Believe it: Bullet trains are coming. **After decades of false starts, planners are finally beginning to make headway on what could become the largest, most complicated infrastructure project ever attempted in the US. The Obama administration got on board with an $8 billion infusion, and more cash is likely en route from Congress. It's enough for Florida and Texas to dust off some previously abandoned plans and for urban clusters in the Northeast and Midwest to pursue some long-overdue upgrades. The nation's test bed will almost certainly be California, which already has voter-approved funding and planning under way. But getting up to speed requires more than just seed money. For trains to beat planes and automobiles, the hardware needs to really fly. Officials are pushing to deploy state-of-the-art rail rockets. Next stop: the future.**

EXPRESS

by James Glave and Rachel Swaby | illustrations by Paul Rogers

THE FAST TRACKS

5 areas of the country have the population and geography to support high-speed rail now. But each route poses unique challenges.

midwest

FIRST PHASE	ULTIMATE GOAL
Chicago to Madison, Detroit, and St. Louis	Hub-and-spoke network: 20 major cities using 3,000 miles of existing railway

ESTIMATED COMPLETION DATE: 2025

TOP SPEED	FINAL TAB
110 mph	N/A

Nine Midwest states have teamed up to develop a region-wide network with Chicago as the hub. They will need to build atop a legacy freight system without a dedicated right-of-way—which means top speeds will be limited to 110 mph. Still, that should be fast enough to win over business travelers who currently brave three-hour-plus car trips between the region's cities.

Foto

California

FIRST PHASE	ULTIMATE GOAL
San Francisco to Los Angeles	Sacramento to San Diego

ESTIMATED COMPLETION DATE: 2025

TOP SPEED	FINAL TAB
220 mph	$45B

Conditions here are almost perfect. Not only does California possess a surplus of big-think, tech-whiz envirogeeks, it also boasts two major cities—San Francisco and Los Angeles—an ideal distance apart for bullet trains. In 2008, voters approved almost $10 billion to get started, and some of the environmental studies are already complete. But the biggest point in California's favor? Ego. Governor Arnold Schwarzenegger wants the system to be his legacy.

Texas

ULTIMATE GOAL: "T-Bone" connecting Dallas/Ft. Worth, San Antonio, and Houston

ESTIMATED COMPLETION DATE: 2020

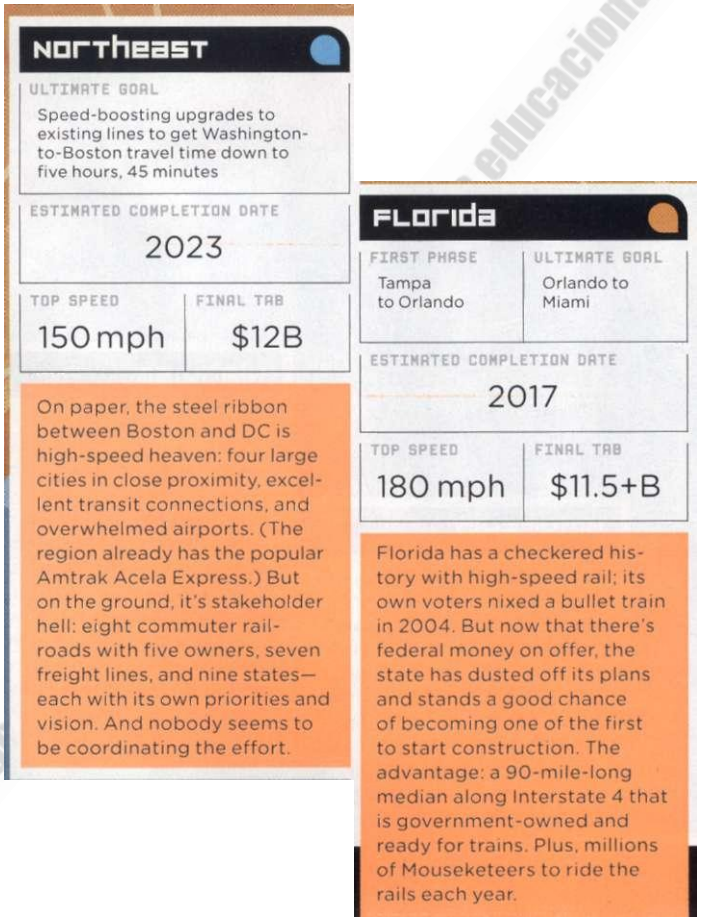
TOP SPEED	FINAL TAB
220 mph	$12-22B

They think big down in Texas—as in a dedicated twin-track, 440-mile elevated corridor that will allow longhorns to wander underneath. The topography is forgiving, but the land-use patterns—miles of suburbs with scant public transit—are less than ideal. Lawyers for Southwest Airlines helped shoot down a proposal back in the 1990s, but with broad popular support this time, a Lone Star Shinkansen might happen.

Fast or Superfast? HOW RULES AND MONEY LIMIT SPEED.

Not all of the projects currently proposed are what many people think of as bullet trains. Turns out that while those 150-plus-mph rockets are insanely fast on the tracks, they're slow to get off the ground. The first obstacle is regulatory: Federal rules demand environmental assessments, which require years of study and fieldwork by consultants, biologists, engineers, and planners. The second snag is cost: Superfast (b'r "express high-speed rail") systems need new, exclusive lines, which are extremely expensive. That explains "emerging high-speed rail" projects, incremental improvements—new stations, bridges, and rolling stock—to existing infrastructure. These, like the Amtrak Acela Express in the Northeast, won't have a dedicated right-of-way but will share tracks with freight and passenger trains and top out at around 110 mph.

Foto



NORTHEAST

ULTIMATE GOAL
Speed-boosting upgrades to existing lines to get Washington-to-Boston travel time down to five hours, 45 minutes

ESTIMATED COMPLETION DATE
2023

TOP SPEED	FINAL TAB
150 mph	$12B

On paper, the steel ribbon between Boston and DC is high-speed heaven: four large cities in close proximity, excellent transit connections, and overwhelmed airports. (The region already has the popular Amtrak Acela Express.) But on the ground, it's stakeholder hell: eight commuter railroads with five owners, seven freight lines, and nine states—each with its own priorities and vision. And nobody seems to be coordinating the effort.

FLORIDA

FIRST PHASE	ULTIMATE GOAL
Tampa to Orlando	Orlando to Miami

ESTIMATED COMPLETION DATE
2017

TOP SPEED	FINAL TAB
180 mph	$11.5+B

Florida has a checkered history with high-speed rail; its own voters nixed a bullet train in 2004. But now that there's federal money on offer, the state has dusted off its plans and stands a good chance of becoming one of the first to start construction. The advantage: a 90-mile-long median along Interstate 4 that is government-owned and ready for trains. Plus, millions of Mouseketeers to ride the rails each year.

The Bullet Decade

C A NW EH A V EF A S T **TRAINS IN 10 YEARS? YES WE CAN.**

The US hopes to have high-speed lines operational within the next decade. Sound impossible? It's not. Other nations have shown the way. In 1990, Spain's rail network was in even worse shape than America's: Trains were slow and equipment dilapidated. Then the government made a commitment to modernize. Spain now has one of the most extensive high-speed systems in the world. Likewise, Taiwan built its entire infrastructure in just the past 10 years—despite a population density greater than that of the northeastern US. All it takes is planning: According to the island nation's head of infrastructure construction, by threading the 60-foot-wide corridor carefully through the landscape, the builders had to knock down only about 1,000 homes over 214 miles. Finally, China plans to pour a staggering $300 billion into dedicated high-speed-rail corridors by 2020. Almost all of the first 60 trains will be manufactured in China under a technology-transfer agreement with bullet builder Siemens. In essence, Beijing intends to slash its costs by cloning the Siemens Velaro train, which could provide a model for a cheaper high-speed rollout in the US.

THE CALIFOR CHALLENGE

Foto

The Golden State's bullet train project will likely be a test bed for the nation. Here are some key hurdles.

RIDERSHIP

To be cost-efficient, any high-speed rail system needs an ample supply of riders. San Francisco hopes to deliver them through a new million-square-foot terminal. Dubbed the Transbay Transit Center, it will connect the new rail line with nine regional transportation systems, including the Caltrain commuter rail, Bay Area Rapid Transit, and Greyhound—once the thing finally is completed in a decade or so.

NIMBYISM

The route across Pacheco Pass and up the San Francisco Peninsula—the California High-Speed Rail Authority's preferred passage to San Francisco—is in peril. Menlo Park and Atherton have sued to stop construction from bisecting their posh towns. In August, a judge found in their favor. As an alternative, the train could run through the East Bay, but planners say the hurdles—46 acres of wetlands, a San Francisco Bay crossing, and a little thing called the San Andreas Fault—are too great.

INSTANT EXURBS

High-speed rail will transform isolated and depressed Central Valley cities like Merced into commuter towns overnight, instantly cutting the hours-long odyssey to Sacramento to just 43 minutes. The resulting population boom (planners are already expecting an increase of more than 80 percent over the next 20 years) will mean higher employment rates and tax revenue but also a massive jump in urban infrastructure needs for local governments.

Rail or Fail

THE ALTERNATIVES WOULD COST MORE.

Getting California's train up and running will be expensive. But doing nothing would cost two to three times more. Why? Currently, gridlocked lanes waste $20 billion in fuel and productivity annually. And it's only going to get worse. The Golden State is growing—quickly. By 2030, another 12 million people could be calling it home. Without an infrastructure overhaul, drivers can expect a 10 percent congestion increase every year. To accommodate the billion trips between cities that residents and visitors will make annually, the state would need to build 3,000 more miles of freeway lanes, five more commercial airport runways, and 90 more airline departure gates. The price: at least $100 billion. Oh, and all that construction wouldn't alleviate traffic; it would simply keep pace with it.

MOUNTAINS

Taking a bullet train over 4,000-foot-high mountains would feel more like a thrill ride than an office commute. So to navigate the Tehachapi range, rail planners initially sought to burrow through it. They soon realized that would require 23 miles of tunnels and negotiations with at least five major state parks, national forests, and recreation areas. The alternative: Lay an extra 35 miles of track to cross farther east, in Antelope Valley. The detour adds 10 minutes to the trip but would link Palmdale (population 139,000) to the greater LA metro area.

FARMLAND

Laying down track in Fresno County is like playing Operation. The goal is to carve out a 100-foot-wide corridor with minimal injury to the state's most valuable agricultural land. Depending on the route from Fresno to Tulare, up to 300 acres of California's best farmland will be disrupted. And parcels enrolled in the Williamson Act's conservation program should be avoided altogether. Planners are scratching their heads over the issue now.

CAR CULTURE

No city epitomizes the insane appeal of driving like Los Angeles, whose citizens cling to their steering wheels even as they face the worst congestion in the nation. Will high-speed rail persuade them to give up their autos? Maybe. Ridership on the local rail system has increased to 306,000 on weekdays, up from 265,000 in 2007. A faster, cheaper trip —the high-speed ride between Ontario and LA will save the average commuter at least 85 hours and as much as $6,400 a year in gas, parking, and lost productivity—might pry even the most dedicated motorist out of the driver's seat.

EARTHQUAKES

Since 1984, seismic activity has doubled in the area around San Diego (which suffered a magnitude 5.3 quake in 1986). But active faults are not necessarily deal breakers. Just look at Japan's Shinkansen, which withstands some thousand tremors a year without any casualties. The trick is in the construction: Motion detectors are linked to a central control system that automatically shuts down trains during a significant rumble. Deep-reaching foundations resist an earthquake's unsettling effects. And crossing fault lines at 90 degrees limits exposure to calamity.

Foto

Speed Trials San FRANCISCO TO L.A. IN 2 HOURS, 40 MINUTES. OR ELSE.

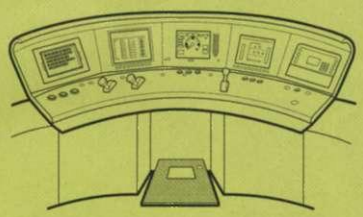
California's bullet train system will need a steady flow of riders—lots of riders—to pay off. But studies show that when transportation times between major hubs exceed three hours, many travelers opt for planes. To address this dilemma, California's high-speed-rail planners specify that trains must travel between San Francisco and Los Angeles in no more than two hours, 40 minutes, a feat that requires sustained intervals at 220 mph. The problem: Standard bullet trains don't go that fast—yet. The state is gambling that technology will improve before it completes the planning process and starts laying track. Luckily, the tech doesn't need to improve much: France's new TGV already hits 200 mph, and Spain's Alta Velocidad Española carries passengers at around 217 mph. Of course, the deadline also puts planners in a bind: Every route change that adds miles means the train needs to go that much faster. So be it. The target is necessary to ensure a fast ride and plentiful ridership.

BUILT FOR SPEED

Forget diesel locomotives and human error. Modern bullet trains are high-voltage rockets with regenerative brakes, powered wheel sets, and centralized control systems.

TRAFFIC MONITOR

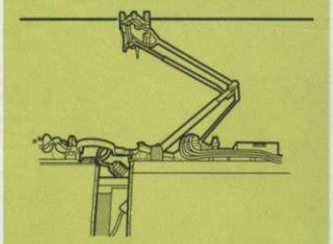
It's easy to blow past a trackside signal, which is why dedicated high-speed corridors don't use them. Instead, operators rely on a system known as automatic train control, in which traffic and speed information is monitored centrally and displayed on a screen in the driver's cab. Trains are assigned a maximum speed, beyond which the brakes kick in automatically.



FAIL-SAFE SYSTEMS

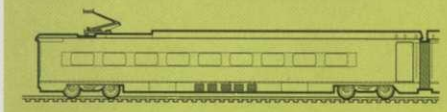
What happens if a train operator passes out at 150 mph? Hopefully nothing, thanks to a time-tested safety device: a dead man's switch. On some lines, drivers must press a button with their foot every 30 seconds. Should they neglect this duty, an audible alarm sounds, and if it's ignored, the train will initiate an emergency stop.

POWER CONNECTION



A hinged arm called a pantograph connects the train to the power line. The trick is to keep the pantograph in contact at more than 200 mph. In addition to a pneumatic system that pushes upward, a small wing creates lift at high speed; the faster the train moves, the more force is applied. The arm can also be lowered to let the train coast between different electrical systems.

A.C. INVERTER CAR



A high-speed line's inverter car looks like any other passenger car, but under the floor lurks the humming high-voltage heart of the train. In the case of Siemens' Velaro, for example, the traction inverter turns 3,000-volt alternating current from the pantograph into direct current. The driver controls speed by changing the frequency of this current, throttling it up or down between 0 and 60 hertz.

Fast Trains: A Brief History

When the first modern rail line connected Liverpool with Manchester in 1830, locals worried that flying sparks would set fire to buildings and that cows near the tracks would stop giving milk. That train couldn't hit even 40 mph. Those British villagers would be downright terrified now. Here's a quick trip through high-speed history.

1830 36 MPH

Liverpool & Manchester Railway, England
A former member of Parliament was injured at the first modern rail line's christening, and the Northumbrian train reached its top speed rushing him to a doctor. (He died soon after.)

1839 57 MPH

Grand Junction Railway, England
Nine years after the Northumbrian's emergency run, the high-speed record was broken in Staffordshire by an engine so powerful it was dubbed Lucifer.

1889 89.5 MPH

Paris-Dijon line, France
France grabbed the speed title from England after a record run on the Paris-Dijon line. The engine that took the prize was designed by Thomas Crampton … of England.

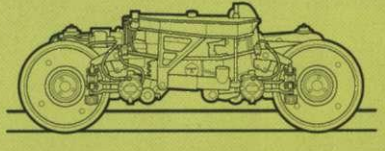
1897 90 MPH

Midland Railway, England
It took almost a decade for England to regain its dominance with a record-breaking run aboard an 8-foot-long, eight-wheeled locomotive from Melton Mowbray to Nottingham.

Foto

DRIVETRAIN

High-speed trains don't have locomotives—they have powered axles paired into wheel sets called bogies. Rather than placing all the drive wheels at the front, state-of-the-art systems have bogies up and down the length of the train. This reduces axle load, maintenance costs, and possibly the risk of a catastrophic "accordion" effect in the event of an accident.



REGENERATIVE BRAKES

Regenerative brakes inside the bogies feed power back to the grid. They employ the same principle as a hybrid car, but instead of storing the energy in an onboard battery, the system shares the juice with other trains on the network.

AERODYNAMICS

Designers must carefully taper the first car, not only for aerodynamic performance but also to eliminate the sonic boom that can occur when a train enters a tunnel at very high speed.

AUTO-SHUTDOWN

Sensors can be placed along the route to monitor for high winds, mud slides, flooding, earthquakes, or misaligned tracks—and can trigger alarms or tell the system to stop the train immediately.

1903 126 MPH
Military railway, Germany
Germany pulled ahead with this 12-wheel all-electric train between Marienfeld and Berlin, which would remain the country's fastest for more than 70 years.

1932 92 MPH
Great Western Railway, England
The Cheltenham Spa Express became the Cheltenham Flyer after going 77 miles in just under 57 minutes—the first regular passenger service to achieve such speed.

1964 130 MPH
Shinkansen, Japan
This new line between Tokyo and Osaka provided the first regular service operating at speeds above 100 mph. The Shinkansen's aerodynamic design earned it the nickname "bullet train."

1981 161.6 MPH
TGV, France
When this high-speed rail opened, it became the fastest regularly running line in the world, shuttling passengers 264 miles between Paris and Lyon in just 2 hours, 40 minutes.

2004 267 MPH
Shanghai Maglev, China
The fastest passenger train in the world, this line zips from Pudong International Airport to Shanghai via an electromagnetic reaction created between the cars and the tracks.

2007 357 MPH
TGV, France
A souped-up, 25,000-hp TGV with oversize wheels holds the current record for non-maglev trains. Journalists on the title run reported dizziness at 300 mph and difficulty standing at around 335 mph.

Fonte: Wired, San Francisco, ano 18, n. 2, p. 74-81, February 2010.