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ATLAS, CMS and New Challenges for Public Communication

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Abstract. On 30 March 2010 the first high-energy collisions brought the LHC experiments into the era of research and discovery. Millions of viewers worldwide tuned in to the webcasts and followed the news via Web 2.0 tools, such as blogs, Twitter, and Facebook, with 205,000 unique visitors to CERN's Web site. Media coverage at the experiments and in institutes all over the world yielded more than 2,200 news items including 800 TV broadcasts. We describe the new multimedia communications challenges, due to the massive public interest in the LHC programme, and the corresponding responses of the ATLAS and CMS experiments, in the areas of Web 2.0 tools, multimedia, webcasting, videoconferencing, and collaborative tools. We discuss the strategic convergence of the two experiments' communications services, information systems and public database of outreach material.

1. First 7 TeV Collisions at the Large Hadron Collider

At 4:04am on Tuesday 30th March 2010, I (LT) was awoken by a phone call from Joe Incandela, the CMS Deputy Spokesperson. The message was short but long-awaited: "The next fill is for collisions". These were not just any collisions but the Large Hadron Collider's (LHC's) first attempt to collide two beams of protons at 7 TeV centre-of-mass energy.

By 5am I was in the "CMS Centre at CERN" [1] along with thirty CMS offline experts (figure 1.). Their job was to process and analyse the first data recorded by the online team in the CMS Control Room, 100m above the CMS detector underground, located in Cessy, France, which is a 25 minute drive away on the opposite side of the LHC ring.

Figure 1. Physicists in the CMS Centre at CERN, preparing for the first ever LHC collisions at 7 TeV.

While the LHC operators were still preparing the machine, 110 journalists, photographers, radio and TV crews from 69 media organisations started arriving in the LHC and experiments' Control Rooms and by 6:30am the CMS Centre was packed with media people (figure 2.).

Figure 2. Press in the CMS Centre watching the physicists.

Then, at 8:05am, there was a sudden electrical trip in CERN's accelerator complex and the proton beams were subjected to a controlled dumping procedure. By 8:36am the situation was recovered, the LHC was re-filled with proton beams, and the energy ramp up to 3.5 TeV per proton was re-started. Then at 11:26 a second dump occurred.

Although such teething problems are a normal feature of commissioning such a complex machine as the LHC, some of the media were starting to wonder whether this was a symptom of a deeper problem. Journalists following the event from CMS Collaborating Institutes in the Far East had impending news deadlines and even started drafting stories on how the LHC had failed again.

At 12:41pm, the fresh beams in the machine completed their ramp to 3.5 TeV without mishap. Together the physicists and the media anxiously watched as the machine operators carefully adjusted the orbits of the beam to bring them onto a collision course in the centre of each experiment. Finally at 12:56pm, to great relief and jubilation, both the ATLAS and CMS detectors observed the first 7 TeV collisions (figure 3.).

Figure 3a. First 7 TeV collisions observed by ATLAS collaborators at CERN.

Figure 3b. First 7 TeV collisions observed by CMS collaborators in the CMS Control Room at CERN.

Within three minutes the collision event data had been processed by the offline computing systems and fully reconstructed event images of the particles tracks and energy deposits (figure 4.) were displayed live on the Web and made available to the media. Soon after basic physics plots were also available, such as reconstructed invariant mass spectra of Standard Model particles.

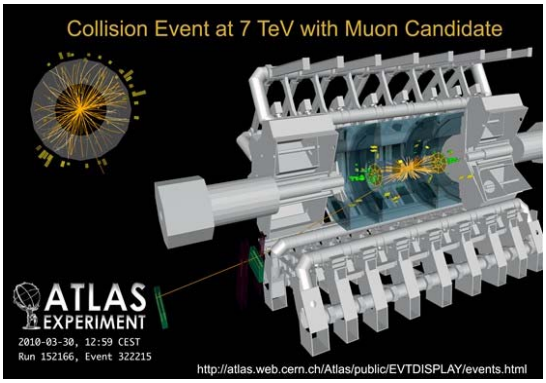

Figure 4a. First 7 TeV collision event display from ATLAS.

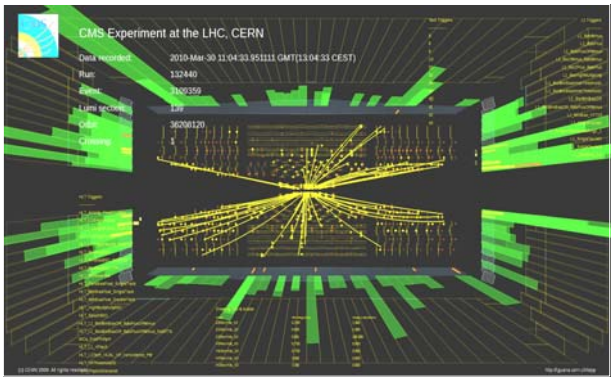

Figure 4b. First 7 TeV collision event display from CMS.

CERN immediately held a press conference and issued a press release describing the achievements of the LHC machine and the first observations of the experiments. The collisions continued throughout the afternoon, with the LHC machine and the experiments performing extremely well. The journalists observed the day's events at close hand, talking to physicists on shift and interviewing many of the leaders of the detector construction and data analysis groups.

More than 800 TV broadcasts and 2,200 news items were produced as a result of the "First 7 TeV Collisions" media day (e.g. figure 5.).

Both ATLAS and CMS held distributed VIP and media events in collaborating institutes. People followed the events at CERN on large screens showing LHC and experiment status displays, Webcasts of TV footage from CERN, and live event displays. Live video-conferencing connections to CERN enabled remote journalists to interview people at CERN.

The events at CMS Centres Worldwide resulted in an additional 300 printed articles, 100 radio broadcasts, and 75 TV broadcasts, as well as a lot of exposure with institute administrations, funding agencies and local government. Public events hosted by ATLAS institutions generated similar exposure for local audiences and media.

Figure 5. Examples of the global press coverage of the first 7 TeV collisions at the LHC.

2. Media Strategy

The "First 7 TeV Collisions" media event, like the earlier "First Beams in the LHC" media event was a great success. One journalist even remarked, "CERN is the new NASA", and in fact CERN's Web site ranking did rise above NASA's, if only for a few days.

However, given all the technical complexity, given the pressures on many people, and given the real possibility of failure on the day, many people legitimately asked why we risked doing it as a public media event. The reason is that science has an implicit contract with society, which entrusts

scientists with significant resources and autonomy to explore fundamental questions about the nature of the world in which we live. The scientists then have a duty to inform society about their progress and to communicate new-found fundamental knowledge and technical innovations. (On a practical note, the media would anyway hear of any major LHC problem, irrespective of whether or not they were actually present at CERN when it happened.)

Lest scientists be complacent about their duties in this implicit contract, it is worth noting that an EU-wide survey[2] found that a majority of citizens think that "scientists do not put enough effort into informing the public about new developments in science and technology". Furthermore, society can withdraw funding if they are unsatisfied with the scientists' performance, as happened catastrophically to the Superconducting Super Collider (SSC) in 1993. In the current difficult economic climate many countries are cutting back on R&D expenditure.

CERN and the LHC experiments have a pro-active communications strategy based on the timely provision of coherent and high-quality information. This primarily relates to the research programme which addresses fundamental questions about the origins of the Universe and the nature of the world in which we live. There is also significant additional interest in the technical challenges of the LHC and the experiments, the technological spin-offs from CERN (e.g. the World Wide Web), and the human aspects of the large multi-national collaborations performing the research.

The message delivery relies on an open engagement with the traditional media organisations, including the written press, radio, and TV, and a steadily-increasing use of new "Web 2.0" media channels, as discussed below.

3. Traditional Media – Written Press, Radio, and TV

CERN has an open approach to the traditional media, who are encouraged to visit CERN and discuss directly with researchers. In the years following the LEP turn-off the number of media visits to CERN was about 200-300 per year or roughly one per working day. This number has now trebled to more than 700 per year and is still rising.

In addition, CERN has organised major media days, involving both the LHC communities and the experiments, to mark the first beams in the LHC and the first 7 TeV collisions, as described in section 1. ATLAS and CMS have very effectively exploited their own media contacts in collaborating countries worldwide to reach a truly global audience. For example, CMS hosted media events in their "CMS Centres Worldwide" [1], which now number more than 50, as shown in figure 7.

The CERN Press Office and experiments build long-term relationships with the media such that the LHC has a steady presence in the media even between major events.

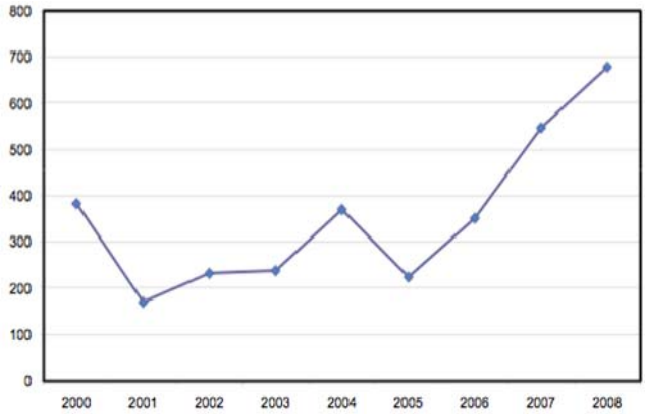

Figure 6. Number of media visits to CERN per year.

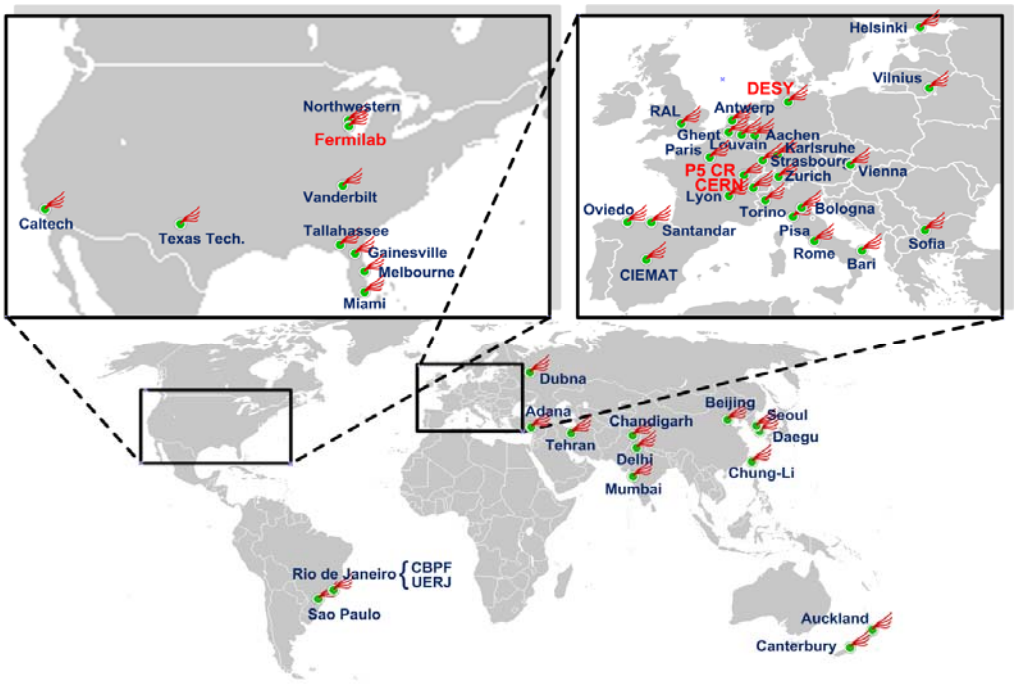

Figure 7. CMS Centres Worldwide, used for remote monitoring of LHC and CMS operations, data analysis, education, outreach, and VIP and media events.

A good example is that of the BBC who, as one of the world's few global news organisations, influence what is generally considered newsworthy. Both BBC TV and BBC Radio news broadcast live from the CMS Centre at CERN (offline control room) throughout the media events and the LHC success was the most-read story on the BBC Web site. We analysed the Google News archives to identify some rough trends in global news coverage of CERN since its founding more than half a century ago, as shown in figure 8.

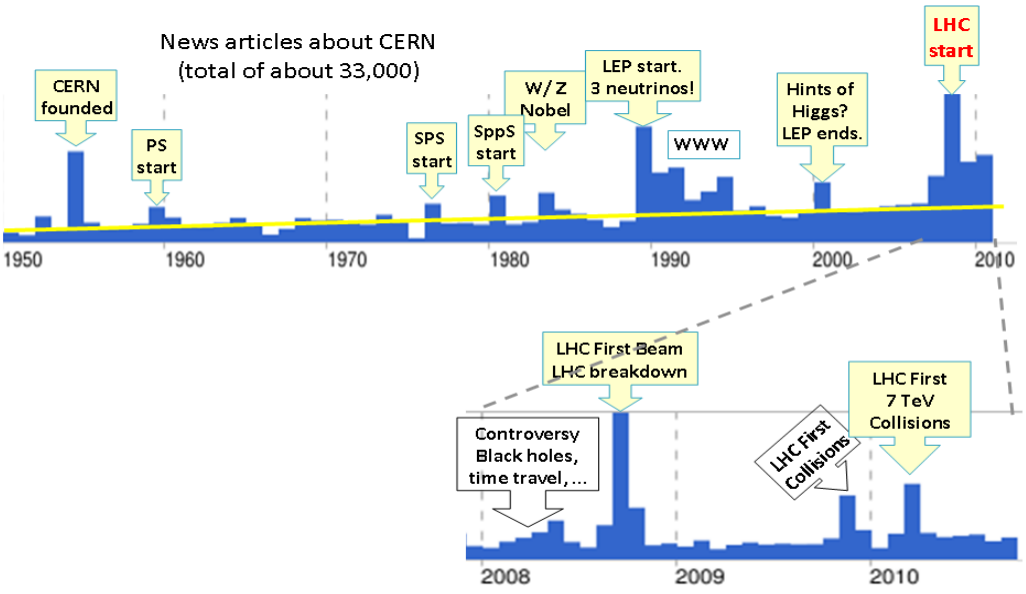

Figure 8. Approximate annual number of news articles (as archived by Google News) relating to CERN physics.

There is a slowly rising coverage of CERN with time, punctuated by spikes of interest as each new machine is switched on, the W/Z discovery and the invention of the World Wide Web. The pro-active media strategy of the LHC era, compared to the previous LEP era, is reflected in a more than two-fold increase in the quiescent media coverage compared to the extrapolations from previous years.

4. New Media and Web 2.0

The advent of the World Wide Web has led to completely new ways of communicating with large audiences, compared to the traditional media of TV, Radio and written press. The early Web – sometimes called "Web 1.0" – was mostly used for posting rather static information. Web 2.0 refers to more collaborative and dynamic forms of communication and information sharing, through services such as Facebook, YouTube, Wikipedia, and Twitter.

Figure 9 shows that these sites are visited daily by between 10% and 40% of all internet users – who now number over 1 billion – and all numbers are rapidly increasing. CERN and the LHC experiments are exploring new ways of communicating with these communities.

In addition, content is provided directly on the Web through CERN and experiment Web portals, Webcasts, Web "TV channels" of live content, and blogs. The status and outlook for LHC exploitation of such Web 2.0 services is described below.

Figure 9. Fraction of all Web users who use popular Web 2.0 services daily.

4.1. Twitter

Twitter is a micro-blogging service that enables users (e.g. CERN, ATLAS, and CMS) to post short update messages of up to 140 characters, known as "tweets" [3]. These often contain links to more information on the corresponding Web portal. Twitter users can choose to subscribe to receive these so-called "tweets".

More than 10% of all internet users access Twitter daily, up from zero at the start of 2009. CERN currently has 235,000 followers on Twitter, including many in the media, who have chosen to be notified of important happenings at CERN. ATLAS and CMS each have several thousand followers and important news from the experiments is "re-tweeted" by CERN to its much larger Twitter following.

Major media events increase the CERN profile on Twitter. For example, "CERN", "LHC", "TeV", and "experiment" were all identified as Twitter global trends on 7 TeV media day, in turn leading to an increase in those people choosing to follow CERN on Twitter.

4.2. Facebook

Facebook is a social networking site that allows users to exchange messages, photos, etc. between individuals or groups. While Facebook is not obviously well-suited to LHC communications its huge user base means it cannot be completely ignored. As shown in table 1, Facebook now has 550 million users, corresponding to 8% of the World's population or 45% of all internet users.

To fully engage with this Facebook community would require considerable manpower. However, several straightforward actions can help increase the effectiveness of LHC communications efforts. The Facebook "home" pages for CERN, LHC, ATLAS and CMS should be made more attractive with

good links to the corresponding Web portals. The content should be kept fresh to encourage Facebook "fans".

Also, non-Facebook Web pages can use the Facebook "Share" facility in which people can click on a small Facebook "Share" icon to notify their Facebook "friends" that the page is interesting. As with the "Like" feature in Facebook, such personal recommendations, often to large numbers of "friends", can help stories spread rapidly to large numbers of people or, in Web 2.0 parlance, to "go viral".

	Population (millions)	**% of total**
China	1340	19.5
India	1189	17.3
Facebook	**~ 550**	**8.0**
EU	501	7.3
USA	310	4.5

Table 1. Number of Facebook users compared to various human populations.

4.3. Web Portals

CERN and the experiments each maintain Web portals that target the general public [4], as shown in figures 10 and 11. These provide introductions to LHC physics, the LHC machine, the experiments' detectors, the international collaborations, and the additional broader benefits of fundamental science such as technical spin-offs and education. The portals provide up-to-date information on the ongoing operations, major events and recent physics results. There are regular newsletters and blogs, press releases by CERN, and supporting material for journalists, such as explanatory "statements", event display images, photos, and short movie clips.

Figure 10. ATLAS public Web portal.

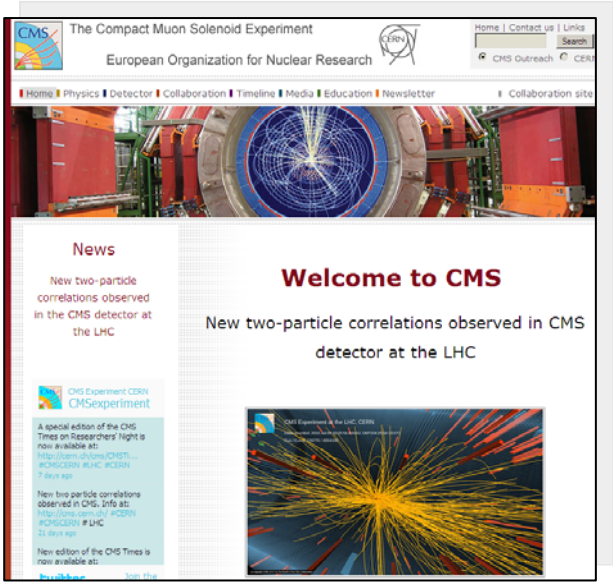

Figure 11. CMS public Web portal.

On the 7 TeV media event there were 205,000 unique visitors to the CERN public web site, 154,000 to the CERN Press Office site, and about 25,000 to each of ATLAS and CMS Web sites. The power of Twitter is reflected in the fact that 80,000 visits on the day to the cern.ch domain originated from people clicking links embedded in CERN "Tweets" on Twitter.

The CERN and experiment Web portals are constantly being improved. In 2011 many will migrate to Drupal, a powerful open-source Web content management system. This will facilitate the Web portal maintenance and make it easier to share and re-use content in different contexts. It will also enable users to give feedback on content and even engage in direct communications with scientists.

4.4. Live Web content (Web "TV channels")

Both ATLAS and CMS have developed Web application services that provide continuous live content that may be viewed in any Web browser. Although the end results are similar, the technical approaches are complementary.

ATLAS Live [5] aggregates live data, such as LHC and ATLAS status displays, live event images, archived footage, etc., converting them to video streams, using professional signage software. Automated scripts pick up material from a variety of locations (e.g. CERN Document Server, Flickr or Picasa), making content modification trivial for anyone with authorisation. Several of the audience-targeted streams are encoded and webcast continually (see also section 4.5). These TV-like channels are displayed on public screens at CERN and in collaborating institutes. They can also be viewed using a web browser on essentially any platform, including iPhone and Android., as shown in figure 12.

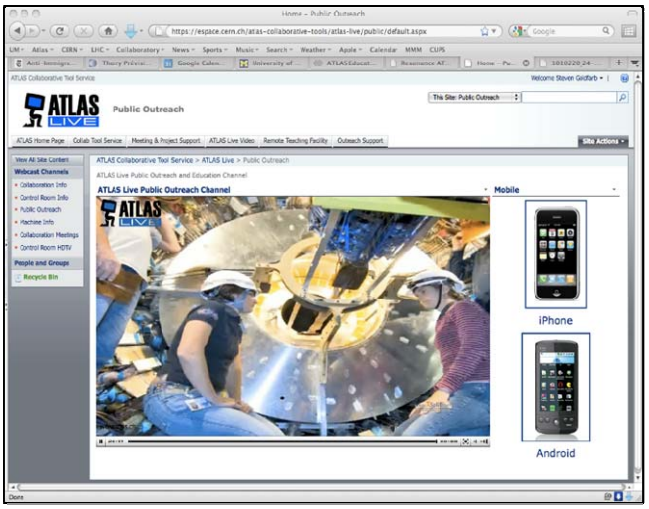

Figure 12. Screenshot of the "ATLAS-Live" application.

The CMS-TV Web application shows live content (e.g. LHC and CMS status displays, live event images, etc.) on big screens in CMS Centres. CMS-TV is similar to a TV news channel that cycles through headlines, business, sports etc. It aggregates a set of URLs to form a single new URL, or "TV channel," viewable in any Web browser, as shown in figure 13.

New channels may be easily created and filled with content. Physicists also access CMS-TV on their local desktops or mobile phones to check the status of the LHC and CMS operations. CMS-TV had 17,000 distinct viewers on First 7 TeV collisions day and the Web server received 1.6 million hits.

No installation of CMS-TV is required – it is a globally accessible Web tool supported centrally by CMS at CERN. CMS-TV could be easily extended for use by non-CMS organizations.

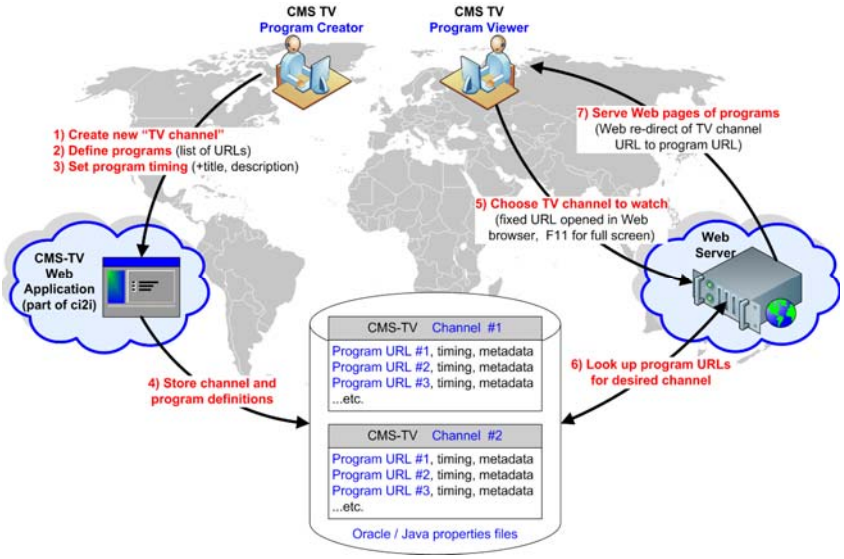

Figure 13 Schematic design of the CMS-TV system.

To watch CMS-TV, open: http://cmsdoc.cern.ch/cmscc/cmstv/cmstv.jsp?channel=1 in a Web browser and press F11 for full screen.

4.5. Live Web video streams (Webcasts)

CERN (IT/UDS Group) increasingly produces live video footage of major events, including the First LHC Beams and the First 7 TeV Collisions media events. Physicists, the media and the general public participated in and watched the events online Webcasts (streamed video) and on satellite and terrestrial TV broadcasts, as shown in figure 14. CERN footage was used by 120 TV stations in 30 countries.

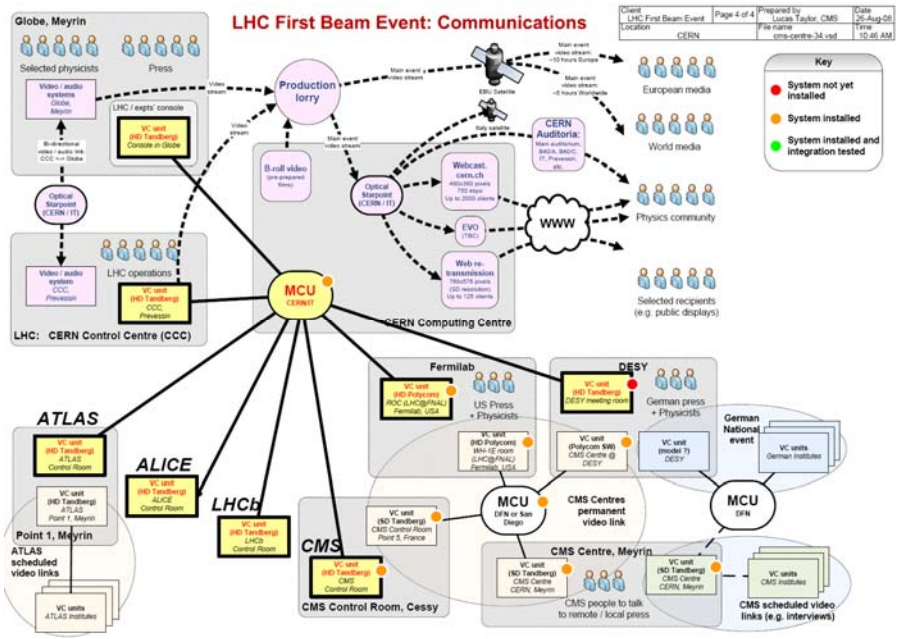

Figure 14
Schematic layout of the communications systems for the LHC First Beam day, 10th Sept 2008.

4.6. YouTube

CERN, ATLAS and CMS all use the YouTube video-sharing website to make video content available [6]. The most viewed LHC item is the "LHC rap" music video, filmed at CERN, with 6 million hits, followed by a number of more serious clips explaining the LHC with up to about a million hits each.

To put this into context, this is only a factor of about three less than items tagged with "Barack Obama Election" (also topped by a music video). To be effective, items posted on YouTube also need to be linked to from the LHC Web portals, and referenced in newsletters, press material and in tweets.

5. Conclusions

Many new developments in LHC Public Communications have been described. CERN, the LHC, and the ATLAS and CMS experiments together have succeeding in obtaining very positive traditional media coverage with a truly global reach (BBC number one story, homepage of Google, etc.).

The LHC media strategy is even more pro-active and open than for previous accelerators and this is clearly reflected in significantly increase media coverage, as shown in figure 8. Anecdotal experience shows that the excitement and drama of the LHC has captured the public attention.

Although systematic analysis is difficult, a clear qualitative indicator of the success is shown in table 2 [7]. "God Particle", "Hadron", and "Large Hadron Collider" each made it into one analysis of the world's top-ten phrases, words and names for 2009, together with other notables, including Barack Obama, Michael Jackson, climate change, deficit, stimulus and vampire.

As the LHC enters its most exciting phase in which data are pouring in and fundamental discoveries are expected, all LHC scientists should be prepared to communicate with society. There are many ways in which they can help, depending on their skills and preferences. Some could develop and deploy new Web 2.0 tools and systems (e.g. ATLAS Live, CMS-TV, improved Web portals, etc.) while others could install outreach facilities in their home institutes (CMS Centres, public displays,

etc.). Some could produce articles or blogs, make a video, or give a tour, colloquium, or public lecture. All institutes should build relationships with the media and prepare to take part in the next big LHC media event which, if all goes well, will be a new discovery of fundamental scientific importance.

Top Phrases of 2009	Top Words of 2009	Top Names of 2009
1. King of Pop	**1. Twitter**	1. Barack Obama
2. Obama-mania	2. Obama	2. Michael Jackson
3. Climate Change	3. H1N1	3. Mobama
4. Swine	4. Stimulus	**4. Large Hadron Collider**
5. Too Large to Fail	5. Vampire	5. Neda Agha Sultan
6. Cloud Computing	**6. 2.0 (next gen.)**	6. Nancy Pelosi
7. Public	7. Deficit	7. M. Ahmadinejad
8. Jai Ho!	**8. Hadron**	8. Hamid Karzai
9. Mayan Calendar	9. Healthcare	9. Rahm Emmanuel
10. God Particle	10. Transparency	10. Sonia Sotomayor

Table 2. Top phrases, words and names obtained from analysing a wide range of media sources.

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[2] http://ec.europa.eu/public_opinion/ archives/ebs/ebs_340_en.pdf

[3] http://twitter.com
CERN: http://twitter.com/#!/CERN
ATLAS: http://twitter.com/#!/ATLASexperiment
CMS: http://twitter.com/#!/CMSexperiment

[4] CERN: http://cern.ch,
ATLAS: http://atlas.ch
CMS: http://cms.cern.ch

[5] S. Goldfarb, "ATLAS Live: Collaborative Information Streams", these proceedings.

[6] http://www.youtube.com.
CERN: http://www.youtube.com/CERNTV ,
ATLAS: http://www.youtube.com/TheATLASExperiment ,
CMS: http://www.youtube.com/CMSExperimentTV

[7] http://www.languagemonitor.com/news/top-words-of-2009/