It's time to plug the television into the Web. Companies have taken all sorts of shots at such a convergence box for the past 20 years, leaving a path strewn with breathless press releases and failed systems. More recently, the industry has churned out an expanding array of set-top boxes most of which take users to a narrow set of video and music services.

But now the pieces are coming together to turn today's appealing flat-panel screens into full Internet clients. When consumer companies start delivering real Internet TVs in volume, they will inspire a new wave of Web services beyond today's Fancast, Hulu, iTunes and YouTube.

Internet TV "is a superb idea and it's going to be the future of television," said Steve Perlman, founder of WebTV Networks, one of the field's pioneers, who now runs Rearden LLC (San Francisco), which incubates consumer startups. "It's just a question of when and how it's implemented."

First, the industry must define iTV. Look up WebTV on Wikipedia and you land, ironically, at a so-called disambiguation page that points both to a history of Perlman's earlier effort and a description of streaming media.

Clearly, we don't really know what iTV is or should be. Blame today's pile of set-tops, each with its own handful of Internet-hosted services.

"It's being rolled out in an ignorant and fractured way," said Richard Doherty, principal of consulting firm Envisioneering (Seaford, N.Y.). "There's no consistent description of what an Internet TV is. If you go to 10 retailers you would get 10 answers," he said.

Startup Vudu's box links to its own movie service, built up from its direct proprietary deals with studios. Apple TV relies primarily on links to iTunes.

"The thing is, you have limited selections of content in systems that only work with certain TVs and Internet connections—there are too many constraints," said Perlman.

An industry group such as the Consumer Electronics Association could play a critical role in defining the platform, even as it helps set expectations for HDTV, Doherty said. "We need a coherent industry understanding that OEMs, content providers and retailers can point to..."
and say, "This is Internet TV," he said.

The time is ripe. Today's new sets are all digital. Analog broadcasts will go off the air completely in the United States in February. Meanwhile, a growing collection of Web video sources is driving new use patterns.

"I have a lot of college-age friends who have no plans to buy a TV," said Perlman. "Everything they watch is online."

Let's take a stab at defining the iTV we'd like to see.

It should be a full, no-compromise TV that plays legacy over-the-air, cable, satellite or IPTV broadcast content in resolutions up to 1080p with picture-in-picture and all the other features to which we've grown accustomed. It also should be a full Web client, able to tap with equal ease a cable modem, DSL gateway or IPTV link to access anything on the Net.

A great iTV will provide simple ways to navigate all content sources. It will provide the best possible playback of the broad spectrum of low-quality Web and mobile media. It will let PC mavens grab their mice and keyboards to hack through giant spreadsheets or obscure Web services, but it also will accommodate novice users in TV modes insulated from the open Internet.

Of course, our iTV will also be a good home-network client, capable of displaying pictures, videos and music that reside on any other system on the net. It must be great at discovering PCs, cell phones, cameras, printers and whatever content or services those devices provide.

The iTV also will be able to anticipate and even drive new scenarios. It will let users access and view high-definition home movies e-mailed from relatives vacationing in Europe, for instance, and will be the vehicle for finally delivering video conferencing to the living room. Ultimately it's about spawning a big-screen, high-def Web.

The components needed to build this iTV are already here, though some still require significant engineering and innovation. At the physical layer, for example, Broadcom is delivering digital TV chip sets that integrate basic Ethernet capabilities as well as a stand-alone Wi-Fi chips optimized for TVs. To date no one has adopted the wireless chip, in part because it adds as much as $15 to the bill of materials. But Dan Marotta, general manager of Broadcom's broadband group, believes TV makers will take the Wi-Fi plunge eventually.

That may not be enough, given the bandwidth requirements for high-def streams. Enter a growing number of startups, including Amimon, Celeno, Quantenna and SiBeam, with aggressive 802.11n implementations, ultrawide-band options and even 60-GHz devices (see "Wireless home network? Any takers?"). The International Telecommunication Union's G.hn standard in the works will also help, unifying coax, phone-line and powerline options into a single chip set in the next 18 months. Bluetooth will play a role, too, linking TVs and mobile devices, Marotta said.

"Each has trade-offs. There's no silver bullet for the last 100 feet," said Perlman.

OEMs will need to experiment with many options. They likely will try to establish proprietary links between their branded systems until the emergence of a handful of standards forces them to open up.

The iTV will also require more powerful processors and more memory to handle a software stack that is expanding on several fronts. Today's MPEG-4 class compression schemes cover a lot of territory, but more is needed to transport high-def video smoothly to and from the Web. Better codecs also will be necessary to push the next big wave—stereoscopic 3D games and movies.

Video and image scalars will become a challenge again, but this time at the low end. Presenting the vast unknown content types from the Web and cell phones will drive new levels of creativity in this otherwise maturing silicon sector.

Toshiba is well-positioned here, with its Cell processor as the killer CPU for transcoding whatever the Web spawns and iTVs demand, according to Envisioneering's Doherty. Broadcom is working on interpolation, motion estimation, filtering and scaling to make everything from YouTube videos to QCIF camera-phone photos look as good as possible on whatever display technologies the TV makers use, Marotta said.

The host processors will also have to run the software stacks that manage interactions with the many other devices that come and go on a home network. Several third-party stacks already have been introduced based on standards such as those from the Digital Living Network Alliance, said Marotta.

The industry must examine ways to expand these standards to create plug-and-play content capabilities. We need a standard by which digital content (video stream, images, music files) let the playback system know its resolution, compression and so on.

The recent move by the Society of Motion Picture and Television Engineers to set standards for broadband content is a step in the right direction. Perlman notes the HDMI interconnect supplies another piece of the puzzle, providing a lot of information about the TV display. "I don't know of anyone really taking advantage of that," he said.

Digital rights management (DRM) is one piece of the software stack that still needs significant work. The Coral Consortium—an ad hoc group of consumer companies including Panasonic, Philips, Samsung and Sony—has completed its spec for creating ecosystems in which
multiple DRMs work together, but so far no one has implemented it, said Jack Lacy, Coral's president.

Another consortium, the Digital Entertainment Content Ecosystem, has tipped plans to announce a broad scheme for content interoperability at the Consumer Electronics Show in January. DECE—which includes several studios and tech companies—aims to ensure playback of content from multiple sources on any device.

"They have yet to announce their technology architecture, but they seem to be pretty far along," said Lacy. "DRM interoperability is just one piece of what they want to do. A lot of the business models [for digital home services] still have to be worked out."

DRM will likely be the last piece of the iTV puzzle to fall into place because it requires collaborations between multiple companies and groups of companies on business models and the security tools to manage them.

Another black art of the iTV is the user interface. The trick here is finding a way to balance simplicity of use with freedom to roam across the full range of the ever-expanding Web.

"I've yet to see a really good UI for an Internet TV experience," said Perlman, whose WebTV set an early watermark in the field. "Some are God-awful and others are not too bad."

Nevertheless "there's an opportunity for a beautiful experience" by blending the ingredients of high-def video, Adobe Flash and the Net on the big flat-panel palette, he added.

Gesture interfaces are an emerging technique to cut through the complexity. Apple and Nintendo in particular have opened the door to new ideas with the iPhone and Wii for gestures using touch screens or wands with motion sensors.

"It's great if it's done well, but it can be overdone," said Perlman, who readily admits many of the lessons he learned from his WebTV experience were in the user interface field. "The list is long," he said.

Clearly there is plenty of work ahead to create a good iTV and plenty of room to differentiate products. So let's get at it. Now that the industry has delivered a broad range of 1080-p HDTVs, this is the next major TV chapter to write.

Every major TV maker who comes to the Consumer Electronics Show in January should arrive with a well-thought out strategy and at least a few working iTV prototypes to demo. Content and other partners need to get on board, too.

With good public feedback and plenty of smart engineering, the first great iTVs could hit retail megastores in time for holiday season 2009.