as configured) | \$1,149 (model 30A3-001WUS) |

(Source: Jon Peddie Research)

Table 1 Configuration specifications for our three review machines

Boxx 4150 XT: The ultimate deskside performer

Boxx has earned a reputation among the Digital Media and Entertainment (DME) and CAD markets for quality, performance, and attention to the specific demands of their field. It's a strength they've recently been leveraging to expand their presence into CAD markets. And based on our two previous reviews of Boxx workstations, we know it's a reputation that's well deserved.

Like the two previous machines we got our hands on, the 4150 XT the company sent us is again liquid-cooled and overclocked. Primarily the domain of eager gamers anxious to get an edge, overclocking and liquid-cooling are technologies that some workstation vendors have begun

dipping their toes into. Even "conservative" HP is now offering a liquid-cooling option for its top-end Z800 series of workstation.

Our 4150 XT came configured with virtually every possible hardware tool imaginable to maximize performance: the top-of-the-line Haswell-generation, quad-core Core i7 CPU; liquid-cooling that takes Intel's nominal 3.5 GHz up to the 4150 XT's 4.3 GHz; the ultra-high end Nvidia Quadro K5000 GPU; 16 GB of 1600 MHz DDR3 memory; and topping it all off, a 240 GB Solid State Drive (SSD). As usual, Boxx spec'd a machine that screams performance. About the only thing we'd have hope to see was 32 GB of memory, rather than 16. But of course, adding components doesn't come free, and that tradeoff of price and performance is something we delve into ahead in our benchmarking.



(Photo: Jon Peddie Research)

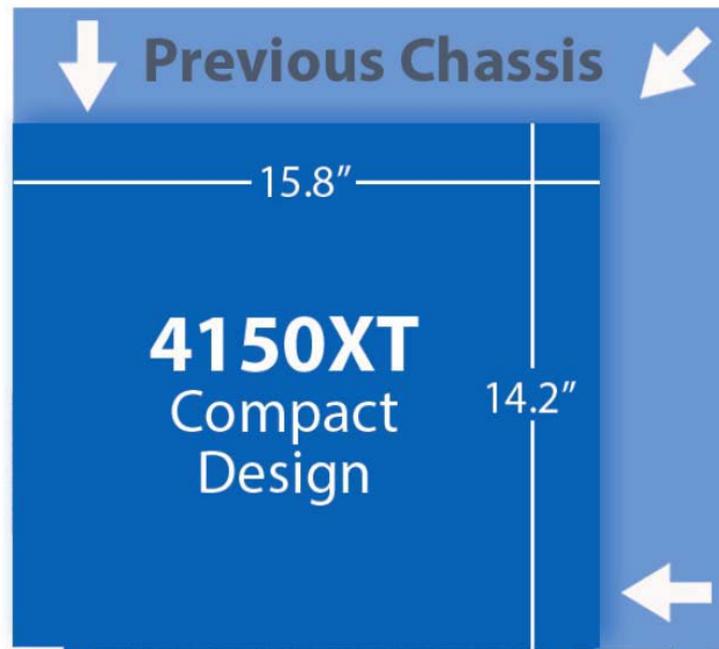
Figure 1 Front view of the Boxx 4150 XT

A premium workstation in a Goldilocks package

Workstations today come in the widest array of form factors ever. Want a desktop with minimal footprint? You can have it, with a host of small-form factor machines out in the market today (and we review one in the Lenovo E32 SFF). Want a deskside with maximum expansion potential? You can have that with a conventional tower, offering plentiful bays and slots. In fact,

Boxx makes workstations with more ability to expand than just about any machines we've come across.

But the 4150 XT isn't either of those. Rather, you could argue it comes in a Goldilocks package — not too big, not too small. It's the first mini-tower machine we've review from Boxx, and as you'd guess, it's designed to hit that sweet-spot in the middle: support for the widest range of cards, and a few slots and bays for expansion, but without the huge footprint.



(Photo: Jon Peddie Research)

Figure 2 Front view of the Boxx 4150 XT

The 4150 XT doesn't exactly require a full handy-man's tool box to disassemble and access (really just a Philips-head screwdriver). But its lesser attention to tool-less design runs counter to the emphasis mainstream OEMs have had in recent years.

Bad choice? Not at all. Boxx wins business specifically by *not* being HP, Dell and Lenovo. While those vendors have done admirable jobs in advancing tool-less access, there's little point in Boxx following the same rules. It has to both differentiate and argue superiority, and one way to do that is to prioritize physical integrity over tool-less access. That means more metal and less plastic ... more screws (the external ones are thumb-type) and fewer tabs. It's the right choice for maximum robustness, and given Boxx's positioning, that's a more important goal.



(Photo: Jon Peddie Research)

Figure 3 The Boxx 4150 XT mini-tower is smaller than some of its siblings and predecessors ... but it's no "small form factor" like the ThinkStation E32

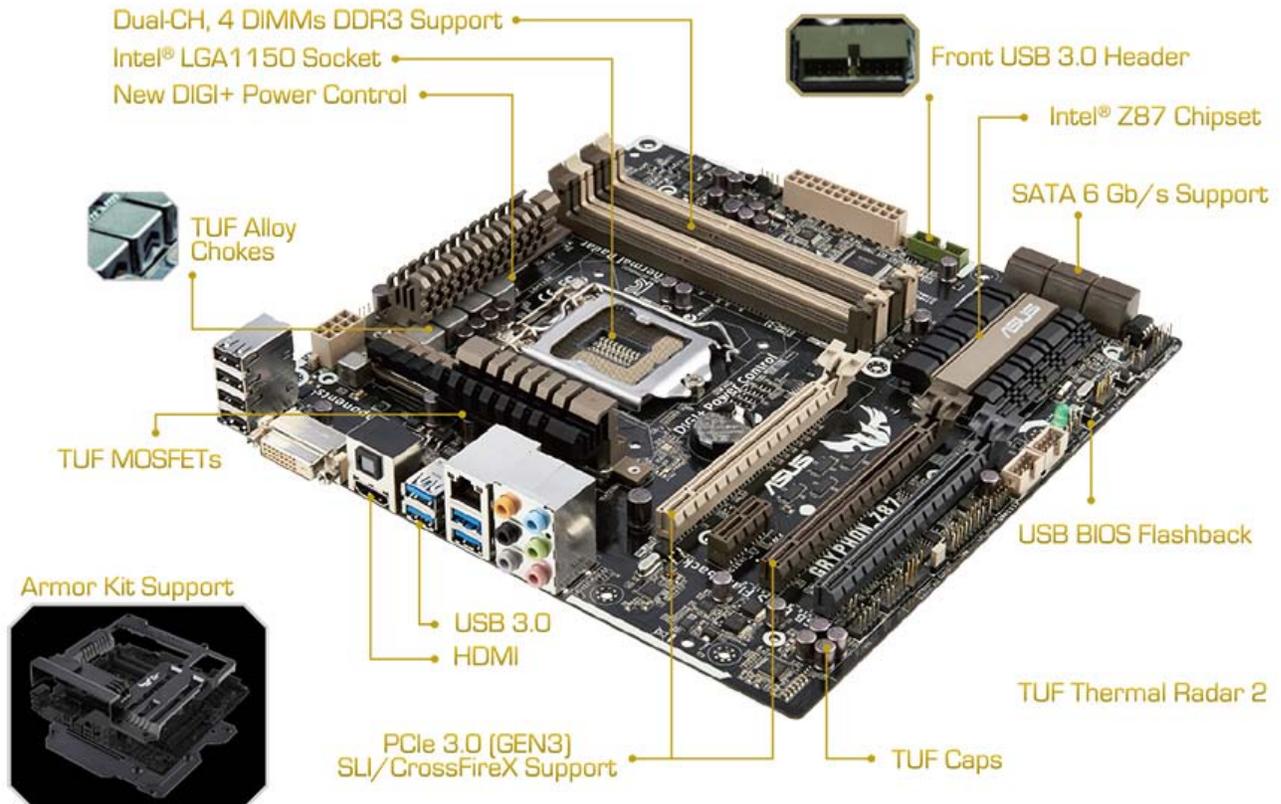
The size of the 4150 XT shouldn't be confused with a small form factor design, like our Lenovo ThinkStation E32 SFF (see side by side above). The 4150 XT is significantly more spacious, offering what we think a machine of its caliber has to offer, for example, dual full-length, PCI Express GPU add-in cards. However, it's small enough that Boxx couldn't design the chassis like its bigger siblings. While the drive bays and add-in cards slots are immediately accessible after removing the side panel, getting at the CPU and memory DIMMs requires removal of a couple of screws and a swing-away of the power supply. No big deal, and a typical extra step for smaller boxes.



(Photo: Jon Peddie Research)

Figure 4 Accessing the CPU and memory requires a simple swing-away of the power supply

A premium workstation requires a premium motherboard. And more and more premium, workstation-specific motherboards are coming from Asus, a long-time supplier to Boxx. The 4150 XT is no exception, built around an Asus Gryphon Z87 single-socket LGA1150 motherboard.



(Source: Asus)

Figure 5 The Asus Gryphon Z87 motherboard

Maximus configuration in a minimus package

The Gryphon Z87 provides three PCI Express x16 slots for graphics add-in cards, one of which was populated in our configuration by Nvidia's ultra-high end Quadro K5000 card. As is often the case, a limit on the number of PCI Express lanes (especially Gen 3 lanes) means that not all three of those mechanical connectors have 16 electrical lanes "underneath". The primary x16 interface is full x16 Gen 3, with the ability to support double-width cards like the K5000. The other two are intended for single-width cards, one supported by a x8 electrical Gen 3 interface and the other by a 16-lane Gen 2 interface.

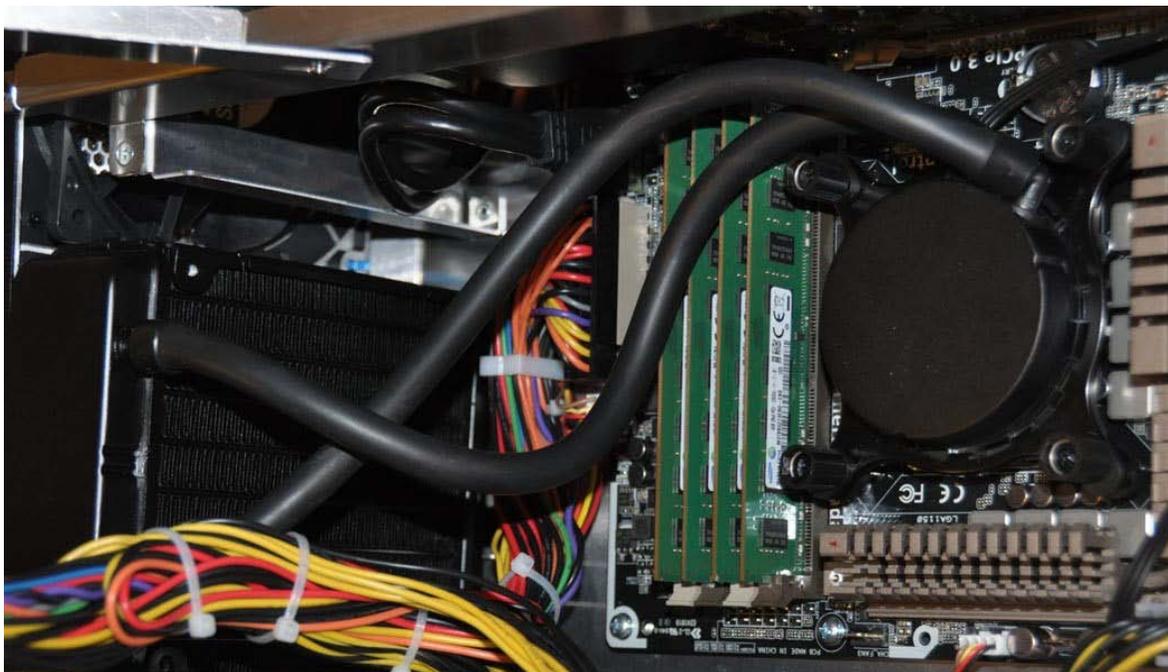
However, this smaller form factor's power and cooling limits population to two of the three slots. Where the former full-size 4920 Xtreme came with a 1050 Watt, "80 Plus Gold" power supply, the 4150 XT is outfitted with a 550 Watt supply, also 80 Plus Gold rated. The 80 Plus Gold rating means this one is highly efficient, turning over 87% of input AC line power into output power across the usual range of DC voltages (+5V, 3.5V, +12V and -12V). That's no easy task and about as high as an efficiency as you'll see.

Two graphics card slots, supporting SLI and Crossfire configurations, will satisfy the vast majority of buyers. And the second is not necessarily limited to another Nvidia Quadro graphics card .. it can populate an Nvidia Tesla GPU compute card to accelerate a range of CAD and DME

workloads, like computational fluid dynamics (CFD) and finite element analysis (FEA). Boxx claims the 4150 XT has the smallest chassis capable of supporting Nvidia's Maximus configuration, combining Quadro and Tesla.

Liquid-cooling makes this a single-thread execution beast ... and that matters in professional computing

While we're slowly seeing other OEMs implement the technology in workstations, there's no doubt Boxx has been the liquid-cooling leader. It's the third Boxx machine we've reviewed, and all have been liquid-cooled. It's not there just for show, but to allow Intel's Core i7 CPU to be cranked up to 4.3 GHz, as compared to the 3.5 GHz nominal (i.e. non-Turbo) frequency, where Intel's standard specs top out. While the clear trend in processor design is multi-core, remember that the degree to which applications can take advantage of multiple cores varies. And sometimes, fewer of the faster cores deliver the goods better than more of the slower ones.



(Photo: Jon Peddie Research)

Figure 6 The 4150 XT's liquid-cooled CPU runs extremely cool and extremely fast

Now, the idea behind any thermal dissipation scheme, be it a car or a workstation, is to transfer the heat from where it's produced, and where it could interfere with system operation, to some other place where it won't. In a car, coolant circulates through the engine and then to the radiator which transfers the heat to incoming cooler air.

Well, the principle behind computer system liquid-cooling isn't very different, though the implementation sure is. Liquid coolant circulates from the CPU to a radiator on the system's front grill, which sports two fans, one to drive air through the radiator, the other to cool the

rest of the system components. We assume both fan speeds are dynamically adjusted, based on measured workload and/or internal temperatures.

Virtually inexhaustible I/O

It would be hard for anyone to take issue with the number, type and location of the 4150 XT's I/O connectors. In front are two USB 2.0, two of the now more common USB 3.0 (blue), and mic in and audio out. In the rear are four USB 2.0, four USB 3.0, one Gigabit Ethernet, one S/PDIF optical out, and both HDMI and DVI-D out (keep in mind, those connectors are four the Haswell Core i7 CPU's integrate graphics on the motherboard, not for the add-in card graphics that the vast majority of 4150 XT buyers would choose).



(Photo: Jon Peddie Research)

Figure 7 Just try and run out of I/O connectors

Now, one of those four USB 3.0 ports in back supports "USB BIOS Flashback". In case you're not familiar, the name says it all. Supported on Asus motherboards, Flashback allows an easy external update of the BIOS. Simply plug in the flash drive with new firmware in the root directory and hit the paired button. A light will flash as the update is in process, turning off to signal the "flashback" is complete.

An SSD a good match for a performance machine like this

Investing in top-end CPU and GPU performance, as well as big and fast memory, can get short-changed if frequently bottlenecked by slow I/O, for example, when reading and writing big model files. As such, an SSD makes a great complement to the rest of our 4150 XT's

configuration. And while SSDs still come at a premium price, a reasonable size (e.g. our 240 GB) can be had for a reasonable sum, particularly when shopping for a machine of this caliber and price.

SSDs typically trade off dollars and capacity per drive to boost performance, in terms of bandwidth and even more so, read latency. Without the slow seek time — and often very long startup time — associated with heads over rotating media, the SSD is much faster loading new data, particularly when bouncing around between disparate data structures, common in professional applications.

Lenovo's ThinkStation E32 SFF: workstation functionality at a PC price ... and a desktop size

On the other end of the desktide spectrum is the Lenovo ThinkStation E32, small form factor version (SFF). The E32 comes in both conventional, convertible mini-tower (CMT) and the more recent SFF version. The major draw to the SFF version is, of course, its reduced footprint, which makes it popular anywhere office and desk space is at a minimum. Trading room floors and the smaller quarters typical of the Far East are common homes for small-form factor workstations.

The E32 SFF measures out at 14.8" x 4.0" x 13.3", at 12.9 liters occupying only 40% of the volume of its CMT sibling. Its more diminutive stature means that this is one "desktop" that actually can reside on a desk, rather than beside it. Lenovo equips the chassis with rubber feet on two sides, for stable positioning horizontally or vertically.



(Photo: Lenovo)

Figure 8 The SFF version of the E32 is quite a bit smaller than its standard convertible mini-tower sibling

Now, of course, despite Lenovo's attempts to maximize use of the SFF's smaller volume, there's a tradeoff in available add-in card slots. Specifically, the SFF version is limited to low-profile, half-height PCI Express cards, making the Nvidia Quadro K600 its top-end offering (which, incidentally, is a similar limit as other OEMs SFF models). Given its target markets — e.g. financial services — that's not a big deal, as more often than not, we'd expect that the SFF version would either ship with multi-monitor focused "2D" card, like the Quadro NVS 310 (We imagine that a fair number (albeit still a minority) ship without a card at all, relying on the Core i7's integrated P4600 GPU.

The card restriction is just about the only difference between the SFF and the much larger CMT version ... and that's a credit to Lenovo's design. The SFF can both populate as much memory (max 32 GB, ECC or non-ECC) and storage (max 9 TB) as its bigger sibling.

It makes the most of the volume it has with a creative mechanical design, similar to what HP's done with its SFF flavor of the Z200 series workstation. Loosening two thumbscrews releases

the side panel. Then finger presses on two clearly marked interior tabs releases the HDD and optical drive bays, which swing up and out of the way.



(Photo: Jon Peddie Research)

Figure 9 Like many smaller chassis, components unsnap and rotate out of the way ... in this case, drive bays

With bays rotated 90 degrees, users get full access to the E32 SFF's interior, allowing easy access to both PCI Express and memory DIMM slots, for upgrade and expansion.



(Photo: Jon Peddie Research)

Figure 10 Neat, tidy and serviceable interior of Lenovo's E32 SFF

Lenovo supports high-efficiency power supply options, though not at the very aggressive \$1,149 price of our system. Our configuration came with an 85% efficiency (80 Plus Bronze) supply, though "special bid" buyers could arrange to have it outfitted with a 92% efficient unit (80 Plus Platinum) of the same wattage. At 240 Watts maximum consumption, cooling the E32 SFF is manageable with one front panel fan.

Despite its smaller stature, the SFF version sports all of the same I/O connectors as the E32 tower, including nine total USB ports: four USB 3.0 and two USB 2.0 in the rear, two USB 3.0 in the front, and one USB 2.0 inside the chassis. The rear panel also includes an old-school VGA connector and an RS232 serial port, next to two modern DisplayPort interfaces, supported by the Haswell CPU's on board GPU.



(Photo: Jon Peddie Research)

Figure 11 Front and rear panels for the ThinkStation E32 SFF

Eurocom's Panther 5D: high end desktside workstation performance ... that can travel

Finally, there's Eurocom's Panther 5D, a descendant of the Panther 2.0 we reviewed a few years back. We tend to break today's workstation market into two basic categories: desktops/desksides and mobiles. And given those buckets, we'd have to label the Panther 5D an ultra-high end mobile workstation.

But really, calling the Panther a mobile workstation isn't really an accurate or complete description. In a way, the Panther 5D defies categorization, or at least not given the basic categories to which the industry is currently accustomed. This machine's specs go well above and beyond even the most aggressive Tier 1 mobile workstation SKUs we've come across.

Now, the key for any smaller workstation vendor hoping to compete successfully is to pick a niche that has its own unique set of constraints, then deliver a product that serves that niche better than anyone else. In the niche of ultra-workstation performance that can travel, Eurocom's Panther is a standout. But more than that, the company's really created its own sub-niche, in which they're — as far as we've seen — the only player.

A desktop replacement? Other mobiles, no ... this mobile, yes.

Eurocom is positioning its machines as more than just high-end mobile workstations, instead pitching its wares as mobile "desktop replacements". Now, ever since the emergence of the "mobile workstation" early in the 00's, we've heard many claim that mobile would cannibalize desktside sales. We didn't believe it ... and we were right.

As a percentage of units sold, the mobile workstation reached around 25% years ago, and has since hit a plateau, fluctuating around that figure ever since. The reasons are simple. First, to build a machine that's at least in the ballpark of a corporate-class notebook means it won't be able to match the performance and capabilities of a desktside. And second, since so many professionals spend the bulk of their active "developing" hours in their office, there's no point in trading off the performance to get the mobility. Rather, we expected to see many mobile workstations going to replace the generic corporate-class notebooks an engineer or designer would have otherwise had to take on the road.

So no, other mobile workstations aren't really worthy of being called a "desktside replacement". But this one is.

A desktside build in a mobile (ish) form factor

It wasn't easy, but Eurocom got there by specifically *not* compromising on components, for all intents and purposes spec'ing a desktside in a portable form factor. Designers not only passed on typical notebook class CPUs, they went out and chose a 12-core Ivy Bridge-E Xeon processor that Intel targets for high end dual-socket desktside workstations and servers. The Quadro K5100M — the top-end of the mobile Quadro line — takes virtually no step back from Nvidia's comparable Quadro K5000 add-in card for desksides, even with respect to its 4 GB video memory. Then they stuffed in 32 GB of DDR3-1333 DRAM and super-fast 480 GB SSD for storage.

I/O is amazingly plentiful, populated mainly on the side panels, as the back is occupied with air vents. All told, the Panther 5D offers three USB 3.0 ports (one powered), two USB 2.0 ports, and even kept a Firewire-800 port that most have dropped. There's wireless LAN and a Gigabit Ethernet RJ45 connector, of course. But that's just the start.

Got flash to read? No worries, built in to the front panel is a 9-in-1 reader for any card you might have. And audio? Well not only does it support the baseline mic in and headphone out, as well as the familiar S/PDIF optical out, but it populates full 5.1 speaker output for its THX TruStudio Pro audio processing, including a 3W subwoofer.

And certainly, something promising to be a desktop replacement has to do what many value most about a desktop over a mobile: multiple monitors. Eurocom covered all the bases, with one DisplayPort 1.2 interface, one DVI-I port and one HDMI 1.4 a.



(Photo: Jon Peddie Research)

Figure 12 From top to bottom: the right, left, back, and front panels of Eurocom's Panther 5D

Even the display, which is unavoidably restricted to that max-for-mobile 17.3" screen, comes with professional-caliber specs, including 120 Hz frame rate, 1920 x 1080 resolution and built-in color calibration.

No question, with its choice in components, the Panther 5D's build far surpasses any conventional Tier 1 mobile workstation offering, even their "high end" models. Furthermore, even a desktside workstation would be hard-pressed to match up with the Panther's components at anything JPR would consider a mid-range price (sub \$7K).

Boosting performance always means tradeoffs ... and the bigger the boost, the bigger the tradeoff

As we verify ahead, with the Panther 5D, Eurocom not only achieved its claim of delivering desktside performance in a mobile platform, it exceeded it. The Panther 5D matches up favorably with not just any desktside workstation, but a top performing one.

But packing such components and specs into a far smaller form factor means there's a compromise. There has to be ... there's just no getting around some basic laws of physics and

thermodynamics. And packing components that exceeds any other mobile workstation means a resulting package that exceeds any other mobile workstation — in several respects, including size, weight, price and noise.

The size and weight — well above and beyond conventional mobile workstations and not anywhere close to typical consumer/corporate notebooks — are to be expected. When it comes to form factor, this Panther 5D doesn't neatly fit into any existing category we have. It looks (and weighs) a bit like a cross between today's conventional mobile workstations (essentially high-end notebooks with professional GPUs on ISV-certified steroids) and a luggable. The "luggable" is another small niche which essentially crosses a desktop and mobile. Far bigger and bulkier, it could never be called a notebook, but it's far more transportable than a desktop. NextComputing is one vendor mining this small, but compelling niche. Eurocom's calling it a "mobile supercomputer" ... that might work. Heck, it might as well name the category, because it essentially owns it.



(Source: Jon Peddie Research)

Figure 13 The Panther 5D "mobile supercomputer": more muscle than a high-end mobile, but not as bulky as a luggable

When it comes to size, the Panther isn't that far from a desktop. In terms of stature, it has more in common with our Lenovo ThinkStation E32 SFF than it does most mobile workstations.



(Photo: Jon Peddie Research)

Figure 14 Eurocom Panther 2.0: desktop performance ... and not much smaller than the ThinkStation E32 SFF

The Panther 5D tips the scales at 12 lbs, and measures 16.76" x 11.4" x 2.31". And when considering total weight and bulk to lug around, you'll also have to consider the huge 300 W AC adapter, with the adapter and half the cords (from adapter to computer) weighing in close to 4 pounds alone.

Leave the adapter home, you say? Nope, you're going to need it. While the Panther 5D can theoretically run on battery, it's something that the company readily admits should be the exception not the rule. Our battery actually proved somewhat of a dud — we couldn't boot off anything but AC power — but with this kind of power consumption, you're not likely looking at more than 20 - 30 minutes (we're estimating) of battery life, regardless.



(Source: Jon Peddie Research)

Figure 15 The biggest, heaviest and most powerful AC adapter we've seen (that is, since the last time we reviewed a Panther ...)

Better have a generous IT budget

Our Panther 5D didn't only tip the scales on weight, but on price as well. As configured, it would sell for \$8,547, on par or exceeding (if memory serves) *any* workstation of *any* form factor

we've ever reviewed. Compare that to the average ASP of a mobile workstation (\$1,837 in Q3'13) and a desktside workstation (\$1,911). And consider also that only about 1.9% of workstations shipped in the third quarter sold for over \$7K. With its price tag, the Panther 5D resides in the thin air of the market's ultra-high end.

This is no lap-top ... literally

To achieve the performance of a desktside, the Panther 5D has to consume the power of a desktside, hence the massive 300 Watt power adapter. Of course, where there's a lot of power consumed, there's a lot of heat produced. And where heat's an issue — especially in the tight quarters of a mobile form factor — you'll find fans. In the Panther's case, there are four underneath, one for the CPU, one for the GPU, and one each for a pair of drive bays. Air is pulled in from below and vented out the back.



(Source: Jon Peddie Research)

Figure 16 Four fans, one each over the CPU, GPU and the two drive bays

With the fans positioned on the underside, this mobile couldn't be designed to sit flat on the desk — the corner pads/posts give the body about a 1/4 inch lift. Certainly, the Panther isn't amenable to sitting on your lap. With all those fans in tight quarters, the Panther's also far noisier than any other mobile workstation we've experienced.

At this point, you might be wondering why anyone would cough up big dollars for a machine the lengthy tradeoffs the Panther presents. Well, hold that thought, until we get to our benchmarking. Because while the Panther has numerous downsides, it offers a level of performance no other workstation in a mobile package can touch ... and for a small corner of

the workstation market, that performance easily outweighs any of the aforementioned tradeoffs.

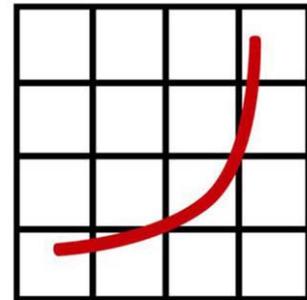
Benchmarking three very different workstations ... and three very different professional GPUs

Introducing SPECwpc and Viewperf 12 ... thank you, SPEC!

Performing our workstation round-up and review in December proved fortuitous for another reason. We wanted to give SPEC's newly released benchmarks a trial run. The long-time torchbearer for workstation-caliber benchmarking was planning to deliver not one but two new benchmarks. One, Viewperf 12, is the more conventional, a logical evolutionary step from Viewperf 11 (and all the previous versions). The other, SPECwpc, represents a brand new, application-based way to more comprehensively assess the aptitude of workstations across a number of the most popular, professional-computing verticals.

"SPEC Reviewed"

As of this writing, Jon Peddie Research is in the process of submitting these benchmark results to SPEC through the "SPEC Reviewed" (<http://www.spec.org/gwpg/specreviewed.html>) program. Results for our benchmarking, as well as others submitted, can be seen at <http://www.spec.org/benchmarks.html#gwpg>.



**spec[®]
reviewed**

Viewperf 12

The latest version in SPEC's venerable Viewperf benchmark is designed to isolate the stress on the graphics card specifically, rather than the system as a whole. As a result, its scores reflect the GPU installed and do not (at least should not) reflect differences in other key system components like CPU, memory and storage. It streams pre-defined viewsets (OpenGL and DirectX), representing typical, visual demands of popular workstation-caliber applications, including PTC Creo, Dassault Systemés CATIA and Solidworks, Siemens NX, and Autodesk Maya applications. New for version 12 are energy and medical viewsets which exercise volume rendering and dynamic data generation.

The usability of Viewperf 12 is better than ever, with its ability to automatically extract all the system's salient configuration parameters. That's not only useful for the benchmarker's own purposes, but a requirement for submission to SPEC. As a "SPEC Approved" partner, JPR submits its own results periodically, and in the past generating all that configuration data for submission was both very time consuming and error prone. But no longer with Viewperf 12.

Viewperf 12.0

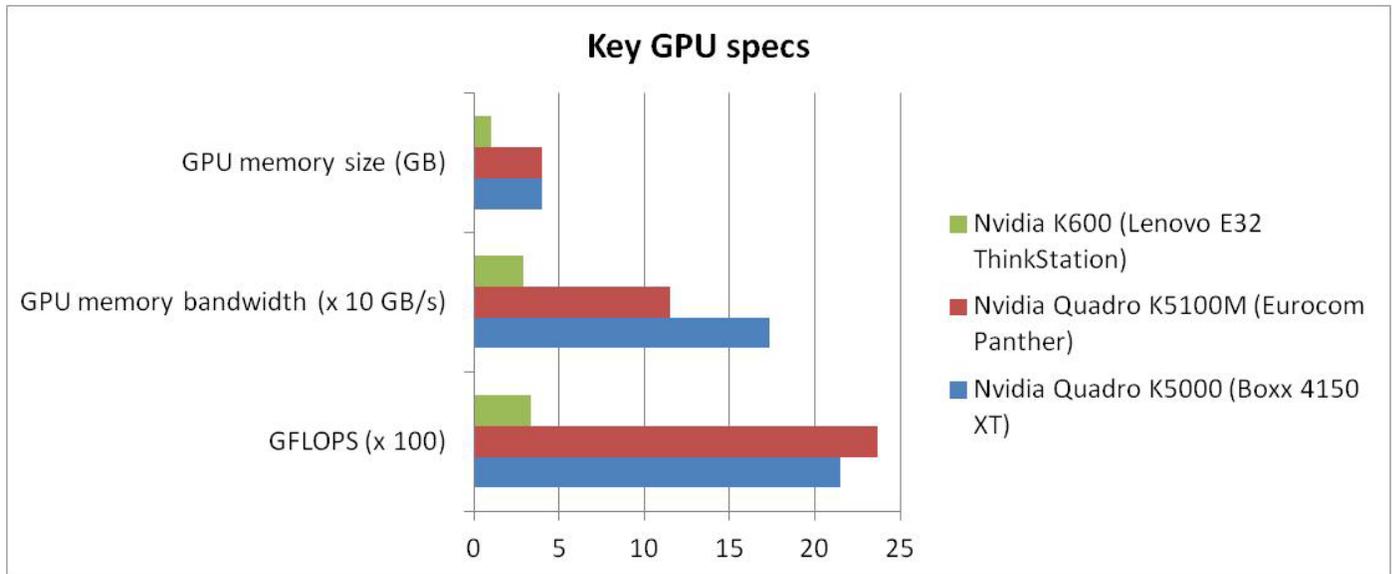
| Viewset | Composite | Window |
|-----------------------------|-----------|------------|
| catia-04 | 56.79 | 1900 x1060 |
| creo-01 | 41.10 | 1900 x1060 |
| energy-01 | 2.36 | 1900 x1060 |
| maya-04 | 46.12 | 1900 x1060 |
| medical-01 | 15.32 | 1900 x1060 |
| showcase-01 | 32.89 | 1900 x1060 |
| snx-02 | 51.75 | 1900 x1060 |
| sw-03 | 49.91 | 1900 x1060 |

| Graphics Hardware Configuration | |
|---|--|
| Graphics Accelerator | NVIDIA Quadro K5000 |
| Display Resolution | 1920x1080 @ 32 bpp |
| Display Size/Technology | 22.8" |
| Display Refresh Rate | 60 Hz |
| Display Name | Generic PnP Monitor Hz |
| System Hardware Configuration | |
| Manufacturer | BOXX Technologies, Inc. |
| Model | 3DBOXX W4150 |
| Processor Type | Intel(R) Core(TM) i7-4770K CPU @ 3.50GHz |
| Processor Base Frequency | 3501 MHz |
| Number of Populated Processor Sockets | 1 |
| Number of Physical Cores per Processor Socket | 4 |
| Number of Logical Cores per Processor Socket | 8 |
| Number of Processor Threads per core | 2 |
| L1 Cache per Socket (KB) | 256 |
| L2 Cache per Socket (KB) | 1024 |
| L3 Cache per Socket (KB) | 8192 |
| System Memory | 16GB |
| Memory Type | DDR3 |
| Memory Speed | 1600 MHz |
| Memory Configuration | 4GB , 4GB , 4GB , 4GB |
| Disk Model | ATA INTEL SSDSC2BW24 SCSI Disk Device |
| Disk Size | 240.0547968 GB |
| Software Configuration | |

(Source: Jon Peddie Research)

Figure 17 Viewperf 12 results and configuration in HTML form

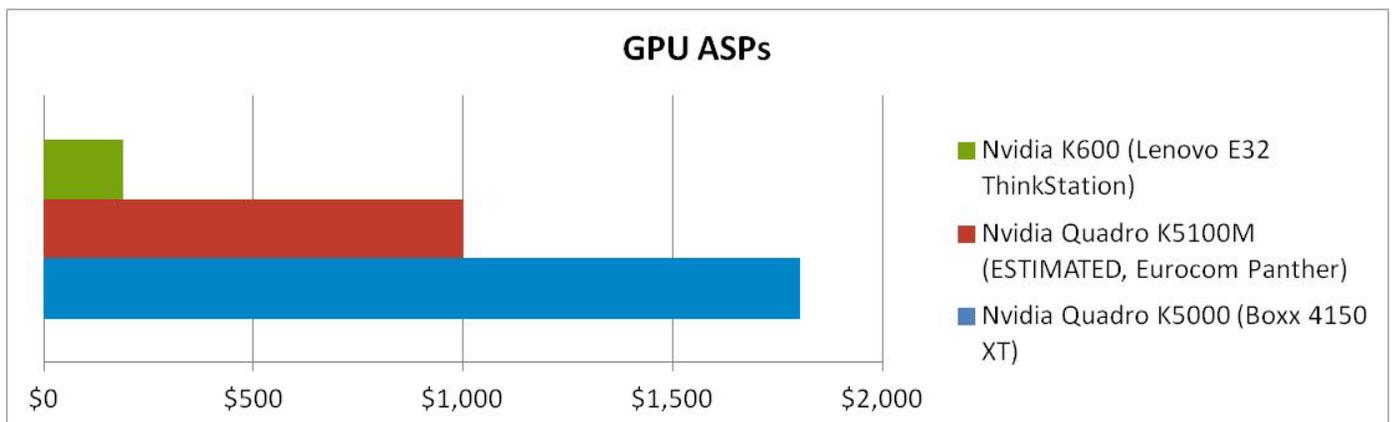
As with systems, we're comparing a "triangle" of GPUs, each one representing a different corner of the market: a different price point, a different power envelope, and in the case of the mobile Quadro K5100M, a very different form factor. So again, we're talking apples and oranges here. Let's take a look at each, in the context of both price and raw graphics capabilities.



(Source: Jon Peddie Research)

Figure 18 Nvidia Quadro professional GPUs, by base capabilities

The deskside Quadro K5000 offers top-end memory size (4 GB, tied with the K5100M) and memory bandwidth. However, the mobile K5100 actually edges the K5000 in maximum FLOPS. The two K5000 class devices offer a whole lot more in GPU resources than does the K600. But premium resources come at a cost, as the ASPs of the different GPUs will attest (note that we did our best to estimate roughly where the K5100M mobile GPU module would price at, but bear in mind there's more margin for error in that pricing).

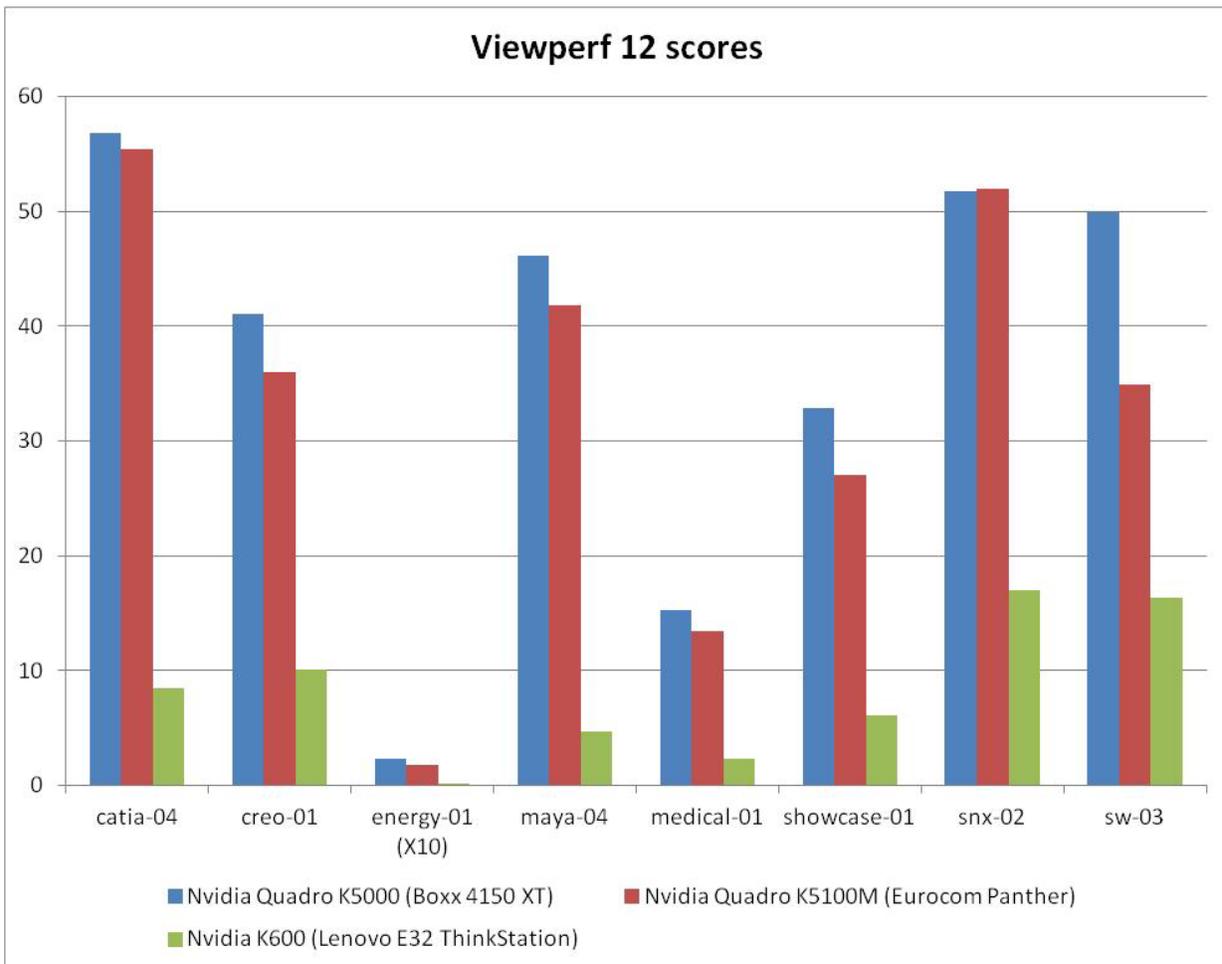


(Source: Jon Peddie Research)

Figure 19 Nvidia Quadro professional GPUs, by ASP

Given the wide range in pricing and capabilities, there's no point in benchmarking to find out which is "best". But there are two appealing perspectives we can view here: one, the machines' relative price versus performance, and two, deskside versus mobile performance. That is, how much more performance can we gain as we pay more? Which delivers the most bang for the buck? And what do we give up, if anything, moving from deskside to mobile? Let's look at raw

scores first. On all systems, Viewperf 12 was run in a 1900 x 1060 window on a 1920 x 1080 display.

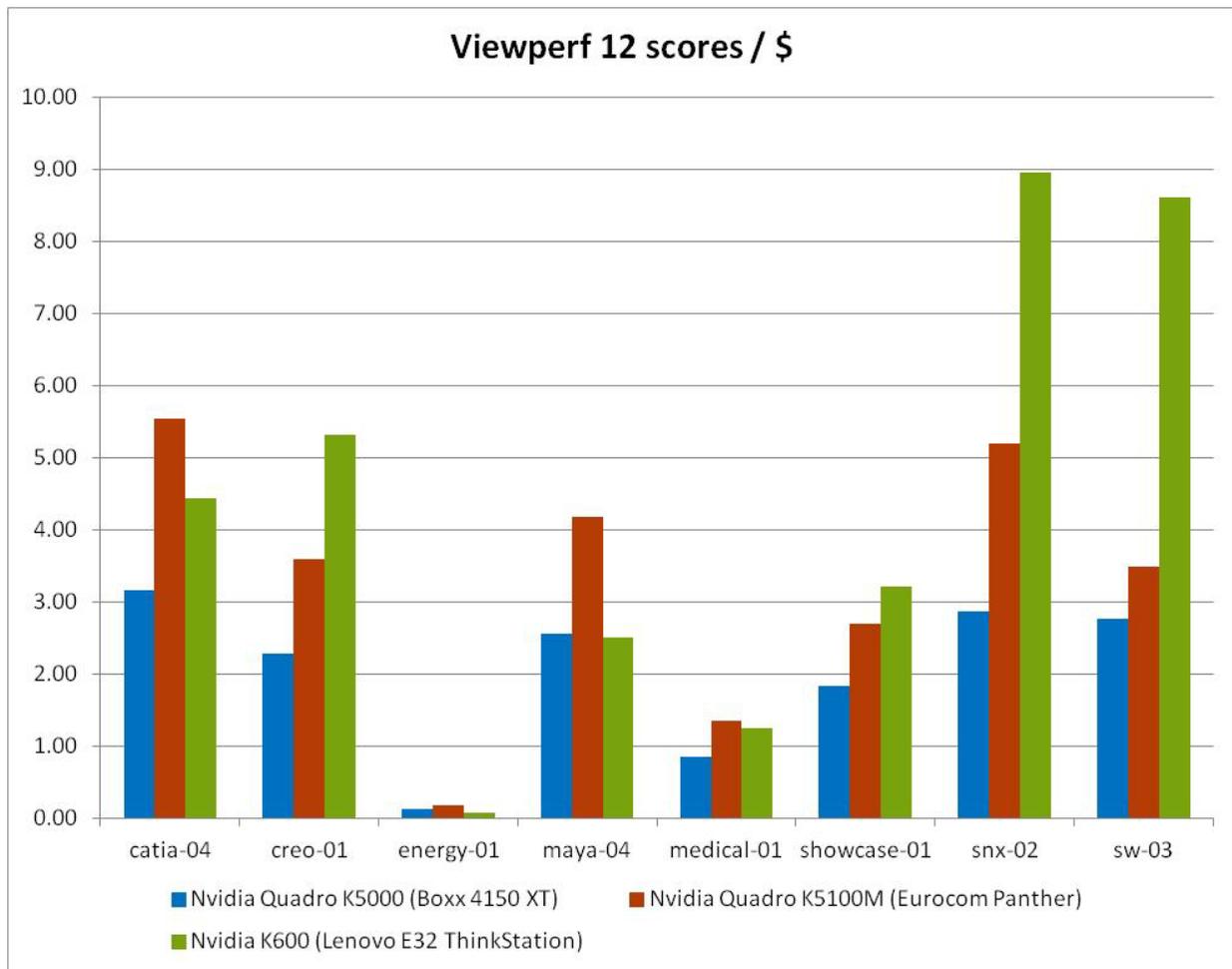


(Source: Jon Peddie Research)

Figure 20 Viewperf 12 benchmark scores

As we'd expect the Eurocom Panther's K5100M and the Boxx 4150 XT's Quadro K5000 beat the Quadro K600 by a wide margin. Furthermore, it's interesting to see that some viewssets (like creo-01, maya-04, and sw-03) appear to be more memory constrained than others, given that the K5000 outperforms the higher-GFLOP, but lower bandwidth K5100M. The snx-02 viewsset, on the other hand, appears more compute bound, as the K5100M edges out the Quadro K5000.

But again, just because the K600 got squashed by its bigger, more powerful siblings doesn't mean the K600 is a bad card. Not at all, as it turns out to be a good performer in the context of its very modest \$190 (street price). Flip the script and look at scores per dollar, and also as we'd expect, it's the K600 that dominates. (Again, bear in mind to take the K5100M's price/performance as a ballpark, as we estimated the price tag).



(Source: Jon Peddie Research)

Figure 21 Viewperf 12 benchmark scores/\$

SPECwpc

While the improvements in Viewperf 12 were a pleasant surprise, it was SPECwpc that really exceeded our expectations. Viewperf 12 is fine for stressing the graphics card, but there's a whole system around that graphics card that figures heavily into the workstation performance equation. SPECwpc's whole-system testing gives a clearer idea of how the fully configured system will perform, considering the entire workload, including application, graphics, memory, OS, I/O, etc.

SPEC says SPECwpc is the "first benchmark to measure all key aspects of workstation performance based on diverse professional applications". We couldn't have said it better, though we have more details and compliments to add. It's designed to be comprehensive, and as such, is comprised of six separate sub-test suites, one per each of six verticals, including Media and Entertainment, Product Development, Energy, Life Sciences, Financial Services, and General Operations. Each sub-suite includes anywhere from five to nine workloads, relevant to those specific spaces.

First and foremost, unlike most previous SPECcapc application-specific benchmarks, no application licenses are required, trial or otherwise ... tremendous for reviewers like us who would have to chase down licenses or beg to have them pre-installed. It's got a clean, easy run-time interface, and generates the same auto-extraction of configuration as Viewperf 12. Results come in simple, organized, easy-to-process HTML and XML. SPEC even provides a converter to translate to XLS. Thank you, SPEC.

The image shows the SPECwpc v1.0 interface. On the left, there's a sidebar with test categories: Official SPECcapc Run, Media + Entertainment Tests, Product Development Tests, Life Sciences Tests, Financial Services Tests, Energy Tests, and General Operations Tests. The main window displays system information for a Precision WorkStation T5500, including CPU (Xeon® CPU X5550 @ 3.33GHz), System Memory (24GB), CPU (Quadro K5000 4GB), Display (1800 x 1200 @ 60Hz), Display Driver Version (9.18.10.2075), and Operating System (Microsoft Windows 7 Enterprise 64bit). Below this is a 3D rendering of a BMW car. On the right, a browser window shows the HTML results page for SPECwpc v1.0, which includes a summary table of scores across various test categories.

| Summary | Raw Scores | MSL | ProdDev | LifeSci | FSI | Energy | GeneralOps | Configuration |
|--------------------------------|-------------|-----|---------|---------|-----|--------|---------------------------|---------------|
| Media and Entertainment | 2.91 | | | | | | 4.15 | |
| Blender | 2.61 | | | | | | Monte Carlo | 4.21 |
| HandBrake | 1.51 | | | | | | Black Scholes | 4.01 |
| LuxRender | 4.06 | | | | | | Binomial | 4.09 |
| IOmeter | 1.78 | | | | | | | |
| Maya | 3.13 | | | | | | | |
| Product Development | 2.28 | | | | | | 3.1 | |
| Rodinia | 3.6 | | | | | | FFTW | 1.92 |
| Calculix | 1.45 | | | | | | Convolution | 4.06 |
| WPCfd | 2.46 | | | | | | Energy-01 | 16.62 |
| IOmeter | 1.67 | | | | | | smp | 2.84 |
| Catala-04 | 3.22 | | | | | | Kirchoff Migration | 3.95 |
| Sharcap-01 | 3.07 | | | | | | Pathom | 1 |
| Six-02 | 4.48 | | | | | | IOmeter | 1.86 |
| Sw-03 | 1.58 | | | | | | | |
| Life Sciences | 3.03 | | | | | | General Operations | 1.85 |
| Lammps | 3.28 | | | | | | 7Zip | 2.41 |
| namd | 3.85 | | | | | | Python | 2.1 |
| Rodinia | 2.32 | | | | | | Octave | 1.25 |
| Medical-01 | 4.62 | | | | | | IOmeter | 1.84 |
| IOmeter | 1.9 | | | | | | | |

(Source: SPEC)

Figure 22 SPECwpc's UI, sample screen, and results (HTML)

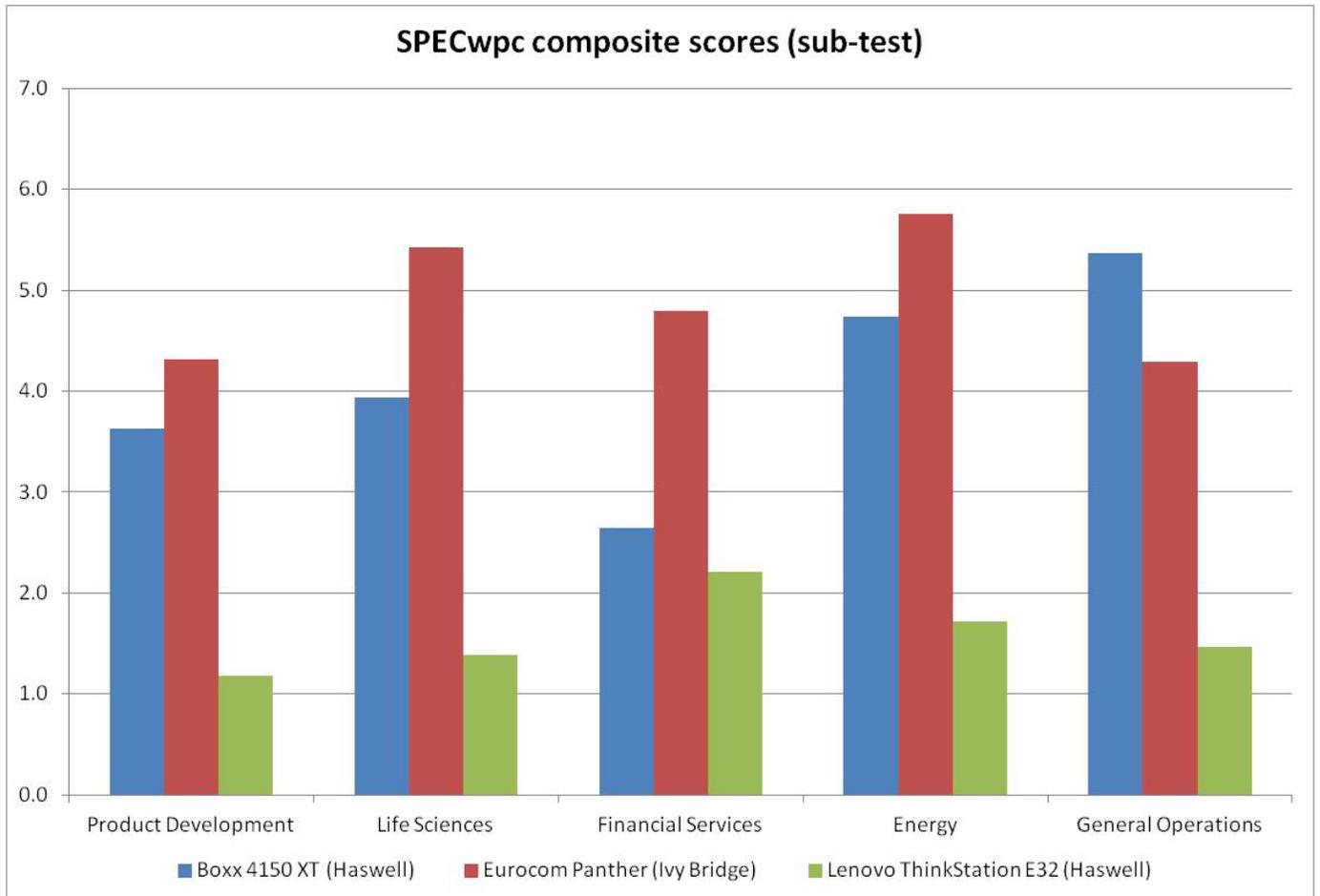
How did our three machines perform on SPECwpc? Well, as with Viewperf 12, very differently given how they are built, how they are priced, and for what purpose they're intended. And in that respect, again, this apples-to-oranges benchmarking proved more revealing than most apples-to-apples exercises we've done. Let's take a look back at each machine's capabilities:

| | Boxx 4150 XT | Eurocom Panther | Lenovo E32 SFF |
|--------------------------------|---|---|--|
| | The ultimate in mini-tower performance | Top-end workstation performance ... that can travel | Workstation functionality at a PC price and size |
| CPU SKU | Intel Core i7-4770K ("Haswell") over-clocked and liquid-cooled to 4.3 GHz | Intel Xeon E5-2697 v2 ("Ivy Bridge-EP") @ 2.7 GHz | Intel Xeon E3-1240 v3 ("Haswell") @ 3.4 GHz |
| # CPU cores (physical/logical) | 4/8 | 12/24 | 4/8 |
| Memory | 16 GB DDR3-1600 (4 x 4 GB DIMMs) | 32 GB DDR3-1333 (4 x 8 GB DIMMs) | 8 GB DDR3-1600 (1 x 8 GB DIMM) |
| Disk (primary) | 240 GB SCSI SSD (Intel SSDSC2BW24 SCSI) | 480 GB SATA SSD (Intel S3500) | 1 TB 7200 RPM SATA HDD (Seagate Barracuda ST1000DM003) |
| Graphics | Nvidia Quadro K5000 with 4 GB | Nvidia Quadro K5100M with 4 GB | Quadro K600 with 1 GB (low-profile/half-length) |
| OS | Windows 7 Professional (64-bit) | Windows 8.1 Professional (64-bit) | Windows 7 Professional (64-bit) |
| MSRP | \$2,800 (base) \$5,261 (as configured) | \$8,547 (as configured) | \$1,149 (model 30A3-001WUS) |

(Source: Jon Peddie Research)

Table 2 Configuration specifications for our three review machines

SPECwpc reports a composite score, aggregating sub-test results, for each of the six application spaces it exercises.



(Source: Jon Peddie Research)

Figure 23 SPECwpc composite scores

Now, you may have noticed the chart only shows five of the six application spaces. That's because we were only able to generate five composites to compare, as the Media and Entertainment composite scores proved invalid for two of our machines (they each failed to run one sub-test, the Handbrake sequence). Here's how the three workstations fared on the individual M&E sub-tests:

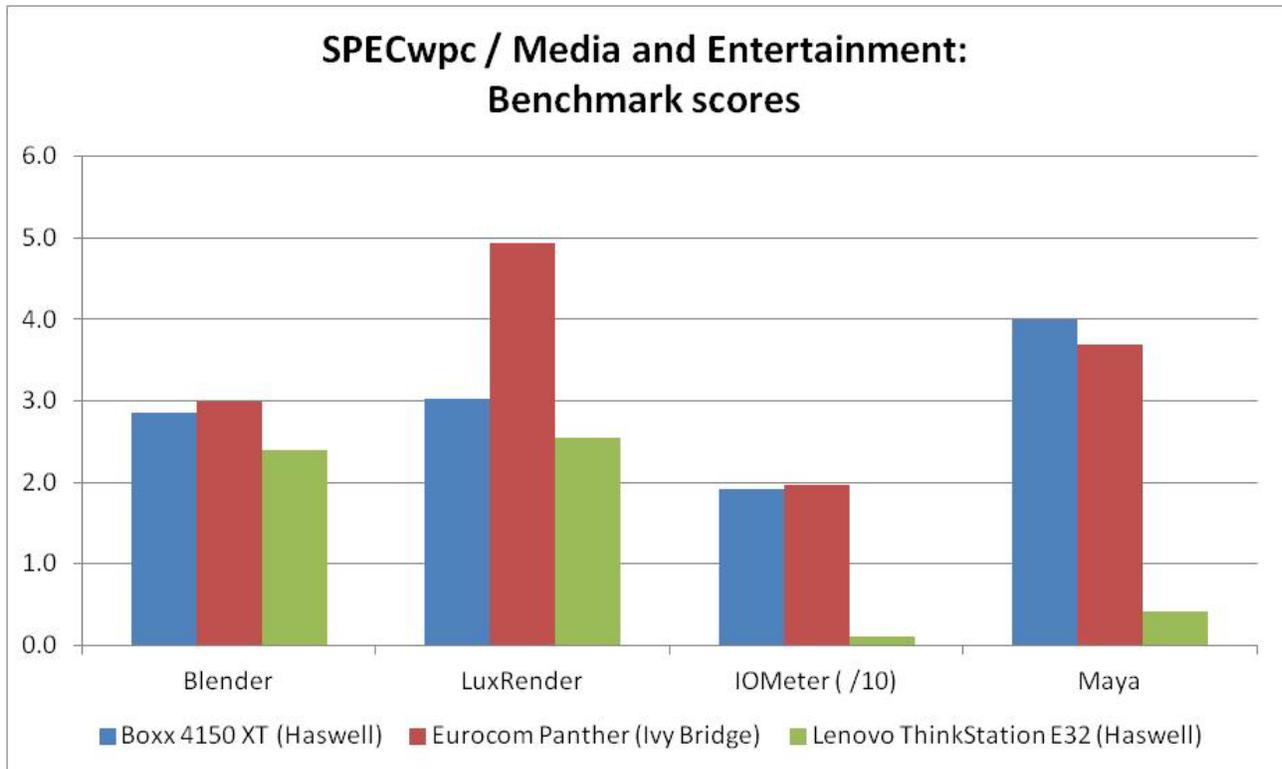


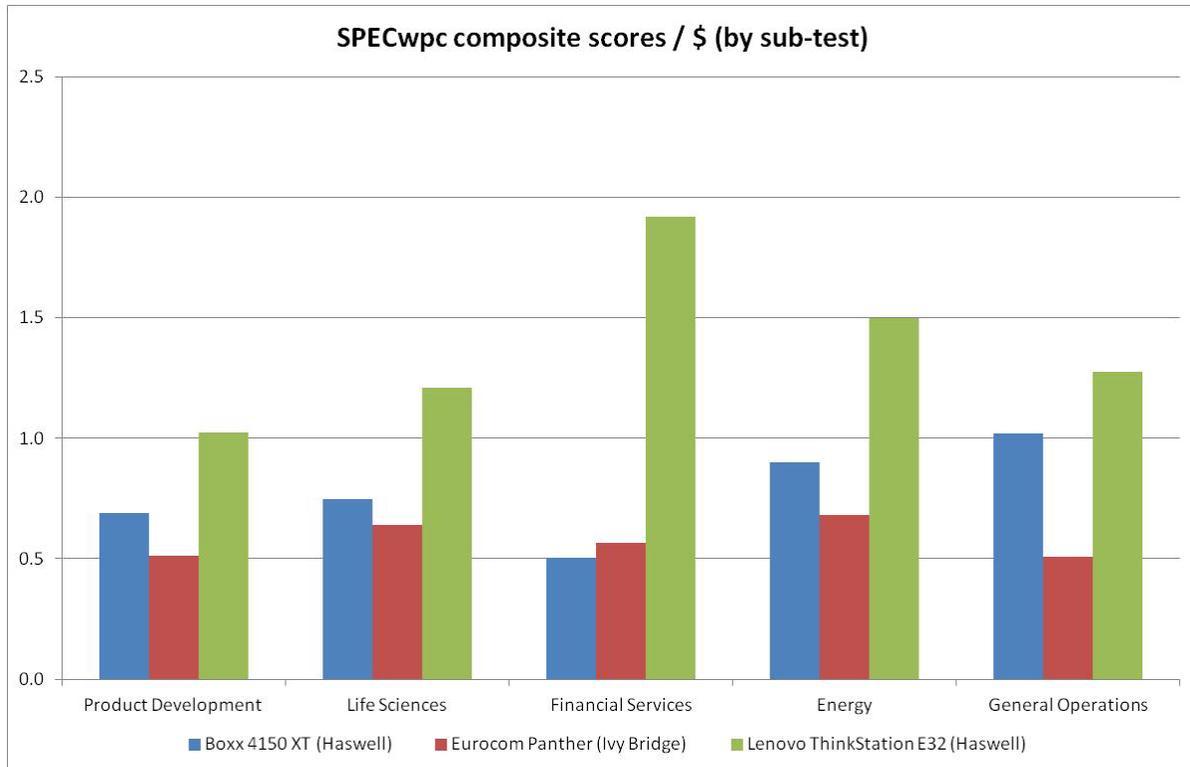
Figure 24 SPECwpc / Media and Entertainment sub-test scores

The composite scores, as well as the M&E sub-test results, definitely reflect the relative capabilities of each machine. The Lenovo E32 SFF was clearly outclassed by the two far more expensive Boxx and Eurocom machine's ... but again, it should be, given the relative price tags.

Eurocom's Panther 5D simply crushed it. The machine performed so well, that it nearly concealed the fact that the Boxx 4150 XT generated some big-time numbers as well. The results clearly reflect (to varying degrees) one or both of the hardware edges the Panther holds over the 4150 XT: more CPU cores (12 versus 4) and twice the memory (32 GB versus 16).

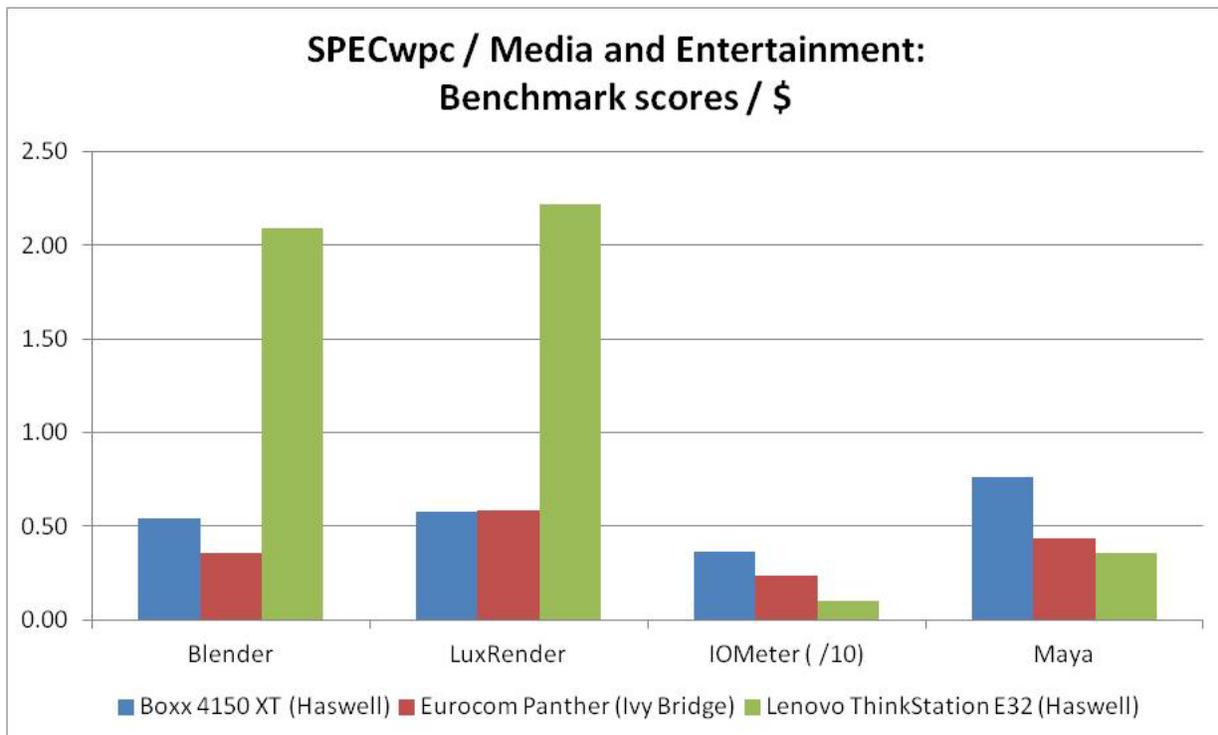
You'll notice that a few sub-tests do favor the Boxx CPU's four, super-fast, liquid-cooled cores over the Panther CPUs slower, more plentiful cores. That result is to be expected, as many workloads are either inherently single-threaded in nature, or the application has not yet been optimally threaded to take advantage of more cores (or in reality, both). (It's also worth noting that Boxx's Core i7 cores are Haswell generation, as well, which — *per core* — should hold a modest edge over Eurocom's Xeon E5- 2600 v2 "Ivy Bridge" generation.)

Of course, the Panther's edge in hardware components doesn't come free .. it's also the most expensive machine, by a wide margin. And guess what happens when we instead chart SPECwpc composite (and M&E sub-test) scores per dollar? Yup, the rankings are completely reversed — the Lenovo E32 wins by a wide margin, the Eurocom Panther lags by a wide margin, and the Boxx 4150 XT runs right down the middle.



(Source: Jon Peddie Research)

Figure 25 SPECwpc composite scores / \$

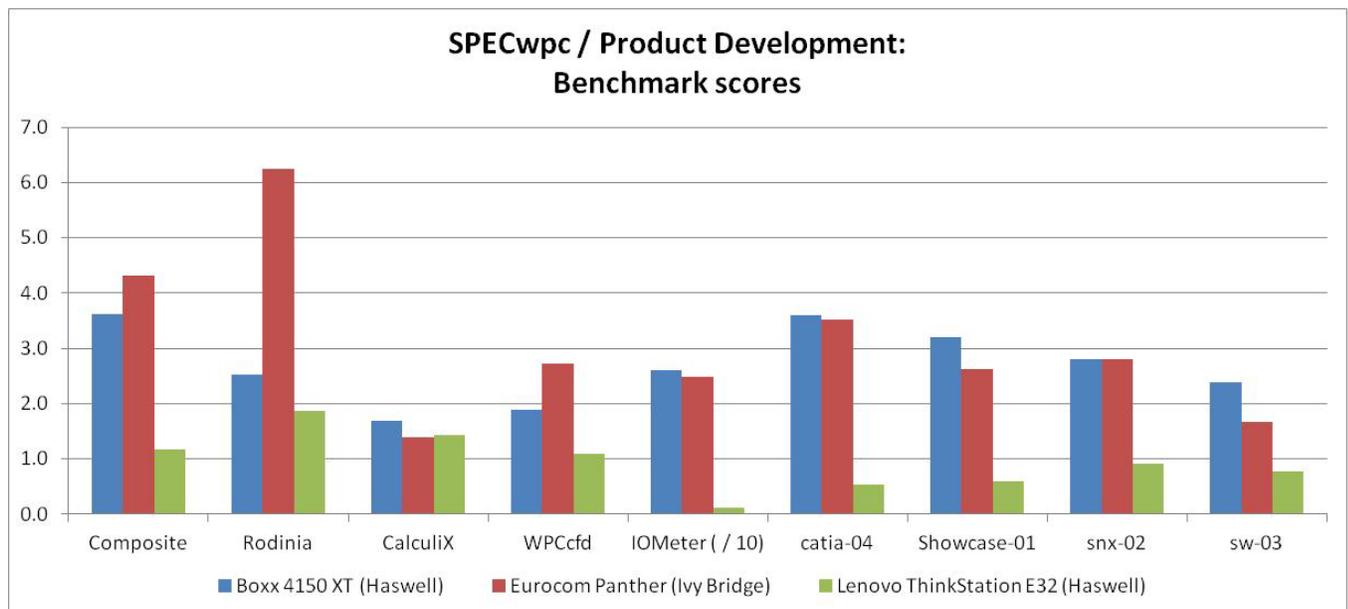


(Source: Jon Peddie Research)

Figure 26 SPECwpc Media and Entertainment sub-scores / \$

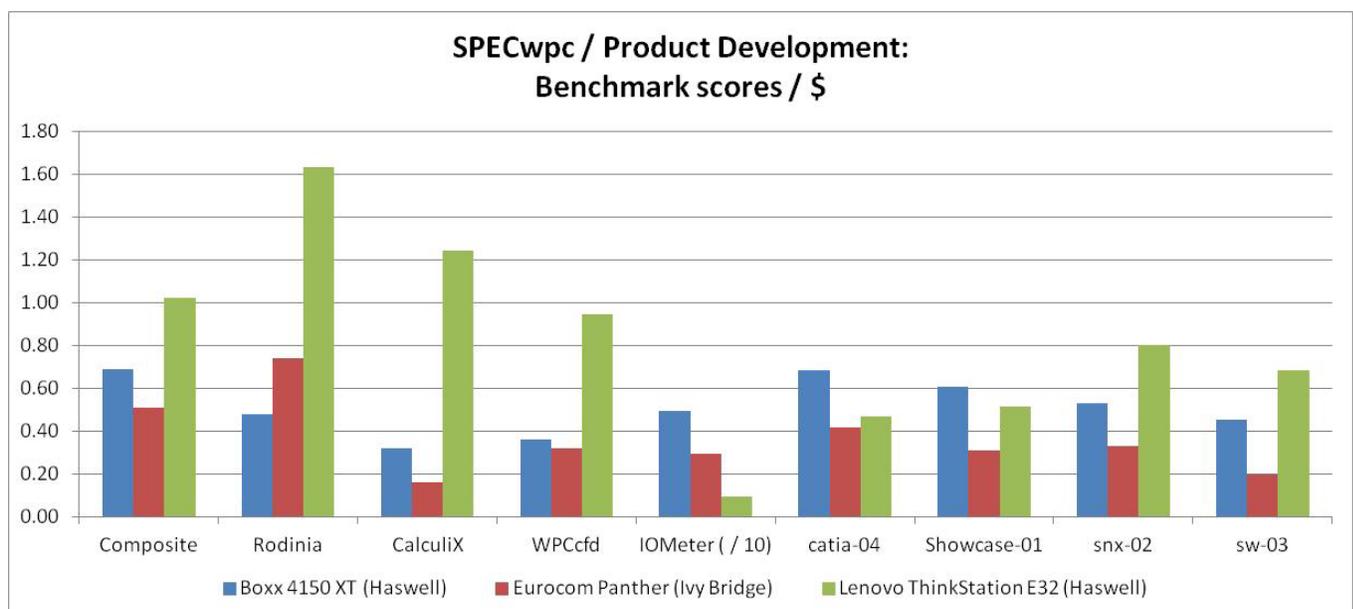
For completeness (and to introduce SPECwpc further), we include the rest of the sub-test results as follows, both raw scores and scores / \$. Though the degree varies by application space and sub-test, the results track the overall composites, with the Panther leading in most raw scores, while the E32 leads in price/performance.

There's one notable exception, where the E32 is bested on both counts, by a huge margin in raw score and by a narrower edge in scores / \$. That's I/O, and for a good reason. The Boxx and Eurocom machines come configured with SSD, rather than the mainstream HDD in the E32.



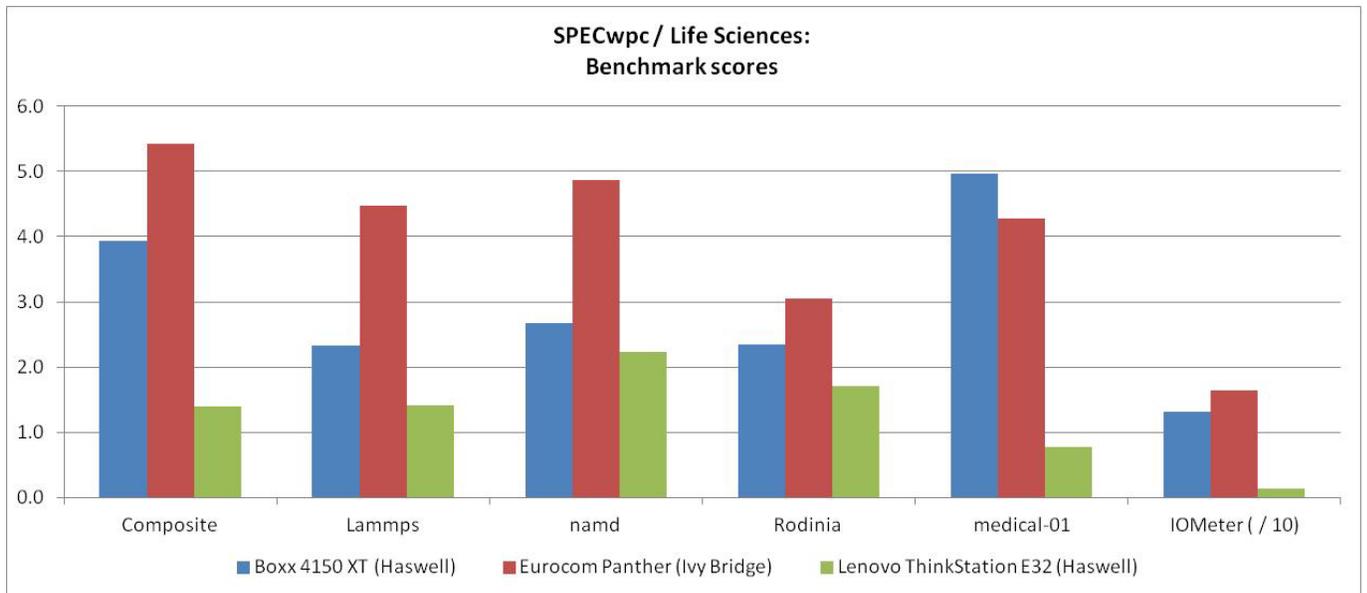
(Source: Jon Peddie Research)

Figure 27 SPECwpc Product Development sub-scores



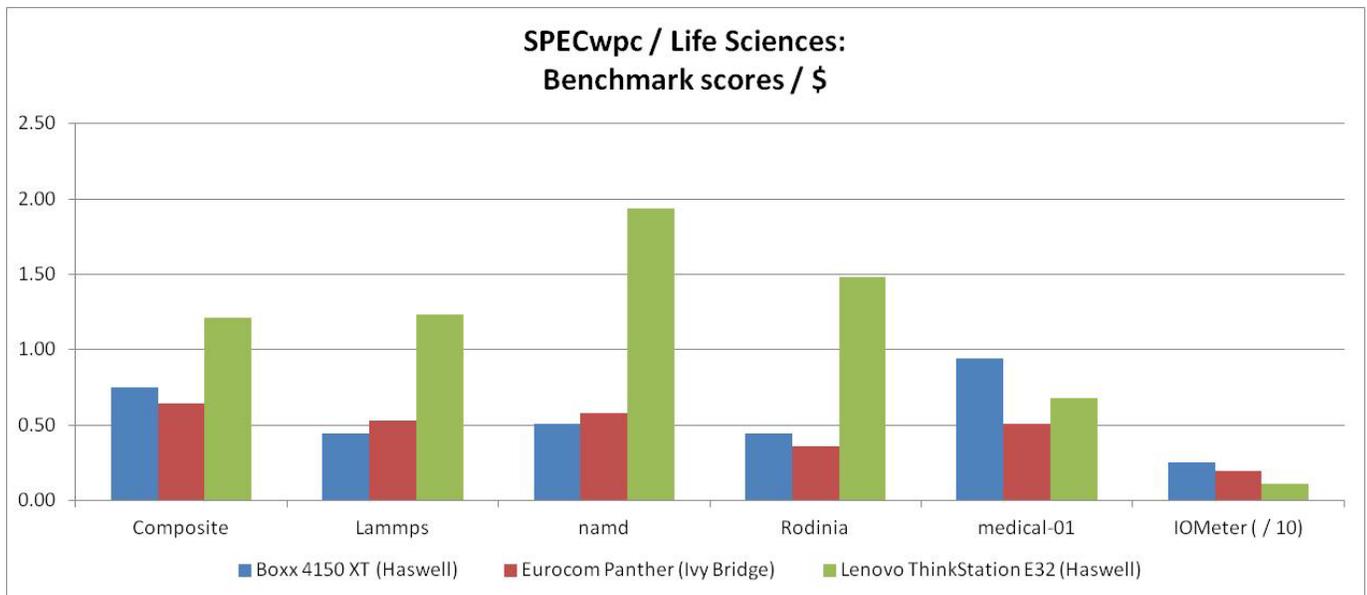
(Source: Jon Peddie Research)

Figure 28 SPECwpc Product Development sub-scores / \$



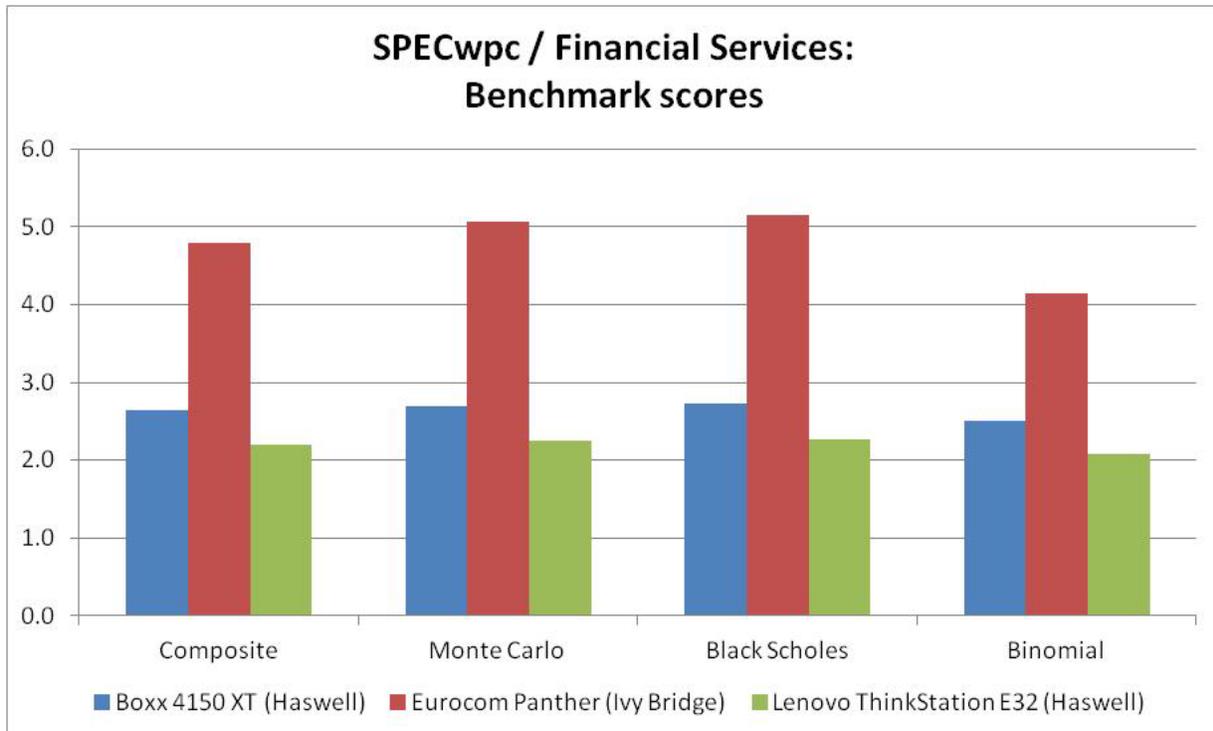
(Source: Jon Peddie Research)

Figure 29 SPECwpc Life Sciences sub-scores



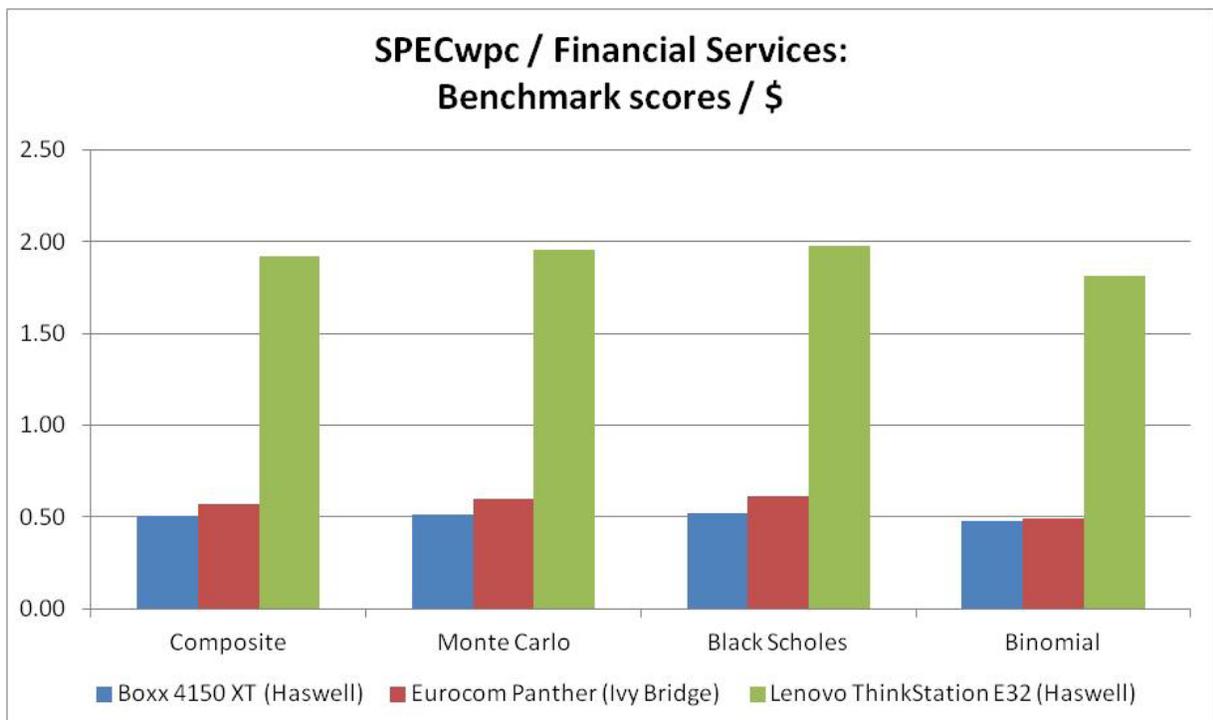
(Source: Jon Peddie Research)

Figure 30 SPECwpc Life Sciences sub-scores / \$



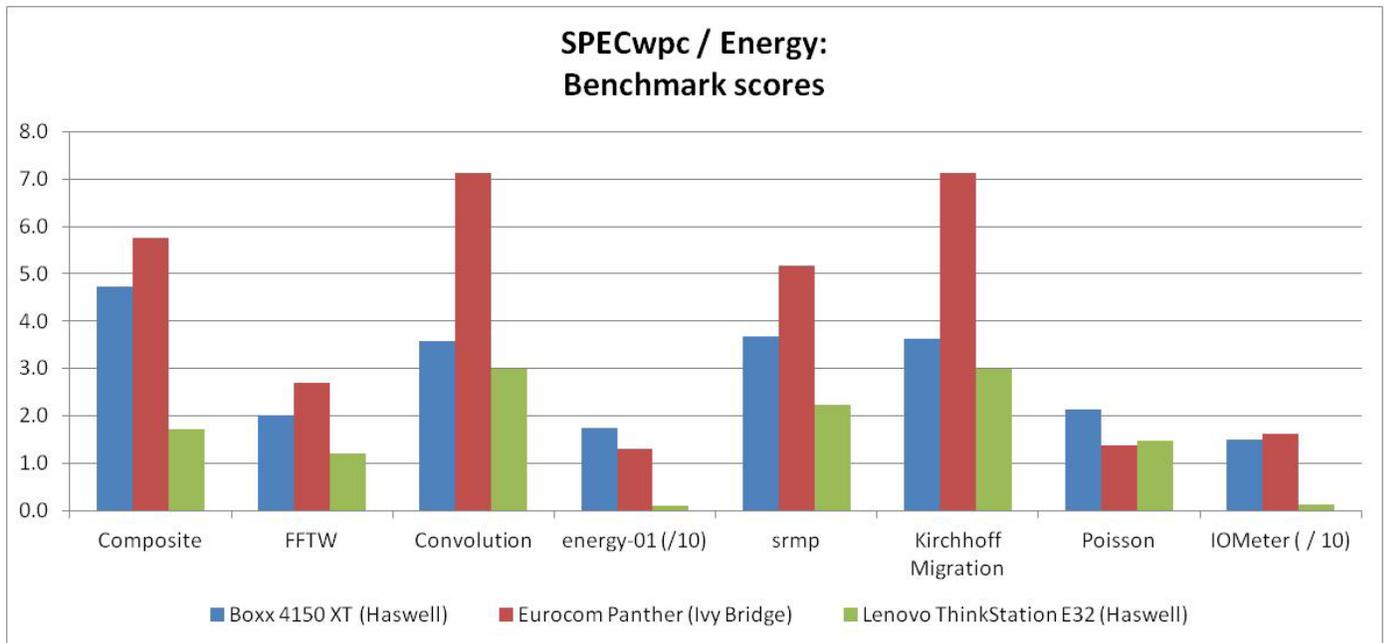
(Source: Jon Peddie Research)

Figure 31 SPECwpc Financial Services sub-scores



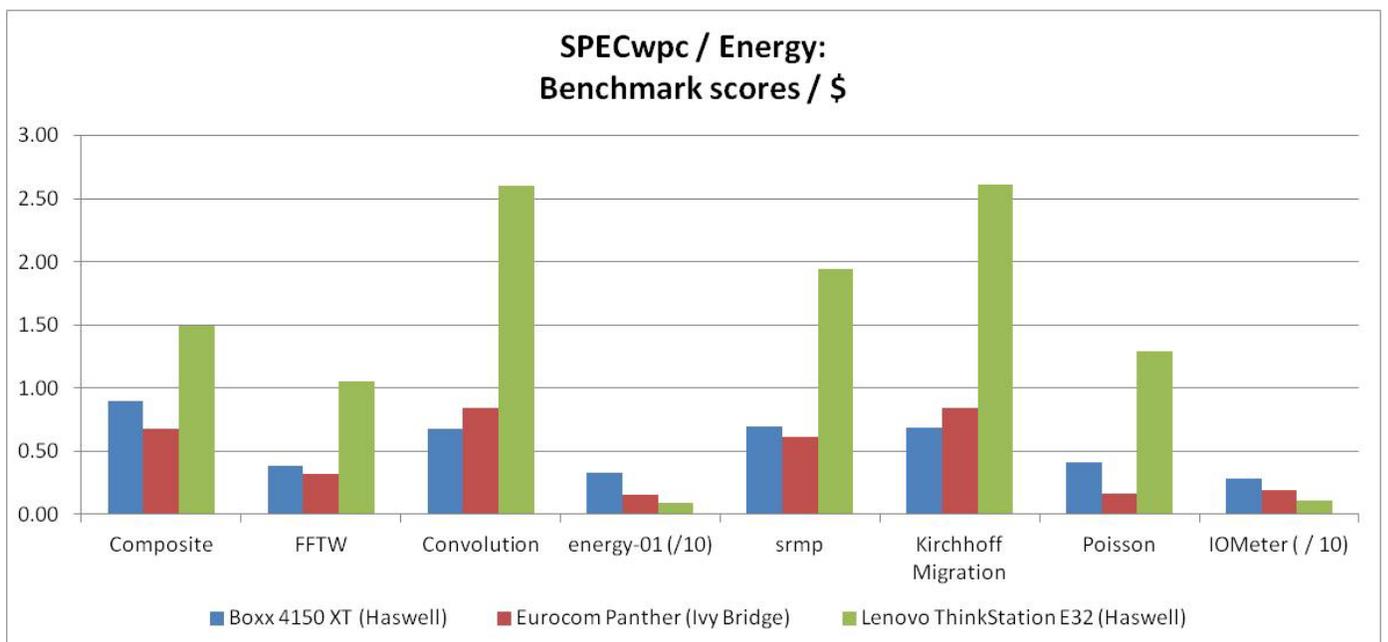
(Source: Jon Peddie Research)

Figure 32 SPECwpc Financial Services sub-scores / \$



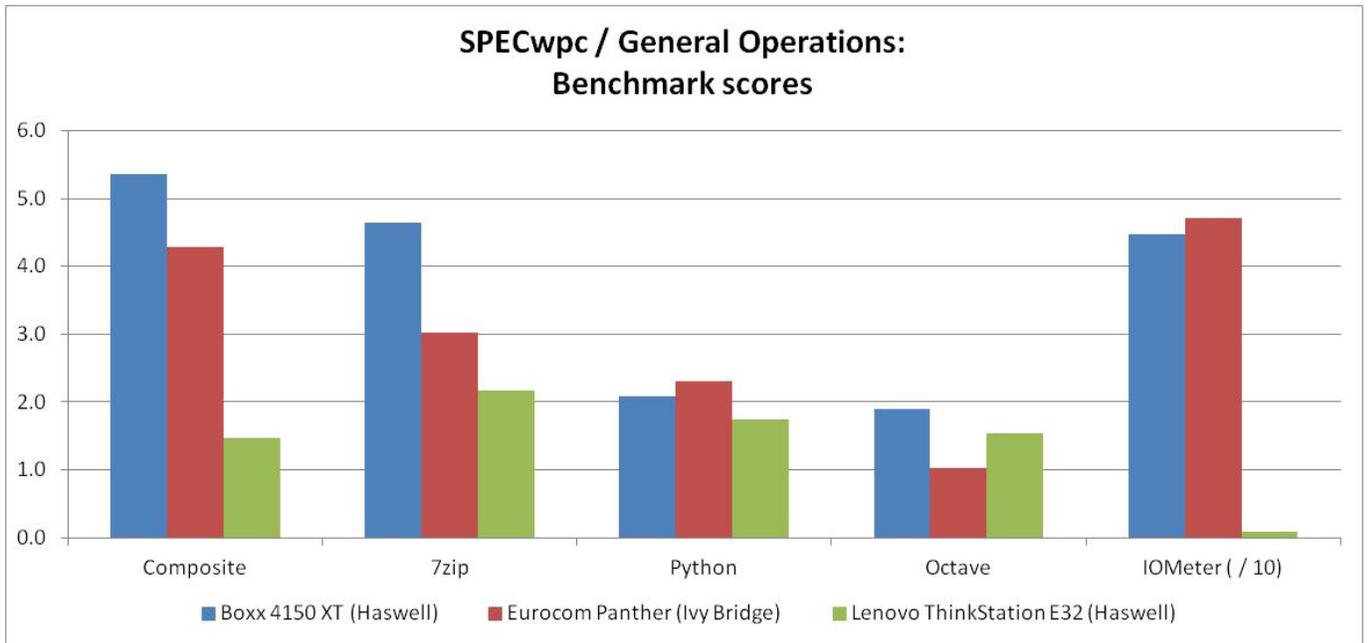
(Source: Jon Peddie Research)

Figure 33 SPECwpc Energy sub-scores



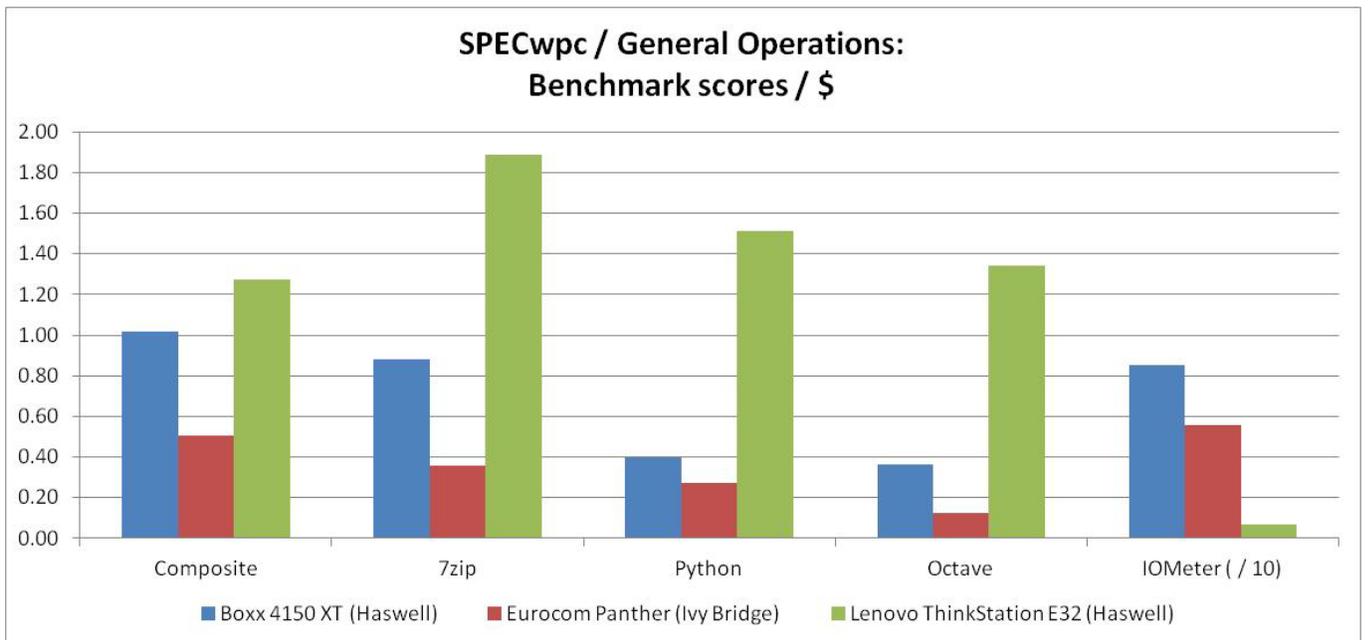
(Source: Jon Peddie Research)

Figure 34 SPECwpc Energy sub-scores / \$



(Source: Jon Peddie Research)

Figure 35 SPECwpc General Operation sub-scores



(Source: Jon Peddie Research)

Figure 36 SPECwpc General Operation sub-scores

The verdict?

Reviewing and benchmarking three very different machines reaffirmed a few beliefs we have about this business. One, nobody out there is building junk. All three systems we reviewed are well-thought out, solid designs, given their respective design goals and constraints. And two, there is no free lunch — everything comes with a tradeoff.

The Lenovo E32 can't come close to the performance and capabilities of the 3DBoxx 4150 XT. But then, the 4150 XT can't come close to the E32's price tag. And it shouldn't. The bottom line is neither of the two machines competes with the other. If your needs and budget have you shopping the E32, you're probably not considering the 4150 XT, and vice-versa. Both represent compelling choices, but not for the same buyers.

Be the least expensive, or be the best ... it's advice we've repeated many times. Lead in price, or lead in performance and innovation. And try not to get caught in the middle: a little better but not the best, or a little cheaper but not the cheapest. Boxx can't compete with big-volume OEMs on price, so it wisely chooses to be measured on other grounds: performance, aesthetics, features, service and dedication to the special needs of the digital media industry.

With the 4150 XT, Boxx wins on those criteria, building another beast of a machine. Like the liquid-cooled Boxx workstations we've reviewed prior, the overclocked CPU is a draw for both CAD and M&E, where many applications and tasks don't scale all that well with core count ... this system wins on single-thread performance (though we would have liked to have the machine configured with 32 GB, in order to better assess sensitivity on these benchmarks to memory as well.)

For buyers looking for the absolute best price/performance, the 4150 XT is not the optimal choice. But for buyers looking for the best performance at a reasonable price, in a machine that's engineered and supported for reliability running the bread-and-butter applications for aggressive designers, it's going to be hard to find anything that fits the bill better.

The Lenovo ThinkStation E32 fits that criteria as well, though not on the latter count of performance, but instead on the former: economy. Now, Lenovo makes high performance workstations— we've tested them — but this isn't one of them. It's not supposed to be. What it is supposed to do is deliver workstation features (like ISV certification) in a package with a price that HP and Dell might match, but they'd be hard pressed to beat. So it can't match the other two in capability, but with that aggressive price-point, it will outsell both by a very wide margin.

And then there's the one-of-a-kind Eurocom Panther 5D. It's not competing with any other machine we know of, certainly no other conventional mobile workstations. The Panther is the least mobile of any other mobile workstation we've ever reviewed, but then it delivers more performance — by far — than any other, too. In fact, it delivers more performance than most any single-socket desktop we could ever hope to configure. When it comes to the Panther, you either value this machine's unique performance proposition, or you don't. If you do, you'll want the Panther, and no other machine will satisfy (at least, we can't think of one). If you don't, it will make no sense to consider. That reality isn't lost on Eurocom. On the contrary, it's exactly what the company is basing its business model on.

So there you have it ... three workstation vendors who know what they're doing, but each going after a specific segment with a carefully-crafted design that will be both compelling to its target market and aligning with the vendor's business strategy. And in that sense, these apples and oranges share *the* most important thing in common.