ascent

A vision for sport and technology

Thought leadership from Atos

innovation in sport

Your business technologists. **Powering progress**

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Welcome

Simon Kuper,
Guest Editor

n the pages of this magazine, the Atos Scientific Community asks us to imagine a 100m sprint final with eight people – none of whom are in the same location.

That could actually happen at an Olympic Games in the forseeable future. Each athlete could run in his or her own city, and yet they could appear together as holograms in the same race. You could imagine a full house at London's Olympic Stadium cheering on the runners they see in front of them even though none of the athletes are physically in London.

Over the next decade, sport is going to transform like this. The experience of the athlete, spectator and television viewer (though 'television' may soon become as outdated a word as 'telegram' or 'fax') will change more than they have perhaps since the first 'Olympic' stadium went up in Greece nearly 3,000 years ago.

This *Ascent* magazine, drawing on the insights of the Atos Scientific Community as well as those of outside experts, tries to foresee some of those changes.

We talk about the new spectator, who will become more or less his or her own TV director, choosing which slices of the action they watch and re-watch, and from which perspective. Soon, they will be able to see the tennis ball through the eyes of Rafael Nadal.

They can compare Nadal's blood-sugar levels, hydration levels and heartrate with his opponent's. After the match, in lieu of the old-fashioned press conference, they can chat virtually to Nadal himself.

Yet beneath all this technology something eternal remains. As Jean-Benoit Gauthier, Chief Information Officer of the International Olympic Committee, rightly insists: "You must leave the athletes at the centre. The athletes are magnificent."

Contents

Foreword

Our job is as much to look forward as it is to deliver in the present. Specifically, in this magazine, we want to glimpse what sport and technology might look like in the year 2020

Thierry Breton,
Chairman and CEO, Atos

he business and technology landscape has never changed as quickly as it is doing now. At Atos, our responsibility is to stay one step ahead of this evolution – and help our clients to do the same.

Our Ascent initiatives are designed to share with our partners and customers advance innovation and thought leadership on emerging trends in many areas. This Ascent magazine explores one specific area in which Atos is proud to have a unique track record: sport.

Technology is driving excellence in sport more than ever before – whether it's smart equipment, kit or data analysis. It's also transforming the experience for fans who get an enhanced experience whether watching live or remotely.

It is now more than two decades since we began working with the Olympic and Paralympic Games. In the years since our first Games, information technology has moved from being a support function to an integral part of the successful delivery of any event.

London 2012 heralded another milestone as the world experienced its most connected Games. We are proud to have worked with the International Olympic Committee (IOC), the International Paralympic Committee (IPC) and the London organizers to help them deliver what was a remarkable success.

But our job is as much to look forward as it is to deliver in the present. Specifically, in this magazine, we want to examine what sport and technology might look like in the year 2020 – knowing very well that what we anticipate for sport will also apply to business in every other field.

Our business technologists from the Atos Scientific Community have helped to identify – and have put their perspective on – the key themes they expect to bring the greatest changes: Big Data, new media, social networks, smart stadia and ubiquity. You can read an in-depth feature on each as well as find examples of how, where and why they will be applied.

Of course, integrated with all five of these themes are two trends that underpin all others: cloud computing and security. Increasingly, we all expect 24/7/365 service via the cloud in every aspect of life – and we expect it to be fully secure.

To help bring all these inter-related topics to life, we have contributions from those who will be at the forefront of developments. Among the many contributors we are honored to include are IOC President Jacques Rogge, IPC Chief Executive Xavier Gonzalez, Chair of the London 2012 Organizing Committee Sebastian Coe and President of the Sochi 2014 Organizing Committee Dmitry Chernyshenko.

London 2012 was the most technologically advanced Games the world has seen, something Atos is proud to have contributed to, as its vision on sports and technology helps to power progress in sport.

2020

A vision of social networks now and then

London 2012 was the most liked and highest-trending sporting event in history. But this is just the start. By the time of the 2020 Games, social networks will be integral to every aspect of our lives and an enormous generator of sporting data

2012
4 billion
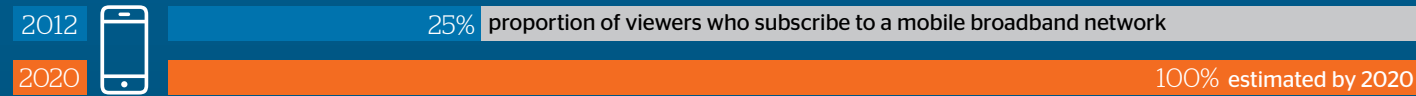estimated global audience for London 2012

57%
of the world's population

2020
5 billion
expected to rise to at least 5bn by 2020, as two thirds of the world's population gain access to mobile broadband

66%
of the world's population

2012
1 billion
people shared London 2012 content via social networks

2020
3000%
forecast increase in data traffic by 2020

2012 25% proportion of viewers who subscribe to a mobile broadband network
2020 100% estimated by 2020

hub.olympic.org

2012
1,000
athletes joining the Olympic Athletes Hub at hub.olympic.org

2020
10,500
all athletes will be on the hub by 2020

2012
1.7 million likes
of London 2012 on Facebook

2020
6.8 million likes
estimated for the 2020 Games

2012
80,000 tweets/second
peak during London 2012 (for the Men's 100m Final)

2020
660,000 messages/second
via single social interface

2012 19 million Most followed Olympic athlete was Lebron James (Basketball)
2020 76 MILLION Who will be the most followed athlete?

2012
1.3 billion
total active users of Facebook, YouTube and Twitter

2020
4.3 billion
estimated total subscribers to a social interface by 2020

2012
1.9 million followers
of London 2012 on Twitter

2020
7.6 million followers
estimate for the 2020 Games

2012 Official London 2012 pages existed on
Facebook Twitter YouTube & Flickr

2020 There will be
One Games channel
that you will access through your social network

Growth in data traffic from 2012 to 2020
2020
30x
2012

Comment

Social media use in London will transform the Movement forever

By Sebastian Coe,
Chair of London 2012

The challenge faced by any Organizing Committee is to essentially host 26 simultaneous world championships in a couple of weeks, before doing it all again for the Paralympic Games. At London 2012, there were more than 15,000 athletes, 6,000 officials, 25,000 accredited media, 11 million tickets and we served something in the region of 15 million meals.

But that only tells half the story. Many of these figures would not be wildly different from previous Games. Where London smashed records into oblivion and changed the face of the Olympic and Paralympic Movements forever was in terms of social media.

At Sydney 2000, barely anyone had fast internet connections; in 2004, in Athens hardly anyone had a smart phone; for the summer Games in Beijing, not many people had a social networking account. Facebook had only just taken off and if you were on Twitter you weren't just ahead of the trend, you were at the forefront.

People no longer just passively consume the Games from their armchair. They are part of the action. They can comment on content, interact with the athletes, create and publish their own content. Where previously they would watch the television, read the paper and talk to their family, friends or work colleagues about what they had seen, they can now talk to thousands of people worldwide, within seconds of an event finishing.

People following London 2012 were able to do so through our website at www.london2012.com where they saw real-time results; they could follow us on Twitter; they could follow each individual sport on Twitter. They could even follow our mascots, Wenlock and Mandeville on Twitter. You could view our content on YouTube, or see our photos on Flickr. Our two smart phone apps were downloaded by 15 million people worldwide, with 5.8 million also upgrading to the Paralympic versions.

Around 4.7 billion people watched at least part of the Beijing Games and most of them on television. As people can now watch on their PC, their tablets and their smart phones, this number was significantly higher for London 2012.

Many more chose to experience the Games further through any number of the above channels. They engaged differently and shared millions of hours of content, more often than not, their own.

For me, the next challenge is to make the most of the opportunities social media presents. Never before has there been such a channel to interact with the world, especially with young people. What we need to try to crack next is how do we use it effectively? How can we use it to get them out and about and active, using the very devices they live on to challenge and inspire them.

I have no doubt that the next Games and the Games after that will only continue this rapid advancement.

Working the crowd

"By 2020, email will be dead. And if that sounds like a big change, it's just the start"

Do you use social media? Are you on Facebook or LinkedIn? Or Instagram? Twitter, possibly? Foursquare? MySpace? Pinterest? Google+?

You probably answered "no" to some of those. But do you use email? The answer is almost certainly yes.

At the moment, email seems to be an immovable, essential feature of the communication landscape. But the rapid rise of social networks has seen young people start to turn their back on the medium.

And, increasingly, business communication, collaboration and knowledge sharing is also taking place over social platforms, as the so-called 'Enterprise 2.0' model takes hold.

By 2020, email will be dead. All online communication will be conducted over a single interface, no matter whether you're a skateboarding teen or a Government minister. And if that sounds like a big change, it's just the start.

When network capacity and mobile technology catch up with the 'always on' generation's heavy use of rich social media such as video and audio, there will be many far-reaching shifts in the way we communicate, do business, create brands, meet friends, even watch television.

Right at the front of the starting grid for this massive social media-led change is sport. With its relatively young, international fanbase and its world-beating use of

Atos social media expert Jan Krans tells Chris Maillard about a near future in which every aspect of a major sports event will be fully integrated with social networks

technology for multi-channel broadcasts and interactive global events, its already strong social element and its ready supply of data, expect to see sport leading the charge.

"Social media has so far revolved around people," explains Jan Krans of the Atos Scientific Community, "but in the future it will increasingly revolve around events.

"As a supporter, you will use your existing social credentials to log on, but then you'll join the event network. My feeling is that you won't need Facebook to do that by then.

"In 2020, I expect social media to behave almost like a TV channel. You become a member and log in and what you will get from that is the opportunity to experience the event in a very different way.

"It will offer a rich user experience – all the channels (video and so on) will be easy to deliver. Just like you choose a channel on your TV, you will choose a social channel.

"By 2020, all information will be shared across all screens. And a much greater percentage of text communication will be voice-generated rather than typed, which will make it much easier to update your status or message your friends on the fly – perhaps while you're driving or, if you're an athlete, even while taking part in sport. This transformation will be enabled by the accessibility of cloud technology.

"After an event, fans will be able to re-live some of the moments; you can't rewind a live sports event, so you mark some of the events for later analysis or playback. Clubs will create a community where fans discuss specific moments in the game.

"As a fan, you can make your own summary of the game and share it with other fans and friends. Spectators and fans will be able to get far more involved, and the experience will run before, during and after the event."

The question is often asked as to what role 'old media' – traditional broadcasters and news outlets – will play in a future where everyone can gain access to rich content instantly via social sources. But Krans sees many ways for these organizations to adapt.

"Broadcasters have the chance to join in with social media: analyze the audience, ▶

sell subscriptions, like buying an app. They have a lot to offer in this world; inside stories and studio recordings that they can make available exclusively because of their contacts and access."

The beginnings of this phenomenon are already being thought about. At his recent speech at the Cannes Lions awards for creative communication, Twitter's chief executive Dick Costolo was keen to push the idea of Twitter becoming the 'second screen' to television.

Though when integration becomes more widespread, of course, your main screen will be a mobile one that is always with you, and you'll use it for social media, video, TV, messaging, and audio.

Not surprisingly, much of Costolo's angle was commercially driven; social networks are still working through the process of how to effectively monetize their members and corporate users.

Atos futurist Krans has a few ideas there too, particularly in the field of sport. "Commercially, there are fascinating possibilities," he says. "Supporters are becoming much more brand-aware. They are eager to know all about their favourite sports.

"Sponsors will be able to analyze supporters's behavior via social media, which generates large amounts of detailed data, to see if their brand works in that market.

"They will get good marketing statistics and know all the background to purchasing decisions, which will enable better targeting.

"For athletes, more sharing – and, therefore, more effectively attracting an audience – is very attractive to potential sponsors: it gives their sponsorship far more impact.

"Also, there are other potential benefits. If the athlete has a list of fans, they could offer discount on sponsors' products to those fans. This could become a new advertising and marketing model.

"Social networks could use sport as a way of monetizing themselves and selling products. They could act as brokers. That's certainly a potential business model for them."

The effect of social media won't only be felt off the field of play. Krans foresees numerous ways in which it will become integrated into performance.

"Athletes will be able to exchange information more easily between themselves and clubs or coaches. Training dates can be distributed to team members and they can record and share training regimes with their club or team too – although, of course, top athletes will still keep secrets.

"Social media will be a normal part of being an athlete, but it won't replace fitness and talent. The most popular athletes will still be the ones who perform best on the field of play.

"The scouting process will change though. By 2020 clubs and teams will be able to tap into their fanbase to find talent. As in the phrase 'the wisdom of crowds', you will go to the social networks to find out who is being talked about and who is being recommended as an up-and-coming talent.

Of course, you can choose to listen to it or not, but currently talent spotting is a major expense in sport. Social media, assuming it is used well, could make the process much more efficient."

It's an interesting thought, and prompts consideration of the many other ways data from social networks can be used to optimize aspects of sport and event management.

Take security, for example. There are two sides to this question, says Krans. "On the one hand, people are always concerned that social networks make it easier for criminal groups to mobilize. But it is clear – and we are already seeing examples of this – that social networks can also be a great source of intelligence for government and security agencies.

"For me, the real question here is around privacy and getting the balance right between protecting people's social data and ensuring the security of the public at events. That will be one of the major challenges between now and 2020."

But if security is a concern, a big opportunity for event organizers lies in the emergence of social software platforms as a better way of communicating, exchanging assets and transferring knowledge, both internally and with suppliers and stakeholders, and indeed from one organizing committee to the next.

Krans says: "It's going to mean events will become more open and transparent in their organization, and it will inevitably optimize business processes across the board."

And that's surely more than enough to console anyone still mourning the demise of email. ∎

> "The real question is around privacy and getting the balance right"

Sochi: all networks

Dmitry Chernyshenko, President and CEO of Sochi 2014, explains how social media is central to his vision for the Games

The Sochi 2014 logo (right) is a statement of intent to embrace digital technology. How important are digital and social communications?
"Extremely important – our logo was designed to reflect this focus in our overall communications for Sochi 2014. The logo is the first Olympic Games emblem that forms a web address and that puts a clear emphasis on reaching new audiences through digital platforms."

In what ways will social media bring a new dimension to the Games?
"Social media is a great way for us to communicate with fans before and during the Games. Fans will be able to tweet, tag and blog like never before. It will give them an opportunity to react to the news and events taking place in our stadiums. It will offer a unique forum to engage in conversations with fellow fans, athletes and partners of the Games."

London 2012 is being described as the first social media Games, but two years is a long time in that field. How will it have moved on for Sochi?
"Within the Olympic Family and Paralympic Family, digital communications tools are being explored continually. Over the next two years we will see an increase in the numbers of people active on social media, with the result that during the Sochi 2014 Olympic Games there will be a much larger community to engage with."

How do you plan to harness social networks to enhance the Games experience?
"We are planning this now. We want to use our social platforms to enhance our fans' experience. We are a digital brand and understand the vast benefits digital platforms and engagement can add to the consumer experience at the Games."

How useful is the opportunity to be able to respond directly to fans and media using social media – and what are the parameters?
"It is extremely important. Never before have we had a platform from which we can respond to comments and questions in real time. Social media provides us with a unique opportunity to interact directly with the people who will be visiting and supporting the Games in Russia."

You are personally well known as an enthusiastic tweeter. How often do you check your feed?
"I check it throughout the day. It's a great platform to not only engage with the digital community but to demonstrate Sochi 2014's Olympic values of excellence, friendship and respect. With less than two years to go, it is great to see the momentum building on our social media channels. As our digital community grows, so does the excitement."

What's next...

For sport? We ask brand leader Facebook and the emergent blueKiwi

Christian Hernandez, Director of Platform Partnerships, Facebook.

Sporting events are some of the most talked about things on Facebook. Fans, athletes and teams come together to share their stories with an audience of more than 900 million people. We work with partners from across the industry to help them build great experiences for fans, whether through their websites, on mobile or via the Facebook news feed. The integrations we're seeing from broadcasters around the Games are the sort of thing we'd expect to become part of the everyday viewing experience. For example, the new BBC Sport app will simultaneously show up to 24 streams during the Games for people to pick what they watch and NBC Olympics will integrate social data into its live broadcasts.

blueKiwi An Atos Company **Jean-Luc Valente, CEO, blueKiwi**

We're used to the idea of social networks being a great way to connect people, and it's making its way into the professional world – but the main issues for organizations are a deep lack of security and privacy. It could be a football team, for example, discussing schedules, or the techniques and strategies they will use. There is so much information you want to keep within a dedicated group of people. New platforms like blueKiwi will build this privacy, while enabling sharing. Then, suppose an athlete has been preparing for the Olympic Games for 18 months. What happens to all the ideas, conversations, meetings, phone calls and suggestions afterwards? With an enterprise social-media platform, these will be captured and turned into assets – data that can be improved upon in the future. Some of this can be shared with the public, but the rest can be distilled as the 'secret sauce' for future success.

Acquired by Atos in April 2012, blueKiwi's enterprise social software makes it easy for companies to create uniquely productive and collaborative working environments

Why Big Data will lead to better sport

By 2020, sports success and IT will be linked inextricably. Celestino Güemes, Atos Big Data expert, talks to Ascent about the connections between athletes and analysts

The referee clears the penalty area and a hush falls over the stadium. The goalkeeper stares into the eyes of the opposition's striker, then walks slowly back to his line. In the dugout, a glance at his monitor tells the coach that his striker's heart rate has soared to 180bpm. He checks the rest of the team and his young winger is as cool as a cucumber, his heartbeat barely topping 90bpm.

He also sees that the winger has a 95% success rate at penalties and the sentiment from the social network is all about the kid's confidence on the big stage. The coach makes an instant decision and relays it into his microphone. Fifty yards away, the striker tosses the ball to his young teammate.

The winger runs up. He shoots. The goalkeeper dives... and the ball flies into the opposite corner of the net. The crowd erupts. It's another victory for Big Data.

Whether or not this picture of future football becomes reality, the fact is that the data will be available to make it so.

The term Big Data describes volumes of data so large, complex and dynamic that they cannot be processed using traditional data-management technologies and techniques.

It is already making a significant contribution to sport and by 2020 it will be the driving force that takes it to a new level: better performance, improved spectator experience,

and better business.

Athletes are used to checking stats, whether it's reps in the gym, pass completion or batting averages, but the next decade will see them adopting far more sophisticated forms of data analysis. So says Celestino Güemes, Head of Solutions R&D, Atos Worldgrid Spain.

"Historically, data has come from relatively simple, one-dimensional sources, but we'll be able to aggregate input from a much broader field; for example social data, as well as automatic video analysis and smart biometric clothes and equipment. It means that athletes and their coaches will be able to get a much more rounded, qualitative view of their performance, both in training and during play."

Not only will this enable them to hone their performance and conduct more comprehensive analysis of their opponents, it will also help them to stay fit, by using historical data to see the patterns that lead to potential injury, or even life-threatening medical problems, such as the tragic heart attack suffered in April 2012 by Livorno midfielder Piermario Morosini, only a month after Bolton Wanderers' Fabrice Muamba's near fatal collapse.

For the spectator, these high volumes of data will enable a far richer watching experience, in both the live arena and via broadcast. The way the data is analyzed and presented – what Güemes calls the

'beautiful visualization' of statistics – will be key. "The skill will lie in extracting the meaningful picture from this vast aggregation of data through clever analysis and presenting it in a way that is easy to comprehend: with striking graphics, perhaps layered onto live video pictures

> "Imagine seeing a speedometer on Usain Bolt"

– known as 'augmented reality'."

A simple example, and one that viewers are already familiar with, is the on-screen graphic showing distance from a free-kick to the goal. Augmented reality will develop this into far more sophisticated and exciting visuals. Imagine watching Usain Bolt in the 100 Metres, but

instead of his shirt number you see a speedometer showing how fast he's running. This level of in-flight data visualization is already within our capabilities. Watch the Olympic Swimming and the national flags you see appear on screen in the lane as each swimmer touches is the result of data being captured, ▶
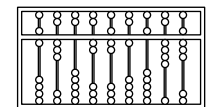

▶ Bytes on the bench
Coaches will become big users of Big Data for tactical decisions

Let the kid take it!

A brief history of data storage and its use in sport

20,000BC

▲ **Tally stick**
Score marks on animal bones are the oldest known remnants of man's need to store data

▼ Abacus
The first abaci emerge in Asia and the Middle East, allowing data to be stored and calculated

5700BC

2AD

▲ **Census**
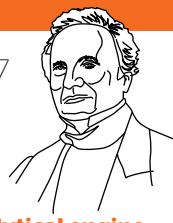The oldest surviving population census is conducted under China's Han dynasty

▼ Domesday Book
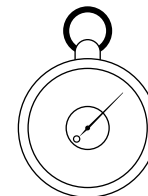The public record is introduced to England by William the Conqueror

1086

1837

▲ **Analytical engine**
A hundred years ahead of its time, Charles Babbage invents the world's first general purpose computer

▼ Stopwatch
At the first modern Olympic Games, times are recorded mechanically and logged on paper

1896

1912

▲ **Photo finish**
Stockholm 1912 sees the first use of automatic timekeeping and the photo finish at the Olympic Games

▼ Punch cards
Olympic Games results are tallied using computer punch cards for the first time at the Winter Games in Squaw Valley, California
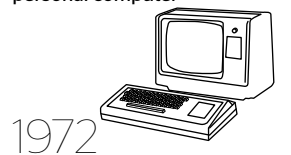
1960

▲ **Results mainframe**
The Olympic Games moves its results database from paper to computer

1964
0101110
1011010
0100011
0101010
1011101
0110101

▼ PC
The home computer is launched with the first programmable desktop personal computer

1972

◄ analyzed and visualized within 0.3 seconds of each touch.

"Fans will be able to play with the data," adds Güemes, "selecting different views as they desire, and even using it to create their own visual representations, rather as YouTube users create their own musical montages now." For the athletes themselves, personal data will become a commodity, selectively packaged and sold for sponsorship activation, education, gaming and spectator information. And this enhanced viewing experience won't be limited to television; spectators at the event will be able to access and interact with the data by pointing their personal device at the action and with interactive infographics on their screen.

The current generation of young sports fans is well versed in using IT and these interactions with data in sport will become second nature. Fans will also play a significant role in the input of data, via the social network. And this brings us on to the role of managing high volumes of data for sports organizers.

The value of data in sports business cannot be overstated. Soon it will be possible for clubs and administrators to store valuable information securely in the Cloud and access it instantly in clear, comprehensible formats. This will help them to know their audience inside out and tailor their supply much more accurately to demand.

"Dynamic pricing, for example, has already been introduced in America in baseball, basketball and ice hockey," says Güemes, "with clubs adjusting their prices in response to the opposition, players on show and even the weather. Add in data from the social network and organizers will be able to see directly the level of appeal any given game has for their audience."

This 'sentiment analysis' will also enable them to gauge reaction to their players, the team's performance and PR issues in real time: the vocal reaction of the live crowd being augmented by the tweets and posts of the broadcast audience. Coaches and management will be able to respond as they see fit.

Assuming that patterns of data will provide the majority of insights, anomalies in those patterns could become an early warning of something amiss. Athlete integrity is currently managed through systematic testing of all competitors over long periods of time.

"Using data to point out 'freak' performances could enable more targeted testing. That, in turn, would help sports like cycling, for example, to continue to its battle against performance-enhancing drugs and to restore public confidence in the integrity of competitors."

Of course, this will raise an ethical debate: would a feat like Bob Beamon's long jump in 1968, which smashed the world record by nearly two feet, mean an athlete becoming the instant target of suspicion? It will be interesting to see how the authorities choose to apply this particular data strand.

It's one of the big questions arising from the use of Big Data. Another is how it will affect the competitive field as a whole. Will the clever application of data enable less wealthy clubs to steal a march on wealthier but less forward-thinking rivals, as it did for the Oakland A's baseball team? Or will such advantages be fleeting, before the giants cotton on and take the use of data to a new level. Time will tell.

Traditionalists may worry that so much statistical analysis will take the emotion out of sport, yet Güemes argues there are aspects of sport where emotion undoubtedly gets in the way.

"Big Data will enable a more scientific approach to sports management, which in turn will enhance performance." And that's where emotion takes over. ■
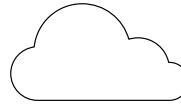
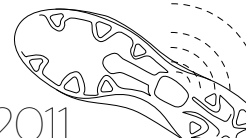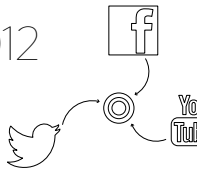> "Anomalies in data patterns could become an early warning of something wrong"
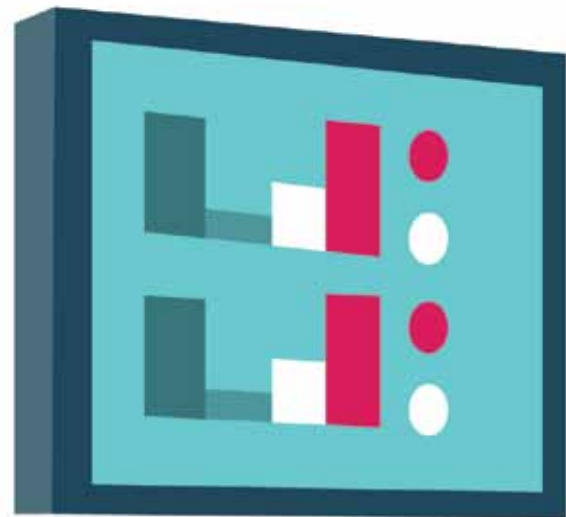
2000
▲ **Smart phone**
The launch of the first commercial smart phone

▼ **Commentator Information System**
Atos' CIS data system delivers Athens 2004 Olympic Games results in less than 0.3 seconds

2006
▲ **Cloud**
Google and Amazon take cloud computing to the forefront of the IT agenda

2004

▼ **Foot pods**
Adidas utilises foot pod technology in its adizero f50 'smart boot', with a chip that records motion

2011

2012

▲ **Social Games**
The IOC's Olympic Athletes' Hub aggregates social media posts from 1,000 athletes

The quantifiable athlete

By 2020, almost every part of an athlete's biometry will be measurable, allowing coaches to make adjustments in real time

Hydration
An implanted sensor will use radio waves to measure dehydration during exercise, indicating whether an athlete needs to stop for a drink

Visual response
Ocular sensors will show how the subject responds to visual stimuli, such as how well a player picks up the flight of the ball

Oxygen intake
Shirt sensors will measure how often the chest rises and falls, giving the respiratory rate, which can be used alongside blood oximeters to assess how efficiently the athlete is taking in oxygen

Heart rate
An electrocardiograph connected to smart kit will measure heart rate, giving an indication of work rate, nervous energy and also showing up any irregularities that could be a warning of a cardiac trauma

Muscle power
Electromyograph sensors fitted to smart kit will measure electrical signals from the muscles, indicating signs of tiring or impending injury

Movement
Subtleties in technique will be detected by video analysis and feedback from smart kit (for example, 'intelligent' footwear)

Mind games

Brainwaves measured by electroencephalography (EEG) via skullcaps or tiny adhesive sensors will give a read-out of an athlete's mental state in real time. Aspects such as relaxation, concentration and agitation can be identified by a coach in crucial pressure situations. In training, a coach can identify situations where an athlete 'switches off' and alter the training regime until the desired level of concentration is achieved. And before a penalty shoot-out, instead of looking into the players' eyes and trying to gauge which ones have the courage to hold their nerve, a coach could pick his penalty takers according to EEG data.

A measured performance

Ascent learns that in the future, even the fans will have a say as data drives sports performance

When Atos Big Data expert Celestino Güemes looks to the future of sports performance, he sees a stage upon which the best players are able to perform to the best of their ability more frequently, thanks to the application of Big Data.

Güemes, the Head of Solutions R&D at Atos Worldgrid Spain, says: "More information will come from athletes. It will be gathered much faster too, using biometric sensors in clothing and equipment, plus video-motion analysis, that will relay data showing how an athlete is performing in real time.

"We will add data from other sources too, for example social data from Twitter feeds, weather data and so on, and you will be able to assess performance from different angles, combining all these views."

In training, athletes will be able to gather their own performance data, upload it to a biometrically secured space in the cloud, and perform their own analysis. This will give coaches far greater flexibility, even allowing them to train their athletes remotely.

The data gathered can be used in two ways: to spot patterns and identify signs of improvement, weakness or

even potential injury; and real time data – providing in-flight analysis so the coach can adjust the training as it happens in order to meet precisely calculated targets.

Real-time analysis will play a much bigger role in competition too. Smart shoes and boots are already available, clocking running speed, distance covered, turning and more; a smart tennis racket is being live tested; and as smart clothing becomes ubiquitous, the dug-outs of the world's stadia will come to resemble

> "You can combine pure analytics with crowdsourcing, where fans are actively involved"

the pits in Formula One, with laptops relaying a constant flow of data.

"There'll be much more of an interface between the coaches and the athletes," says Güemes. "They will be able to change tactics in-flight because of that information."

One interesting aspect will be the addition of social data into the mix. Increasingly, social media will come to be considered part of watching a sporting event with the ability to gauge the 'social pulse' of the event being integral to the overall experience. Aggregating social data with all the other performance data will provide an added dimension that could well see coaches responding to spectator sentiment.

Pass completion, for example, can be a misleading statistic, but it will be possible, with pattern recognition, to trace each pass further down the line so you can gauge the effectiveness of that pass – with the emphasis moving more to 'pass appreciation'.

"I think there is an important role for the human part in Big Data," says Güemes. "You can combine pure analytics with crowdsourcing, where fans are actively involved in analysing data. If done properly it could lead to better decisions and a more engaged fan base." ■

▶ *Boom times*
Dutch sailor Marit Bouwmeester relies increasingly on Big Data

119°
46%
MB#1025699
Load -25% · personal best: 98% · victory result: 1/5

Load -25% · personal best: 98% · victory result: 1/5

The sports leading the data revolution

Sailing
Whether it's GPS or the use of high-definition video footage to assess how maneuvers are carried out at sea, data plays a huge role. Weather forecasting tools are also being adapted from military systems to provide detailed knowledge of conditions before a race.

Athletics
Imagine a team of more than 20 scientists and technicians assessing every aspect of how you run the 100m; while a camera zooms along beside you taking pictures at 1,500 frames a second. At the top end of athletics, this is a normal day at training.

Rugby
The sport of rugby has pioneered the use of GPS to capture player data. Elite players wear GPS monitors in matches, generating data that is used to measure performance, track injury risk and identify positional demands.

Cycling
The high-performing British Cycling team deploys a timing system based on military technology that uses lasers and bar codes on riders to give exact identification, split times and velocity data. Bikes capture force measurements, velocity and acceleration – and the data is all logged in real time with video streamed directly to coaches' tablets.

Roberto Mancini, Manchester City's manager, knew in his gut that the most dangerous corner was the outswinger. His many years of playing football had taught him so. It took a while for City's large team of data analysts to persuade him otherwise. They had analyzed more than 400 corners, from different leagues, over several seasons, and concluded that the most dangerous corner was actually the inswinger.

The beauty of the inswinger was that it sent the ball straight into the danger zone around goal. One touch from a striker, or an accidental deflection off a defender, and it was in the net. All in all, the stats showed, inswingers produced more goals.

Gradually, the analysts persuaded Mancini to go with numbers over gut. Over the course of last season, City began hitting more and more inswinging corners. By the season's end they had scored 15 goals from corners, more than any other team in England's Premier League. Ten of those goals had come from inswingers, including Vincent Kompany's header at home against Manchester United that effectively won City the league title. You could argue that data analysis decided the Premier League.

Yet the data revolution in football has only just got started. When it comes to statistics, the world's biggest sport is one of the most backward. Too many senior people in football are still traditionalists driven by their gut – and less willing to accept the evidence of data. To understand where football will be 10 years from now, we need to look at possibly the world's most statistically advanced ballgame, which is baseball.

Billy Beane, general manager of the Oakland A's baseball team, the man recently portrayed in the film 'Moneyball' by Brad Pitt, spends a lot of time thinking about the future of data in football . It's not simply that Beane in the 1990s more or less started the data revolution in all sports. It's also that he – like many Americans over the past few years – has become a football nut. He fell for the game on a romantic vacation in London with his wife, and now spends many hours on a battered sofa in the A's dilapidated clubhouse watching football on TV, while his bemused baseball players watch him wondering why he is wasting his time on a sissy European game.

Some critics argue that the data analysis that revolutionized baseball can't work in football. Baseball, they point out, is a stop-start game. The pitcher pitches, the batter hits, and that isolated event produces oodles of data for the statisticians to crunch. Surely, the conservatives say, football is too fluid a game to allow that kind of analysis?

Well, for a start, about a third of goals in football don't come from fluid play at all but from dead-ball situations: free-kicks, corners, throw-ins and penalties. Those are static plays that rather resemble a pitch in baseball. Indeed, football's leading teams are already applying data analysis to dead balls.

Before the Holland-Spain World Cup final of 2010, I contacted Ignacio Palacios-Huerta, professor at the London School of Economics. He is a game theoretician and possibly the world's leading expert on penalties. I grew up in the Netherlands, support Holland, and had a good contact inside the Dutch camp. Would Ignacio be interested in writing a report for Holland on Spain's penalty-takers, to be used if the final went to a penalty shootout? "Yes," said Ignacio.

But wouldn't he as a Spaniard mind helping Spain lose the final? "I'm a Basque. I don't mind at all," he replied. Then I contacted the Dutch camp and offered them his report.

The Dutch decided they wanted it. Ignacio spent several nights researching it. On the morning of the final, we got an email from the Dutch keepers' trainer saying, "This is a report we can use perfectly." Ten minutes from the end of extra time, up in the stands in Johannesburg's Soccer City, I was no longer watching the game but rereading the pdf of Ignacio's report on my laptop. He had predicted how players like Fernando Torres, Xavi and Andres Iniesta were likely to take their penalties. He had also found that Spain's keeper, Iker Casillas, was weaker on penalties hit to his left. I thought, "If this report is right, I could be about to help Holland win the ▶

Football's data with destiny

More sports are using data to inform strategy and the trend is set to accelerate as huge new quantities and types of data become available. But when will football catch up, asks Simon Kuper

% INSWINGING

% OUTSWINGING

◄ World Cup." At the same time I thought, "But if it's wrong, I could be about to help them lose it." Then Iniesta scored and thankfully for my cardiac health, the shootout never happened.

But this is the way data analysis in football is moving. Beane says: "I don't buy the idea that 'I trust my eyes more than the stats,' because I've seen magicians pull rabbits out of hats and I just know that rabbit's not in there."

The complexity of data in football just keeps increasing. In a decade, big clubs will probably have something like chief information officers (though they won't be called CIOs), who manage teams of statisticians. Before a match, or before a decision on who to buy or sell, the coach and the club's CIO and a few other senior people will get together and work out what to do. The CIO will be listened to in a way that statisticians simply aren't now (except perhaps inside the German national team).

Ten years from now, the complexity of data in football will be such that the old-style autocratic 'total manager' who ruled a club alone, an Arsène Wenger or an Alex Ferguson, will no longer be thinkable. Clubs will increasingly be run by the wisdom of crowds.

By then, not just dead balls but even the fluid parts of a football game will be mapped. Germany – which uses data analysis better than any other national team – is already working on that. Before every game Germany's 'Team Cologne', based at Cologne's Sporthochschule, performs data analysis on how the opposing side builds and defends. The search is always for weaknesses. For instance, before Euro 2012 Team Cologne established that Holland's defenders tended to position themselves more than the ideal eight to 10 metres apart. When Germany met Holland in Kharkiv, the Germans found the gaps in the Dutch defence and won 2-1.

Someone who has thought harder than most about what shape data analysis of football might take in the future is Beane's right-hand man at Oakland, Farhan Zaidi. The director of baseball operations at the A's is an MIT economics graduate with a sense of humour. He's the sort of guy you'd expect to meet late one night in a bar in a college town after a gig, not at a professional sports club. For work, Zaidi crunches baseball stats. But he and Beane spend much of their time arguing about their other loves: the British band Oasis, and football .

In 2006, in the middle of the baseball season, he and Beane traveled to the World Cup in Germany together. "We spend so much time together," chuckles Zaidi, "that if all we ever talked about was the numbers on these spreadsheets, we would have killed each other a long time ago."

Because Zaidi knows where the data revolution in baseball has gone, he can make predictions for football . Football's holy grail, he thinks, is a stat he calls 'Goal Probability Added'. That stat would capture how much each player's actions over his career increased the chance of his team scoring, or decreased it. Zaidi explains: "With some of the tools that are being created now to track everything that's happening on the football field, I really feel like this is the next frontier: having enough data so that whenever a player advances the ball from point A to point B on the field, you know that play has happened 100 times before, and you know exactly how valuable it is. So if a ball is in 'grid one' of the field, you know that over the next five minutes the team scores a goal 0.5 per cent of the time. Now that player advances it to grid six, say. You know that the team scores a goal in the next five minutes with a probability of 2 per cent from there. He's raised the probability of scoring by 1.5 per cent."

Does this mean that one day pundits might say things like: "Luis Suarez has a Goal Probability Added of 0.60, but Andy Carroll's GPA is only 0.56"?

Zaidi replied, "I think that will happen, because that's what happened in baseball. We talk now about players in ways that we wouldn't have dreamed of 10 or 15 years ago." Even in football, brain will eventually supersede gut. ■

> "We talk about players in ways that we wouldn't have dreamed of 10 or 15 years ago"

▼ Everything's bigger in Texas: *the 'Palace in Dallas' is considered to be the world's most advanced stadium*

Augmented reality is set to take that experience further still. In its infancy now, in just a few years it will provide comprehensive information based on your view of the field of play. For instance, let's say you're watching the high jump from a seat at the back of the stadium. To get a close-up of the action all you'll need to do is point your smart phone camera at the athlete and it will show you how high they've jumped over the bar as they leap from the ground.

Your phone will augment the data that's coming from the action and place it on top of the video image that you're seeing to create a more interactive and data-enabled view of the event. You'll also be able to replay key moments from the action. Increasingly, over the next few years, this technology will become the norm.

But it will not come without complications. There will be a revolution in the way images are captured, with spectators much more involved in taking photographs and sharing them on social networks. Laws relating to broadcast and image rights will inevitably demand a rethink.

"Rights managers and broadcast right managers will need to decide how to deal with people creating their own content," says Cuartero. "The challenge will be how to embrace this rather than pretend it is. By 2020, the traditional mode of selling broadcast rights for major events will inevitably be challenged by the explosion of mobility and social networking."

While this – along with the privacy issues that will emerge – are all up for debate, one thing remains certain. Smart stadia are on the way, and the technology is unlikely to disappoint.

"If you're at the event you'll get a much better enriched data-enabled experience than you would today, and if you're viewing on-screen you'll also get a much richer experience," concludes Cuartero. ■

What is the most futuristic stadium in the world today – and what can it tell us?

Its statistics are as impressive as those of any of the players who perform on its state-of-the-art artificial turf. Cowboys Stadium, home to the NFL's Dallas Cowboys, is the largest domed stadium in the world, with a capacity of 110,000.

It has the world's largest column-free interior and two of the world's largest high-definition video screens – which, at 2,100 inches, is bigger than a basketball court.

And, as you might expect, it is – at a cost of more than $1 billion – one of the most expensive sports venues that has yet been built.

The stadium, which opened in 2009 in Arlington, Texas, is often quoted as being the world's most advanced stadium. Renowned stadium architect Rod Sheard, of Populous, praises the work of the Texas-based firm HKS, which designed the so-called 'Palace in Dallas'.

"They've done a lot of things right," he says. "The enormous screens may not be to everybody's taste, but it does depend on what the client wants and what, as an individual, you want from your day out at a sporting event."

However, Sheard's choice as his favourite sporting venue, one that has embraced the latest technology and got it right, highlights that success is not just about having the latest equipment.

"For me, it's Wimbledon that

does most things really well," he says. "It has an interesting mixture of engaging you as a spectator and also offering you something that is just a bit different.

"There's this English garden party, strawberries-and-cream thing, and they do that really well. But then they also think about the view spectators get on court and the atmosphere.

"Then they embrace technology like augmented reality and they have use the latest materials when building the roof over Centre Court.

"The key to success is to understand what you've got and how technology can help you to enhance the spectator experience.

"It's not just a case of installing the latest gear for its own sake."

💲
$1.15billion
Total cost of build of the Cowboys' stadium

👤
110,000
Capacity of the venue

A sense-able vision of 2020

Eric Baczuk of MIT's SENSEable City Laboratory tells Max Leonard how the data we generate with our smart phones will help to design Olympic Host Cities of the future

One of the more unusual contributions to the London 2012 Cultural Olympiad was the Emoto project. It measured the worldwide audience's emotional response to the London 2012 Games, sifting Tweets for Games-related themes, then divining the sentiment of each one. The result was an evolving, real-time online visualization of the global mood, and eventually a data sculpture – a testament to the world's feelings about the Games. On paper, Emoto sounds intriguing; in practise, it is potentially one of the most exciting contributions to London 2012, one that has huge ramifications on how we organize, deliver and enjoy future Games.

How might human emotions do that? That's where the MIT SENSEable City Laboratory, one of Emoto's creators, comes in. It combines data analysis on a city-wide scale with an interest in

urban infrastructure and in how human activity affects specific places. Unlike some visions of the 'smart' city of the future, the SENSEable City Lab's work doesn't require vast new infrastructure or electronics: it takes the ever-increasing wealth of data out there, adds some processing power to crunch the numbers, and correlates seemingly unrelated data sources to provide powerful and unexpected insights. It joins the dots, makes patterns comprehensible and uses this information to create better places to live.

"We do a lot of work with smartphones, because they're ubiquitous, and they have enormous computing potential," Eric Baczuk, GE Research Fellow at SENSEable City Lab, says. "The city is a multifaceted place, with complex interrelationships and dynamics. An easy example might be combining maps of precipitation patterns, taxi pick-ups and cellphone usage. If we look at the intersection of all three, what are the trends that come out of the data, what can we learn?" When it rains, people take more taxis. But what does that have to do with sport? The Olympic Games are a once-in-a-lifetime event for most cities: when it comes to

getting it right, there are no second chances. And social media sites are essentially huge resources of hard data on those most unpredictable of things: human feelings. As such, they are incredibly valuable.

It might be obvious to speculate that if Usain Bolt breaks the record in the 100m there will be celebrations and good feeling in Jamaica; but what if you could, say, measure in real-time the British nation's reaction to an unexpected star performance by Team GB in Handball? Perhaps you'd lay on more trains and buses to open-air screens, adjust the TV schedules, or even

The stadium gets smart

Attending a sports event in 2020 will be a safer, smoother, richer experience, Atos major events expert Jordi Cuartero tells Luke Ponsford

These days, an excursion to a major outdoor event is a straightforward affair. You buy tickets online, make your way to the stadium and enjoy the spectacle. You might buy some food and drink, even a souvenir or two. This may involve a little pushing and shoving, and a degree of queuing. But that's what we expect of the modern stadium experience: a degree of hassle that's usually just about worth it.

However, by the end of this decade, the experience will change to being a far more interactive pursuit. Forget about those queues, you'll be able to pre-order and pay for your food while you watch and have it delivered to your seat. You'll get updates with alternative views of the event and the latest data in real time. You'll be able to shoot your own video of the action and share it with other fans, both in the stadium and elsewhere through social networks.

All through your smart phone. And that's only the start.

The change from simple spectator to full-blown interactive cast member will be down to progressive built-in technology and increased network capacity via the cloud, ensuring that rather than being mere arenas in which events are staged, the stadia of the future become active devices.

Jordi Cuartero is Chief Technology Officer at Atos Major Events and an expert on 'smart stadia'. He says that this process is already underway and increased connectivity is currently being built in to the plans of new stadia in order to enable a host of innovative, interactive services that will ultimately cover the thousands of people sitting in a modern stadium.

"All the major manufacturers of connectivity devices are now building solutions for covering high-density wireless networks, and technology providers are preparing themselves to implement these kinds of ▶

◀ solutions," he says.

So, what exactly do the planners and connectivity manufacturers have in store for the viewing public? Let's tackle the simple stuff first. Entrance to your everyday stadium presently requires a paper ticket, which allows access to the event, and not a lot else. Issuing tickets to smart phones is nothing new, but by the end of the decade mobile devices will play an almost essential role in day-to-day life. By issuing spectators with an electronic ticket sent directly to their personal device they'll be able to consume all the services on offer from the stadium automatically.

Intelligent ticketing will mean far greater differentiation in the price categories on offer, with dozens of levels between 'general entry' and 'VIP' each offering consumers different access rights and benefits.

What's more, ticket holders will be able to alter their choices dynamically in the middle of the event – such as upgrading their seats or accessing premium match data. This type of ticketing approach also works to the advantage of the stadium by optimizing revenue streams – for example, ticket prices can rise as availability reduces. By 2020 stadia will be far more connected to their audience, with many possible applications for customer loyalty programs.

The accreditation process for athletes and the stadium workforce will become more straightforward and easier to manage too. Identity authentication, based on biometric measurements – fingerprint, iris or face recognition – will be made through an electronic ID or smart phone. One implication for the press will be journalists having their access rights extended – or rescinded – dynamically and automatically. Indeed, media numbers could be much reduced. Real-time data and multiple views of the field will allow journalists outside the
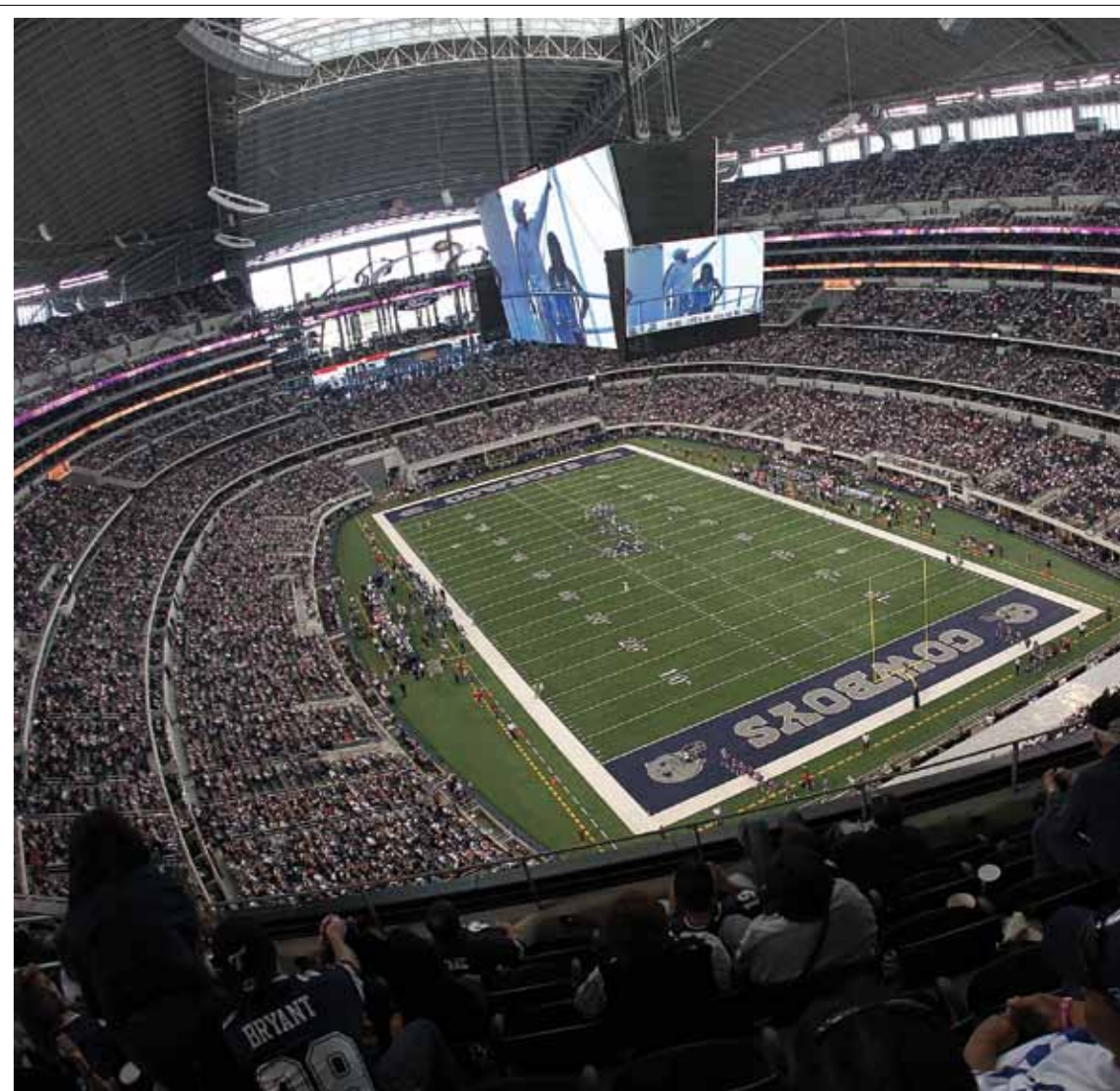
"Ticket-holders will be able to upgrade their seats in the middle of the event"

stadium to have the perception of being inside it. Commentators will be able to comment from their own media headquarters with the same level of feeling as though they were actually there. As well as freeing up space, this move could reduce the cost of constructing and maintaining expensive media facilities.

Additionally, predictive analytics will be able to control crowd flow, assess where people are and move them to alternative seats if required. It will also monitor the availability of additional space and check the status of emergency exits. This cloud-hosted technology will also

be crucial in providing security at large events. Face recognition through high-definition cameras will increasingly be used to assess – in almost real-time – any potential terrorist or hooligan threat within a large crowd.

But the new stadia technology will go a lot further than just providing enhanced convenience and security for spectators and event managers. Thanks to multiple cameras, biometric sensors, image recognition and 3D tracking, a vast array of information and images will become available, allowing fans to become much more involved in the event. The live spectating

experience will become closer to the on-screen experience, while for those viewing on-screen it will become more like the live experience.

"From the stadium perspective the revolution will be in the way we capture this information," says Cuartero. "We'll be able to allow the spectator to understand more of what is happening in the field of play through real-time data and stereoscopic, 3D or holographic viewing. It will enable the viewer to watch an event from almost any perspective from their mobile device or from home."

Venue perspective

What trends will shape the stadia of the future?
Environmental sustainability will continue to have more emphasis. We know that stadia don't conform to the general rules of sustainability, because they don't get used as much as other buildings. So the consequence is, if you want an environmentally responsible stadium, you build smaller.

Having said that, stadia are being used more. Not because of sport, but because of music. Groups aren't making money out of selling records, because everyone's downloading them. So they're all making money out of touring. Ten or 15 years ago, Wembley Stadium, for example, would have been lucky to get five sell-out music events a year, whereas now it might do more than twice that. But, if you plan it right, you can hold a concert one day and football match the next and it really is no big deal.

What about specific technological advances?
Lighting is one. We're starting to get low voltage, long-lasting bulbs in our houses, and that's starting to creep into sport. The biggest thing, though, is information technology, which has already changed sport fundamentally and will continue to do so. Take Stadium Australia, which we did for the Sydney Olympics. We wired it so that almost every seat could get a fibre optic cable connection. But they've never used more than 10 per cent of the capacity because, roughly about the same time, wireless technology started to take off. The technology changes so fast that it's really difficult to put your finger on where it's all going to end up. Not that it ever stops – it just keeps moving forward.

What does that mean for fans at stadia?
There are two separate audiences at every venue these days. There's the live audience –

Australian architect Rod Sheard is Senior Principal at Populous, the firm behind many of the world's great stadia. Here, he looks at how new technology will shape the stadia of the future

that goes to all the trouble of going there – and then there's the digital audience; the audience that picks it up in dots and dashes at home. Since technology has become so mobile, what we'll find is that the live audience will get more information than the remote audience, because the live audience always has the advantage that it's close to the centre of what's happening. So the operators, the owner, the club, whoever it might be running the event, can feed them

stuff that they may not necessarily want to put over a public network.

They could feed the local audience a choice of interviews coming out of the tunnel, and the information that will enable viewers at home to enjoy 3D multiview and in-event gaming, and generally feel much closer to the live stadium experience.

What else might change for the fans?
Smart-card ticketing will become commonplace. Once you've got there, then depending on what sort of smart card technology you have, it could actually be used as an automatic debit card, so you can just order up food and drink and you don't have to pay for it.

But probably the single most important thing the smart card does isn't really used very much yet, but I think in 20 years it will be, and that's the feedback. It will compile your profile; your Whereas now we've where you live; the sort of things that define you as a human being. The question is how much should we let someone else know that?

A smart card can recognise that you are a regular attendee at a certain event; that you regularly buy a certain product; even where you go because it traces your movements. If you can have all that information on all your potential customers, it makes you, as an operator, so much in control. "If we're going to book this act up, who should we contact?" It might push the ticket price up, because it's an 'know' you're going to have a very much more targeted audience.

How has the London 2012 stadium moved things forward?
It's taken a really important step. Everyone bought into the concept that Seb Coe and his team came up with – which was to say: "Look, it's just daft to submit all these big, fixed facilities every four years, and have them sitting there."

So we had a wonderful opportunity of an enlightened client, who wanted to think differently. When you've had the opportunity to move sport forward a little bit, make it a little bit more accessible to a few more bidding cities; and you do these things and touch the earth all a bit more lightly, that's the kind of project that sticks in your memory.

The 2020 stadium

The stadium of the future may not look too different at first glance, but the technology involved will transform the experience for fans, athletes and organizers alike

90,000
Smart devices

6 billion
Virtual spectators

Everyone track-side
Every spectator will have a 'second screen' for watching the action, perhaps connected to wireless goggles for ease and comfort. The screen will enhance their experience, and offer the option to switch their view – for example from the back of the stands to a pitch-side seat. This application will prove especially useful for those watching events such as the marathon, which leave the stadium.

Augmented action
Point your smart phone or tablet at an athlete and a range of relevant real-time data will appear on screen. For example, you could track the speed of a runner as he sprints for the line in the 5,000m.

Cloud control
With all the data stored securely in the cloud, there will be less need for expensive physical infrastructure such as a broadcast compound and operations center. The money saved can be diverted into the athlete and spectator experience or invested in other vital social or infrastructure projects.
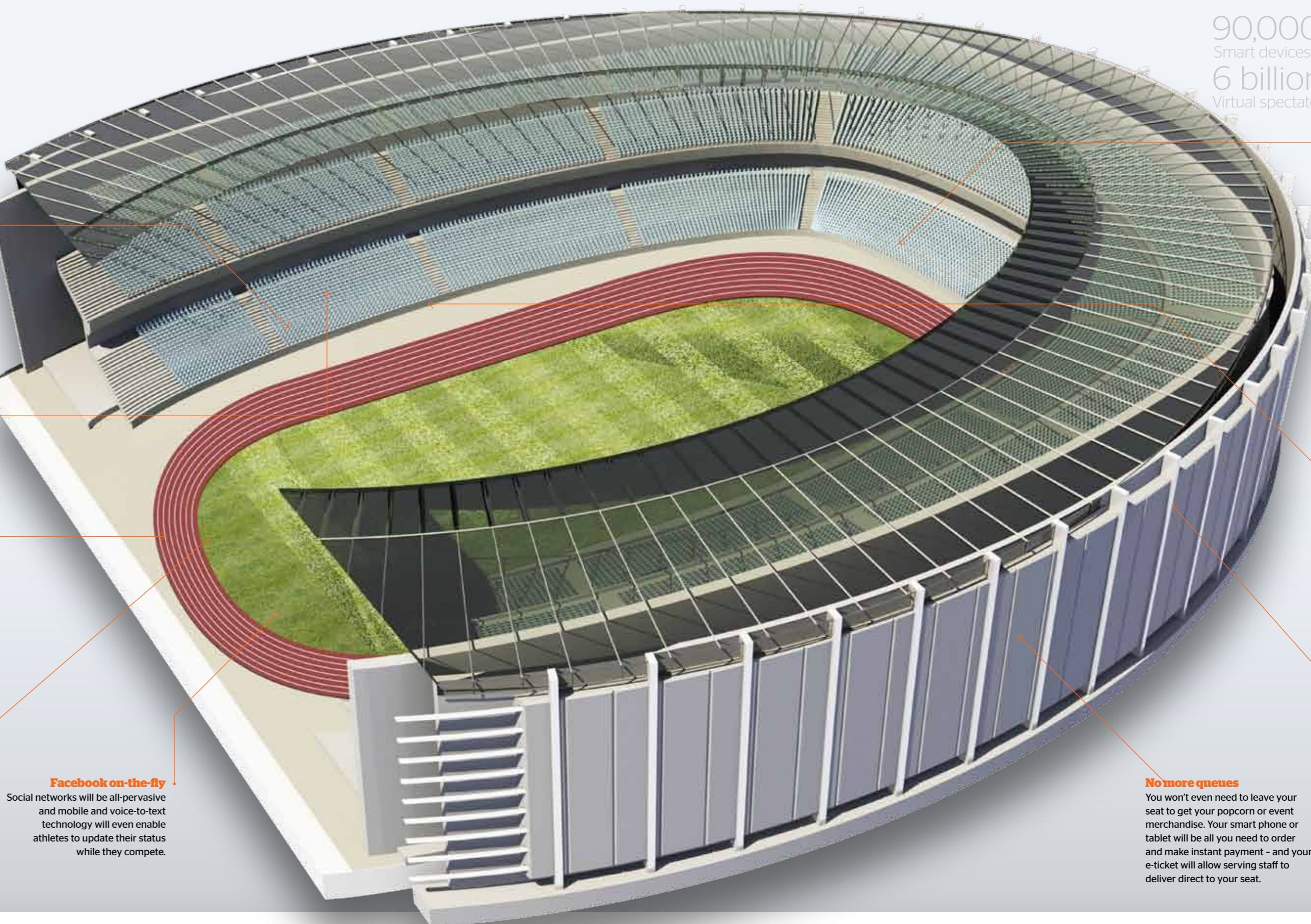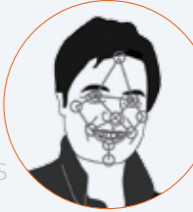
Cameras, cameras everywhere
Tens of thousands of lenses will cover tens of thousands of angles, generating the data that will enable viewers at home to enjoy 3D multiview and in-event gaming, and make instant payment – and your e-ticket will allow serving staff to deliver direct to your seat.

Facebook on-the-fly
Social networks will be all-pervasive and mobile and voice-to-text technology will even enable athletes to update their status while they compete.

Face in the crowd
Security and safety will be greatly enhanced for fans. Facial recognition technology and Big Data tools will be used to deliver information about people in the stadium in just 0.3 seconds.

Winning by numbers
The coaches' section will resemble a Formula 1 pit with trainers huddled around multiple screens assessing a range of real-time performance data.

No press please
With vastly increased quantities of data available remotely, the demand for on-site media provision will be greatly reduced. And the press pack could get even smaller if companies such as Narrative Science continue to hone their product. The US firm is pioneering the development of automated news reporting in highly data-driven sectors such as finance and sport. They've even got journalists involved in developing sophisticated algorithms which may yet spell the end of the wire reporter by the 2020 Games.

No more queues
You won't even need to leave your seat to get your popcorn or event merchandise. Your smart phone or tablet will be all you need to order

A sense-able vision of 2020

Eric Baczuk of MIT's SENSEable City Laboratory tells
Max Leonard how the data we generate with our smart
phones will help to design Olympic Host Cities of the future

One of the more unusual contributions to the London 2012 Cultural Olympiad was the Emoto project. It measured the worldwide audience's emotional response to the London 2012 Games, sifting Tweets for Games-related themes, then divining the sentiment of each one. The result was an evolving, real-time online visualization of the global mood, and eventually a data sculpture – a testament to the world's feelings about the Games. On paper, Emoto sounds intriguing; in practise, it is potentially one of the most exciting contributions to London 2012, one that has huge ramifications on how we organize, deliver and enjoy future Games.

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It might be obvious to speculate that if Usain Bolt breaks the record in the 100m there will be celebrations and good feeling in Jamaica; but what if you could, say, measure in real-time the British nation's reaction to an unexpected star performance by TeamGB in Handball? Perhaps you'd lay on more trains and buses to open-air screens, adjust the TV schedules, or even sell advertising targeted at the new handball fans. And this is just a small-scale example. By the 2020 Games, this kind of intelligence on what people are doing and feeling may help to deliver better transport provision, energy use, resource allocation and infrastructure planning. It could also help organisers and stakeholders react to events – managing the experience in the best way possible at a time when the city is subject to new rhythms and unpredictable disruptions.

There is also a commercial dimension. "We like to look at the broader interests, but there are intrinsic commercial interests that can come out of this type of information," Baczuk says. "People are looking for the crowd's response these days, to understand how people are reacting to the events that are happening. You're investigating crowd dynamics, you're looking into the make-up of the crowd, what their interests are, where they've been spending money."

More than that, though, the essential connectedness of the whole Olympic Games audience means that future Games will have to be ever more aware they're playing to the global stadium. "Now the world at large is participating, these people are finally having a voice, which can completely change the dynamics," Baczuk says. "You have to think of your audience as not being the 60,000 in the stadium, but as the global stadium, the millions of people watching – and this shifts how the events are organised and communicated. There's huge potential for re-thinking who the audience is and tapping into the people who aren't immediately there."

The next radical leap, which is only now becoming clear, is that the internet will soon be carrying more machine-generated than human-generated communication. The first practical applications of this are now being seen in the networked home, but perhaps, by the 2020 Games, your geolocated mobile phone will see your meeting is running late, check your diary and set your TV to record the athletics so you can catch up when you get home. Meanwhile, your fridge will see you've invited friends over and order more beers, to make sure there's enough to go around.

That's what it could look like on a human scale. But, as Baczuk says: "As all these things increase their interoperability, increasing operating efficiency, there will be a change on an even larger scale than just people."

For organisers, cities and governments, the possibilities are yet to be mapped out. After the social media revolution, watch out for the rise of the machines – but it will take human ingenuity to make it happen. ■

New media has already transformed the way viewers who aren't at the stadium experience live sport. Where previous generations gathered around a radio to find out who won gold, today we can stream events live on smart phones while simultaneously checking out what results are trending on Twitter.

Advances in media technology mean that by 2020 the passive 'armchair fan' will be a thing of the past. Tomorrow's remote spectators will be able to interact directly with events, share their passions with a global audience and get closer to the action than ever before. As Paul Moore, new media expert from the Atos Scientific Community, says: "Our ultimate goal is to expand the collective experience of the people in the stadium to everyone around the world. The person watching remotely will be part of the extended crowd."

Fans will even have the power to step virtually onto the pitch, as live footage and gaming merge into one. Everyone's seen someone fudge a penalty, or trigger a false start, and thought, 'I could do better than that.' By 2020, viewers will be able to put their money where their mouth is as the cloud allows for almost instant uploading and downloading of data. This data will be stored securely and deliverable to different groups.

"It's really exciting," says Moore. "For instance, you could take over a particular player in the middle of a football game and replay the situation they faced. You could take over the Formula One car and compete against the other drivers, or re-take a free kick your team missed."

As he explains, the technology to achieve seamless live gaming by 2020 already exists. The real work will be meshing two different systems into one immersive experience.

"Some of the replays you've seen during televized football matches work by converting live action into 3D," he points out. "Video games create a simulated animation model of virtual sport. Now we're working on merging those two together seamlessly."

Gamers will be able to share their results through social media, compete with strangers for prizes, or even challenge friends and family to a replay. By enhancing reality with the dynamics of an online video game, players will connect with athletes on the field like never before and open up a whole new level of interaction. A new generation of sports fans will discover the real meaning of performing under pressure.

However, if competing against world-class athletes sounds too tiring, there are plenty of other ways in which new media is making the sports viewing experience even richer. Viewers today are just part of the crowd, but in 2020 they'll be able to pick a virtual vantage point, from high above the stadium to the front row of a stand. And it's all possible thanks to multiview 3D.

As Paul explains, multiview 3D is technologically distinct from its close cousin, stereoscopic 3D. The latter is what you see when you go to a 3D movie at the cinema, whereas multiview is like being inside one of those 3D panoramic photographs you find online.

"Multiview 3D technology is already here," says Paul. "It's not great quality in real time yet, but it will be by 2020. By then you could conceivably watch a match from any angle you want."

One of the great things about new media is that this drive for greater interaction with any sport, on any device, at any time means information flows both ways. Spectators at the stadium can post pictures and videos online while tweeting about what they're seeing.

As viewers become broadcasters, spectators will have access to amateur feeds that capture the authenticity of the live experience, rather than relying on what a director and cameraman want to focus on.

Social media will also take the place of the commentator, as smart 'recommender' systems do the job of flagging up content based on what your friends are watching, what you've watched before and what's popular with people like you.

This trend towards a more social experience will have a knock-on effect for the design of future stadiums. "You know the big screen they have at stadiums, with pixels that are a couple of metres wide?" says Moore. "We won't need that anymore. Everyone will have their own device in the stadium so they can see the results and replays instantly."

That's just the start of what's possible. Wherever they are, viewers will be able to tap their screens and bring up archived video, social media feeds and relevant news on other events instantly. Data will literally become part of the picture, with real-time measurements superimposed on the action – showing us, for example, how far a long jumper is leaping even while she's still in the air.

Instantly delivering this amount of on-demand data involves meeting some truly global challenges. Increased access to video will mean developing smarter media devices backed up by an infrastructure that won't buckle under the demand.

But let's assume for a second that a breakthrough is made that solves these problems overnight at the click of a mouse. What might be possible then? Welcome to what Moore calls "virtual stadium world"...

"You watch the match in a virtual stadium, where you can 'sit' anywhere and interact with other spectators, who may be completely virtual but may also be there in person," he says.

"There would be real camera and microphone inputs (via smart phones or tablets) from real spectators, used to augment realism of the virtual world. The actual match is in multiview 3D and you can watch from anywhere, even on the field."

Moore's dream stadium may be educated speculation, but it's enough to get sports fans salivating. So, is it achievable by 2020? With the mix of optimism and pragmatism typical of a technology expert, Moore's answer is a definite "maybe".

But it's worth remembering that, in the world of sport, with a lot of determination and a little luck, anything is possible. ∎

Be part of the action

Atos new media specialist Paul Moore tells Matt Chittock that viewers will soon be able to take on their sporting heroes while they watch

"Our goal is to expand the experience of those in the stadium to everyone watching around the world"

Video vault

Some of the biggest new-media developments of the next decade will come in video-recognition technology and automatic data tagging. As they become standard, the cloud will come to host a vast library of instantly-searchable sports footage. Owen Slot, Chief Sports Reporter at *The Times,* picks out three obscure highlights he would search for first

Olympic Shooting, 50m rifle, Athens 2004 & Beijing 2008

At Athens 2004, American shooter Matt Emmons was so far ahead in the rifle shooting (50m rifle, three positions) that, for his last shot of the competition, pretty much all he had to do was hit the target. What Emmons did next was this: he did hit the target, but the wrong one. He aimed at his neighbour's target. An unbelievable way to blow a gold.

Four years later, Emmons was way ahead of the field, and with a half decent last-shot his Athens experience would be redeemed. He took aim and hit the target. But only just. It was such a bad shot that he went from gold position to fourth.

He was back in London to try to put it right. Again.

Jimmy Connors versus Mikael Pernfors, Wimbledon, 1987

Wimbledon's lawn tennis courts offer a cruel reflection of greatness getting old. We thought we were seeing the great Jimmy Connors age before our eyes in the fourth round in 1987 when the determined, punchy young Swede, Mikael Pernfors was putting him to the sword. Pernfors was 6-1 6-1 4-1 ahead when he found himself on the wrong end of what is arguably the greatest comeback Centre Court has ever seen.

There was a point in this match – a backhand double-fister down-the-line – which seemed to transform the 34-year-old American. He whipped himself and the crowd into a frenzy, won 18 of the 25 games and took the match. In his words: "My ego was hurt. I had to do something."

Olympic Skicross, Vancouver 2010

American-born skier Chris Del Bosco nearly blew his career with wild antics – but he was given a shot at redemption with the Canadian Skicross team at the Vancouver Winter Games. He was phenomenally talented at the sport, courageous, loved competition and went into the final as one of the favourites.

But he got off to a bad start – and going into the last jump he played the gambler's card, an all-or-nothing high-risk maneuver that cut off the corner and, if executed well, could have got him gold.

But Del Bosco lost control and blew the race and his bronze. "Third place," he said, "I guess it's all right for some people." It wasn't for him.

Steve Cram is in a commentary booth, watching five views of Wimbledon on different screens, when Ascent drops in to meet him. Once the preserve of commentators, such a wealth of action is now increasingly available to ordinary viewers through digital TV and the internet.

It's not only video where the viewer has caught up either: he or she now enjoys the same information sources as the commentator: "Sometimes an athlete walks off the track, tweets, and the viewer knows instantly," Cram says.

"Where we the broadcasters used to be the only conduit between the event and the viewer, now, they don't have to wait for us. Sometimes the viewer is better informed than we are. Our job as this happens is increasingly to lend something extra: insight, opinion, background. They've got what's happening, it's about interpretation – my interpretation."

Of course, Cram's interpretation is one that has the authority of experience, and will spark interest in the millions of social-media conversations going on among fans. But he also provides a human touch, and is successful thanks to his discretion.

"My role, as a good sports journalist is using my contacts and my background information," he says. "I know lots about athletes that I won't mention on air, but it will help me to make that split-second decision about what to say."

Looking ahead, Cram sees the media landscape fragmenting still further: "Now, at an athletics event we have separate track and field feeds. You might be a field-event fan and take just the field-event feed," he says.

"At the London marathon we do the integrated feed for BBC One, but you can watch the women's race all the way through if you want to. You might soon be

30 minutes with... Steve Cram

Ascent speaks to the Olympic medallist and award-winning BBC broadcaster

able to choose which camera you want to watch – something that is normally the job of the director."

In years to come, viewers on internet-enabled TVs will not only be their own director; they'll use multiple windows to conduct their social-media conversations and frame the event in a unique way.

"You'll also be pulling up archive videos," says Cram. "You can say, 'I'm preparing for this 100m final, I'd like to see Jesse Owens winning in 1936, because they've just mentioned it in the studio. And you can go and grab that. You can add your interpretation of the build-up to the one they're offering in the studio."

Yet there are still questions about how this rich experience will be achieved. High-quality events need high-quality coverage – and the ubiquity of free-to-all media such as Facebook and Twitter threaten sponsors' ability to monetize their contribution. Which will pose a problem for sport, if commercial interests cannot justify investing in the events and the technology that brings them to us.

Cram explains: "Companies will say, 'why don't I just sponsor the individual athlete, or the footballer, since he's got two million Twitter followers and his own TV channel?' It offers some real opportunities for individuals, but collectively it's yet to be worked out. These issues are going to come to a head over the next four-to-five years." ■

Reaching out to people

Paralympic sport is embracing digital technology as it pursues a seamless solution for fans, says Xavi Gonzalez, CEO of the IPC

As the Chief Executive of the International Paralympic Committee (IPC), Xavi Gonzalez (pictured) has a vision of new media as a powerful tool for uniting and extending the Paralympic community – delivering increasing amounts of high-quality content to fans and partners as quickly as possible.

The IPC has been a trailblazer in the field of new media since 2006, when it launched an internet television channel – one of the first sports federations to do so – for the Torino 2006 Winter Games.

And Gonzalez sees the iPad- and Flash-based SMART Player, developed in conjuction with Atos for the London 2012 Games, as only the first step in the IPC's expansion into content that is suited to the emerging multiple-screen environment.

The SMART platform delivers real-time results tickers, stats, athletes' biographies, news and social media, all integrated into the same view as live sports coverage or highlights. Already available for Paralympic Swimming events and Wheelchair Basketball, this information should cover all Paralympic events by 2020.

Gonzalez's vision is that the new media experience must be seamless, ubiquitous and deliverable, to whoever wants it in the language and format that suits them. "New technology is a fantastic tool for us. It needs to be flexible, innovative and applied with common sense," he says.

Less important is the form the new media takes: his demand is simply that it is the most effective, convenient conduit for the multiple information streams that enrich the Games experience. He says: "The spectator at home must understand the event as well as people in the stadium do, with all the scoreboards and information that they have."

For Gonzalez, a crucial aspect of new media is that it allows you to develop a dialogue and a closer relationship with fans: "One of the ways we believe Paralympic sport excels is being close to the people. We see this in the atmosphere, the spirit of interaction between the spectators and the athletes in competition at the Games.

"Our challenge – and at the same time our opportunity – is to use new technologies to bring a more customised, personal experience, transmitting that unique atmosphere to the viewer.

"Our new media programme is also dedicated to partners, broadcasters and other media. We must deliver the information for them to use. Part of this process is to include our athletes, who are consumers of technology, consumers of information, and also generators of content," he says.

"We're quite new to this digital path, and who knows where it will take us," Gonzalez adds. "The Paralympic Games is a community, one that we're building by creating engagement in this new world of technology. If, by 2020, we've integrated all new technology opportunities, whatever they may be, in a product that can be scaled to all our events, which we can deliver anywhere in the world, then we'll have succeeded.

"For me, the key issue is that content must be as accessible as possible, and technology must make that happen." ∎

▶ *Crowd pleasing*
One of the ways Paralympic sport excels is in being close to the people

"New technology is a fantastic tool. It needs to be flexible, innovative and applied with common sense"

Atos | Worldwide Paralympic IT Partner

Games changing

Ubiquitous network connectivity is coming – and it will transform our lives. Atos ubiquity specialist Guy Lidbetter considers its impact on sport with Chris Maillard

What if communications networks were truly like air? Always on, rarely thought about but absolutely everywhere, ubiquitous even? And what if they included not just computers, but other physical objects: ovens, washing machines, medicine bottles, even clothes – all capable of communicating over the internet responding to and initiating interaction. Now that would be real magic. It's a mind-boggling thought. But prepare to be boggled; it's almost here.

Network connectivity is enabling the latest information revolution. The digital generation shows no sign of losing its appetite for the applications and networks that deliver its daily diet of information and social interaction. As those networks become more pervasive (WiFi, 3G, 4G and so on), we are heading into a new era of technological 'ubiquity'.

So what happens when we reach the point when the network becomes a web of invisible, continuous connections? And what does that mean for sport?

"Ubiquity," says Guy Lidbetter of Atos' Scientific Community, "is about the merging of things that have been separate up to now. The boundary between the physical and digital experience is blurring and this is just the start. While it may not seem so, when compared to what we can expect in the future our world today is only loosely connected."

The number of variables could almost be infinite, and it poses some very big questions for sport. One of the biggest is 'how should sport connect with its digitally aware audience?' At the moment, sporting events like the Olympics and other major tournaments are delivered as completely physical events. From a sustainability perspective, with cloud computing and ubiquitous networks, that may soon start to seem a bit old fashioned.
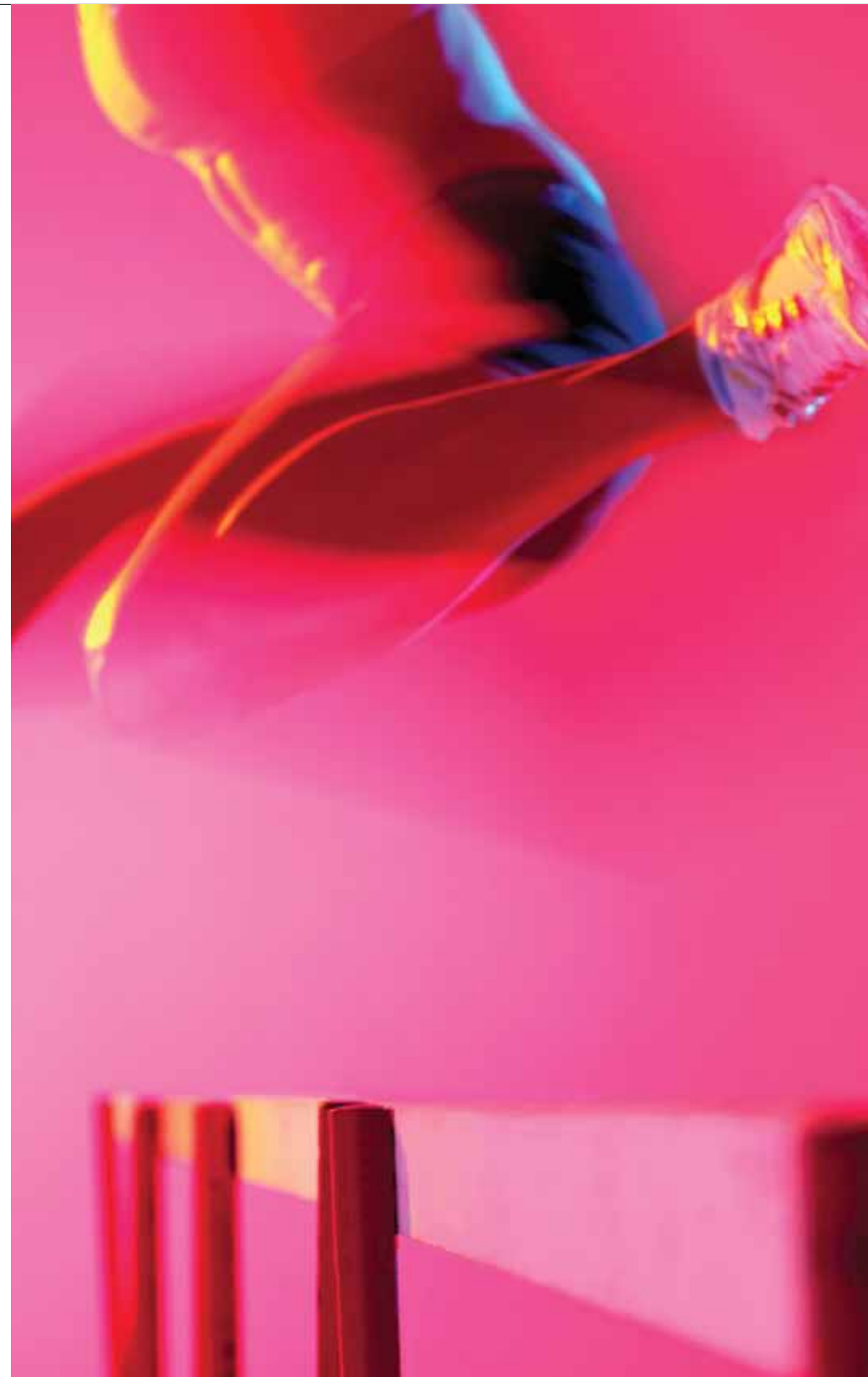
Lidbetter speculates: "Thanks to advances in cloud technology, for example, will there really be a need for a single city to host a major event like the Olympic Games – building major infrastructure, broadcasting compounds and operations centres?

"Will events even need to be hosted by just one city? Today, there are very few cities that have the capacity and financial means to be able to host an Olympic and Paralympic Games, with their demands on infrastructure, funding, facilities and manpower. So why not use the technology available and open it up to a number of cities, bringing the event to many more people locally but more remotely accessible than ever before?".

This may not happen by 2020, but looking further ahead Lidbetter sees major sporting events being hosted across separate countries but presented as a fully integrated experience, no matter where you are.

"Imagine a 100m final with eight people – none of them physically in the same place. Technically, it's conceivable, even if all the pieces have yet to be put together," he says.

So, it is no surprise to Lidbetter that football body Uefa has recently declared the possibility of delivering a 32 nation European Championships from 32 'host' cities. "You can certainly expect some cultural opposition to such a prospect," he acknowledges. "But the so-called digital natives will simply take it in their stride. By that time the boundaries will have blurred so much between the real and the virtual experience that major sporting events will be well placed to make full use of the underlying technology to deliver the ultimate user experience – until of course the next revolution comes."

The 2020 Olympic Games will still be the greatest show on earth. It has the widest audience of any sporting event. Nevertheless, there are many areas where ubiquity will change fundamentally how it is experienced, enabled by the cloud and with the necessary security checks and balances to protect personal identity and information.

Lidbetter adds: "For example, embracing the full potential of social networking could help sustain public engagement in the four-year cycle between Games. A large section of the audience loses interest in the interim period, but that will change." He envisages a more on-going attraction with a long-term relationship between event and fans that is more involving and immersive.

Many sports already generate vast amounts of data. Formula One, for example, has long been at the vanguard of applying technology and has excellent telemetry that generates real time data which enables the team to change tactics and ultimately affect the outcome of a race. The quality, quantity and immediacy of the input is enormous. Ubiquity isn't just about volumes of data but how and when they can be applied in the right context at the right time.

"Other sports are catching up" says Lidbetter. "Physical sensors for athletes, providing data on performance impact,

positioning, physical condition and other information we haven't even thought of, are starting to arrive. Today, you see the coaching booth with a couple of guys looking at their laptops, but how long will it be before you see a bank of displays analyzing every detail of every player in a football match like an F1 pit crew is already doing with every component of a car?"

Sports fans will love player trackers, and the data is available; it's just a case of getting it into the network and out to the fans, feeding into social media to provide a whole new experience for supporters. As ubiquitous connectivity becomes the norm with mobile devices delivering a complete user experience, it will all become much more integrated.

Fans will be able to get all the information they want by choice and the underlying systems will learn their behavior to tune that experience to their preferences.

"There are great opportunities for franchise owners and broadcasters," says Lidbetter. "And in a world where everything is merging together, who will those broadcasters even be? Who will own the data and who will provide the channel to get it to the fans? Maybe today's big broadcasters will shift across to social media and rework their offering? But who is to say the broadcast rights of a major sporting event won't one day be snapped up by Facebook or Twitter?"

One thing is certain. These questions will all be answered in tomorrow's world in which ubiquitous data meets ubiquitous connectivity to deliver a user experience that we are only just starting to understand, and it will all happen sooner than we may think.

"The evolution of social networking, Big Data, new media and smart stadia will combine to provide a virtual experience that would be unrecognizable today," concludes Lidbetter. "10 years from now, the way in which we consume sporting events, whether at the venue or from afar, will be like comparing the widescreen HDTV experience of today with watching black and white TV in the 1960s." ∎

"Imagine a 100m sprint final with eight people – none of them in the same place"

What the cloud means for you…

Paul Albada Jelgersma, an Atos authority on cloud computing, reveals where the ubiquitous digital world is heading

"

The whole world is going to be ever more digital than today. If everything becomes digital, everything can be stored in the cloud – which leads to three key outcomes

1.
Location relative to information is taken out of the equation. It doesn't matter where you are in the world, you can access all information in all formats quickly and easily.

2.
Because the cloud is completely scalable, almost every question you can ask will be answered in real time. That's not particularly new from a consumer point of view, but it will have a remarkable impact on business processes and automation when completely distributed systems and databases are talking to each other in real time.

3.
There will be a change in the cost model as customers will pay at the moment of access and use. If you think Apple App Store, that's the kind of model we'll see increasingly. You won't be buying the complete application suite anymore but paying for the functionality you need at that point in time.

Our life in 2020

07.00 Sensing she's had exactly eight hours of sleep, Olympic athlete Ana-Sofia's alarm goes off and instructs the curtains to open. She sits up and watches a sequence of news items, tailored to her interests, on the video wall.

07.30 Ana-Sofia's microwave senses the label on her breakfast and cooks it to perfection as she logs in to her personal message wall.

07.45 The fridge detects that the orange juice is running low and sends a message to the supermarket adding it to the next delivery.

11.15 Ana-Sofia's smart phone has sent a message to the taxi company ordering a car, pre-programming it with her itinerary and paying the fare. The taxi arrives exactly on time.

11.30 In the taxi, Ana-Sofia accesses her secure personal file in the cloud and finds some concentration exercises prepared by her coach.

12.30 At the stadium the auto-accredit machine scans Ana-Sofia's accreditation badge on her smart phone, correlating this with a facial recognition match against her biometric data record to admit her to the competitors' area.

"Welcome to the Stadium, Ana-Sofia. Good luck."

How much is too much?

What's the right balance between technology and sport? Simon Kuper asks IOC Chief Information Officer Jean-Benoit Gauthier

If an ancient Greek somehow rose from the dead and showed up at London's Olympic stadium, he would quickly figure out what was going on. It might take him a while to learn the rules of the newer sports, but if he had been a regular at the Games nearly 3,000 years ago, he would soon feel at home. Sport stadia have not changed that much since the first one went up at Olympia. Thousands of people still gather to cheer the athletes in the arena below.

Suddenly, though, everything has begun to change. Already the crowd comes armed with smart phones. A decade from now, everyone in the stadium could be their own TV director, effectively choosing which images they see, how often, and who they share them with. By then some events might not even feature real people, but holograms.

Jean-Benoit Gauthier, Chief Information Officer at the International Olympic Committee, knows more than most about the shape of the future. You would expect him to be a cheerleader for change. But in fact, Gauthier has great sympathy for the traditionalists. He worries that technology might damage an eternal human experience.

One central trend, says Gauthier, is that spectators, both inside and outside the stadium, will become less passive.

"Today, we are still pushing lots of information towards people. In eight years there will be a different approach: they will want to gather the information, diffuse it and comment on it," he says.

Jacques Rogge,
President of the IOC

"The four-year time-frame of the Olympiad gives us the opportunity to assess how the sports industry – and indeed the world at large – has developed since the previous Olympic Games. This is particularly poignant when you consider the rapid advances of information technology. Since Beijing 2008, for example, social media has become ubiquitous, transforming the way we communicate with one another and engage our audiences. Information technology has also given athletes a new, highly sophisticated set of training tools. All this in just four years; who knows what new developments will come next. The Olympic motto, 'Faster, Higher, Stronger', encapsulates the human desire to always strive for better. It is vital then that we embrace new technology and remain open-minded to all the ways in which it can enhance sport, not just for those who perform, but for those who watch and manage too."

The spectator will communicate ever more with people outside the stadium, but perhaps also with athletes after the event. Wherever spectators are watching from, 'augmented reality' will become the norm. Let's say you are watching a cycle race through London. The bikes pass Westminster Abbey. You are curious to learn more about the building. You click on an image of it, read about its history, and then tweet it.

This sounds great, but if everyone is watching their own personal event, then we might lose the thing that has made stadia magical ever since those originial Olympian days: togetherness. As Gauthier says, "What people on-site remember is that they were together, assembled. The thing that scares me is that we can all be watching alone."

People don't go to a sport stadium for the view. You can see sport better on TV, and then you can see the replay. Gauthier says: "If people are in the stadia they are looking for something else: for ambiance, for atmosphere."

But the trend to individualism has already invaded the living room. Traditionally, people watched sport with family or friends. Now, however, they increasingly watch with virtual 'friends' on social networks. One eye is on the TV, and the other on their computer and perhaps also the mobile phone, where they are constantly sending and receiving messages about the event. That reduces the emotional intensity of the viewing experience. And that new behavior could

reach the stadium if – in one vision of the future – every seat has its own screen where the spectator can watch selected scenes from the event. That's not the future that Gauthier wants. He says: "To come to the stadium to watch a screen would be idiotic. We don't want to harm the stadium experience."

Obviously, he agrees, there will be some technological innovations. For instance, rugby spectators can already listen into the referees' remarks on a particular FM radio station. "That works very well," Gauthier admits. But perhaps stadia can have too much technology. Fifty thousand screens would distract our gazes from the action happening before our eyes. Gauthier says, "You must leave the athletes at the centre. The athletes are magnificent."

It is the millions watching outside the stadium, rather than those inside, who probably need technology most. Advertisements for TV sets have long boasted about taking you so close to the action that you are virtually in the changing room. That proximity is what distant viewers crave.

Stanislas Magniant, an expert on social media, notes: "Sports events seem to be democratic events, but in fact they're not. Most people cannot afford to go."

One day, if you haven't got the money to fly to the Olympic Games, you will just take the bus to your local stadium, buy a cheap ticket, sit with 100,000 others, and watch the Olympic 100m final as if it were happening in front of your eyes. You could even watch a race between dead athletes, brought back as holograms, just as the dead rapper Tupac Shakur recently appeared at the Coachella music festival.

Or, you could imagine a race where the entire crowd is present virtually. Magniant muses, "The ultimate test may be to create a virtual Mexican wave. Can you do that virtually? I hope not, but everything seems possible these days."

If we can extend the ancient experience of the stadium to the excluded millions, that's marvellous. If we destroy the stadium experience, that's not so good. ■

"The ultimate test may be to create a virtual 'Mexican wave'"

Screen test
Ascent asks the experts

**Dominic Rumbles,
Head of Communications,
International Rugby Board**
"We want to be at the forefront of technology – to look after the welfare of players and also to improve the officiating of matches. Referees can already consult with the video judges to see if a try has been scored and soon they'll be able to consult over infringements in the build up in a trial we're running. Getting it right is important because jobs often depend on results. But the hot topic in rugby is GPS use. At international level we monitor the G-force involved in impacts – which can be ferocious – and how performance drops off when players get tired. We want to get a better understanding of the physiological side. But we have to make sure that the benefits any technological improvements bring outweigh any adverse impact on the shape and character of the game."

**Sheila S. Hula,
Publisher of Around the Rings**
"The recent explosion in tech is unbelievable, mind-boggling and impossible to keep up with. Hardware confusion, we call it. The digitalization of media has forced journalists to become more tech savvy. It also means that anyone with an internet connection can now call himself or herself a journalist, which means that a reporter's competition has become everyone else at the event. It's also the sheer number of programs, media and software to manage. Dashboards do nothing to make life easier and – in my humble opinion – contribute greatly to making us feel that while we are running faster and faster, we aren't getting anywhere. That's not to say everything is harder. Digital recorders make it easier to conduct and upload interviews of professional quality without the drudgery

of transcribing and editing tape. It's also fantastic to be able to check what the weather will be at a specific Games venue to see if we'll have a full moon during the Opening Ceremony!"

**Klaus Schormann,
President of the International Union of Modern Pentathlon**
"We are a traditional sport, celebrating our 100th anniversary, but we are also one of the Olympic sports that has embraced technology most. We really are Modern Pentathlon. In London, athletes were able to shoot using laser guns and electronic targets for the first time. It has been a complicated change and we've spent a lot of time working on it. But there are many advantages: safety, sustainability and really improving the spectator experience. Today, no sport can afford not to embrace technology. It's vital because it's the way to bring new young people into sport. They love technology. And they want to see it in sport."

**Charmaine Crooks,
five-time Olympian and former IOC Athletes' Commission member**
"Technology is already pretty much everywhere, whatever you do in everyday life, and also for athletes – and I think that's only going to increase. It's made everything more efficient and faster, and given athletes new ways of training and communicating. But it's not essential. You can succeed without it. There's plenty of athletes from developing countries who don't have access the latest technology and who still record great results. Whatever technology you have or don't have, you still have to work hard, to train hard, to have drive and determination and talent, because there is no app for any of those things – at least not yet."

Count down to Rio

While the Olympic and Paralympic Games are famous for putting a global spotlight on local talent, it's not just the athletes that get their moment to shine. For Elly Resende, Chief Information Officer at Rio 2016, the Games will be the latest milestone in a successful career that has brought together his twin passions for events and technology.

Elly's road to Rio 2016 began deep in rural Brazil where he was born into a household that was full of "the backs of televisions and radios" – part and parcel of his dad's job as an electronics technician.

This early exposure to the nitty gritty of IT inspired him to leave home and study electronics as a teen. After establishing his career in telecommunications he was invited to work on the prestigious 2007 Pan American Games.

"The PanAm Games were definitely where I got the 'bug-bite'," he says. "It brought together my technology background with the excitement of working on a major event."

Elly Resende is the man planning to leave Rio – and the whole of Brazil – with an IT legacy it can be proud of in 2016

What does it mean for you to be working on Rio 2016?
"It really is a dream project for me. It's a once-in-a-lifetime event in my country and being able to participate in writing history, which is what I think we're doing, is amazing."

How does the challenge of the Olympic Games compare with the Pan American Games?
"I thought the PanAm Games were big, but just winning the Olympic bid was a huge achievement for Brazil. Our bid was not just about preparing the information infrastructure – it was convincing other people that our ideas were viable. I think that in the public's mind Rio started off being compared with countries they thought were more developed and established. To overcome that was a significant challenge."

Could you give us an idea of the scope of your role?
"Paving the way for a world-class event means supporting people's modern telecommunication needs – from spectators sending text

messages across the stadium to journalists live blogging from the media centre. It also means planning for the devices that people will be using in the near future. We're still four years ahead of the Games and each year more innovations come to light. Think about tablets, for example, it's not long ago that they were launched and they are already a mass success."

What are your priorities?
"My main priority is to provide a secure and robust infrastructure that will be virtually future-proof. We're working on a good infrastructure in terms of capacity that will deliver all the bits and bytes we need to provide to the end user – whatever device

> "My priority is to provide a secure and robust infrastructure that will be virtually future proof"

they're using. Having that in place will allow us to react quickly as the technology evolves."

What about a technological legacy that extends beyond 2016?
"We've got the chance to improve the information infrastructure of the city, state and arguably even the whole country. By ensuring stadiums are fully wired up for modern sports spectators they can attract all kinds of events – from trade shows to pop concerts. For instance, we're working with the city to develop public WiFi networks. If you go to places like Copacabana or Ipanema you can already use WiFi on the beach. This becomes our legacy.

What message do you have for your fellow IT professionals?
My message is probably that hosting the Olympic and Paralympic Games in 2016 is not a chance for us to showcase cutting-edge technology just because we can. We have to use reliable, mature technology that will ensure that the events happen successfully. Despite what we might like to think, we have to keep reminding ourselves that this is a sports event – not a technology event!" ∎

Atos will be working with Elly and his team to deliver seamless and secure technology operations and services for the Rio 2016 Games.

Elly Resende: sound bytes

Tablet or mobile? You can only have one...
It has to be both! I can't decide between the two.
What's your favourite city outside Brazil?
Paris.
What are your favourite Olympic sports?
I've got a general interest in everything, but if pressed I'd say that my top two sports are Beach Volleyball and Swimming.

Do you prefer the beach or the city?
The beach.
Facebook or football?
Football.
Restaurant food or street food?
Restaurant food.
Bill Gates or Steve Jobs?
Steve Jobs.
Facebook or Twitter?
Facebook.
Email or face-to-face?
Face-to-face.

My life in 2020

At just 23, judo star Teddy Riner is already an Olympic and five-time world champion. He tells us how he imagines his life will have changed

When you're an athlete and in the middle of your career, your natural tendency is that you don't look too far ahead. At 18, I was the youngest ever world champion in Judo, and I'm still only 23. This year, becoming Olympic Champion was my only focus. I'd been preparing for it for four years. I'd been the individual world champion five times and part of the team world champions – and the title that was missing was the Olympic Games. I was determined to win gold.

But if I do now start to look further ahead, I realize that I'll be in my early 30s by 2020. There's no doubt in my mind that I will still be competing at the highest level in my sport at that age. In judo there are already several world-class athletes in their 30s – and I hope to still be there.

It won't be my only focus though. I hope to be an accomplished businessman too. I'm studying at the Paris Institute of Political Studies. My course contain a bit of everything – history, economics, management, finance and English. I want to learn more about society and the world, to plan for my future.

If you understand a bit in all these different fields, it means you have a lot to bring to any career. To combine sport and business might be a good thing. I'd like to be working with kids somehow in 2020, probably 16-17 year-olds who are experienced young people who've already had some training and who can benefit from what I can teach them about Judo.

I already travel a lot for competitions and I can't see that changing. I'd love to think we'll have flying cars by 2020, but at least cars will all be electric and we won't be dependent on petrol any more. I can easily see myself living in London, Spain or the States too.
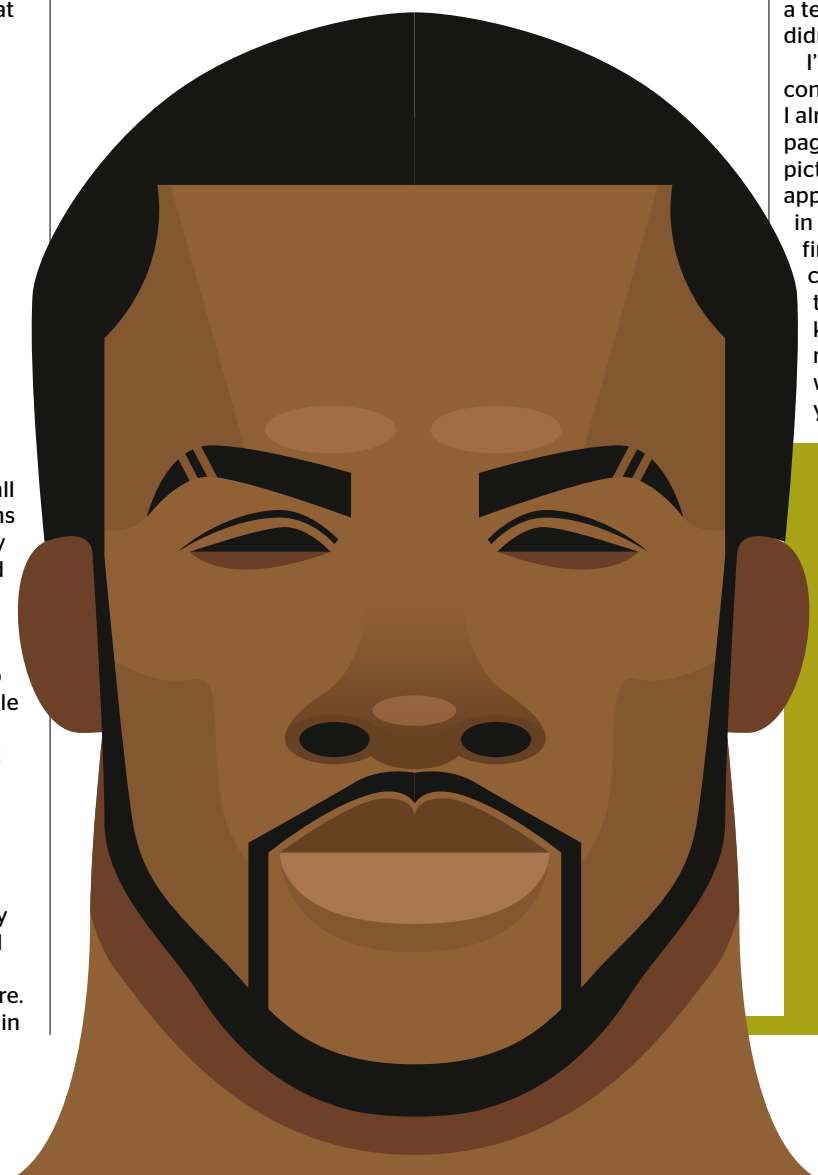
In terms of technology and sport, I expect broadcast technology to change a huge amount. We'll have cameras all around us as we compete, smart kit and sensors monitoring our breathing and heart rate. There'll be all manner of gadgets to improve the way we train and compete. I think I'll be much more reliant on data to assess how well my training sessions are progressing and video footage to analyze the technique – and any weaknesses I can pick up in my opponents.

Even now it's changing quite rapidly – the recourse to video replays in the refereeing and judging is just one example of a technological change. That didn't exist until recently.

I'll also be much more connected to my fans. I already update my Facebook page every week with words, pictures and videos and am approaching 100,000 fans in social media. Even now I find that hundreds of people comment on posts and thousands click 'like'. That kind of reaction is incredible now, so it's hard to imagine what it will be like in eight years' time. I can't wait! ▪

Quick CV

DOB: 7 / 4 / 1989
Born: Pointe-à-Pitre, Guadeloupe
Height: 2.04m
Weight: 130kg

Olympic Games:
Gold medal: 2012
Bronze medal: 2008
World Championships:
Gold medal: 2007, 2008, 2009, 2010, 2011
Team Gold: 2011
European Championships:
Gold medal: 2007, 2011

Top tech trends for 2020

The Atos Scientific Community pick out their five to watch

Real-time data use
Allowing us to identify and respond to patterns even as they are forming

The standardization of social networks
Moving from a proprietary ecosystem, dominated by one or two big players, to a more open and federated environment including many more different types of network

Customized viewing
Technology that allows everyone to have their personal TV channels showing their preferred shows or events, angles and commentary styles

New security sources
From social analytics to voice and facial recognition, robo-cops, robo-cameras... even crowd sourcing

Techno-sport
The rise of 'athletic' video gaming, virtual sports leagues and robo-competition

ascent magazine

key contributors

editorial

Atos Worldwide IT Partner

Atos Worldwide Paralympic IT Partner