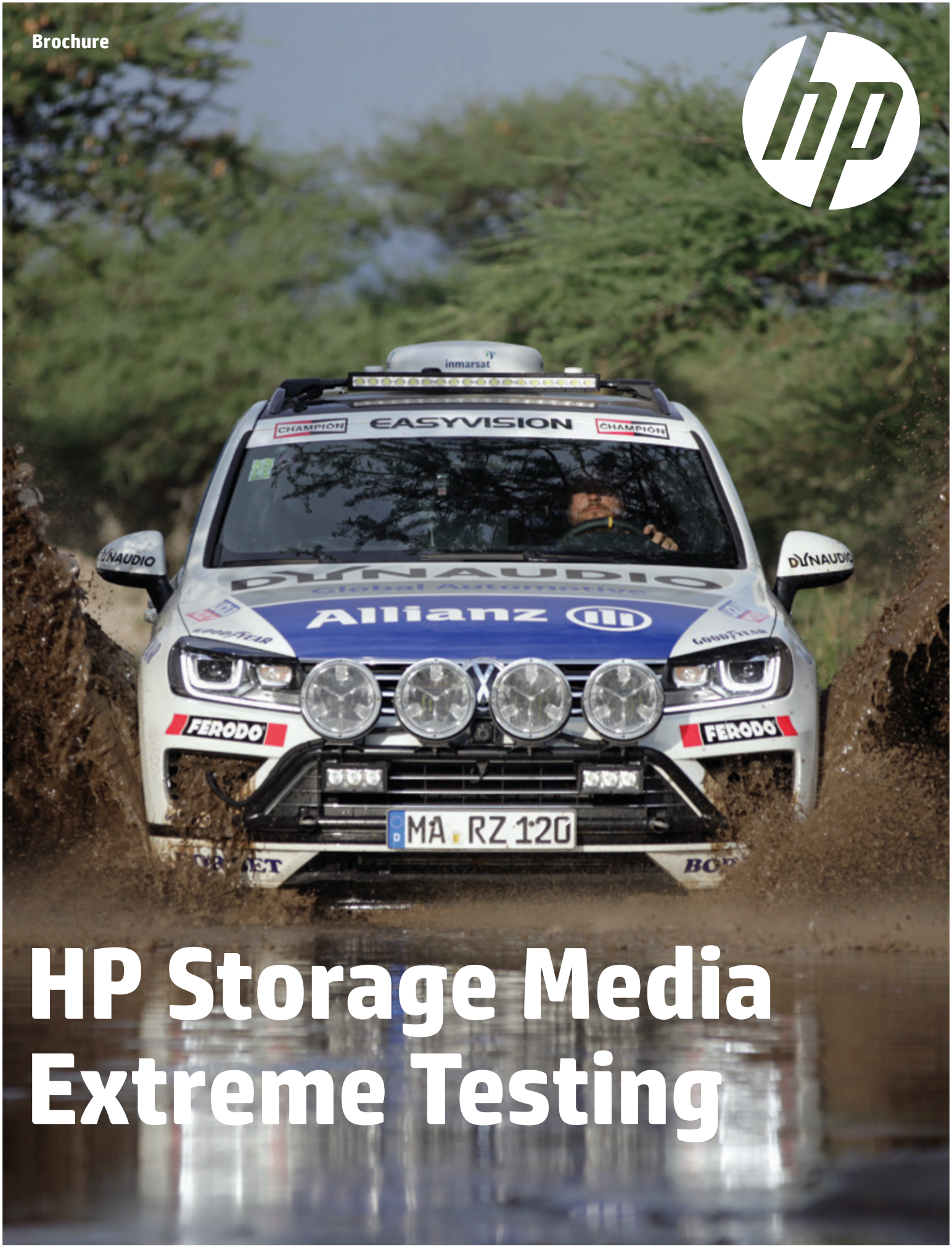
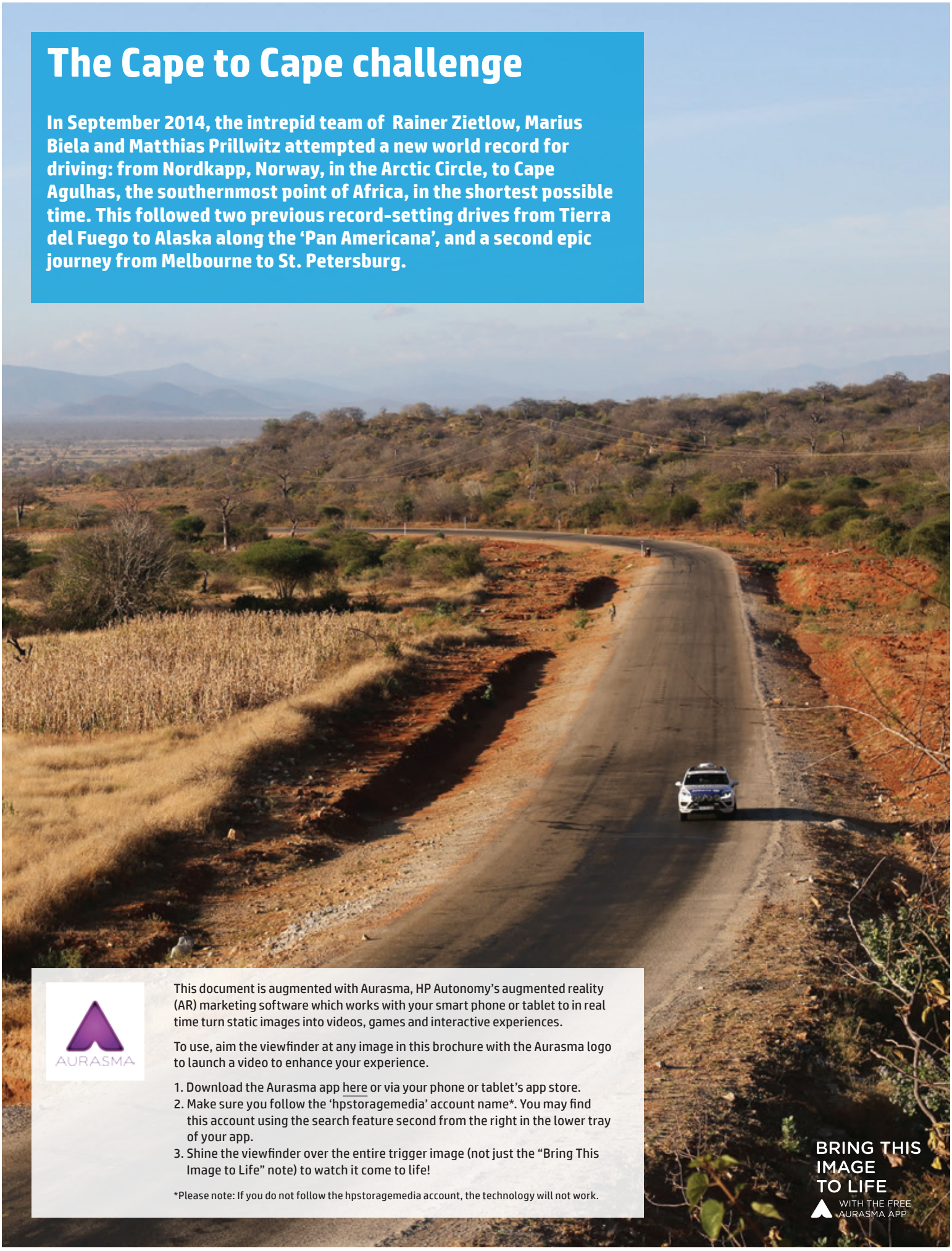
Brochure



HP Storage Media Extreme Testing

The Cape to Cape challenge

In September 2014, the intrepid team of Rainer Zietlow, Marius Biela and Matthias Prillwitz attempted a new world record for driving: from Nordkapp, Norway, in the Arctic Circle, to Cape Agulhas, the southernmost point of Africa, in the shortest possible time. This followed two previous record-setting drives from Tierra del Fuego to Alaska along the 'Pan Americana', and a second epic journey from Melbourne to St. Petersburg.



AURASMA

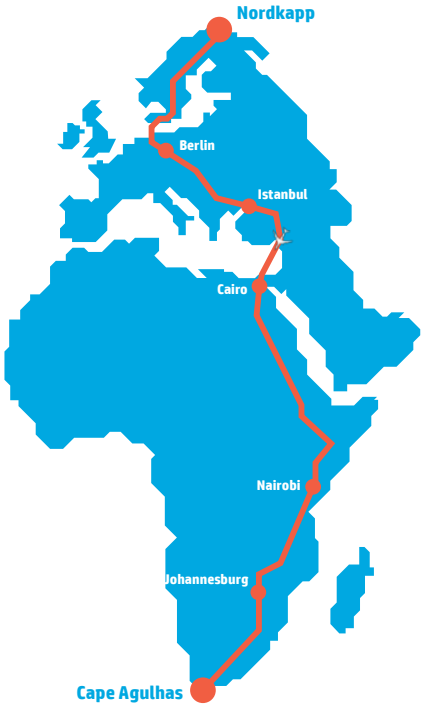
This document is augmented with Aurasma, HP Autonomy's augmented reality (AR) marketing software which works with your smart phone or tablet to in real time turn static images into videos, games and interactive experiences.

To use, aim the viewfinder at any image in this brochure with the Aurasma logo to launch a video to enhance your experience.

1. Download the Aurasma app here or via your phone or tablet's app store.
2. Make sure you follow the 'hpstoragemedia' account name*. You may find this account using the search feature second from the right in the lower tray of your app.
3. Shine the viewfinder over the entire trigger image (not just the "Bring This Image to Life" note) to watch it come to life!

*Please note: If you do not follow the hpstoragemedia account, the technology will not work.

BRING THIS IMAGE TO LIFE
WITH THE FREE AURASMA APP



The route took them through 19 countries: Norway, Finland, Sweden, Denmark, Germany, the Czech Republic, Slovenia, Hungary, Serbia, Bulgaria, Turkey, Egypt, Sudan, Ethiopia, Kenya, Tanzania, Zambia, Zimbabwe and South Africa. Awaiting them along the way were ice, snow, mountains, deserts, rivers, potholes and the infamous 'Road of Hell' with its corrugated and volcanic rock surface in northern Kenya.

When it comes to demonstrating the superiority of HP LTO Ultrium media, HP likes to go the extra mile as well. So going 9,000 miles with Rainer and his team seemed to be the perfect extreme test for a HP LTO-6 cartridge. This would continue a tradition that has seen HP Storage Media climb Mount Everest, cross the Sahara and journey deep into the Venezuelan rain forest.

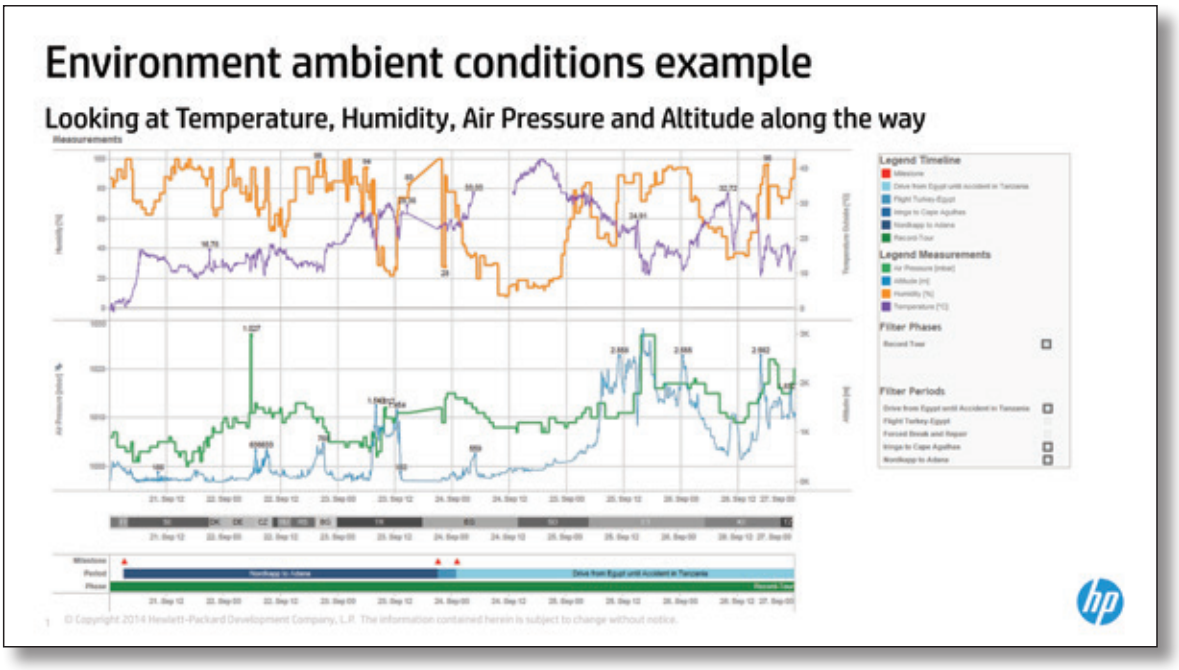
The ultimate tape drive needs the ultimate tape

As always, the test had to have a direct link to the real world conditions and processes that could be experienced by your tape cartridges. One of the key benefits of HP StoreEver tape is that it allows you to move and protect data off-site. But whether your data originates on an oil rig, a film set or in a state-of-the-art data center, it needs to arrive safely. This is why HP tests its data cartridges for shock and vibration, even though this not a requirement for the LTO industry-standard logo.

So how better to demonstrate shock and vibration than to attach a HP LTO-6 data cartridge to the roof of a VW Touareg, hurtling across Europe and Africa in a race against time, battling through all terrains and conditions on its record-breaking mission?

No special padding was used to protect the cartridge from the rigors of the journey other than to wrap it in waterproof tape purchased from a household DIY store. Otherwise, the tape traveled entirely in its own original shrink wrap. The same adhesive tape was then used to secure the cartridge to the roof of the car. The placement was quite deliberate to make sure that the HP data cartridge would feel every bump and jolt and be exposed to the same changes in external temperature and humidity as the vehicle.

With altitudes ranging from sea level to heights of nearly 10,000 feet, the cartridge experienced an enormous range of temperatures and humidities, a real world version of the recent environmental interchange tests deployed in HP's laboratories. At times, humidity levels reached 90%, while temperatures ranged from below 10°C to above 40°C, all within a matter of days.



At the end of the trip, which was 21 days, 19 countries and 9,000 miles later, the HP LTO-6 cartridge still worked flawlessly when it came back for testing at HP's media laboratory. No degradation of error rate, capacity or transfer speed was observed.

It is unlikely your data will face the same perils between your data center and off-site archive, but no matter what conditions lie ahead, with HP Storage Media, you are ready for whatever may occur on the journey – as the adventurers on the Cape to Cape Challenge discovered.

When the unexpected strikes, you need backup

Even the most meticulously organized project or business can suffer major disruption that no one could have foreseen or planned for. So it was with the Cape to Cape. On the sixth day of the journey, and through no fault of their own, the team were involved in a major collision in Tanzania.

"Nobody was injured, but when I saw the car, I thought we'd have to give up," recalls Rainer Zietlow. "However, it soon became clear in the garage that the engine and gearbox had remained intact – so we still wanted to see what we could achieve."

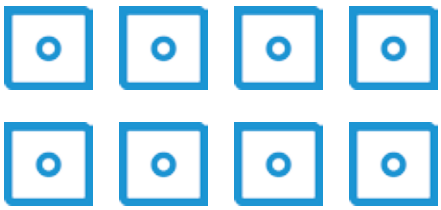
Using Volkswagen original parts, the mechanics in Tanzania were able to repair the Touareg for the final stage from Inringa, where the accident occurred, to Cape Agulhas. At 21 days, 16 hours and 36 minutes, they beat the time of 28 days, which was last set as the world record in 1984.

If you take away the time for the repair, the complete Cape to Cape trip was actually covered in just 8 days, 10 hours and 26 minutes!

In spite of the tremendous shock of impact and deceleration over that time and those conditions, the HP LTO-6 tape on the roof of the car remained safe and viable. And thanks to having such excellent backup, Rainer, Marius and Matthias were able to complete their journey. Although it was unwelcome and unforeseen, the accident in Tanzania is the perfect metaphor for why you need the best possible contingency. The team could rely upon their backup support to get them up and running again. If you use HP Storage Media, you can rely on yours too.

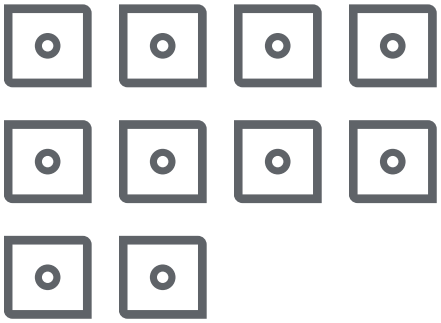
400,000 GB

of data storage required



500 HP LTO-4

tapes needed to store 400,000 GB of data



550 non-HP

tapes needed to store the same amount of data if merely 10% of capacity is lost due to higher error rate

$1,250

cost savings using HP branded tapes

Ensuring your restore is always available

With the world's archival needs doubling every year, tape provides the perfect blend of long term, secure and easily accessible storage. Linear Tape Open (LTO) Ultrium is the most successful tape format and HP, with its broad portfolio of tape data cartridges and services, has been the leader in LTO branded cartridge shipments since 2002.

How much margin for error can you afford?
Ask any IT manager, and the key issue is not 'did my backup work successfully?', but 'how certain can I be that the data will restore successfully if I need to recover the contents of my tape?'

So how does HP ensure its storage media is always reliable? Simply by performing the most comprehensive study of error rates, capacity and data transfer speeds that technology can deliver. Error rates tell us how much margin there is before failure. Did the backup and restore operation only just complete successfully, or did it have lots of margin to spare? It may not sound severe, but bad error rate can lead directly to slower transfer rates, reduced cartridge capacity and, in the worst case, backup or restore failure.

Poor capacity and transfer metrics have real life consequences. Reduced capacity means more tapes are needed to backup the same amount of data. That means more cost. Slower transfer speeds mean longer backups or backup windows being exceeded or breached, pulling in valuable IT resource to fix the issues. Again, the additional unnecessary cost can be significant and easily overturn any benefits from choosing a cheaper tape.

How hidden costs hurt your business

Once your business is regarded as a medium-size enterprise, chances are your IT infrastructure has grown to match. In this case, you are probably using tape automation as a means of backing up and archiving your data. In automated environments with so many tapes in use, it may be difficult to assess the impact of the hidden cost of poor media reliability. But just like low inflated tires can eat into the fuel economy and increase the costs of motoring, so can sub-standard quality affect your bottom line.

Let's assume your data store is **400,000 GB**. Depending on your data and compression ratio, you could need **500 LTO-4** tapes to store that amount of content.

A HP LTO-4 tape costs **$27** and Another Brand costs **$25**. In total, 500 tapes from HP will cost **$13,500 versus $12,000** for the competitor.

HP testing has observed reduced capacity levels of up to 20% due to higher error rates on non-HP tapes – e.g. edge damage, coating defects, servo-tracking issues, tribology.

But even if you were only to observe **10% capacity loss – 40,000 GB** – you would still require an additional **50 tapes** to complete the archiving of all 400,000 GB if the non-HP tape performed that badly.

When you compare the price for 500 HP tapes with 550 non-HP tapes, now the **HP cost of ownership is $1,250 lower**. This difference is the hidden cost of poor quality media with a high error rate.

Industry standards reveal much. HP demands much more.
The Compliance Verification (CV) process for the awarding of LTO Ultrium logo status is primarily concerned with interchange, to ensure products from different vendors work across platforms. It is not a measure of quality – i.e. how reliably those products perform.

HP Storage Media Brand testing requires potential HP LTO cartridges to pass a number of extremely demanding procedures that other media are never subjected to during CV evaluation. All tests must be successfully negotiated for HP to qualify and ship the HP LTO cartridges.

And where there is overlap with CV, the HP procedures are tens, sometimes hundreds of times more stressful. For example, the HP Locate/Rewind/Append test surpasses the industry-standard by 1000%. And the Shoeshine test, which measures the ability of the media to withstand repeated passes over the tape head, repeats for 25,000 cycles. The Industry Logo test has no Shoeshine equivalent.

That's why the HP brand specification is the most demanding measure of how storage media is used in real life, not just in once-a-year logo tests.

Since 2000, HP has shipped over 80 million LTO Ultrium cartridges and been the leading brand of storage media throughout that time. Every cartridge that bears the HP logo is the culmination of HP's extreme testing.

Unrivalled scale and depth
The cornerstone of the HP branded LTO Ultrium media specification is our leading position as a tape solution provider. But to achieve comprehensive coverage and cover all potential customer environments, HP uses both HP and non-HP drives to test HP brand LTO media. No matter what model of hardware you own, HP LTO Ultrium data cartridges are an outstanding choice.

The testing falls into three key areas:

1. Ongoing testing, including 'Green Tape'* and Full Volume Life.
2. Archival Life testing.
3. Interleave testing.

* A green tape is a brand new data cartridge that has never been previously used. Green tape tests are important because newer media is typically more abrasive than cartridges that have been used several times. Duty cycles using large quantities of green tape (e.g. archiving) affect drive performance differently than those where tapes have been used and rotated repeatedly.

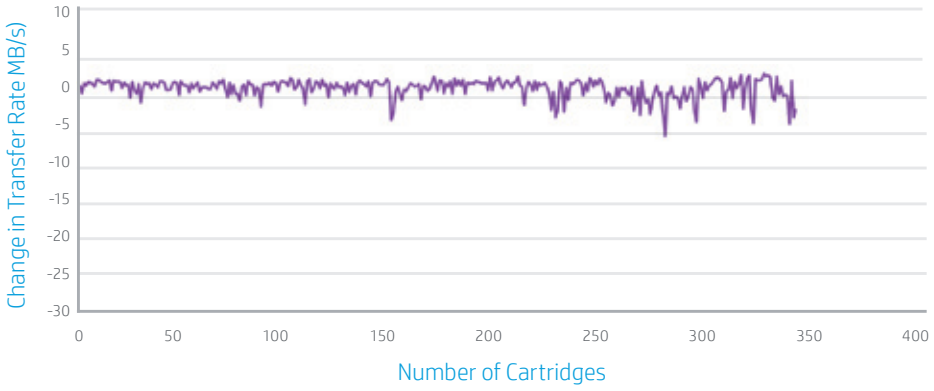
Ongoing HP brand LTO media testing

The table and charts show some of the key quality control procedures used by HP to ensure the safety of your data. In every instance, successful completion requires no user capacity loss, and no significant degradation in transfer rates or error rates.

For example, HP LTO-6 Constant Transfer Rate Performance testing.

This test shows the constant transfer rate achieved when writing full volumes to multiple green tape HP LTO-6 MP cartridges. Performance is expressed in terms of the difference from the theoretical maximum value of 140 MB/sec. The HP drive never deviates by more than 5 MB/sec throughout the test.

LTO-6 Constant Transfer Rate Performance



Test	Description
Full Volume Green Tape test	A series of full volume write/read operations are conducted using at least 200 new (green) cartridges using HP and non-HP drives. This test supports customers that use brand new cartridges for each and every backup and restore operation – e.g. in archival activities.
Full Volume Life test	Multiple full volume write/read operations are conducted using a single cartridge on HP and non-HP drives. This test supports sustained product performance for those customers that use the same cartridge for each and every backup and restore operation.
Servo Pattern test	All LTO Ultrium drives rely on a tape servo pattern to accurately position the drive head on the relevant area of tape. HP engineers have developed a unique servo specification that lists the requirements for all key servo pattern parameters for HP LTO Ultrium media.
Environmental Interchange	HP thoroughly checks its storage media for full interchange between multiple tapes on multiple drives in all the following conditions (R.H. = Relative Humidity): 50°F/10°C and 80% R.H. cold and wet 50°F/10°C and 10% R.H. cold and dry 113°F/45°C and 10% R.H. hot and dry 113°F/45°C and 24% R.H. hot and ambient 84°F/29°C and 80% R.H. hot and wet Data is continuously written to, and read from the tapes for 24 hours in each environment. The benefit for the user is that the drive and media are robust enough to withstand sustained use in all conditions, not just in controlled environments such as an IT data center.
Drop testing	No loss of function to a data cartridge following a 29.5 inch drop on a concrete floor. 20 data cartridges are dropped successively on their top and bottom faces, and edges. In separate tests, cartridges are dropped by themselves, in their library cases and in different packaging configurations.
Load/Unload	This test uses an automated mechanism cycle of load, grab Leader Pin Assembly (LPA), thread (with a few meters of tape wound onto a take-up reel), unthread, park LPA, and unload. Each cycle is repeated a minimum of 20,000 times in three different drive orientations – as in different vendor tape libraries.
Locate/Rewind/Append	This test measures the ability of a section of the tape to withstand repeated stress (i.e. file locate, retrieve and append operations) in a highly demanding customer environment (84°F/29°C, 80% R.H.). It is repeated through 2,500 cycles.
Shoeshine test	This unique HP test measures the ability of the media to withstand repeated passes over the tape head. This is particularly relevant to the library environment where media may be frequently loaded or unloaded by the operating system. Data is written to a short section of tape, the tape is rewound, the data is read and error rate checked. This 'rewind – read – error check' procedure is repeated 25,000 times.

HP LTO Ultrium Archival Life testing

If you place a tape into an archive and a legal officer, sales manager, publisher or newsroom manager asked you to produce the data ten years from now, how certain would you be that it would be preserved, complete and good as new? The uncontrollable growth of data, combined with the necessity of keeping it safe, means that tape storage is still the best solution when it comes to long term archiving.

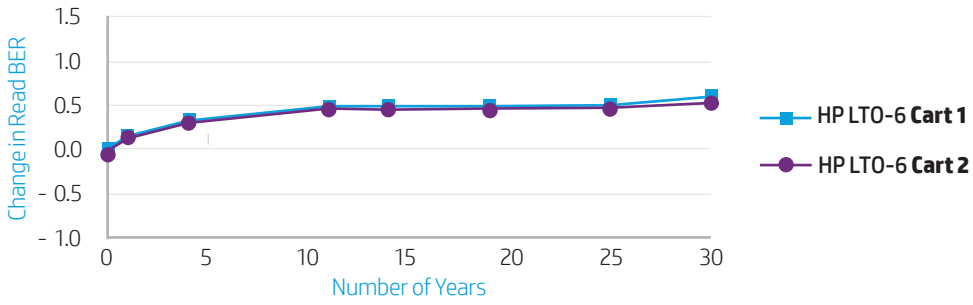
Not only is tape highly scalable and cost-effective, it offers significant benefits when considering how to protect information over a period spanning years and even decades.

While a real time machine would be a true miracle, in the world of tape media, the next best thing is the HP Brand Specification for HP LTO Ultrium media. HP's exhaustive archival testing is the only way to prove that HP branded LTO media will perform to the highest standard throughout its working life.

In order to prove archival durability, HP needed to conduct accelerated aging tests. External academic research has shown that 252 days storage at 55°C/131°F and 80% Relative Humidity is equivalent to a predicted archival life of 30 years, when stored at 25°C/77°F.

These torturous conditions are extremely unusual and well outside the normal recommended operating environments for tape media. Bear in mind the hottest climactic temperature ever recorded on Earth was a 'mere' 134°F at Death Valley, California in 1913.

Change in Base Error Rate for LTO-6 media over a simulated 30 year period



HP stored the most advanced HP LTO-6 Metal Particle cartridges at 55°C/131°F and 80% R.H. for a total of 252 days (36 weeks). From the chart, it is clear that the error rate of the media barely changes from when it was new in comparison to when it had become 'old'. That means you could be confident that your data would be as recoverable in 2040 as the day you recorded it in 2013.

How HP LTO-6 stood the test of time
There are a number of technologies that converge to make HP LTO-6 Metal Particle tape one of the most reliable technologies for long term archiving:

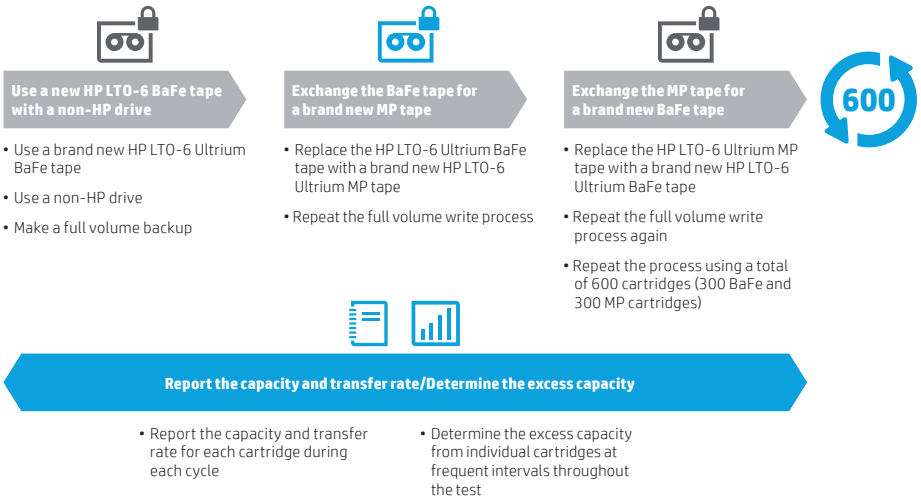
- Thinner magnetic coatings to improve recording performance at high recording densities.
- Smaller, finer particles to support increased capacities.
- Smooth tape surface to help improve overall tape solution reliability (with HP drives).
- Enhanced binder resin to avoid hydrolysis – especially relevant to archival storage.
- Armored coating to protect against premature oxidization – again, very relevant to archival storage.

Real world archiving with HP LTO-1
While the accelerated aging tests demonstrate theoretical performance, HP is also at the forefront when it comes to proving the 'real world' performance of its media. In this case, eight LTO-1 cartridges filled with data that were archived in 2003 for the purpose of measuring LTO Ultrium reliability during natural time.

Recently, HP engineers removed these LTO-1 cartridges from storage and conducted a series of read/restore tests on them to confirm that the data could still be read successfully. Not only was all the data fully recoverable, but the chart on the previous page shows that the error rate seen by the drive for the ten year old media is indistinguishable to that for brand new media. No noticeable degradation of any kind has occurred in the intervening period.

For more information, please refer to the detailed HP technical white paper 'The benefits of tape for archiving'.

HP LTO-6 Ultrium Storage Media Interleave testing
An extreme comparison of BaFe and MP green tape performance



Interleave testing

During 2014, in an exhaustive program of new tests known as 'Interleave testing', HP subjected its LTO-6 MP and LTO-6 Barium Ferrite (BaFe) media to unprecedented levels of scrutiny. In doing so, HP threw new light on the performance of MP and BaFe designs, to give end users complete confidence that both types offer excellent performance for backup and archiving.

What's more, HP used a non-HP tape drive from a leading competitor, proving beyond all doubt that HP LTO-6 tapes (both MP and BaFe) work just as well in solutions from other vendors as they do in HP StoreEver products.

Interleaving is the ultimate measure of how well your tape solution is performing in an intensive archival environment.

It involves:

- Using a non-HP drive.
- Taking a brand new piece of media, starting with HP LTO-6 BaFe, and conducting a full volume backup.
- Exchanging the original BaFe tape for a brand new HP LTO-6 MP tape and repeating the full volume write process.
- Swapping out the MP tape and repeating the process again using a brand new LTO-6 BaFe tape.
- Reporting the capacity and transfer rate for each cartridge during each cycle.
- Determining the excess capacity for individual cartridges at frequent intervals throughout the test.
- In total, HP performed 600 full volume write backups in a unique test pattern that lasted for almost six months. It included 300 HP LTO-6 MP and 300 HP LTO-6 BaFe cartridges on the same non-HP tape drive.

The ultimate interchange reliability test for an archival usage model
There are several reasons why this is the ultimate interchange reliability test.

Brand new media – sometimes called green tape is the most demanding for a tape drive to work with. That is because new cartridges have not yet been subject to the 'smoothing' that occurs over time as media is used more repeatedly, making re-used tapes less abrasive than green tapes.

One in, one out interchange of MP and BaFe. In the HP Interleave test, not only is the tape drive having to cope with 100% green tape, but it also has to deal with both LTO-6 media choices: MP and BaFe. If there were any performance differences as a consequence of using one tape/particle design over another, interleaving would highlight the differences. Simply put, if one media type performs well, but another causes the drive to struggle, the capacity and transfer rate metrics for the sub-par formulation would be clearly visible.

Time and cost. Performing this kind of test, using 600 tapes on a single drive and in a controlled environment, is a colossal undertaking. Almost certainly, it's beyond the reach of end users who are unlikely to possess the time, facilities, budget and, most important, forensic diagnostic tools to complete such an analysis.

The Interleave LTO-6 Green Tape test completed successfully, using a total of 600 cartridges. During the test, more than 1.5 PB of data was written. There was no significant degradation of key metrics, indicating excellent stable performance in terms of:

- User capacity
- Excess capacity
- Transfer rate

To find out more, please refer to the detailed HP technical white paper 'HP LTO-6 Ultrium Storage Media Interleave testing – An extreme comparison of BaFe and MP green tape performance' Pub Number 4AA5-5090ENW

Conclusion

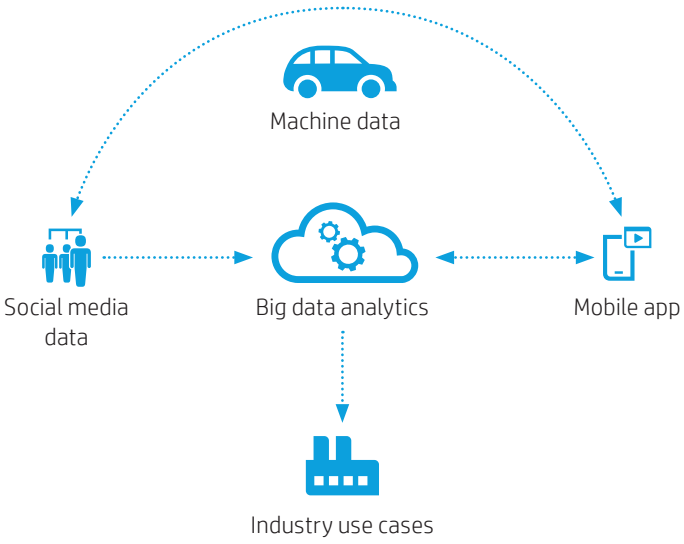
Only by having the most reliable media can we offer you the most reliable restore. HP understands that backup and archiving are not some disconnected IT processes removed from the rest of your business activities, because one day, vital customer information, important orders or even the business itself could depend on a restore from tape. While we hope that never happens, when you entrust your data to a HP data cartridge, we want you to feel it's as safe as it would be in your own hands. HP LTO-6 has just completed a 9,000 mile journey but it's a fact that HP examines hundreds of thousands of miles of tape to ensure that our media is always the most reliable you can buy.

The driving power of big numbers

HP's mobile app, which had been developed for the Cape to Cape world record tour, was integrated closely with social media, providing the perfect opportunity to examine a campaign in-depth and use HP's big data solutions to interpret the 1.8 billion rows of raw data and 53,000 single social media interactions. The team examined the activity of the race sponsors across Facebook, Instagram and Twitter plotting frequency of posting against numbers of followers to determine effectiveness. This insight readily identified the actions that clients would need to take to increase and optimize impact. The team also developed a timeframe optimization for responding to comments to ensure optimal effectiveness.

Looking further into the data, would it be possible to differentiate driving styles and develop new use cases? Algorithms and application techniques were designed to combine and correlate the signals from the different data streams, including braking, acceleration, speed, steering and onboard protection assistance systems. A team of specialists analyzed the output and identified three distinct driver profiles – exactly matching the race team – despite having little knowledge of the race itself. The detection of such a clear and compelling 'driver signature' was unexpected but is typical of the power of big data to turn up 'hidden' correlations and insights. A number of potential use cases present themselves.

How HP powered the Cape to Cape car



Optimize social media based communication
Communication effectiveness

An insurance company could reward safer driving with a reduction in premium. Similarly, a car rental company could offer lower rates to customers whose style of driving was more sustainable, thus increasing vehicle maintenance intervals and ultimate residual value. The ability to incorporate a great number of real-time data feeds paves the way for more sophisticated business models which can accurately incentivize lower risk behavior across a range of scenarios.

Road maintenance optimization
Decision support for the sound utilization of public resources

A smoother road ahead. Road maintenance optimization is another potential future use. The rear axle of the car contained sensors which measured vertical acceleration forces. Analysis of this data stream again produced some very clear signals, which were grouped into four distinct sets of road conditions for this exercise. Plotting these on a map clearly showed the different types of surface and relative bumpiness of the road, even the position of potholes and other road defects. A practical application of this technology would be to develop a road condition map of an area, combining data feeds from many vehicles which could automatically survey while being driven normally.

When combined with a GPS feed, defects could be pinpointed and graded in order of severity to ensure that the biggest potholes were fixed first. Extending this capability further still, live data from such a system could be broadcast to connected cars nearby, warning drivers of oncoming hazards. The likely driverless cars of the future could even alter their course automatically.

While driving records were being broken, the race illustrated how the collaboration of social media, mobility and big data can deliver fresh experiences and new insights. The digital transformation brought about by these technologies is already helping industry to achieve more, engage new customers and heralds a paradigm shift in enterprise decision making – and a new way of doing business. See how much faster your business could be driven through HP innovation.

See more at: hp.com/go/hpc2c

Additional resources
Device compatibility: hptapecompat.com
HP LTFS technology: hp.com/go/ltfs
HP LTO Ultrium: hp.com/go/ultrium
HP LTO tape drives and tape automation: hp.com/go/tape
HP TapeAssure: hp.com/go/tapeassure

Learn more at
hp.com/go/storagemedia
hp.com/go/bigdata
hp.com/go/mobility
hp.com/go/helion

Sign up for updates
hp.com/go/getupdated

Share with colleagues

Rate this document

Follow HP Storage Media

4AA5-7067ENW, February 2015