Breaking News:
The PLASA-ESTA merger

Concerts:
Styx/REO Speedwagon

Special Events:
The Eiffel Tower turns 120

U2
“The tour lays down a gauntlet for the industry”

ALSO:
Zero 88’s ORB
Wireless Solution Sweden
Rusty Brutsché’s career of innovations
QLab in Central Park
NO LINE ON THE HORIZON

Is U2's 360° the most ambitious tour ever?

By: Steve Moles

THE U2 360° TOUR LAYS DOWN A GAUNTLET FOR THE INDUSTRY. THIS SHOW, JUST THREE GIGS IN WHEN I ARRIVE TO SEE IT IN PARIS, DISPLAYS ABSOLUTE MATUREITY OF DESIGN, THOUGHT THROUGH IN EVERY DETAIL. THIS ISN'T JUST TRUE OF THE MAJOR DISCIPLINES—SOUND, LIGHT, VIDEO, AND STAGING—BUT ALSO OF THE LESS GLAMOROUS DETAILS—BARRIERS, DECKING, AND POWER.

To view this show is to be overwhelmed. There can be hardly a member of the audience who hasn’t seen the structure beforehand somewhere on the Internet, yet the first sight of what Bono calls “our Space Station” still takes your breath away.

I had thought to compare the show’s grandeur to an Olympic opening ceremony, but that’s unrealistic: This is an entirely different context. Frankly, we’ve never seen anything like it. It is a towering achievement for the band, Willie Williams (show designer/director), Mark Fisher (production architect/designer), Frederic Ospomar (video screen concept), Jake Berry (production director), and every single contractor involved. All are to be congratulated.

Consider the scale of the achievement. The four legs of the “Space Station” or “Claw” structure spans an area roughly one-third of a soccer pitch; they support over 160 tons of equipment. There are three of these structures, leapfrogging from venue to venue. As of the Paris gig, it takes 42 hours to load in. That will shorten as the tour goes on, but at this early stage, it is tough as hell.

The LED screen you see hung within is—in true U2 fashion—an entirely new development, matching a totally flexible pixel system to a transformable structure. Jaw-dropping to view in motion, staggering in its engineering complexity, it is the perfect counterweight to the Claw’s massive presence. The stage below, ringed like Saturn, is dwarfed by comparison, yet is larger than any stage set ever toured by a rock band.

The PA—effectively two stadium systems—breaks new ground by resolving a dilemma: How do you fly line arrays side by side without seriously compromising the sound field? The lighting rig features just one type of moving light: it is physically never closer than 98’ from its target zone on the main stage, yet it embraces every corner of the stadium. All of these elements conspire to produce a show that engages every audience member directly, no
These detail shots show the set’s meticulous engineering.

matter how remote. That’s the 360 ethos; there is not a bad seat in the house. Frankly, the nosebleeds are, in many ways, the best place to be to view the show’s full majesty.

“The goal of playing in the round was a brief from the band,” says Williams. “My primary goal for this tour was to move U2 on from the big video backdrop, which they pioneered from Zoo TV/Pop-Mart onwards, and which has now become the biggest cliché in live performance today. The trouble is, having thrown away the most powerful tool you have, what do you replace it with? A painted backdrop? Hardly. When I thought about the backdrop being a grandstand of full of excited punters, it started to feel like this might be a way forward.”

A few details: The Claw, built by Stagecoo, forms a 28m (92') high canopy over one of the largest stages ever toured. Pivotal to the Claw is a central spire, or pylon, which is 164' high and loaded with 34 PRG Bad Boy moving lights and two 600m mirrorballs. The pylon was developed and fabricated by Brilliant Stages; it has a diameter at its center of 7.8', tapering toward each end, and is composed of nineteen 7.8' high sections, constructed of aluminum, with high tensile steel connections between each. Each section has six 5cm diameter cords welded at each end to a 10mm profiled aluminum plate, which form the roof and the floor of each section. Within each section is an access ladder to the sections above and below, with DWE lighting battens integrated into the structural element.

The stage set, built by Tait Towers, consists of two elliptical shapes: a solid central disk—the main stage—within an outer ring, which is the B stage. The main stage has an upstage tongue that affords the band access from the backstage area. The tongue also houses the subterranean monitor world; it also transects the B stage, which is generally accessed by the band during the show via two movable bridges. The bridges each span more than 40', are self-propelled, and have unique motion-control parameters.

The main stage is over 80' in diameter. It is weatherized, including extensive draining management systems to protect electronics, the back line crew, and other personnel below decks. Areas of the substage have been acoustically modified to the specifications of Clair Brothers, the audio supplier. Both stages feature integrated camera tracks that alleviate the need for space-consuming floor-track dollys; these tracks also manage cables for the cameras and have Tait-designed shock absorber mounting plates for the cameras. The central drum riser for Larry Mullen, located on the main stage, rotates.

The video screen makes use of FLX, a new transformable LED from Barco: it can be combined with a variety of specifically designed carriers, or mechanical structures, into any shape. Two pixel modules, both used in the show, are available. The FLX-24 is 24mm in diameter and contains one full-color LED; the FLX-60 is 60mm in diameter and contains a cluster of full-color LEDs. The FLX-24 is built into the transformable cone-shaped structure. It is a 360° display measuring 78.5' x 52.5', consisting of 92 separate parts, approximately 500,000 pixels. It can expand and move in all directions, while still offering full high-resolution video images. As the screen expands down, it becomes transparent.
Mark Fisher: the architect

The structure permeates every conversation you have with this production team, and every story embellishes the previous one, so I am extremely grateful to Mark Fisher, of the firm Stufish, for presenting the most coherent and sober assessment of its evolution.

"The Space Station has its basic story in New Zealand," says Fisher. "We were at the end of the U2 [Vertigo tour] in 2005 and Willie Williams had the inspiration: We had played arenas in the round during the tour, and the question was how to do it in stadiums. Willie's insight was to make the structure much bigger, so the audience was inside it. As an example, he presented us with a picture of the [Encounter Restaurant] at LAX. He showed it to Hedwig [de Meyer, of Stageco] and Jake Berry, the product.“hips” are, where the arch tops off, you get huge forces to resolve," explains Fisher.

Fisher worked backwards from the practical considerations of touring to determine the critical engineering of the structure: "We knew to sketch the trusses to one-half the size of what will go in [i.e., a 45' sea container]. Then we chose a tube size that would work. The truss also had to be big enough to walk in and store equipment; more than 50% of the truss floor is used.

"That West Coast Modernism was part of Willie's early vision, so it was fixed from the outset that it would be smooth-skinned," continues Fisher. "At first, it was conceived as a hard skin, though it was in the back of my mind to do it tensile; besides, hard covers just took up too much space for transport."

You have to consider it like a journey, where your job is to make sure all the travelers are comfortable. We ended up with something that is not a copy."

It's not uncommon for clients [also known as fickle rock stars] on evolving projects such as this to backtrack; U2's willingness to progress allowed enough time to solve the logistical and engineering challenges ahead. Based on many of the following conversations, it's all too apparent that, had they blinked, we would not be seeing this today.

Fisher continues: "Next came video. Initially, the idea was to project upon the audience, maybe 48 large-format projectors. That came from what Willie had done so beautifully on the Elevation tour. Apropos of nothing, I sketched the video screens used indoors for Vertigo; you may recall the MSpheres invented [by

The above shots show how the design functions as a total environment.

Fisher's elegant solution for the skin was the "Polyps," a series of orange domes that push out from the surface, providing a tensioning force to the skin in all directions; however, the unbroken smooth surface is lost.

"Presenting the idea to the band did distance us from the original idea," he says. A potentially contentious moment, I venture? "I wasn't nervous.

Barco for that tour? I sketched a cube of those video balls above the stage; Adrian Mudd, who does all the animation at Stufish, said immediately, 'That isn't going to work, because you'll never know it's 3-D.' He was right—we all went to Fred Opsomer's warehouse to look at a mock-up, and it didn't. Opsomer is a blue-sky thinker in the video world; more about
him later.] So next, I sketched 2-D roll-up screens under the legs.”

In view of what’s hanging above stage now, a 2-D solution sounds like a poor substitute: fortunately, Fisher was busy with two other projects that influenced him heavily. “One, I was working in China with Fred Opsomer to do the floor of the Birds Nest,” the stadium for the Beijing Olympics opening ceremony. “Secondly, I was working on expanding/contracting screens for a building in Las Vegas for Steve Wynn. Chuck Hoberman was involved. [Hoberman, of the firm Hoberman Associates, specializes in transformational structures.] So, over a few beers in a bar in China, I mentioned Hoberman to Fred.”

From this came the expanding, inverted, cone-shaped screen. “Chuck made a proposal to Fred, I did the cone, and things then fell into place fairly quickly. By March 2008, we had the CAD renderings, and the dimensions of those original CAD models are pretty much within a meter of what we have now. This was fed out to Stageco; trucking estimates were made—that’s when we did the tensile cladding—and by the end of April/early May 2008, we had the complete proposal in place. Then the band went on holiday and it wasn’t until the first of September that Willie got acceptance.”

Richard Hartman: the practical engineer

“The screen is the project of Innovative Design, Frederic Opsomer’s company, but there were many other people involved, myself included. There are 477,000 pixels individually placed,” says Hartman, who is charged with video screen technical management. Each pixel is mounted in groups to a tile; either triangular or square, multiples of these two tile shapes form the slightly flattened hexagons that make the screen. These, in turn, mount to a lattice of pantographs that expand to form the inverted core basket shape you see in various stages in the photos. Compressed, the screen is 7m (23’) deep; extended, it is 22m (72’).

“Hoberman Associates in New York has built a reputation for conceiving transformable structures,” says Hartman. “They conceived the iris device you will have seen used for the Winter Olympics in Utah 2002. The engineering on the scissors/pantographs was verified by [the engineering consultancy] Euro Happold; it’s a very complex structure mechanically, as I’ll explain. But to continue the history, the pixels are Frederic’s design; he developed them for Barco. They differ from other products in that the circuit boards live separately from the pixel cluster.

“We have already experienced a problem with weather in Milan, but not too serious,” adds Hartman. The second show of the tour, Milan, was when we switched off overnight, the wind was strong enough to push the flaps. This, in turn, led to six racks flooding. However, we stripped them out, dried them off, and, to our amazement, the whole lot worked again, so no damage done.”

Screen load-in and assembly

Since rehearsals drew to a close in Barcelona, rumors have been circulating in the industry that the screen is the biggest, slowest problem for load-in. Look at it closely and immediately the difficulties are apparent. It’s not just an inverted cone with the tip cut off; it’s also an ellipse in plan view, mimicking the shape of the stage rather than a simple circle. As a 3-D structure, that’s complex enough—add the ability to expand, and a number of conflicting forces begin to weigh upon it.

“Hoberman Associates has enabled a magical, transformational structure, but the screen’s real magic lies in its application. Especially when expanded, images pass like ciphers through your field of vision; at times, they can appear to be free-floating, transported upon the rays of light emanating from within the cone. It’s as close as you can get to hallucinating without pharmaceuticals.”

“The screen modules weigh about 400kg [880lbs] each,” Hartman says. “They cannot be manhandled. We examined two routes to mounting them: a modified powered pallet truck or a counterbalanced machine-handling device, the sort of thing you see in automobile factories for assembly line workers to precisely manage heavy-parts placements. I would have gone for the latter, because it gives the human direct control; it’s natural and intuitive. With a forklift, you have to shift the load
right a bit, up a bit, tilt a bit, out a bit, down a bit; just to locate the screen module in what would be, for a hand-manipulated motion, one single, fluid movement. But U2 has employed powered pallet trucks on tour before, so they’re a known quantity. The trucks are Italian; we had them modified in Belgium. The trucks perform all the motions described above and have side shift.

“There are 24 columns of scissor mechanisms, with 19 modules in each column [five, five, five, and four in A, B, C, and D tiers respectively]. To assemble, we first hang the center front and back panels, then four pallet trucks work outward in each direction from them.”

It’s tricky: No two panels are the same, and the scissor arms are different lengths. It locks together with pin pins: Hartman introduced a small, hand-operated pin extractor to shave seconds off the load-out regime. “We’re getting faster—it’s a matter of learning to drive the pallet trucks—and the guys are getting better already,” he says. Nine hours is assembly time; Hartman expects it to reduce to at least eight before long.

“Frederic got in touch with Hoberman after Mark Fisher suggested him,” says Hartman. “Innovative Design drew it up and applied the roadworthy aspects to the electronics. It’s 52 tons in total, including the drive racks above and the custom truss from which it hangs.”

The whole assembly—trusses, rigging, and screen—is entirely self-contained, hanging from wire winches, so the complete screen, in whatever state of extension or contraction, can be lowered or raised. “There are 40 chain hoists [Kinesys Evo—a mix of one- and two-ton units] powering the extension movement, eight large drum winches for raising and lowering the whole structure,” says Hartman. “The structure is tiered; four layers with A at the top, D the lower section. For various complex reasons, the C tier hangs from one-ton motors. One critical area involves contracting the scissor joints; it’s vital that one tier doesn’t rise quicker than any other and take on the load of the tier above.

“The two-tons are in sets of eight per tier; the one-tones hang in intermediate positions, 16 of them. The algorithms to shift this thing are complex, to say the least. We also have protection codes in the Kinesys [K2-3D software] to prevent the overload potential. The drum winches are, of course, also on load sensors: the inner four winches—those physically closest across the narrow sides of the ellipse—carry more than the outer ones. If you look to the top of the screen, you’ll see it’s actually saddle-shaped in the horizontal plane; again, that’s for reasons of movement. The fact that it extends makes that top edge shape advantageous.

“In the short time we’ve been using it, we’ve been able to relax some of the sensing limits. It was always envisaged there’d be some adjustment, so we started with extreme limitation and, as we learn how it behaves, we’re able to adjust the tolerances on moves.”

Raffaele “Raff” Buono, who controls it, is sanguine about the complexity of the beast: “The Kinesys K2 is just following a chart” of plotted coordinates that have already been calculated. Hoberman provided a spreadsheet to import directly to K2. “It works fine, though, like everyone else when we first encountered it in fast, rigid at the Sportpaleis in Antwerp, it looked scary.”

It also makes a pretty appalling noise when you shift it, but who
The important thing is that K2 provides millimeter-accuracy, and Kinesys developed sophisticated algorithms to keep the real-world hoist control matched to Hoberman's calculated chart.

"Then there are alignment cones and hub stabilizers on the scissors," continues Hartman. "I'm not going to go into the full description, but think of those joke-extending devices with a boxing glove on the end, so beloved of cartoonists: The multiple scissors joints facilitate extension, but, laterally, they are inherently weak, extended with the scissors flat in the vertical plane. That's no problem but, with the scissors flat to horizontal, the tip will droop. The cone shape of the screen tends to bow out or in, for the same reason. These are difficult forces to imagine. Fully extend the screen, place an indestructible balloon inside the cone and inflate; the sides of the cone would bow out. Now, think about the electronic circuit boards and the tile-mounted pixels beyond them that have to live upon the surface of this unstable mechanism.

We allowed 2mm of clearance between the electronics and the mechanics," adds Hartman, nonchalantly. "Yes, and there are little tiny wires in there between the electronics and pixels. Oh, and of course the tiles have to remain horizontally aligned throughout expansion and contraction. Who'd want to solve these problems? That's what Hoberman and Innovative Design have achieved.

**Nick Barton: The lighting crew chief**

Lights are mounted all over the Space Station, and most of the control electronics are sited in the Stageco main trusses above: it's not quite your normal stadium rig, is it? "It's been well-thought-out," says Nick Barton. "There are two lifts to take stuff up into the octagon that forms the structural hub of the beast. We have dimmers and distro up there. Yes, dimmers—the spine is full of DWEs and there are lots of bulkhead lights. Everything has to go up in order; there's no space up there to swap stuff around.

"Putting the eight [Zap Technologies] BigLites on the roof is one of the most time-consuming jobs; here we had a 40m [131'] jib crane, which meant moving it five times to get the lights up there. With a 52m [170'] jib, you can do it from two positions. It took [the moving light tech] Blaine Dracup five hours in total."

"Andy Beller looks after the spine [also known as the Pylon]. It's assembled top down, and hoisted up into position. In fact, it climbs itself, getting re-rigged as it passes the upper limits of the station so that a good 65.5' protrudes above it. That goes on while the screen is constructed around it, so you can imagine the restrictions it places on everything; Andy has smoke machines, Bad Boys, bulkhead lights, DWEs, bloody big ripple lights built by Specials, sodium floods, and a bunch of [Martin] Atomic strobes to fit in and on it."

(The tour's rigging vendor is Five Points Production Services, using gear supplied by Show Distribution.)

This Pylon lighting system is architectural in function; it's the sheer horsepower of the Bad Boys, DWEs and the 6kW MSR Ripple Lights, developed specifically for Williams by the Birmingham, England-based lighting-solutions firm Specials, that make it work. A huge, decorative indulgence, it's one of the elements that make 360° such a great show for every seat in the house.

Barton continues: "Alex Murphy calls the spots and runs all the deck LED clusters. The latter consist of 1,200 Barco FLX-60 pixel modules fitted along the edges of the stages. The Polyps were made by Bristol, England-based Steel Monkey Engineering; the U2bes (pronounced "you tube"). color-changing LEDS in the Polyps, were developed in the U.S. by New York-based 1212 Studio. These are also run by Murphy. "There are LEDs in everything—all over the decks, the bridges, even in the handrails of the bridges," says Barton. "Andy uses a PRG Mbox EXtreme media server to run the LEDs." (LEDs are everywhere; the Belgian company ShowTex provided a flame-retardant gray Polystretch P5 fabric for 55 LED covers for a seating area in the VIP section.)

A redundant MediaION show control system, Manager V5, is behind the stage in charge of the control of the video playback. It is
Ethan Weber: the lighting director/Alex Murphy: followspots

Ethan Weber runs the show for Williams: “I worked with Willie on the band’s 3D video, and we got on, so here I am,” he says. He has two grandMA full size consoles, while Murphy has two grandMA Lites for the LEDs. “I’m now down to 21 followspots,” Murphy says. The spots are a mix of Strong Gladiators in the house and Lycians hung beneath the Space Station’s legs. They did number 25 in all, but the tally proved unnecessary and was reduced. “Willy and video cannot stand hard edges,” continues Murphy. “All the spots are used as key light, very tight. The Gladiators have sighting devices, because they’re so remote.”

Followspots are used sparingly, but very effectively; it’s a relief to see that Bono isn’t—photographically speaking—six stops hotter than the stage around him, and the stylized video images look gritty, super-real, and great because of it.

Murphy adds: “We’re always trying for head and shoulders: With three Lycians in each leg of the structure, I can always call spots opposite the camera position, but we do have to be careful of flare-out if it spills into the lens.” Remember that the band is moving around 360° and you’ll immediately recognize this is more a ballet of moving objects than mere spot calling. Murphy and Tom Krueger, the video director, skilfully move their respective operators into the line of action while simultaneously tracking the band members. It’s a tour de force of technical choreography.

As with all aspects of this show, the PRG-supplied lighting rig is unique, if only for the Bad Boys. These large-format moving lights, launched at PLASA06, are the only moving heads on stage—196 of them. A breathtaking decision by Williams, it was not taken without careful consideration: “We managed to stage a field test at Wembley Stadium during the PLASA Show,” explains Robin Wain, PRG’s client manager. “Willy saw enough to order them then, 240 initially, later reduced to 196; manufacturing really pulled out the stops to get these made in time.”

Williams adds, “It happened largely because it was an appropriate product, which came along exactly at the right time. It’s usually sensible not to put all your eggs in the basket of a new-generation first product, so I did the research and came out convinced that this unit stood as good a chance of winning as you’re ever likely to have.

“The brightness was the main appeal, providing the chance that it might be bright enough not only to wash a stadium but to create readable gobos textures onto a stadium audience. I also liked the fact that it is a very specific fixture. It was created with an application in mind, and all the elements of the fixture work toward that—i.e., large-scale events, probably outdoors. It isn’t overrun with extraneous features or fiddly bits that might need additional maintenance. It’s a 21st-century VL2/icon, without ideas above its station.”

Those units located furthest from the stage receive wireless DMX signals via City Theatrical’s new SHoW DMX system; PRG deployed four Show DMX transmitters in rack-mount panels and eight Show DMX receivers in outdoor-rated enclosures. The transmitters are fitted with standard 5dBi omnidirectional antennas; the receivers utilize 8dBi directional panel antennas. The omnidirectional antennas allow the wireless signal to be transmitted to any location around the stadium, the directional units allow the receivers to listen to the transmitters in a specific location. With the number of fixtures in use and the large channel count, multiple universes of Show DMX were necessary; there was concern about possible wireless interference and congestions, but the Show DMX’s built-in user configuration solved this problem. Technicians on site can monitor the wireless spectrum, and, if required, make adjustments to the

www.lightingandsoundamerica.com • October 2009 • 51
spectrum usage of Show DMX, so all wireless systems in the stadium can work together harmoniously.

The Bad Boys perform a remarkable service. "Even at the kind of ranges we’re shooting—the closest lamps are around 80’ away—we can still narrow the beam down on the band to pinpoint sharpness," says Weber. "I don’t know any other lamp that can do that." Does anyone?

FredERIC Opsomer: the video screen developer

"When Willie first showed me a sketch of the Claw," says Opsomer, "he asked me, What can we do with this?" I always had a dream about an expanding video screen, like on the screen of your PC, where you can grab the corner of a window, click and drag, and expand it to fill the screen. Sometime later, I was in a bar in China with Mark Fisher when he told me about Chuck Hoberman. I met with Hoberman and we agreed to set up a project."

Opsomer funded this development himself. "I was committed to developing a standard commercial product for Barco [the single plug-in FLX 24 pixel]," he says. "It’s intended for installed use on buildings or other large structures. Then Willie called, so we set about designing how this would work for U2. We looked at putting it around the legs, but finally settled on the center cone. Eventually, it came to a meeting between us all—Willie, Mark Fisher, myself, Hadwig, Jake. ‘Do we all believe this is possible?’ was the question.

“There were two factors: time and money. It was March ‘08; we got the go-ahead in September,” Opsomer adds. “We had a schedule and we delivered to it; the screen went into the Sportpaleis in May ‘09 for testing.

But was the U2 screen the sole impetus for the new Barco FLX LED pixel? “The way I see screens going, they will become more and more integrated into set pieces and structures,” says Opsomer. “If you look at the cost of a screen and the mechanics, it’s roughly between 80/20 and 70/30 cost split, with the higher costs being the electronics, so you have to recoup the development costs on the electronics somehow—and hence the commercial product.”

It should be emphasized that Opsomer’s Innovative Designs is directly connected to Barco in these commercial developments. “Every tour is a different sculpture, so you want a reusable pixel,” Opsomer says. “The pixels in these panels are 25mm apart approximately, but this pitch does vary, panel to panel.” Not as you’d notice, however: “Yes, the processor has to know where every pixel is; at the front end, Smasher [Stefaan “Smasher” Desmedt, the video technical director] uses a D3, a powerful computer that will install 3-D volumes in space.”

“Would I do anything different with hindsight?” asks Opsomer. “Technically, not really. Next, we will look at making the scissors in carbon fiber, but I had just two days to decide that one, and we already knew aluminum engineering and what was possible. There just wasn’t the time then to learn all about fiber.”

Watching it work, there is something surreal about this screen. Hoberman Associates has enabled a magical, transformational structure, but the screen’s real magic lies in its application. Especially when expanded, images pass like ciphers through your field of vision; at times, they can appear to be free-floating, transported upon the rays of light emanating from within the cone. It’s as close as you can get to hallucinating without pharmaceuticals.

“The screen on the 360° tour offers the opportunity to create a huge visual ‘object’ in the center of the performance area, which is a hybrid of physical staging, lighting, video content, and camera pictures,” says Williams. “Some of the time, it is hard to figure out exactly what you are looking at, as there are also LEDs on the inside surface of the screen, and lights contained within.”

Speaking of the video content, Williams says, “It has been my express goal to create a show which moves away from making a centerpiece of this now very clichéd form. The ‘statement’ pieces come from the band, usually from Bono, although the Aung San Suu Kyi protest, which pays tribute to the unjustly imprisoned Burmese politician, was Edge’s idea. There’s a new segue piece, which situates ‘Sunday Bloody Sunday’ firmly in Iran, the idea for which again
came from Bono. The [digital] clocks are mine and are just there to raise an abstract question. The idea may become more specific, or it may go away altogether. These days, I find myself much more interested in questions without answers, and, indeed, answers without questions.”

Joe O’Herlihy: that U2 sound

Any sound person worth his or her salt will immediately be struck by the photos showing the Clair Global PA in all its mighty glory—with arrays side by side. You’ll ask yourself, “Can that be right?” Well, it is, and it works. Clair has come up with a radical approach.

With 31 years as front-of-house mixer for U2, Joe O’Herlihy is, to our world, as famous as Bono, so he is the man to ask: What’s happening here? “Some of the main PA is there for a physical, visual reason, to look in scale with the whole thing,” he explains. The PA had to look big, as anything less would have appeared ridiculous. It’s a statement that underscores the fully integrated approach this show has received from all contractors.

I ask O’Herlihy how the switch into the 360° stadium format has altered his approach to getting the U2 signature sound. “It’s a huge functional departure, and it’s involved a year-and-a-half’s work of preparation, implementing design, maintaining the criteria,” he says. “This is done under an inclusive work ethic, in which design is integrated into every element; the goal is to not lose the sonic uniqueness that is a U2 show. When you look at the main system and its mirror pointing to the back, there are two line arrays, side by side. Everybody knows you can’t do that. So we came up with the idea of splitting the signal. My biggest fear was not getting the U2 power alley—the big volumes of sound the Clair S4 produces. That fantastic energy is a lot harder to achieve with line arrays.

“So the only program information going to the onstage line array is Bono’s vocals and The Edge; the outer array is bass and drums. When you do that, your SPL increases to somewhere between 3 and 6dB, in terms of power to the system. You get incredible clarity and definition. In the middle of last year, we put this system design into various stadium diagrams and EASE-modeled it, to check how it would function; we used the Stade de France and Wembly as starting blocks.”

The acoustic modeling was effective: the two small delay towers at the Paris show are there to fill the back pitch area and just the first few rows of the first tier; the main system carries the throw to the upper tiers and is not found wanting.

“Then there’s the inner ring, what I call the Turbo Club,” he says, referring to the audience sandwiched between main stage and outer ring. “There are BT218 [subs] under the main stage, with the FF2 [front fills] on top to pull the image down to crowd level. Then there’s the B stage ring, with 72 paired S4 subs below it; that’s just to get sub energy onto the stadium floor.” (By “paired,” O’Herlihy means arrayed in pairs for cardioid propagation; see Joe Revitch’s discussion of this below.)

Subs in three positions—flown above, under the main stage, and in the outer ring: In terms of horsepower, it’s immense, and the potential for enormous peaks and troughs is equally huge. The complexity of time-alignment, to steer and manage the low end, is easy to imagine, but, again, it’s an essential job that takes time to get right—a commodity in short supply on this tour.

“We took the system into the Toronto Skydome for a complete simulation to figure out how it would work, particularly to figure out a method that would stop the B stage sub ring emissions travelling all over the stage,” says O’Herlihy. “Historically, we’ve always had problems with sub energy—particularly around 160Hz—being transmitted through the stage. We looked at treating the stage acoustically; we had Tait Towers install a hard face panel between each BT218. There’s also what you might call a floating floor in the sub-deck beneath the stage proper; both have acoustic treatment—and there are bass traps under the stage as well. It’s now a lot nicer for the 15 people working below.”

On the Vertigo Tour, O’Herlihy had a pair of DiGiCo D5s out front: now he’s moved up to the company’s new SD7 console. “With the matrices on board, I can manipulate audio destinations in any shape or form I wish—and it’s a cleaner, more efficient delivery. Five years ago, I wouldn’t have been able to do this. In terms of what the SD7 can do, it’s not just a five-year advance in
You might carry 120,000lbs of equipment for a major show; we’ve got four times that. That’s the commitment to 360, and it takes 360% from everyone to make it work.” —Berry

Joe Ravitch: the Clair Global crew chief
I ask Joe Ravitch, O’Herlihy’s long-serving Clair Global crew chief, front-of-house baby-sitter, and system tech, to expand on the split feed PA, and how the system works in practice. “At rehearsals in Barcelona, we SMAARTed every inch of Camp Nou [the stadium where the show played],” he says. “What we have is like four arena systems combined: of the structure. I never thought that was going to happen; the speaker cabinets alone weigh too much. So when they said, ‘Oh, we’re 28,000lbs overweight,’ we put the amps down at the bottom of each leg, four carts for each leg. The amp racks all live and travel within 8’ x 4’ carts. ‘It’s all digitally driven over AES; there is also an analog back-up. There are two Digico stage racks—one takes 40 inputs and seven AES outs, the other 40 ins and seven analog outs—so each structure leg has multiple feeds, and just two fiber lines to FOH, dual redundancy as you’d expect.

Under the stage are BT218 subs, stood on end with an FF2 for front-fill on top of each, as Joe [Herlihy] said. The B stage outer ring has a cardioid arrangement of S4 subs, paired inner to outer, below the deck, 4’ apart. Each pair is on 30’ centers to the next, the inside ring being 4.5ms-delayed and out of phase for the cardioid effect. They’re all driven by Powersoft K10s—everything else is off Lab.gruppen. The Labs are a mix of PLM10000Qs and PLM14000Q; both models have integral Lake processing, a feature to be especially valued with a complex system set-up like this.

And the two line-array trick? “The on-stage column takes Bono and Edge, the offstage column takes bass and drums, as do the flown [58] subs. It’s a trick that gives us tons of headroom and reduces distortion because, line to line, you’re not asking the speakers to do too many things at once.” To me, that added clarity has a natural sound, almost like being in a small club, hearing the band perform acoustically. The results are there for all to hear: Bono’s vocal is more distinct than I’ve ever heard, and the Edge can, at times, decapitate.

“Such a thing might be the first stage in the history of rock that is acoustically coupled to the sound system,” says Adam Davis, of Tait Towers. “Twenty four high-capacity bass cabinets on the front of border of the main stage are firing bass into the first ring of the audience, between the B stage and the main stage. The bass is radiating in both directions, in an ellipse, so there’s an epicenter to the bass. There’s 75,000W of bass, all hitting one point in space, which is enough power to make the space lift up and vibrate. Clair Brothers is next door to us. We knew this would be a problem, so we built a mockup of the stage, in the right proportions, for a test. There was so much bass that the whole building started vibrating. The neighbors were calling, because their dishes were falling out of kitchen cabinets.” As result of these tests, he says, “We developed a system of baffles between the bass cabinets. They radiate the energy forward, and, on the inside, they absorb whatever energy goes backwards. Basically, the front edge of the stage is a gigantic bass diaphragm.”

This configuration works, and it has implications for every audio rental company in the market. The tour may use a large amount of PA, but the delays are tiny, just there to lift the mids and highs to the lower seats at
the far end of the stadium, where the
the curve of the main stage arrays
preclude the coupling needed to reach
those seats. If the concept gains
traction, then we could all soon be
seeing paired line array PA systems as
a real benefit for managing audio at
stadium gigs. In arenas, it’s not so
certain, because of cost; the issue of
vertical coverage dictates lines of a
certain length. It’s typical to use 12-
14 cabinets. Hang two arrays of such
length each side of stage, and you’d
far exceed the power required for an
arena-sized room; apply the split
signal method, and the benefits of
clarity may become persuasive.

**Dave Skaff:**
**monitors and vibes**
There are three monitor men on this
tour, all ensconced below the tongue
that leads to the backstage area.
Previously, they were directly below
the main performance area, but the
relocation affords them more space to
work. The site is remote from the
band, but, as being onstage with
them is an impossibility, this is as
good as it gets.

Dave Skaff explains how it all
works and the division of labor: "Tait
weatherized the decking above, and
installed a drainage system that
keeps our area secure and dry," he
says. "The XL Video camera team
supplies the vital visual link to the
artists. We just take what we’re
given—the drums have a fixed
camera, but the other three feeds
from FOH are a little trickier." Each of
the three monitor consoles sports a
wide-screen video monitor with four
split-screen images.

"There’s a guy on the video crew
who tries to give us all the four band
members in shot; it’s not always
possible. Niall Sleven mixes for The
Edge. Alistair McMillan is mixing
Bono; both use a Digico SD7. I have a
Digidesign Profile for everything else—
drums, bass, and keyboards." Terry
Lawless, on keys, is below stage, just
downstage of Dallas Schoo, Edge's
guitar tech.

"Alistair makes a multi-track
recording; in fact, there are four
multi-tracks running—two from
Alistair, one as an archive, and I do
one for myself as a tool for work.
FOH does their own thing as well. It’s
difficult to have that library; for example,
do I need to use processing on that
new mic? It’s a question I can easily
answer. Monitor-wise, on hardwired,
I’ve got Larry, Terry Lawless on keys,
and the drum tech Sam O’Sullivan;
they’re all driven by Lab.gruppen,
limited of course. There are two feeds
to the drummer, the second for subs.
In total, we have around 60 pairs of
in-a-s, including all the back-ups,
technical feeds, and of course, below
stage—all Sennheiser G2 systems.
The vocal mics are all Shure wireless
Beta 58s. There’s also a song where
Bono sings through what looks like a
B52 hoop mounted hanging from a
wire that he swings on. The look’s important, but it would have been a disaster for a vocal mic, so we popped an SM98 capsule in there and it works great.”

**Camera tracks and cable management**

There are camera tracks affixed just below the deck on the outside edge of the main stage and B stage ring; the track also doubles for cable management for the cameras. The outside edge of the main stage also carries a comparable tracking device that carries the power and control for moving each of the two bridges. I speak to Jeremy Lloyd at Stufish, who worked closely with Mark Fisher on the production. “The camera track is an amazing piece of work on its own,” he says. “It’s very tight in there; in terms of geometry, it’s a very good use of space, and the clever part is just how quick and easy it is to install.”

I ask Matt Hales, Tait’s project manager for the stage set, to give me a guided tour. “It’s Harken track, a sailing product,” Hales says. “It looks like a tab track, but is designed to take bearing pressures in all three dimensions.”

The runners on the rib track have a ball-bearing race that fully encloses the rib, lubricating pressure from any direction, making them ideally smooth whatever load is placed upon them—in this instance, camera cables. The Harken is enclosed in an outer track, a linear cage frame raceway that provides the runway for the wheel dollies that carry the heavier loads of cameras and, elsewhere, the bridge electronics. Both the wheel race and rib track have carefully engineered joints that overlap in a way that prevents any pair of bearings or wheels from crossing a join at the same time as any other pair, further minimizing the possibility of jarring.

Mark Cruikshank operates Camera 4 on the B stage. “On a normal tour, my camera would be on a typical track and pipe dolly on the floor,” he says. “There is a positive advantage in having the Tait system along the edge of the stage; for one, it exactly follows the curve of the stage, which is a big plus when you’re following an artist. And it gains ground, because there’s nothing cluttering up the floor.”

That may seem an obvious statement but, with so much of the audience within the confines of the performance area, not having floor-laid camera track eliminates another security barrier issue and travel at variable speeds to keep the bridge in line.”

There’s just nothing simple about this show: What Tait has done to overcome this inconsistency is typical of the company’s ingenuity, in that it has made something very tricky look easy. “The off-stage end is friction-driven; a big drive wheel pushes it along the B Stage deck,” says Hales “Within the Harken, we’ve added a rack and pinion that simply drives an incremental encoder to provide positional information to the motion control system. The onstage

“The B stage alone has more deck sections than the whole of the stage for the last Rolling Stones tour. The main stage is over 4,000 sq. ft. It’s the biggest thing we’ve ever done, yet it looks small.” —Fairorth

...keeps the audience closer to the band and in a coherent mass. With dollies, much of the band’s hopes for an inclusive 360° audience would have been dashed.

Does the track eliminate camera shake? “Not entirely,” says Cruikshank; “there’s still a little shake, especially when the bridges are moving, but Tait has come up with a shock-mount suspension system for the camera—it’s a bit like a sleep comfort bed, pocket springing—and that dampens the shake a lot. We also have gyroscopic stabilization on the Televar cameras.”

**The bridges**

“The bridges are driven at both ends,” explains Hales. “The difficulty is that the main stage and B stage are both ellipses, but, for reasons of perspective, they’re not regular or parallel to one another; there are actually four different arcs. The bridges have to deal with expanding and contracting gaps between the two stages as they track around. The inner and outer bridge ends have to end has a drive unit that connects directly to another rack and pinion, the two drives then cross-reference one another as they progress around the perimeter, the outer speeding up or slowing down accordingly. If the bridge lags for any reason—catches a dislodged flight case from the tight storage areas below stage, for example—once it goes 20” out of square, it shuts down.”

And if you’re wondering about the expanding and contracting gap between stages, the bridges sit upon free-wheeling double casters—that’s a center-pivoted triangular plate, with three further center pivoted wheels, one at each corner below it, so the whole thing is free-floating.

**Stage assembly**

“In order: We build the B stage for the video crew, then the onstage end of main stage,” explains Hales. The main stage is a lollipop in plan view, an elliptical lolly with a stem, or tongue, which runs to the backstage. “That is where monitor world lives, so they can get set up as soon as it’s
built. Every part of this stage is on wheels; everything. In itself, this would be normal; every arena tour these days builds the stage out in the house while the rigging goes up, and then rolls into place later, but consider this statement from Tait's James “Winky” Fairorth: “The B stage alone has more deck sections than the whole of the stage for the last Rolling Stones tour. The main stage is over 4,000 sq. ft. It’s the biggest thing we’ve ever done, yet it looks small.” Look at any photo and you’ll gain some perspective, the main stage is just over 25m (82’) at its widest, yet looks tiny in this context.

“We zero the main stage off the Pylon, then we use a laser distance finder mounted to the monitor shelf, that surrounds the stage to fine-tune the position to known points off the main structure,” adds Hales.

At its most distant, it’s just over 43’ to the inner edge of the B stage. During the show, it’s not till you see Edge and Bono walk along them—and how long that takes—that you start to get some perspective on just how massive this thing is. As for the Pylon built by Brilliant Stages, it is an integrated, coherent object; everything about it—the way the Bad Boys, DWEs, and Ripple Lights fit, the Brilliant-designed rain hats for the Bad Boys—is of a piece. As such, it’s functional without compromise to its elegance.

Tom Krueger: the video director
The inclusion of a dedicated video director is a departure for Williams and U2, but a welcome one. “My goal is to make the band look as good as they can,” says Krueger. He takes a single-point key light approach, putting the band into sharp relief. “It’s challenging in 360; the wild-card elements are the band and where they go. Keying from one side allows me to shoot from the dark side.”

“Yes, it’s in high-contrast, but only in benefit to the artist—it’s much more dramatic. I love the way it highlights their movement. Bono’s gestures, and the way he moves, are a huge part of his performance; edge light brings emphasis. Doing the show in 360, I have to hand it to the band, they really go the extra 10 miles for the camera system, because they can’t physically be everywhere at once in 360.”

Krueger is relatively new to the job; he only recently met the band as director of photography for the film U2 3D. “For this, I have 13 cameras,” he says. “That’s a lot of operators and equipment,” I interject. “Jake Berry has been very helpful in realizing the camera system,” he notes. “It’s a lot more demanding in terms of quantity and quality, these rail cameras by Tait are very sophisticated, and I do see the different in the image. Most vulnerable is the center stage camera on B; it has a longer lens and has to move more and faster to keep up with the band. The addition of gyro has helped; that’s a $10,000 item.
“When you look at the main system and its mirror pointing to the back, there are two line arrays, side by side. Everybody knows you can’t do that. So we came up with the idea of splitting the signal. My biggest fear was not getting the U2 power alley—the big volumes of sound the Clair S4 produces. That fantastic energy is a lot harder to achieve with line arrays.” —O’Herlihy

The rail cameras provide about 80% of our show; Cameras One and Two on the main stage are getting images just not seen before. I’ve looked at all their previous DVDs, and what we have here is the band locking their most flattering and heroic.

And what does Krueger think of the screen? “It’s far better than I thought it would be; even when open, fully extended, it’s a better image than I thought. The cameras are standard-definition; the screen doesn’t demand higher resolution. I find the band very exciting to watch, to anticipate what they’re going to do. As they refine their show, we refine the cameras so I can better emphasize what they’re trying to communicate. We’re learning how to best capture that now. Smasher is working beside me out front with the D3. It’s great for me to watch Smasher come into his own, to watch him refine his own choreography as he takes what I give him and makes it work on the screen. I can’t emphasize that enough—he makes it work.”

Johan “Bellekes” Van Espen: the Space Station builder

Bellekes, as he is known to everyone, is one of three team leaders for Stageco, the demands of this tour dictating that three complete steel structure systems leapfrog around Europe. It looks like a tough job. “We allow a little headroom,” he says. “There’s maybe 170 tons of production loaded up there. We have 38 trucks of our own for the steel and sub stage, and 20 crew plus 10 drivers who rig.

“The set-up is simple but lengthy. First, we build the octagon; that’s the ring of large trusses that form the top of the structure. Then, at the four corners of the octagon where the legs attach, we build eight standard Stageco roofing towers in four pairs, two on either side of where each leg will stand. These we call ‘portal towers.’ It means that, as we add the leg sections to the structure, we can make a synchronized, controlled lift of the whole thing. In build terms, putting up eight towers is like building for a regular stadium show, just to get the structure up. You couldn’t do it with cranes—there aren’t enough venues where you can get that many cranes in for a start, and it wouldn’t be safe to try and raise it on four cranes. Once it’s up, you have to dismantle the eight Stageco towers, only to have to put them up again for the load-out. Each main leg has a load capacity of some 70 tons.”

The legs taper down to ground level, where they join to a fairly hefty ground block; even so, the load transfer down to the leg must place enormous pressure at the base of the tower. How is that managed? “We have very big base plates, 6m by 6m [19.5” by 19.5”], then we have Dywidag links diagonally across to stabilize between towers.”

Dywidags resemble lengths of steel reinforcement, the sort of steel you’d see being wired into frame-

works for, say, the construction of a motorway bridge. These particular items are about 30-40mm in diameter, have a coarse thread, and span across the base area with a turnbuckle-type device to tighten and load. “We fit these when the whole structure is still hanging off the eight Stageco towers, before we lower it to the ground. In total, it’s about 42 hours to put up, but that’s broken over a longer period, slightly less to get it out. It’s new, it’s a challenge and we’re enjoying it.”

The structure is of course, prone to natural forces, wind being the major one. “We have slosher tanks up there to dampen movement, one in each corner. They hold 1,500 kg (3,307 lbs) of water; each tank is compartmentalized, so the water moves in measured fashion.” Slosher tanks are a simple, tried-and-tested method for stabilizing significantly heavy structures.

Jake Berry: the master of ceremonies and production director

At the first show day in Paris, everyone I speak with mentions the Hungarian team that pulls the cables up inside the legs. It’s not hard to see why this falls to a special team: Lighting alone has 400A three-phase supplies up three of the legs, and audio has a ton of signal cable running between amp racks at tower bases up to the PA. But that still leaves the question: How did a team of Hungarians get the job?

“The question was, how long would it take to get the cables up and down the legs?” replies Jake Berry. “We knew we’d get local crew to do it, but, until we got to Barcelona for rehearsals, we didn’t know just how tough a job it would be. We quickly decided we needed our own team to do it, and someone suggested the local stage crew out of Budapest. I called them up; we have 12 of them with us, and they’ve proved an absolute godsend.”
There is no shortage of production crew people willing to endorse Berry's statement: Nick Barton, for PRG, is typical: "They're absolutely brilliant; it's a lot to haul up, and yet, when they're done, they help with everything else."

"They deal with every cable you can name," says Berry. "In that one decision, we took away a headache that, in turn, left people free to be focused on what we pay them for: their technology. They're brilliant; I take six of them and do the back line, and it's great, because I don't have to watch them."

The fact that Berry supervises the back-line load-in caught my attention: Again, on the first show day in Paris, he tells me, "We started load-in at 3am yesterday." And he hasn't left the building since; Helen Campbell, his assistant production coordinator, tells me he's slept a few hours on a first-aid gurney. Yet, "just a few hours later that day, I see him backstage, organizing the strip-out of the opening act's (the Kaiser Chiefs) stage gear during changeover. The following day, I watch him helping to load the Kaisers' truck. Shouldn't he be in the office resting?"

"Yes, every team has a leader," he says, "but that's what we are—a team—and I like to be amongst them." Look closely at the photo of him and you'll see a man smiling, but you can also see the fatigue of long days and heavy responsibilities; he is a remarkable man with an insatiable appetite to make this work.

"You look at our show here," he says, "at a minimum, we've got at least two of everything: two PAs, two camera systems, double the normal number of followspots. Our B stage has more decks than Bridges to Babylon [the Rolling Stones tour]—shit keeps coming!" He refers to the endless procession of equipment loading in. What's his measure of the logistical challenge?

"The first two moves have been f***ing overwhelming. My lead truck driver now travels on the bus with the crew because he has so much to keep on top of, he doesn't have time to drive the truck." And the secret to managing such an unbridled beast? "Getting people involved: I wouldn't tell Willie Williams what lights to use, or Joe Ravitch and Clair Brothers what PA to pull in. When Bono came to us four years ago and said, 'Can we play stadiums in the round?' I thought, yes, a roof in the middle of the pitch with a few runways—not this! The commitment of the vendors has been unbeatable—Brilliant, PRG, Barco, Tall—everyone, but Stageco especially, I don't think there's another company that would have done it, or even could have.

Just how much gear is there?

"The mind boggles. You might carry 120,000 lbs of equipment for a major show; we've got four times that. That's the commitment to 360, and it takes 360% from everyone to make it work. I knew we were in for a hard start when I found myself eating lunch in the sunshine at Barcelona during load-out, the day after the show. The thing about this production is, problems compound very quickly. One thing slows you down half an hour, and, half a day later, you've lost six hours. I initially thought, a 36-hour set-up? No problem. But we even take three truckloads of Mojo barriers and our own stadium flooring from Germany-based EPS AG with us, three sets of 6,000 sq.m. It's more work, yes, but another godsend, because you know what you're going to get and you can rely on it. If we'd allowed the local promoter to put down plywood in Barcelona, we'd still be loading out now.

"That piece arrived from the States just as we loaded in to Paris," says Barry pointing to the rear curved ramp that completes the ring of the B stage. "We stuck it in straight away to give the band something new to play with." That's a telling statement: Berry and his team had just suffered two major downpours in Milan, only their second stop on the tour and their first load-in/out gig. By his own admission, "we were overwhelmed by it." Yet he chose to add the extra parts from Tall on the first day in Paris, when it would be less pressured had it been done for the second show. It's decisions like that, which qualify Berry's nom de guerre of Mr. Showbiz. "I'm also sending Fisher away, so he can't keep adding things," Berry adds with a laugh.

And what is it that keeps Berry motoring along? "I've lived the dream for 30 years—and now I'm seeing something different. It's a huge thrill when you see the show happening."

Has this changed his approach? "The process is no different than with other productions, just more of it. We deliberately said no to 150-ton cranes, because it would have severely reduced the number of venues where we could play—Nov Camp in Barcelona, for example. Yes, we could have done the Olympic stadium, but Nov Camp was better for vibe, and a better stadium," especially since Berry paid for the roadways in to be tarmacked. "You pay for that vibe; no one relishes playing there. But it was the best place for the show." There's a statement to savor, and that's the thought Berry keeps closest to his heart.

Summing up, Williams says the band "just wouldn't be able to see the point of going to all the trouble of touring a show which wasn't entirely new and groundbreaking. I have to say that I sympathize, and, on some tours, we're better at this than on others. It might seem like a daunting task to have to reinvent the wheel every time, but certainly it beats the alternative. As Bono is fond of saying, 'It's easy to be average.'"