Chapter 1
TV or Not TV: Where Video Is Going

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Abstract Television used to be a simple affair: a technically highly standardized medium, with fairly similar organizational structure, content types, and business models across developed countries. It provided a nationwide, middle-of-the-road content delivered by national networks, distributed regionally by TV stations with some local programming thrown in, and with either advertising or governmental funding as its economic model. But now, TV is getting quite complicated and varied. And the question is, where is this taking us?

Four generations of television picture quality can be distinguished:

1. *Pre-TV*. In this exploratory stage of the TV experiments of the 1920s and 1930s by Baird, Zworykin, and Farnsworth, a crude picture was being projected. Baird's 1926 video image had 30 lines of picture resolution.
2. *Analog TV*. This regularly scheduled TV has 525 lines. Its content aims at the broad taste center of the population. In the USA there were on average seven broadcast channels operating. The typical spectrum "pipe" was thus 42 MHz (7 × 6 MHz) in the 1950s and 1960s. The flow of information was synchronous because it was scarce, meaning that it was shared and simultaneous.
3. *Digital TV*. After the 1970s, analog broadcast TV branched out and was distributed over cable and satellites. In time, they became digitalized. Broadcast TV, too, became digital in the late 1990s, with standard and high-definition TV emerging and entirely replacing analog transmission by 2009. Cable TV and satellite created alternative TV transmission infrastructures. Today, cable TV uses pipes of about 3 Gbps, about 75 times more than the actual typical terrestrial broadcast spectrum used in a locality. This extra transmission capacity was used first in a horizontal fashion of a "widening," or expansion, of traditional-quality channels. This led to a "narrowcasting" in terms of content and audiences. But after a while, digital technology was also extended to a vertical "deepening" of the channel. HDTV is an example. It displays twice the number of horizontal lines, as well as a wider line and more bits per pixel.
4. *Individualized TV*. This new generation of TV is presently emerging, and its main manifestations are Internet TV and mobile TV. They are dependent

D. Gerbarg (ed.), *Television Goes Digital*,

on fiber, coax or wireless. Together they increase enormously the individual transmission capacity in both upstream and downstream directions. This raises the number of channels horizontally, but also enables individualized, asynchronous, and interactive TV. Mobile TV also creates a ubiquitous availability of such individualized content. Internet TV permits user-generated content, which leads to a greater networking among users. This led to two-way transmission, moving from narrowcasting to individual casting, and to user-generated content sites such as YouTube. In bit terms, such low-resolution content translates to about 300 Kbps – a very low quality. However, we are willing to accept such video if the content is noncommercial and community based.

At the same time and by the same logic, there is also a *deepening* of picture quality, because the transmission path is becoming more powerful, and because people have always moved to a richer media experience. The introduction of 4 K HD (also known as S-HD or S-HV) has proceeded from the direction of advanced electronic film exhibition. It provides a picture quality with 4,096 vertical lines (pixels) and 7,281 vertical pixels at an aspect ratio of 1:1.78. Pixels at film theaters are at an aspect ratio of between 1.85 and 2.35, which would translate to about 8,200 horizontal pixels. Also, color coding would be 36 bits, and after all of the additions, generation 4 K TV would be 35 Gbps, uncompressed. Further developments such as three-dimensionality (3-D) provide for a richer media experience but also require a larger transmission capacity of about 70 Gbps, or 400× the transmission requirement of an analog generation TV channel.

Thus, the overall transmission capacity increase from analog generation TV to individualized TV is immense, mainly because the individualized two-way consumption requires much more bandwidth than shared synchronous media, even if each user does not consume a huge channel by himself. When compression is utilized, requirements are reduced but are still high. Standard TV, can be compressed from 150 to 3.4.

With this in mind, can an economic case be made for such a prolific transmission? What exactly would one do with 4 K TV? There are four industries or categories that will be greatly impacted:

- *Film Theatrical Distribution*: Such distribution has been talked about for a long time, but the transition is difficult and will happen only when the cost of projection equipment has significantly dropped. Also, diversion away from home theaters will need to occur – this can happen if film theaters greatly surpass the home theater experience. And this is increasingly unlikely when viewers move to individualized, interactive, and immersive experiences, which are harder to do in large-group settings such as film theaters.
- *Specialized Applications*: Examples are marketing uses, billboards, or medical services.
- *Gaming*: High-resolution TV will allow for more interactive and immersive games. However, even interactive games do not use all that much transmission capacity – on average, for *Counterstrike*, about 40 Kbps is used. The reason for this is that the processing capacity on the central node is limited, so that each player's stream is limited. But this will presumably change.

- *Home Entertainment*: Going back to the earliest days of consumer electronics, each generation has persuaded itself, with the help of marketers, that it has life-like audio and video quality. This history has long contributed to the traditional short-sightedness of expectations. The question, in relevance to home entertainment, remains: what would be the use of Internet TV on the consumer level?

Analog and digital TV have a clear economics base, namely, advertising and some subscription. In contrast, Internet TV has not yet found an economic model. Low-definition TV, e.g., YouTube, is mostly given away, or interspersed with some ads. Interactive and immersive HD does not exist yet. The willingness to pay for such premium interactive and immersive content is probably high, but this requires strong security and encryption for the content. One could show dozens of regular channels so the revenue for a single premium channel or program would have to be as large as those of alternative channels and content.

What kind of impact will this issue have on content of higher and lower resolution TV? Is there a difference between the content style of films made for high resolution theatrical film, and for lower resolution? There is a relation between media technology and content, as summarized by Marshall McLuhan's dictum that the medium is the message. When films were silent they favored slapstick and physical styles. Sound added dialogue, and sophisticated comedy and drama; romance became possible. Animation and computer technology added highly sophisticated special effects. The impact of higher resolution on style is to enrich the content in terms of the sensory stimuli and signals. The two-way capabilities of Internet and mobile phones also create direct involvement possibilities for the user, i.e., dialog instead of monolog.

Also, there is a budgetary effect of higher resolution. On the one hand, technology and its dropping cost lower the costs of a given production. But it lowers the cost for everyone. There is still competition for attention, which will ratchet up other cost elements, and lead to an escalating budget for special effects. Also, a higher resolution requires that details have to be done better. When film moved to color it favored large spectacular shows, and when computer animation and editing emerged it favored special effects. Interactivity, 3-D, and immersion TV add further cost elements. It can therefore be concluded that next-generation TV will be more expensive for premium products that vie for mass audiences.

This diversity of television in terms of technical quality will have implications on standards and protocols. In the Internet TV environment fewer standards and protocols are needed. Different providers or provider groups can encode visual images in a variety of ways, and users' terminals can decode it, based on software and hardware cards they acquired. Standards and protocols can coexist and compete. In other cases, servers can store content in several ways, or be able to reformat them.

To conclude, TV is becoming too big, too advanced, and too important for a one-size-fits-all medium. Television, whatever that means anymore, will be diversifying horizontally and vertically. Horizontal diversification includes more standard quality programs and channels and more specialized "long-tail" content in standard quality. Vertical diversification means a variety of quality levels, from cheap low

resolution to highly enriched, immersive, participatory TV. Viewers will also accept low-quality resolution from noncommercial sources. But for commercial content, despite the lowering of cost of a given technology, competition and user expectations will drive the production cost to ever-higher levels.

Such premium content will be increasingly interactive, immersive, and 3-D. The greater bandwidth of next-generation broadband transmission, together with the ability to store content for downloads rather than through synchronous transmission, will enable a much richer content in terms of bits or sensations per second. Multiple TV standards and protocols will coexist and compete. There will also be further diversification in terms of business models, media firms, and global providers.

As a result television will have many more legs to stand on. It will have a wide range of quality levels, content dimensions, technical dimensions, and policy treatments. The traditional looking TV content, as well as some standardizations, will still be around, but there will be coexisting multiple TVs.

So is it still "TV"? Yes … Let a hundred televisions bloom.