Chapter 9

Beyond Viewing and Interacting – Inhabited TV

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Abstract: This chapter presents the development, broadcast and data associated with two experimental broadcasts, *The Mirror* and *Heaven and Hell Live*. Both the content and viewer participation are described. These inhabited TV experiments, which combined TV and the Internet, were broadcast virtual worlds, replete with TV celebrity appearances, which people could view or participate in at will.

1. INHABITED TV

The convergence of the Internet and television is seen as the coming together of a broadcast and an interactive media. TV viewers watch programs whereas on the Internet one is freer to respond or even publish alternative views. The combination offers increased choice of program viewing and additional applications like home banking and online shopping.

But what are the killer applications of the Internet? For Pavel Curtis the answer was simple, people. Just as the phone has moved from it conception where services like listening to opera were considered important so the Internet is increasingly about bringing people together in communities. Figure 1 shows the four basic orders of communications relationships.
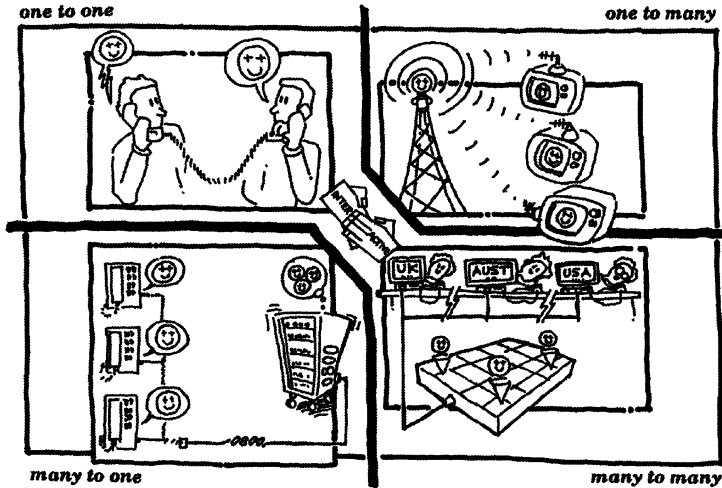
Figure 1.

- *one to one* communication is the phone, which we understand well.
- *one to many* communication covers current television broadcast, advertising, and many companies web presence. It allows one corporation to talk to many people or customers
- *many to one* communication is the free phone number or the feedback form. It allows one corporation to listen to many people or customers.
- generally missing is *many to many* communication where people form communities.

2.   SO WHAT IS INHABITED TV?

   Communities may be focused around many things: a task e.g. business meetings, products, education, or entertainment to name a few. Inhabited TV follows the broadcaster's route through Figure 1. The social nature of the phone has already collided with the information provision of the Internet to give us Internet chat spaces. The TV is moving towards the Internet in the shape of Web enabled TV or TV viewers on the PC. The final coming together is between the TV and Internet chat spaces into Inhabited TV – a term coined by Dr. Steve Benford of Nottingham University.
   Imagine combining the proven pulling power of professional broadcast television with the enduring appeal of audience chat and participation, and

you have a vision of Inhabited TV. The producer defines a sophisticated audio-visual framework, but it is the audience interaction and participation that brings it to life. Professional content mixes with social conversation in a rich graphical environment. A community develops around celebrity characters, staged events, and chance encounters.

Inhabited TV uses telepresence technologies to enrich television with interpersonal communications. The audience in Inhabited TV are no longer passive couch potatoes, but can chose an appropriate level of involvement in the life of the community and are able to play an active role. Moreover, the potential for worlds with completely different physical and social rules opens up limitless possibilities for creative Inhabited TV programs.

3.   BUSINESS MOTIVATION

From a broadcaster's perspective there are two concrete reasons to enter the world of Inhabited TV.

–   In the UK, like the US before us, we are seeing the advent of digital TV, satellite TV, and cable TV leading to a proliferation of TV channels. This is an opportunity to provide cheap yet compelling TV shows. One model for this comes from American Talk Radio where listeners phone in and debate an issue between themselves, with little need for celebrity guests.

–   Broadcasters are loosing viewers to more collaborative media. Studies indicate that children from homes connected to the Internet spend more time online than they do watching TV. And for Internet service providers like AOL and CompuServe almost half their customer's time online is spent in chat spaces.

From a telecommunications perspective we cannot assume that telephony will remain the principle form of remote communication forever. Inhabited TV allows us to experience large persistent communities, where issues of technical performance, content and user interface in large scale, inhabited spaces can be explored.

4.   PC EXPERIMENTS

How do we understand the issues that we need to conquer before Inhabited TV becomes a viable business service? Experimentation. We need experiments to drive the technology and our understanding of the service as a whole towards their limits and see where the stress fractures appear. So our experiments need a large number of users from a cross section of society.

However we cannot offer mass availability Inhabited TV services to peoples TVs without the expensive provision of equipment. To get early inexpensive results we must use the PC as the end user terminal.

At BT Labs we have been conducting a series of experiments into Inhabited TV. In this chapter I want to report on the first two of these experiments: "The Mirror" and "Heaven & Hell – Live".

5.   TWO EXPERIMENTS*

We have experience of two Inhabited TV experiments The Mirror and Heaven & Hell – Live.

5.1   The Mirror

The Mirror was collaboration between the Shared Spaces team at BT Labs, Illuminations, the BBC, and Sony. We came together around a BBC series called The Net, an Internet and multimedia magazine style program in its third series commissioned by BBC Education from Illuminations. In fact there were two parts of the BBC involved: BBC Education and the BBC's Multimedia Center whose head, Martin Freeth, came to the labs with a vision of online communities very close to our own.

The virtual worlds of The Mirror reflected the themes of the six broadcast TV programs. An entry portal, which highlighted a "World of the Week" corresponding with that week's broadcast TV program, linked them. The graphical design of this portal was closely aligned with the mood boards and title sequence of The Net.

The six virtual worlds were built around the following themes: Space, Power, Play, Identity, Memory, and Creation[1] is an overview of the six worlds in The Mirror and the results from the experiment. Here I'll elaborate with details of the Community, Distributed Computing, and some of the Service Management features involved.

Space – Figure 2: Based on aspects of navigation and space on a lunar terrain, the environment included alien creatures, some of whom responded to your presence. Teleports were used to produce unexpected transitions, there were a number of visual illusions, and a cage encouraged co-operation between visitors, since a trapped avatar could only be released by a friend on the outside. The ambient audio was closely linked with The Net. For example Space World used music by the "composer", Italian astro-physicist Fiorella Terenzi who was covered by The Net.

Power – Figure 3: Animated figures from the past and present of computing were included in a hall of fame, which led visitors into a debating

arena. The arena could be customized, with an option to modify the image at the rear of the stage and to include celebrity "super-avatars", able to broadcast their chat to all of the audience. Additional functionality allowed the audience to record their votes, which were then visible on a scoreboard above the stage again accomplished as an application object. Exploiting this special event functionality was a key aspect of The Mirror. A stirring drumbeat in the hall of fame was replaced by a background murmur in the region around the stage.

Play – Figure 4: An over-sized playroom filled with games and tricks designed to promote co-operation and rivalry between visitors. Features included a rocket that required three people to launch, a shuffleboard with persistent scoreboard to foster competition, and a bouncy castle which shook the avatars. The shuffleboard and bouncy castle both required application objects with persistent state. The bouncy castle's state ensured that the more avatars there were bouncing, the higher they bounced. As with all the worlds, audio clips from The Net were attached to objects - in this case larger-than-life toys - with the objective of prompting discussion related to items in the TV series and relating the worlds back to the programs.

Identity – Figure 5: Experimentation with notions of identity and the influence of the environment on people and places. The world changed between day and night, as did the characters and their surroundings. An X-ray machine identified new arrivals to those already in the world, a guided tour was on offer, and a garden with musical sculptures hinted at future instrumental possibilities. As with Play world, these complex shared behaviors were implemented as application objects.

Memory – Figure 6: Significant events from the last few decades were brought alive along memory lane, which wound through an open landscape. There were snippets of technological, political and cultural history designed to prompt comment and discussion: President Kennedy's motorcade would drive along the lane, and Elvis made fleeting appearances. Audio clips and image flick-books suggested scope for streaming of broadcast audio-visual content within a shared space. We played with the notions of shared state versus local state with the random appearances of Elvis. He would appear among a group of chatting avatars, but only on one client, so if you saw Elvis you were likely to incur the ridicule of your friends. A key feature was the clock counting down to the End of the World: three hours before the final shut-down of The Mirror at 22:00 on February 28th, Memory world changed to a party setting complete with dance floor, a beer tent, and Java fireworks. This amount of behavior made Memory world incredibly processor hungry and on our target base machine – a P90 with 16 Megabytes of RAM – it sometimes ran at less than 1 frame per second.

Creation – Figure 7: Vibrant flora and fauna brought life to a world which provided visitors with a chance for Andrew McGrath's touted "fifteen Megabytes of fame" [2]. Creatures included frogs, a dragon and a turtle. We believe user authoring will be an important element of Shared VRML Worlds, promoting a greater sense of community involvement and ownership. A simple VRML2.0 authoring package, Spinner [3], was supplied to citizens of The Mirror, and an art exhibition was held with exhibits downloaded into Creation world. However because of the low response to this invitation we cannot draw conclusions from this aspect of the experiment.

6.   COMPUTING INFRASTRUCTURE

The Community Place server side system from Sony [4] consists of the World Location Server to pass on initial requests from client browsers to join a world to the server for that world. The server itself called a bureau and the application objects mentioned earlier. The server side hardware configuration involved five UNIX workstations and three PC's, supporting the six Sony Community Place Bureaus, one Sony Community Place World Location Server, the five application objects, a WWW server and ancillary support and monitoring services. The servers were connected through a SunScreen firewall to a 2-Megabit per second pipe from BTNet, BT's public Internet service.

7.   SERVICE MANAGEMENT

People registered to become citizens of The Mirror by going to a URL mentioned at the end of the first program in The Net series. The web page used to register applicants was mainly written in Perl and consisted of a legal agreement and then a registration form covering personal details, type of machine, and previous experience of virtual worlds.

Including all six worlds and the avatar changing room, the content amounted to 2.4 Mbytes of VRML code, supported by an additional 4.6 Mbytes of textures and 29 Mbytes of audio files. This content and client technology was sent out on CD.

The Mirror had over 2,200 citizens of which just over half appeared online. Once online citizens spent an average of 15 minutes in a world.

8.   LESSONS ABOUT COMMUNITY

When asked which worlds they preferred citizens of The Mirror came out in favor of Play and Identity as shown in Figure 8.
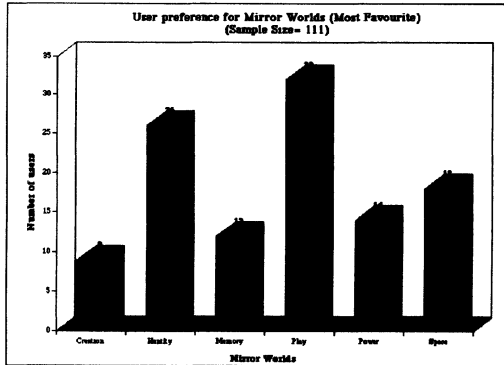

Figure 8

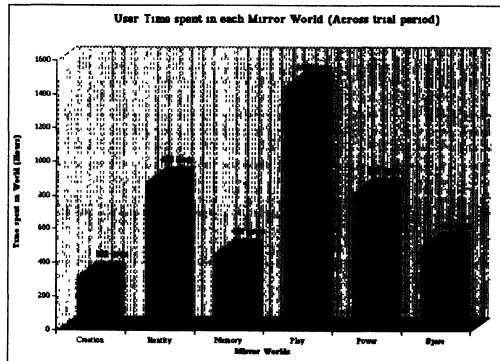And hours spent in the worlds shown in Figure 9 tell a similar story.

Figure 9

In fact the two populations are almost distinct. Play World was in use during the working hours of weekdays. Identity World was popular at night and the weekend. Why were these worlds popular? I contend that they were the two worlds that successfully combined sophisticated shared behavior

with coherent design that did not sacrifice frame rate. So when you first arrived at these worlds the shared behaviors helped and encouraged friendships to form, after that friends were happy to return to worlds to meet up with their new found friends because they felt at ease there.

This was not the only formula for success. Consider the usage of Power World shown in Figure 10.
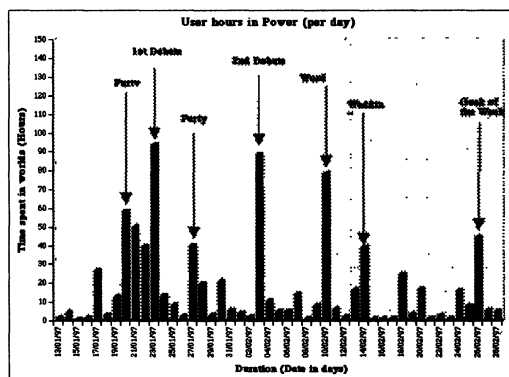

Figure 10

Here special events are used to draw and hold citizen's attention. These events range from the anarchy of the debate between Peter Cochrane and Douglas Adams titled "The Book is Dead" to the more structured narrative of the BBC quiz evening. Our next experiment concentrated on special events in Inhabited TV.

You may have noticed several attempts in the design of The Mirror to link it closely to The Net program on TV, for example copying styles from the mood boards and adding sound clips from the series to each world. Our original hope was that goings on in The Mirror would receive extensive coverage on The Net. However due to among other things broadcasters concern about the exclusivity of aiming at mid range specification home PCs attached to the Internet The Mirror received minimal coverage. That was far from true of our next experiment that went out live on TV.

9.   HEAVEN & HELL – LIVE

At one o'clock in the morning on Tuesday 19th August, Channel 4 broadcast Heaven & Hell - live, a one-hour long live transmission from

"inside a shared space". The shared space was a Shared VRML World, developed and delivered by the BT Labs team again using Sony's Community Place technology. The TV program was commissioned by Channel 4 as part of the Renegade TV series, and produced by Illuminations.

Heaven & Hell - live was structured around a game show. The host or compere was Dante (Craig Charles), and two "fallen angels" Johnny (Katie Puckrick) and Angelica (Malcolm Jeffries) were competing for points. So that the celebrities could concentrate on the verbal dialogue, they had assistants to "drive" their avatars in the virtual world. The inhabitants of the shared space were referred to as Lost Souls, and the elements of the game show were designed to promote audience participation.

The TV director had six virtual camera feeds from within the world - the three celebrities, and three reporters who were tasked to follow the action as the games progressed. There were also audio feeds associated with each camera, and from the three celebrities and three reporters. The broadcast was made from BT Labs, an exercise involving roughly 40 production and technical people.

9.1   The World

Instead of several worlds we decided to focus on one world with three distinct areas: purgatory, heaven, and hell.

Purgatory – Figure 11: quiet but sinister country graveyard on a hot summer's day. This was the home of Dante represented as in The Mirror's Power World by an application object based super avatar. This was the starting point for the program and the anchor point for the quiz. The first aspect of the game was a treasure hunt to find the bones from a dismembered skeleton littered around the virtual world. An application object controlled the piecing together of the bones. This first game helped accustomize viewers to the structure of the world.

Heaven – Figure 12: very tacky visions of heaven, mostly in pink, complete with fluffy clouds and cherubs. The only game to take part solely in heaven involved each contestant trying to build the largest stack of avatars they could. **Hell** - Figure 13: maze of Giegeresque fleshy tunnels leading to caverns in which the lost souls were harassed by invisible flying demons screaming on their passage through. Hell was the venue for the soul betting game. Most caverns contained a cluster of pods a la "Aliens" with touch sensors that caused either good results – being surrounded by flashing stars – or bad ones – having a vile sucker stuck to your face. We changed the virtual world on the PCs in the studio so that the behaviors on TV were not those that the Lost Souls had played with over the previous weekend. This was

done to avoid the experience from Habitat [5] where smart users solved an elaborate treasure hunt in a fraction of the time intended by the hunt's designers.

<div align="center">Figure 14</div>

Avatar Customization – Figure 14: based on Sony's Sapari World[6]. In The Mirror we opted for human avatars with an avatar changing room to choose and then color ones avatar based on the changing room of a department store. The emoting was also mostly near to life: goodbye was a wave and smile was a smile. With a polygon budget of around 150 polygons per avatar this was a mistake as subtle body language is only effective if the avatars are realistic. We learnt from the popularity of Captain VRML's goodbye emoting in The Mirror that had red lasers shoot from his eyes. In Heaven & Hell – Live the avatars were a mixture of human and non-human with grand gestures like falling into fragments on the ground and then regrouping. The customization was also more abstract with two user views given: a palette of colors and a ruler for re-sizing body parts. It is interesting to note just how much customizing avatars captures peoples imagination. There were still users tweaking their appearance long after the server was shut down, long after anybody would see them.

9.2   Computing Infrastructure

Because Heaven & Hell – Live was built around one virtual world and not six the server side configuration was easier for Heaven & Hell – Live than for The Mirror. We ran two suns, one with the Sony Community Place Bureau for the world and one with the web server and ancillary support and monitoring services. Again the servers were connected through a SunScreen firewall to a 2-Megabit per second pipe from BTNet.

Unfortunately the studio could not be connected to the same network as the servers and instead used the 2 Megabit connection from BT Labs to the Internet. This is shared by other BT Labs traffic but proved fairly empty late at night when the broadcast took place. There were several machines in the studio:

1. 3 PCs running the Sony Community Place Browser for the compare and special guests
2. 3 PCs running the Sony Community Place Browser for the invited journalists or "cameramen"
3. 2 PC servers running the application objects
4. 2 standby PCs

9.3   Service Management

The virtual world browser and content was distributed on CD to 400 registered participants, of whom 219 logged on during the days before the TV program, recording 1100 hours of on-line time. There were over one hundred people in the world throughout the broadcast. Viewing figures for the TV program were over 200,000 which is twice the figure expected by Channel 4 for such a late night slot.

Authentication on The Mirror was written by us. This proved unreliable and eventually had to be turned off loosing us valuable information about the actual identity of users. In light of this experience Sony re-implemented the Community Place authentication mechanism which we were able to use for Heaven & Hell – Live. This proved invaluable in rehearsals for removing people from the world and has also allowed us to trace users through several sessions.

As a Channel 4 live program Heaven & Hell – Live had far tighter governance constraints than The Mirror. Two key behaviors were identified by Channel 4 as unacceptable: incitement to commit crime and incitement to racial hatred.

Figure 15

Figure 15 shows our governance interface. Initial thoughts focused on lagging the broadcast behind the virtual world to allow behavior to be monitored. This was rejected, as it would make it difficult for participants to follow conversations they were partaking in via their PC on the TV. Our final process went

 – Identify user
 – Update user's database entry
 – Signal change to authentication process
 – Disconnect user from the bureau running the virtual world

This was accomplished through a Channel 4 lawyer watching both the broadcast signal and a window listing all the text generated from each conversation in the world. He was then able to pass on the name of any user to be disconnected to the bureau administrator via an open phone line. In the event no one was ejected from the world.

This process of governance is costly and would not scale to large scale Inhabited TV services. Solutions may include automatic behavior monitoring though it is hoped that these services be clarified so that the content is not the responsibility of the broadcaster.

The web pages surrounding the experiment are an ideal opportunity to manage the expectations of prospective users. The first weeks' support for The Mirror was dominated by complaints from Mac users unsupported by

our application. We prepared for this more carefully second time. We also used ODI's Objectsore an Object Oriented database to handle the users registration details, which was a more robust, extensible, and simple solution than the Perl scripts used for The Mirror.

Because Heaven & Hell – Live was only ever intended to focus on the one hour of the television show less effort was focused on support. Because Heaven & Hell – Live was live on TV there were new support dilemmas we were unable to adequately prepare for. For example, when the program was mentioned in the TV Listings it was often described in terms of the Internet or the Web. This led a large number of viewers to expect that they could interact with the program using their Web browser alone. These people were disappointed and angry to be told tat they needed a CD sent to them in advance.

9.4   Viewing or Inhabiting

Heaven and Hell – Live attracted a community of people around a TV program. Did that population define their own narrative for the evening or did they follow the narrative of the show provided by us?
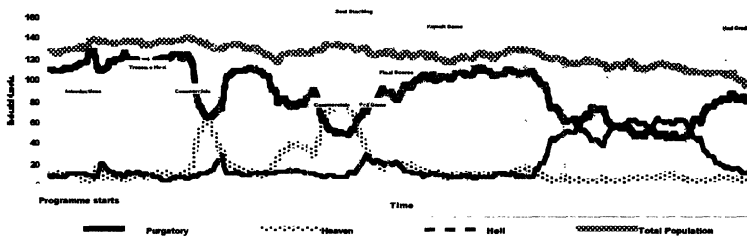

Figure 16

Figure 16 shows that the population followed the narrative of the world. Not only is the number of citizens fairly constant throughout the hour (compare that to TV viewing between 00:50 and 01:50) but the movement through the different planes within the world follows the movement of the contestants in the quiz show itself. This also hints at a model of participation based on viewers, inhabitants, and performers which was proposed and expanded in "Experiments in Inhabited TV"[7].

9.4.1 Lessons about Aura

For virtual worlds to be able to cope with the hundreds of users we can attract now up to the hundreds of thousands found in a TV audience the multi-user technology has to support some notion of aura, horizon, or acuity. This prevents the position and text chat from all the users of the virtual world being sent to each client, flooding their network connection. It also alleviates the rendering bottleneck caused by having hundreds of avatars in view on each client. It does this by limiting the number of avatars that each client receives information on text and movement from to a subset based on proximity and performance of the client. The notion of aura used in Sony's Community Place[8] suite is based on work done in Europe as part of the COMIC project[9]. However on TV this notion did not work. As Heaven & Hell – Live opens on TV Craig Charles say "We have with us 150 Lost Souls joining us from across the Internet", but on screen viewers could see and empty world with only eight avatars visible. There were other effects:

- Avatar stacking was made harder by only being able to call on the eight avatars in your aura group
- Some users watching the TV in the same room as their PC moved to get on the camera shot but failed because they were outside the aura of the camera
- People arranging to meet in a popular part of a world could be stood close by each other but unable to even see each other because they have ended up in different aura groups
- Because aura groups are not transitively closed you may be able to hear just half of a conversation

The first of these problems, crowd aggregation, is being tackled by academics[10] but currently remains beyond current home machine based implementations. The remaining aspects require a more sophisticated approach to aura management, that allows people to see crowds, meet friends, and follow conversations but that is still intuitive to use.

10. WHERE NEXT

In this chapter I have presented two experiments conducted at BT Labs into Inhabited TV. These experiments used Shared VRML Worlds delivered over the Internet to participants PCs. They have followed a trend towards increased blurring between the TV and the Shared VRML World client and a trend of increasing numbers of concurrent users.

11.   EXPERIMENTS IN INHABITED TV

Any experiment constructed using members of the public with their home PCs and Internet connections has to accept the consequence that brings. The experiment is not clean, most of the client side lies beyond our control. For example some results from Heaven & Hell – Live suggest that as the number of concurrent users peaked so did the churn of users. Average session lengths dropped. Without knowing more about the clients network connection it is difficult to pinpoint what was happening.

As Internet chat spaces and TV combines the computing and the broadcaster's worlds face a challenge. It is difficult to imagine the Web centric interfaces familiar to computer scientist taking hold of TV audiences just as it is difficult to imagine people being satisfied by the removal of social interaction offered through TV.

Hence our experimentation needs to move away from the home PC and look at Inhabited TV delivered on a Set-top Box.

12.   LESSONS ON COMMUNITY

Communities form around anything. Those that form around business products, services, and tasks often have the money available to try technology that they believe will give their outfit an edge. I would like to take some of the lessons we have learnt on communities and some of the questions that remain unanswered and pose them again, but this time in the context of business communities and desktop PCs.

13.   CONCLUSIONS

We have shown that the TV of the future may indeed be the provider of places where communities of people come together. Rather than individuals or families viewing and interacting with their TVs they are able to enter and form part of the content they watch. They are able to inhabit their TV.

To understand the impact of such an idea we conducted two experiments attempting to merge online PC based virtual worlds with broadcast television. The first of these, The Mirror, concentrated on the community nature of such a service and brought together several thousand TV viewers to inhabit a virtual world. The second experiment concentrated on structured narrative and further integration by taking the bold step of making the happenings in the virtual world the sole element of a live TV broadcast.

There are still research issues to be overcome in computing, service management, design, psychology, and sociology before Inhabited TV is a readily available home service. Next steps include the exploration of the set-top box as a delivery terminal and allowing users the ability to build their own elements of the world.

Through our research we have shown that with some care to collaboration, design coherence, performance, and narrative Inhabited TV is a possible and an intriguing future for TV.
  * Figures with color plates precede the chapter

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