

REAL GENIUS
As Hollywood's first full-time science advisor, Underkoffler [far right] has [clockwise from top] created *Minority Report's* gestural interface, made plausible the cloning technique used in *The Island*, helped design *Aeon Flux's* futuristic city, and biochemically justified the *Hulk's* bulletproof skin.

HOLLYWOOD'S SCIENCE GURU



For guidance in the path of the scientifically accurate, hotshot Tinseltown directors turn to MIT's John Underkoffler **BY GREGORY MONE**



IT'S EARLY 2002, and John Underkoffler is leaning over the desk in his small office on a Universal Studios production lot. Just over a year ago, he was a professor at the Massachusetts Institute of Technology. Now he's an adviser on *Hulk*, an adaptation of the popular comic-book series. The film's director, Ang Lee, has questions, and it's Underkoffler's job to answer them. Why is the Hulk green? Why don't poisons

affect him? Why do bullets bounce off his skin when he's angry? Lee wants credible explanations that use the latest science, and since the movie is already being shot, he wants them quickly. In effect, he wants Underkoffler to reverse-engineer a superhero.

For months, Underkoffler has been scouring the relevant scientific literature on genetics, chemistry, materials science and animal behavior. He has

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consulted leading experts, even flying to Boston to meet with iconoclastic Harvard University cellular biologist Donald Ingber. The walls of his office are plastered with DNA printouts, cell diagrams and sketches of fictional nanotech devices, mementos of his search.

Today he makes the breakthrough. He sprints down the hall to Lee's office and makes a triumphant announcement: "I know why the Hulk is bulletproof!" He explains that the Hulk's DNA must have been spliced with that of another creature, a docile, seafloor-dwelling

invertebrate that can harden its body tissues when in peril. The Hulk is . . . part sea cucumber.

Fast-forward three years. Underkoffler is sitting in his own office now, a cavernous, computer-filled lab in downtown Los Angeles. With gray-speckled hair and a goatee, Underkoffler's serene exterior masks a mental energy more common to a heavily caffeinated college kid than a 38-year-old consultant. We're watching the DVD of *Hulk*, which came out in 2003. The movie's opening sequence is science delivered in the quick-cut edits common to music videos. It shows David Banner, the Hulk's mad-scientist father, splicing genes from other creatures into his own DNA, changes that he will pass on to his son. In quick cuts, Banner pokes a needle into a jellyfish, shocks a sea cucumber, tests the resistance of a genetically-reengineered monkey to poisons. The camera pans over sheets of lab notes—for the movie's purposes they're Banner's scribbles, but Underkoffler wrote every word.

He's quick to admit that Banner's sea-cucumber trick isn't technically possible. But it's conceivable, and that's the point. As Hollywood's first full-time science adviser, he can't make everything accurate, but he hopes to reduce the gibberish and mitigate people's fear of science. "One of the things I hate hearing is, 'You have to keep it simple.' You don't," he insists. He thinks many filmmakers don't give their audiences enough credit. When actors sound like real scientists, the result is a more believable film. "Even if you don't understand it completely, you get a sense," he says. "It's better than mumbo jumbo."

Technically, Underkoffler is an engineer; that's what the degrees from MIT say. But to do this job he must also be a physicist, a molecular biologist and a cloning expert, not to mention futurist, urban planner, script doctor and inventor. He must think like a brilliant mad scientist, talk like a neurologist, and extrapolate modern technological trends 50 years into the future. And he must do all this with



REAL DEAL Underkoffler developed his gestural interface while at MIT's Media Lab. *Minority Report* later made it famous.

TO DO THIS JOB UNDERKOFFLER MUST BE A PHYSICIST, CLONING EXPERT, FUTURIST, SCRIPT DOCTOR AND INVENTOR.

POPSCI MOVIE AWARDS



WORST SCIENCE-INSPIRED BUSINESS PLAN

Of all the impossible occurrences in *Fantastic Four*, none seems as implausible as scientist Reed Richards' scheme to make billions of dollars by studying the human genome through the exposure of plants—yes, plants—to cosmic rays.



MOST INSIDIOUS BREACH OF SCIENTIFIC ETHICS OUTSIDE SOUTH KOREA

Ignoring all the evidence that his clones are real people, preferring to think of them as soulless machines, *The Island*'s evil scientist TKTKTK Merrick harvests their organs for profit. All in the name of—you guessed it—science.

one foot grounded in reality and the other in fantasy.

Underkoffler is not the only science advocate in Hollywood, but his wide range of knowledge makes him unique in the business. In the past five years he has worked on at least eight major studio films, including last year's *Aeon Flux*, about an assassin who tries to overthrow the totalitarian ruler of a seemingly utopian city 400 years in the future, and *The Island*, about human clones bred to provide body parts for others. Currently he's assisting on a movie slated for release in 2007 called *I Am Legend*, about the sole human survivor of a massive pandemic. "The interesting thing about John is that he's such a generalist," says Tim Squyres, the editor of *Hulk* and brother of leading Mars scientist Steve Squyres. "In a movie, where we're not trying to solve some biological problem, where we're trying to tell a story,

someone who's just aware of a lot of science is far more valuable because he can suggest interesting notions that a specialist wouldn't necessarily get."

Many Hollywood stars have a story about how they were "discovered." Underkoffler's differs from the norm. In the spring of 2000, production designer Alex McDowell was visiting MIT's Media Lab, the future-focused design, engineering and science arm of the university. McDowell was researching advanced technologies for *Minority Report*, Steven Spielberg's thriller set in the year 2054. Spielberg didn't just want far-out stuff; he wanted "future reality." But despite the flood of innovations McDowell witnessed in Cambridge that day, the flexible computer screens and wild-looking vehicle designs, he was most impressed with a young engineer named John Underkoffler. They talked about technology, of course, but also music and

movies and books. "He's got this incredible brain," McDowell says. "He's very, very adept as a scientist. But he's also got pop-culture sensibilities and he's very knowledgeable about filmmaking."

Underkoffler had been part of the Media Lab since its inception in 1985. He'd worked in holography, and was part of a research team that was featured in the January 1991 issue of this magazine. When McDowell met him, he was building the prototype of a machine called a gestural-recognition interface. This device interprets the user's gestures as commands, turning a person's hands into a keyboard and mouse. Spielberg loved the idea, and Underkoffler's invention was adapted for *Minority Report*, which came out in 2002. In the film, the interface helps enable police officers to read the future and arrest killers before they commit their crimes. At police headquarters, Tom Cruise, the detective protagonist, moves his hands through the

POPSCI MOVIE AWARDS



MOST IRRATIONALLY BEAUTIFUL MATHEMATICIANS

Although *Proof* won praise for some accurate math-speak, anyone familiar with probability and academia would tell you that the chance of two intellectuals as attractive as Jake Gyllenhaal and Gwyneth Paltrow working in the same program approach zero.

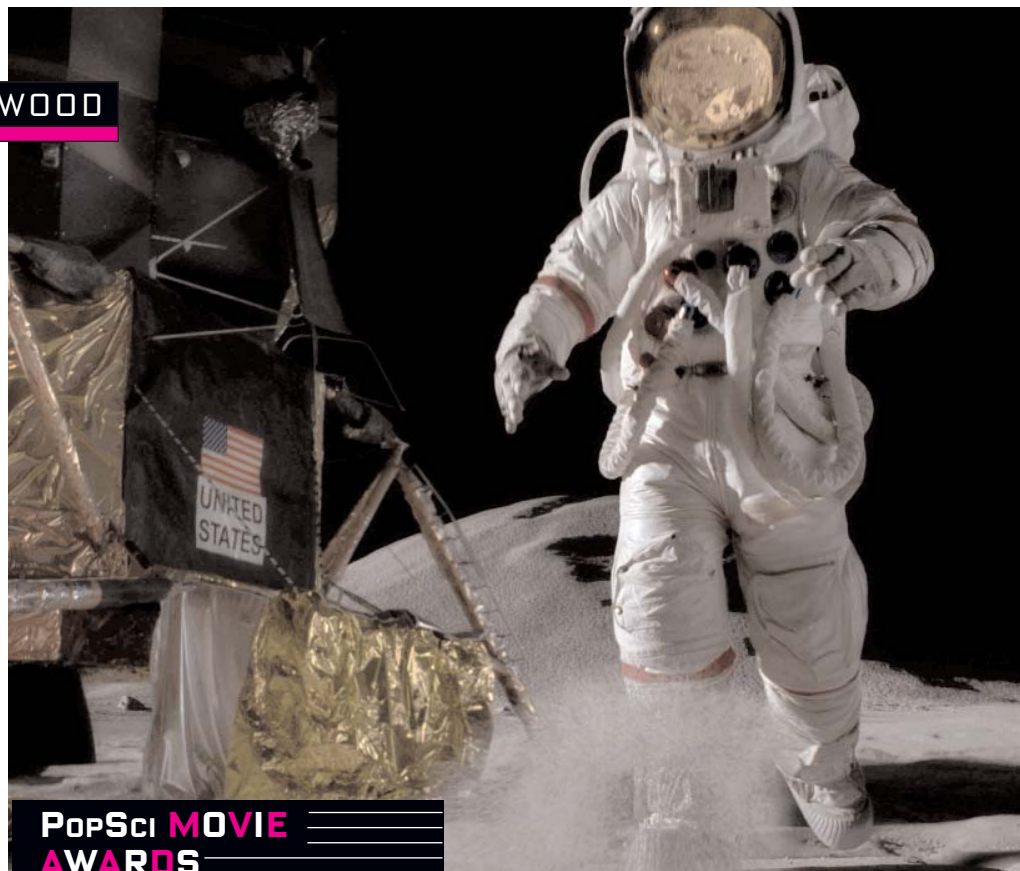
air to sort through future crime scenes.

Underkoffler was gratified that his invention was incorporated into Spielberg's movie, but he was looking for more. He had begun studying film and literature on the side. He'd even co-founded a comedy troupe, the Hoist Point Orchestra, and had contributed to humorous philosophical riffs on such mysteries as disappearing socks. He was, in a way, already moving beyond the lab when McDowell called him up a year later. "John, have you ever thought of working in Hollywood?"

"Sure."

"Good," McDowell replied. "Get on a plane."

Underkoffler's position is hardly glorified—his name sometimes appears after those of the carpenters, electricians and tailors. But he exercises a subtle influence. In *Aeon Flux*, Underkoffler acted as urban planner, suggesting that the buildings in a self-contained 25th-century city should be made of bamboo and cement, since metals would be too precious to use in construction. On last year's *The Island*, he was



PopSci MOVIE AWARDS

BEST ALTERNATIVE FOR THE WANNABE SPACE TOURIST

Until tickets to space dip below \$200,000, the closest most of us will get to the great beyond is *Magnificent Desolation*, the IMAX hit that plants the viewer's feet right down in the regolith. Other benefits over space tourism: Watching the 3D film is much less dangerous, the food's better, and it's less than an hour round trip.

brought in to help make the cloning-related dialogue believable. On *Hulk*, he showed the actors how to handle a confocal microscope and even selected the screensavers for their computers, images of growth processes of cancerous brain cells borrowed from Ang Lee's wife, who is a molecular biologist. For the *I Am Legend* job, he is studying up on virology and disaster planning.

Underkoffler throws his heart into his research, yet he knows he must choose his battles. While watching *Minority Report* with him in his lab, I suggest that the transparent video discs used in the movie seem unnecessary, that in 2054 information would most likely be stored digitally. He winces slightly. Although he was hired to develop the gestural interface, he quickly got more involved, writing impromptu lines of dialogue for scientist characters, pointing out inconsistencies and, yes, noting that discs would be technological relics by 2054. But he was told that they looked good on film.



BIG HAND The gestural interface's gloves transform your hands into keyboard and mouse.

As a counterexample, he excitedly skips to a scene in which the Tom Cruise character views a holographic home video of his wife and son. When this scene was in the works, Underkoffler recalls, the holographer in him couldn't stay quiet. He'd worked in the field for years. He understood the limitations, even 50

years out. If he had to choose his fights, this was going to be one of them. The image couldn't be a complete, in-the-round holograph because it was shot from one angle, with a handheld camera. Underkoffler pointed out that if this were the case, there couldn't be any back to the images. The filmmakers heeded

AND THE SCI-TECH OSCAR GOES TO ...

Now presenting the Academy's 2005 Scientific and Engineering Awards

HOT-HEAD

WINNERS Laurie Frost, Peter Hannan and Richard Loncraine, Shepperton Film Studios

USES The original remote camera head (the device at the end of a tripod camera crane that actually holds the camera), the Hot-Head TKTKTKTKTK WHAT IT DOES.

CREDITS TK

SKYCAM

WINNERS Garrett Brown, Moving and Talking Picture Company, Inc.

USES Originally developed in 1984, the then-revolutionary Skycam was the first-ever remote-controlled, cable-supported flying camera system. These days, the system is most conspicuously strung just

behind the quarterback during professional football games.

CREDITS *Highlander*, *The Boy Who Could Fly*

PERFECT HORIZON CAMERA HEAD

WINNERS David Grober, Scott Lewallen, Motion Picture Marine

USES This stabilizing camera head uses electronic sensors to detect motion, and a microprocessor calculates counteractive measures in real time. It neutralizes the pitching and rolling motion generated by boats, camera cars and other vehicles, creating a perfectly level horizon.

CREDITS 2006's *The Fast and the Furious: Tokyo Drift*

RUSSIAN ARM CRANE AND FLIGHT HEAD

WINNERS Anatoliy Kokush, Yuri Popovsky and Alex Zolotariov, Filmotechnic

USES This is the first film crane that stabilizes both the camera head and the boom arm with gyroscopes. Filmmakers can mount the remotely-operated rig on the roof of almost any car and rotate it smoothly 360 degrees around the vehicle for wobble-free shots—even while crossing rocky terrain at speeds of up to 100 miles an hour.

CREDITS *War of the Worlds*, 2006's *X-Men 3*, *The Fast and the Furious: Tokyo Drift*, *Mission Impossible 3*

CASCADE CRANE SERIES

COURTESY IMAX/PLAYTONE



CAPTION TK s very, very adept as a scientist.

WINNERS Anatoliy Kokush, Filmotechnic

USES Because these cranes are made of a lightweight aluminum alloy, filmmakers can expand them up to 70 feet, allowing for shots from previously unreachable locations.

CREDITS Popular in Europe, the cranes have been used to make a number of tel-

evision commercials and music videos but no American films.[MM checking]

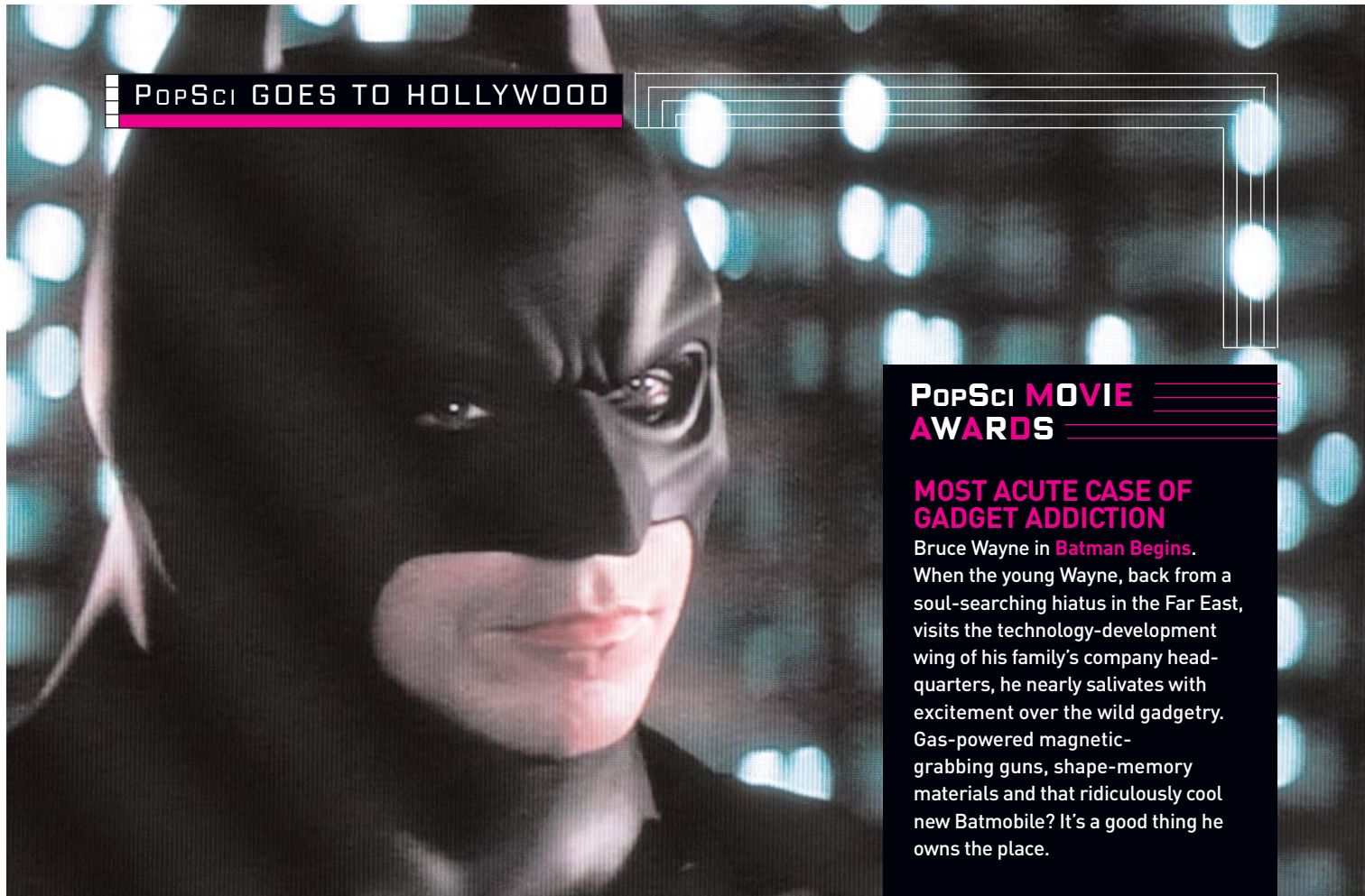
CLOTH SIMULATION FOR FILM

WINNERS Andy Witkin, Michael Kass, David Baraff, Pixar Animation Studios

USES Pixar's software plugs scene-spe-

cific physical data about, say, the weight of the fabric in a character's shirt into a series of mathematical equations that determine how it should move. Based on those physical parameters, the software creates lifelike wrinkles and movement.

CREDITS *Monsters, Inc.*, *Finding Nemo*,



POPSCI MOVIE AWARDS

MOST ACUTE CASE OF GADGET ADDICTION

Bruce Wayne in *Batman Begins*. When the young Wayne, back from a soul-searching hiatus in the Far East, visits the technology-development wing of his family's company headquarters, he nearly salivates with excitement over the wild gadgetry. Gas-powered magnetic-grabbing guns, shape-memory materials and that ridiculously cool new Batmobile? It's a good thing he owns the place.

his advice, and the result—grainy, incomplete holograms—looks like real technology, complete with flaws and glitches. Both suggestions were attempts to make the world on the screen more real, to build a more believable future.

It's not just science, but scientists, that Underkoffler wants to portray realistically. His eyes light up when I mention the 1985 comedy *Real Genius*, about a group of brilliant science students. "They absolutely nailed the Caltech/MIT culture!" He pulls the 1980 movie *Altered States* from his DVD collection, slides the disc into his Mac, and clicks forward to a dinner scene in which a group of scientists are chugging from wine bottles, arguing vehemently about the nature of consciousness. This, he says, is science. Not the booze, necessarily, but the energy and enthusiasm. These aren't detached, Spock-like drones in white lab coats. "[Physicist Richard] Feynman and the really good ones are often just the opposite," he says. "They're passionate and sometimes irrational."

Underkoffler is intellectually omnivorous—his library says it all. The ground floor of his lab holds the light reading, such as *300 Years of Gravitation* and a two-volume set entitled *String Theory*, plus entire bookshelves stacked with works on cinema, art and philosophy. Upstairs in the loft are several hundred works of serious literature, including 17 novels by the influential postmodernist author John Barth. The organized engineer in him is also apparent: All the books, along with hundreds of DVDs, are sorted by subject and alphabetized.

Along with his Hollywood accomplishments, Underkoffler remains a working engineer. With funding from defense and aerospace contractor Raytheon, among others, his research team recently completed a working version of the gestural-recognition interface in his L.A. lab. Raytheon thinks it might be useful for military planning, but when I was visiting, Underkoffler presented it to a Hollywood cinematographer as a potential



MOST EXTRANEOUS ALIEN CITY

Close to the end of James Cameron's documentary *Aliens of the Deep*, the director accomplishes the near impossible—he makes robotic space exploration positively gripping. As he takes you through a step-by-step animation of a future mission to Jupiter's icy moon Europa, it feels like you're watching a thriller, not a science lesson. Then he destroys all that good work by unveiling the potential payoff: a dreamland alien city beneath the ice. The misplaced fantasy not only overshadows the mission's real science, it makes the whole enterprise look absurd.

JOHN B. CARNETT (2)

tool for filmmakers.

The success of *Minority Report* in particular has earned Underkoffler acclaim outside Hollywood. He speaks at technology conferences around the world. He consults with videogame developers, helping them construct realistic futures. His popularity raises the question of why the science adviser isn't a more common breed. "If you're doing a cop show, you've always got a cop on set. It's the same with doctors," Underkoffler says. "But people rarely get science advisers."

Occasionally a director will bring in a scientist to mine his or her particular area of expertise—for example, Jet Propulsion Laboratory geophysicist Richard Terrile worked on 2003's journey-to-the-center-of-the-Earth movie *The Core*. And recently, a Harvard mathematician and University of Oxford biochemist teamed up to form a consulting firm, Hollywood Math and Science. So far their work has been limited to the math-based TV show *Numb3rs*.

McDowell suggests that the problem isn't that filmmakers are averse to science consultants but that good advisers are hard to find. "On the whole, you contact a specialist and they tell you what they know, and then you extract from it what you can," he says. "John is much more proactive. He'll go, 'Well, if that's what you're thinking about, you might be interested in this.'"

Hulk editor Tim Squyres hopes that this man of many talents will someday move from the margins to the center of the action. If he wants to cram all his goals into a single film, if he wants scientist characters conveying passion for their subject, if he wants to draw fantasy closer to reality by basing ideas on real research, then he is going to have to be more than an adviser. "I keep telling John to write a script," Squyres says.

Gregory Mone is a POPSCI contributing editor. He's currently working on his second novel, a comedic interpretation of Dante's Inferno.

A TRUE HOME THEATER

Kiss the multiplex goodbye. First-run movies are coming to your living room

BY BILGE EBIRI

Going to the movies today: Your family drives to the ginormoplex, fights for parking, empties the wallet on tickets and stale popcorn, then braves the catcalls of 500 other "patrons" to watch an out-of-focus print of the latest blockbuster.

But imagine this: On the same day a film hits theaters, you pay \$20 online, punch a code into a remote control, and everyone enjoys a high-definition digital stream of that same blockbuster on your plasma TV—legally. Sound too good to be true? It's not. Slowly but surely, the major studios are coming around to the idea of releasing films simultaneously across a variety of platforms. "I think everyone agrees it's inevitable," says Patrick Goldstein, a film columnist for the *Los Angeles Times*.

So why the early resistance? For starters, Hollywood claims it loses \$3 billion a year to piracy, so the thought of sending high-quality digital films straight to people's homes has the industry scared to death. But that's just outdated paranoia. Digital-rights management (DRM), which keeps media from being spread illegally, has come of age. The studios already rely on Microsoft DRM for their online movie-rental sites such as CinemaNow, Movielink and the new Starz Vongo.

"All the pieces are in place for this to work," says Joe Kane, a film producer who also works as a consultant for technology companies such as Samsung. Indeed, the only hardware required is a hard drive, a stable operating system, and a



high-definition decoder, all of which can be found in the digital video recorder from your cable company.

But getting all the major players to agree on how to do it may prove more difficult. Many studios already have distribution or DRM agreements with competing services such as Apple and AOL. This means early boxes may only play movies from certain studios.

Then there are the theater owners, who promise to fight any technology that gives people an alternative to the cineplex. Last year, Disney CEO Robert Iger reportedly wanted to sell DVDs of *Chicken Little* at theaters showing the film. It didn't work. "If you try to sell DVDs in the lobby," Goldstein says, "the theaters aren't going to show your movie."

Well, some theaters. And that's where those entrepreneurs come in. Mark Cuban and Todd Wagner, the duo behind Broadcast.com, also own the Landmark Theatres chain, the production company 2929 Entertainment and the HDNet movie channel. In January they inaugurated a new series of films with the release of *Bubble*, a low-budget thriller directed by Steven Soderbergh. It was released through HDNet and screened at Landmark Theatres, which also sold the DVD, all at the same time.

Whether this vision of a convergent future comes to fruition doesn't depend on the success of *Bubble*. But if Cuban's experiment works, you can bet the major studios will take note, and your living-room theater may arrive even sooner than they'd like.

JOHN B. CARNETT; INSET: TK

MARCH 2006

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