think:act STUDY

In-depth knowledge for decision makers

* Economic costs per annum due to paralyzed traffic flows in the world's 30 biggest megacities alone

CONNECTED MOBILITY 2025

How tomorrow's passenger transportation will add new value

Chinese commuters in Chengdu preparing for a 60-hour train journey. Millions of rural workers travel to the cities in search of work

CONNECTED MOBILITY 2025

Adding new value in the passenger transportation of tomorrow

CONTENTS

EXECUTIVE SUMMARY

A 360° VIEW OF THE INTEGRATED PASSENGER TRANSPORTATION OF THE FUTURE

Connected Mobility 2025 paints a new, optimistic picture of the future of passenger transportation – a future that promises fresh business prospects and substantial gains, both personal and economic. In this vision, the stop-and-go traffic and inefficient resource allocation that we know today gives way to fast, flexible and efficient travel based on intelligently networked infrastructures. In tomorrow's world, today's rules will no longer apply and innovative business models will redraw the contours of our mobility. In this process, they will add value for the economy and the environment, as well as enhancing our quality of life.

Connected Mobility 2025 presents the big picture, revealing what integrated passenger transportation could look like in the future, irrespective of the mode of transportation. The latter point is significant, because we can only achieve smart solutions for more freely flowing traffic by tearing down old barriers.[1] In the past, market players were content to defend their traditional turf. Networking with other modes of transportation or mobility service providers rarely happens, although it is technically feasible. Such a fragmented value chain is clearly less than satisfactory in purely economic terms. Yet it is also awkward and inflexible for users: Every journey involving more than one mode of transportation becomes a disjointed sequence of individual events.

The logic behind connected mobility is different, placing each link in the chain – planning, booking, travel itself, service and billing – in the hands of a single "mobility manager". Value is created within a joined-up, intermodal, trans-sectoral network. Commuters and travelers can access integrated information in real time wherever they happen to be. They can quickly decide which mode or modes of transportation will get them to their destination in the best way possible – in other words, what is their quickest, shortest, cheapest and most convenient journey.

In fact, the fundamental conditions required to turn connected mobility into a reality are already in place. The first is the triumph of the mobile Internet. More than a billion smartphones are already in use worldwide.[2] By 2015, the figure is likely to be well in excess of two billion.[3] The second condition is intelligent network management in real time. And third, the sheer economics of it clearly favors connected mobility: After all, what we are set to leverage is an annual value potential roughly equivalent to the GDP of a medium-sized European country, such as Finland.

1) This publication builds on the findings of "Connected Vehicles – Capturing the Value of Data" (2012), an analysis and assessment of potential business models for networking cars with their environment.

2) World Economic Forum: Global Risks 2012; businessinsider.com

3) Mary Meeker: "Internet Trends", December 2012, http://tinyurl.com/bvybu54

OUR ARGUMENTS ARE AS FOLLOWS

1. Today's passenger transportation is inefficient.
This has both microeconomic and macroeconomic implications. Annoyance on a personal level (wasted time, restricted mobility, inconvenience) is compounded by damage to the economy. In the world's 30 biggest megacities, paralyzed traffic flows have an annual cost of more than USD 266 billion.

F1

2. This inefficiency is likely to increase.
Around the world, 180,000 people a day are moving to big cities.[4] The global population is growing mainly in emerging countries in Asia and Africa. Metropolitan regions are coming under increasing pressure to organize more efficient and environmentally friendly systems of passenger transportation.

3. Mobile information and communication (I&C) technology has the necessary solutions.
The networking of different modes of transportation, the spread of smartphones and the availability of data plus the ability to process it in the cloud are the key drivers of change. These factors will make it possible to exploit the untapped economic potential without making huge investments in infrastructure.

Connected mobility will have a tremendous impact on the economy. But it will also have far-reaching consequences for the traditional role of incumbent market players such as automotive OEMs, regional transit networks and interregional transportation service providers. Players in the Internet, technology and telecommunications industries are expected to launch their own initiatives.

4) United Nations, Department of Economic and Social Affairs: World Urbanization Prospects, the 2011 Revision – http://esa.un.org/unpd/wup/index.htm

WE HAVE PINPOINTED FIVE SUCCESS FACTORS

1. Clear the way for networking.
Online and mobile platforms are needed that integrate functions, products, services and technology. Strategic partnerships between companies will make it easier to master the complex requirements while enabling networking effects and economies of scale.

2. Meet the needs of individual customers.
Market players must learn the art of "mass customization".

3. Position your brand.
Market players should position their brands clearly and in a way that adds value, mapping their brands' core values onto new products and services.

4. Create a solid legal framework.
The government should set out the playing field, striking a healthy balance between data security and data protection (i.e. privacy) on the one hand and data transparency and data interfaces on the other. This is especially important in the context of cross-border markets.

5. Manage infrastructure bottlenecks.
Free-flowing traffic comes at a price. Intelligent management based on economic and ecological criteria (such as carbon emissions) seeks to optimize utilization of the transportation infrastructure. The government's role is that of a regulator.

At present, connected mobility remains a promise for the future. Yet it is a promise whose economic potential can be expressed in very clear numbers – as we will see below.

Personal efficiency: Has this passenger on board the Intercity Express from Berlin to Hamburg already figured out what to do when he gets to the station?

Organized inefficiency: At the critical moment, we lack the information that would let us simply switch to another mode of transportation – like these New York commuters, pictured waiting for the train

Privacy is not part of the deal: Massive crowds on the Guangzhou subway in southern China

If he had known earlier that his flight from Chicago was delayed, he wouldn't have had to rush away from the meeting

Business as usual: Stuck in a taxi in the daily congestion that plagues Indian megacity Mumbai

Grim – and bear it: Commuters make the best of a slow, uncomfortable journey on this Beijing bus

A WORLD ON THE MOVE

HOW PASSENGER TRANSPORTATION WILL KEEP PACE WITH THE ACCELERATION OF DATA AND KNOWLEDGE

Chicago/USA – New York/USA

*Chicago on a rainy afternoon in fall. Richard Hammer still has a good two hours before his flight home leaves for New York. In this weather, the Kennedy Expressway to O'Hare International Airport will soon be congested. To make matters worse, his taxi is 20 minutes late. Richard had wanted to reach the airport in good time and without getting wet. He'd planned to catch up on some phone calls from the taxi. But now he keeps glancing nervously at the traffic reports that pop up on his smartphone. Hmm, there's an exit up ahead. Should he stay on the expressway? Ask the taxi driver to let him out at the next Blue Line stop? But where do you buy tickets? And how much does it cost from here to the airport? Come to that, when is the next train due, anyway? He hesitates. No time now to download the Train Tracker app. The taxi driver looks questioningly in the rear-view mirror. Heck... road works. The exit is blocked. The wipers scrape monotonously over the windshield. Ahead, nothing but an endless line of red brake lights...**

F1

Megacities: More stop than go

The cost of paralyzed traffic flows in the world's 30 biggest megacities alone adds up to USD 266 billion

By 2025, only two of the 15 largest agglomerations – Tokyo and New York – will be in industrialized countries.

New York

Nowhere in the US do commuters suffer more delays than in Los Angeles. The Texas Transportation Institute puts the figure at 72 hours per traveler per year.

Los Angeles

Chicago

Mexico City comes top of the Commuter Pain Index with 108 points. Moscow is Europe's most congested city – and scores only 65 points.

Mexico City

São Paulo's streets have become so clogged that restrictions have been imposed on when cars can access the city center. Access depends on the day of the week and the last digit on the car's number plate.

São Paulo

Rio de Janeiro

Buenos Aires

180,000

people move to the world's biggest cities each day

The UK capital began levying a City Congestion Charge – a fee of around ten pounds for cars driving into the city center – in 2003. It is one of the largest areas in the world for which an urban access toll is payable.

Moscow experiences 850 traffic jams a day, each lasting 80 minutes on average. This means every commuter spends two days a month sitting in traffic – the highest figure in Europe.

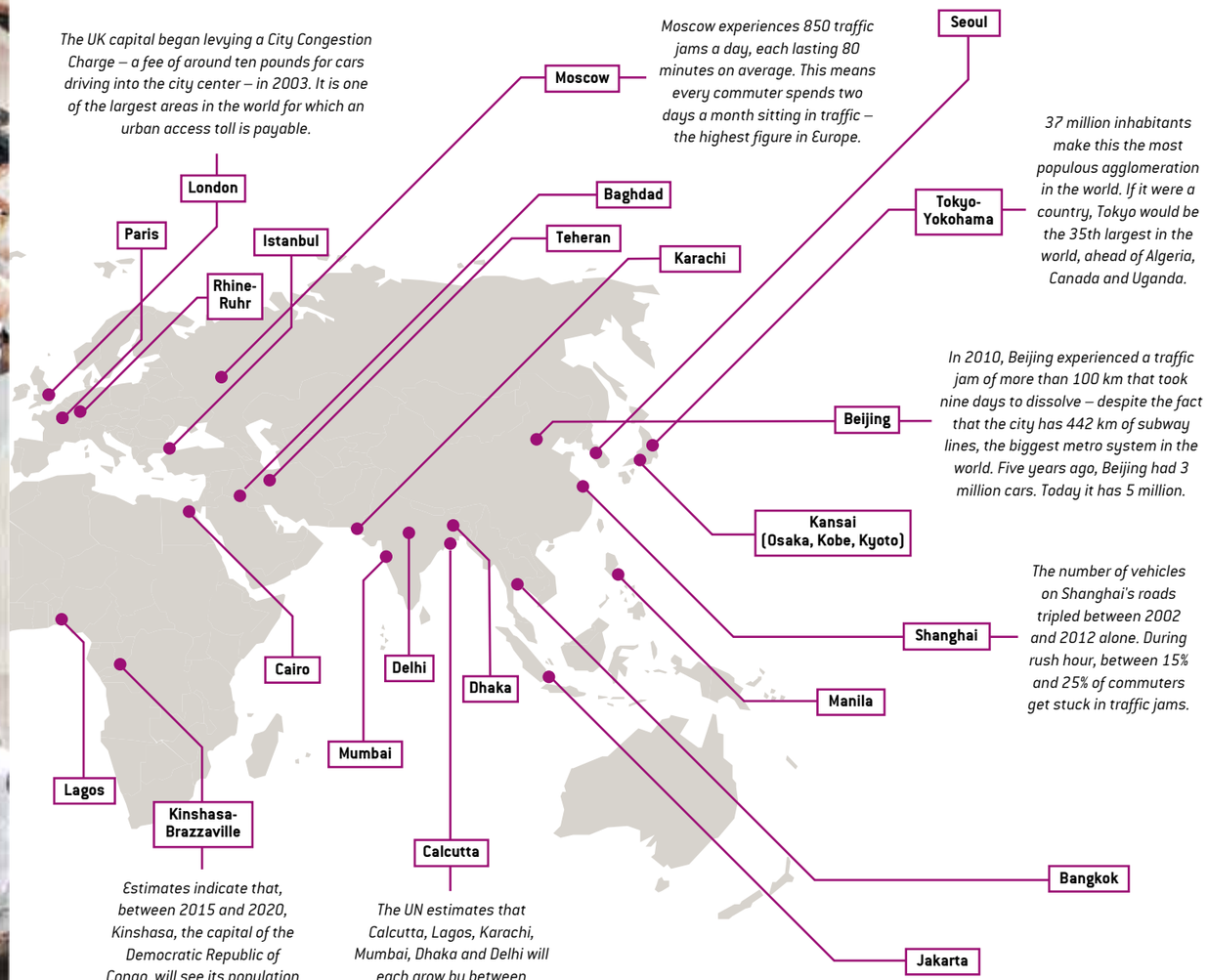
37 million inhabitants make this the most populous agglomeration in the world. If it were a country, Tokyo would be the 35th largest in the world, ahead of Algeria, Canada and Uganda.

In 2010, Beijing experienced a traffic jam of more than 100 km that took nine days to dissolve – despite the fact that the city has 442 km of subway lines, the biggest metro system in the world. Five years ago, Beijing had 3 million cars. Today it has 5 million.

The number of vehicles on Shanghai's roads tripled between 2002 and 2012 alone. During rush hour, between 15% and 25% of commuters get stuck in traffic jams.

Estimates indicate that, between 2015 and 2020, Kinshasa, the capital of the Democratic Republic of Congo, will see its population grow faster than any other city in the world: by another 424,000 people every year.

The UN estimates that Calcutta, Lagos, Karachi, Mumbai, Dhaka and Delhi will each grow by between 300,000 and 500,000 people a year between now and 2025.



F2 Mobility is fundamental to the success of a dynamic economy. We live in a networked world. Yet passenger transportation[5] is not keeping up, as data and knowledge move into the fast lane. It is impossible to find the best way from A to B – the fastest, most convenient and most resource-efficient way – when we need this information most. We lack the real-time, location-specific information required to link transportation systems together. In Germany, for day-to-day travel, nearly half the population always uses their own vehicle rather than public transportation. One in five Germans uses their own vehicle for journeys of under three kilometers. We avoid switching to other modes of transportation because we fear complex timetables, confusing pricing systems and unpredictable wait times. Yet we pay for the convenience of sitting in our own vehicle with ever increasing congestion on the roads.

The Commuter Pain Index, which compares the relative emotional and economic costs of traffic congestion across all six continents, has recorded recent scores for other megacities such as Mexico City, Nairobi and Bangalore that are similarly devastating.[6] Clearly, this is a problem of global proportions. Our own analysis puts the economic and social cost of traffic jams at more than USD 266 billion every year for the 30 biggest megacities alone.

And things are set to get worse. The future of passenger transportation is influenced by various long-term trends[7] – first and foremost, population growth and urbanization. More people in less space inevitably adds up to more traffic and congestion.

It is a known fact that, almost without exception, global population growth will take place in the world's major cities – in the places where more than half of the people on the planet already live. By 2050, the share of the world's population living in these cities will increase to two-thirds, or six billion people. According to United Nations figures, some 180,000 people currently move to major conurbations every day – or two every second. Many urban spaces are converging to form outsized metropolitan regions. This process is placing unprecedented demands on the traffic infrastructure. TIn 2011, twenty-three megacities had more than ten million inhabitants each. By 2025, this number will be 37. The megacities of China and India are growing fastest and will soon have ousted Tokyo from its long-standing position at the top of the charts. Today, 37 million inhabitants make the Japanese metropolis the most populous agglomeration in the world. If it were a country, Tokyo would be the 35th largest in the world, ahead of countries such as Algeria, Canada and Uganda.

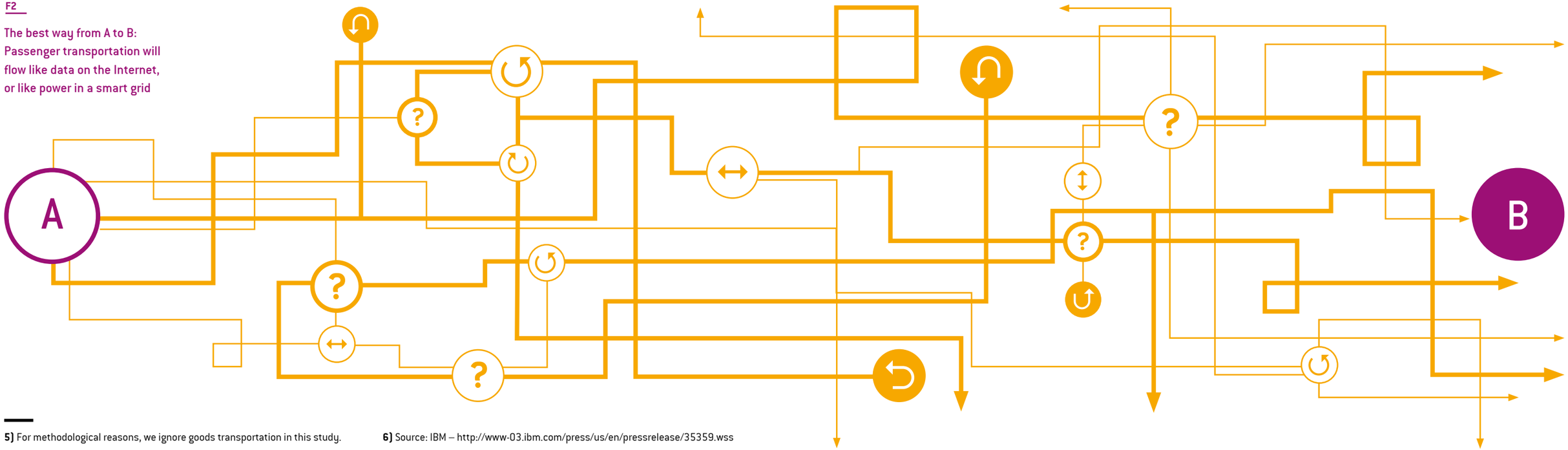
CONNECTED MOBILITY DRIVES ELECTROMOBILITY

Over the next decade, the world's biggest development banks plan to spend USD 175 billion on more sustainable transportation systems in emerging nations. Connected mobility can play a pivotal role here, improving the effectiveness of this investment in sustainable, controlled urbanization without causing unmanageable extra costs for the public purse.

The connected mobility model is also a good way to advance the politically and socially desirable aim of electromobility. For the foreseeable future, batteries will remain less powerful than combustion engines, giving electric cars a shorter range than traditional vehicles. However, connected mobility infrastructure makes it easier to charge or swap batteries, or indeed the entire vehicle. If swapping is combined with the intelligent use of parking space, for example, it will become as normal to use electric vehicles as it is to use any other mode of transportation. In the mobility chain, integration means that picking up a vehicle, driving it, parking it and switching to another mode of transportation is simple. Past attempts to manage traffic in megacities have missed the mark. Beijing limits the licensing of private cars, for example. Singapore and London levy city center tolls. The heart of São Paulo remains closed to some vehicular traffic on certain days. Yet restrictive regulation is only part of the solution. A much more promising approach is to manage travelers' needs and resources – which is precisely where connected mobility comes in.

F2

The best way from A to B: Passenger transportation will flow like data on the Internet, or like power in a smart grid



5) For methodological reasons, we ignore goods transportation in this study. However, many of our findings also apply to this sector.

6) Source: IBM – http://www-03.ibm.com/press/us/en/pressrelease/35359.wss

7) See "Trend Compendium 2030"

Links between road users, mobility service providers and infrastructure are already beginning to appear. Few cars today lack a navigation system. Soon vehicles will be online and able to communicate with each other. Yet these tender shoots seldom blossom and grow at present.

Only now are people beginning to change the way they think about transportation. More and more public transit companies are sharing and transmitting data about their inner-city connections in a format that complies with the General Transit Feed Specification (GTFS). GTFS is a standard co-developed by Google that is establishing itself worldwide, whether in Adelaide, Bilbao, Paris, Plymouth, Kyoto or Lviv. More than 460 public transit companies and networks worldwide, 250 of them in the US alone, used this interface as per the end of 2012[8] – not just with Google but with other online services, too.

Models such as the Internet and smart power grids lend credence to the idea that commuting and travel can be influenced dynamically, in other words in real time. On the Internet, for example, routers make flexible decisions on how to forward data packets from A to B. Depending on the availability of data highways, they simply take an alternative route calculated on the basis of time, cost and quality. Like the Internet, road and rail networks form interlinked physical routes that each have a limited capacity. Integrated real-time data would enable decisions to be made on the fly as to which mode of transportation would get passengers to their destination the fastest, with the shortest route or at the lowest price.

We can draw similar parallels between connected mobility and smart grids. Smart grids involve the networking and management of communication – including power lines and storage units – between power producers and power consumers. The aim is to operate an efficient and reliable system that delivers a constant supply of power. In a traffic and transportation concept, parameters such as traffic density and the level of CO_2 and particulate matter can be used to manage passengers, vehicles and infrastructures in real time on the basis of ecological, financial and economic criteria. The concept may also include passive levers such as tolls, and active levers such as dynamic traffic light/speed limit management and access rights.

F3 Powerful mobile devices, intelligent network technologies and improved human/machine interfaces make this development possible. Further impetus will come from the rapid increase in the speed of data processing.

TO SUMMARIZE, CONNECTED MOBILITY MEANS:

- **Intelligently networking different modes of transportation (cars, buses, trains, etc.) and their infrastructure**
- **Applying self-organizing technology in which management mechanisms optimize traffic flows**
- **Seamlessly integrating modes of transportation and mobility services (buses, trains, taxis, hired cars, private cars, parking facilities, rented bicycles, etc.) and making it possible to combine the different options as required**
- **Making real-time traffic information accessible to all users via apps**
- **Leveraging mobile devices as an identification, booking and payment tool for travelers**
- **Increasingly moving the processing and storage of data out to the cloud**

Some of the required technologies are already in place. Key gaps remain, however. Not enough technological standards have been established. There is a lack of open interfaces – and hence networking possibilities – between different modes of transportation. And lastly, not all components in the wider infrastructure have yet reached the technological maturity that is essential for connected mobility.

Connected mobility does not mean less traffic: It means smoother traffic flows and, hence, fewer emissions. Dynamic traffic information helps to optimize the utilization of rail and road capacity, resulting in a win-win situation for customers (i.e. travelers), the government, society and – by no means least – those mobility providers that seize the opportunities that are now opening up. Incumbent players such as OEMs are starting to reconsider what part they play, even as new players penetrate the market. One thing is clear, however: Connected mobility will force all market players to rethink their business models. In the next section, we look at how value will be added in tomorrow's mobility market, and by whom.

8) http://www.gtfs-data-exchange.com/agencies.

F3

Traveling by smartphone

Technical progress will get passenger transportation moving again

	Technology	Details
Front end	LTE	Fast LTE products complement 3G mobile communication technology and will soon replace it. Telecom companies are already planning the next standard (5G).
	IPv6	The IPv6 Internet Protocol supports far more addresses while easing the computing burden for routers. It also enables data packets to be encrypted and their authenticity to be validated — a considerable advantage for booking and payment models. Mobile IPv6 enables seamless (uninterrupted) mobile communication.
	Battery technology and consumption mgmt.	Superior battery technology and consumption management for electrical components in mobile devices will make service lives longer and extend the intervals between charging.
	NFC	NFC (near-field communication) chip cards and NFC-enabled mobile phones will enable unique user identification and thus allow payment transactions to be authorized reliably.
	HMIs	Modern HMIs (such as touchscreens and voice input) will enable smartphones to be used in vehicles without distracting the driver. As soon as the technical aspects of this legal requirement are in place, these HMIs will supersede OEMs' navigation systems.
	Localization	Location-based services are vital, because they give users the information they need at their current location in real time. Three factors will help drive the spread of these services: 1) Technology (GPS today and Galileo in the future), assisted by local data from mobile base stations and the mapping of WLAN hotspots 2) Traffic infrastructure developments such as dedicated short-range communications (DSRC) and the global navigation satellite system (GNSS). Collecting toll payments will be one key application 3) User data
Back end	Cloud computing	Cloud computing involves the provision of IT services, with customers paying on a flexible basis only for those services they actually use. Data is stored by a third party, accessed by users over the Internet and is modeled into tailor-made data sets and functions, irrespective of the proprietary infrastructure.
	Digital identity	In the electronic world, every real person receives one or more digital identities that represent them in electronic systems. The associated data can be spread across different organizations, locations and/or databases.
	Authentication	Authentication: Whenever a user ID is needed, it is created on the basis of a digital identity. Credit cards, passwords, password challenge questions, confirmation of e-mail addresses and biometric methods (iris scanning, handprints, voice recognition) will be used for this purpose.
	Big data	Connected mobility will accumulate huge volumes of complex and largely unstructured data. The challenge lies in storing, searching for, splitting, analyzing and visualizing this data. The trend toward ever larger data sets ("big data") is continuing. New analytical methods promise to deliver additional benefits such as insights into economic trends and/or forecasts about current traffic developments.

NEW WAYS TO ADD VALUE

GREATER TRANSPARENCY, MORE FLEXIBILITY: THE MOBILITY MANAGER TO GO

Frankfurt/Germany – Zurich/Swizerland

*Regula Kolmer works for a financial service provider in Zurich but lives with her family in Frankfurt, where her husband works and their two children go to school. She has a travel package from "Travel Integrated Rhine-Main AG". With this arrangement, she pays a flat yearly price that allows her to use different modes of transportation for the commute between home and work. The package includes a frequent flyer component, car sharing with vehicles from a manufacturer of her choice, and first-class train and rapid transit tickets in the event that roads are congested. Travel Integrated negotiates prices with its suppliers, bundles the resulting services on a single website and sells them to people like Regula, adding its own profit margin. Unused capacity is optimized across the various modes of transportation. It's an idea that is making waves throughout Europe. "Travel Integrated Greater London plc" is currently being set up in the UK, while negotiations to set up "Transit Paris & Ile de France SA" are about to commence.**

Connected mobility lives or dies by mobility providers' ability to deliver highly specific yet comprehensive offerings to individual customers and customer groups – offerings that match the typical travel routes and preferred modes of transportation of each. These offerings need to be completely transparent at all times and feature a choice of options that can be combined at will. They must also be attuned to customers' financial capabilities, their preferred travel experience and modes of booking and billing.

For companies, connected mobility means closer customer relationships. The companies that succeed will be those that do not try to sell one-size-fits-all offerings to everyone, but that learn the art of mass customization. We show that this is not the only paradigm shift needed in passenger transportation.

MOBILITY THAT TEARS DOWN BARRIERS

F5 Traditionally, the mobility value chain consists of a set of largely autonomous systems. OEMs, public transit utilities and airlines all communicate separately with customers. Travel is treated as a series of sporadic individual events, despite the fact that comparable steps – planning, booking, paying and driving, riding or flying, alone or in company – take place in each segment. In this fragmented mobility chain, customers have to deal with a separate contractual partner for each part of the journey, all of which adds to the effort involved in planning and billing.

F6 Connected mobility tears down these systemic barriers. Technological progress, growing demand and new customer relationships make the supply side more dynamic and flexible. Traveling becomes more convenient, because each customer now only has to deal with a single intermediary: the mobility manager who dynamically manages and handles each step in the journey, combining these steps to form a seamlessly integrated mobility chain. Travel planning does not stop until the destination is reached. Until then, the mobility manager continually examines environmental variables such as the weather, traffic density and pricing structures, and uses real-time local information to offer alternative routes or modes of transportation (see figure below).

The mobility manager thus becomes an online and mobile platform whose functionality enables customers to adapt both their route and their mode of transportation to external constraints and personal preferences at all times. There will not just be one mobility manager making sure that the market works: A number of mobility managers will compete with each other to sell their portfolios of functions – thereby rendering obsolete the "silo mentality" that underpins the traditional value chain.

INTEGRATING SERVICES

F4 Mobility managers will thus integrate and coordinate individual services, some of which already exist. Looking ahead, it is they who will make multimodal networking technically feasible, economically viable and attractive for customers.

Two examples:

- **China TransInfo[9] runs "PalmCity"**, China's first real-time information service, based on GPS data from taxi companies and traffic sensors. A multimodal navigation service for smartphones promises no-gaps transparency about public transit, including comparative costing. China TransInfo also offers parking guidance systems, toll collection and local services.
- **Waze[10], the community-based navigation app** from the US, links drivers with each other via smartphone, using the devices' GPS data as well as manual input from members. Traffic information is swapped, alternative routes calculated and gasoline prices compared. Links to social networks also make it possible to coordinate travel with friends.

While many innovative offerings limit themselves to a single mode of transportation, some companies are already edging closer to intermodal traffic management:

- **San Francisco Bay Area Rapid Transport[11]** is now offering real-time information on departures, travel advice, travel planning and tariff details via an online platform open to third-party apps.
- In Stuttgart and Berlin, Daimler is currently testing **"moovel"[12]**, a mobility platform that finds the best way from A to B by integrating different providers and considering travel options such as the car2go car sharing service (including the Daimler Group's own Smart cars) and car2gether (ride sharing service).

9) http://www.chinatransinfo.com.
10) http://www.waze.com.
11) http://www.bart.gov.
12) https://www.moovel.com; "Handelsblatt", 29.11.2012.

These systems intelligently combine information and align it with customer demand online, countering the fragmented mentality typical of the traditional value chain. As a result, various sources of revenue are emerging:

- **Fees paid by customers for the provision of tailor-made mobility services**
- **Revenue-linked commission fees from mobility service providers**
- **Sales of apps**
- **Sign-up fees for new service providers, who in turn benefit from a successful portal**

Companies that can generate economies of scale stand to benefit because, in accordance with Metcalfe's Law, the use made of a network increases exponentially with the number of users. In simple terms: The bigger the network, the better. For new market players, fast, early growth is vital, as aggregating mobility offerings is a commodity business. On the other hand, some of the factors that influence mobility cannot be multiplied without limit. Think of parking spaces and road space, for example.

A strong brand is needed to give customers an attractive, credible promise of mobility. Given suitable market size, strong brand awareness and a solid reputation, a company is much less likely to see itself quickly overtaken – or even replaced – by an upstart rival. In the connected mobility ecosystem, the multimodal mobility manager's platform is the control center where everything comes together. The critical question is: Who is most likely to take on this role? We try to answer that question below.

F4

Looking ahead – Acting now

New service providers in passenger transportation

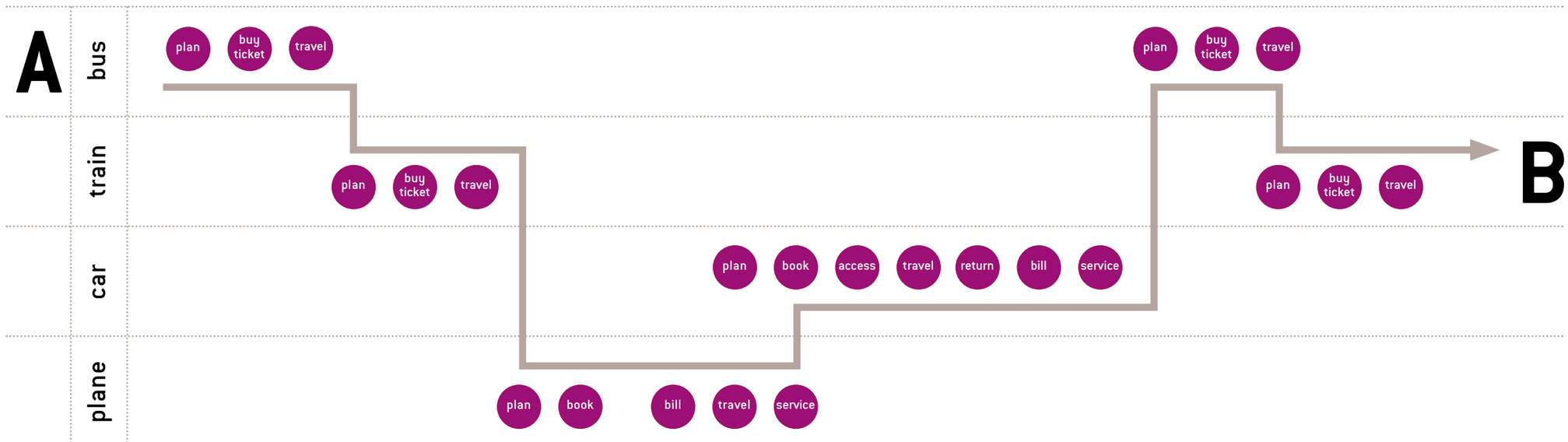
Integrated travel booking **Integrated management of bookings, ticket dispensing and payment** Octopus Card (China), Touch and Travel (Germany), Multicity (France, Germany, etc.)	**Multimodal navigation** **Navigation across different modes of transportation, integrating real-time information** Baidu Navi (China), Moovel (Germany)	**Community-based navigation** **Navigation in networks and synchronization of traffic flows to improve the distribution of road traffic** Waze (global), Nunav (formerly Greenway – Germany), PalmCity (China)
Multilocation car sharing **Short-term car rental at different locations around the city** Car2go (Austria, Canada, France, Germany, Netherlands, UK, USA), DriveNow (Germany, USA), Zipcar (Austria, Canada, Spain, UK, USA), I-GO (USA)	**Networked car sharing** **Peer-to-peer platform on which users rent their cars to each other** Caruso (Austria), tamyca (Germany), Whipcar (UK), RelayRides (USA)	**Corporate car sharing** **Car and ride sharing tailored to corporate customers and company fleets** Avis On Location (global), Pocket Taxi (Germany), Alphacity (Germany), Fleetster (Germany)
Parking **Parking space provisioning: information services, notification when parking space is freed up and peer-to-peer rental in private networks** Parkopedia (global), Park at my house (UK), KurbKarma (USA)	**Ride sharing** **Dynamic, spontaneous real-time sharing, including taxi rides** Carpooling.com (Austria, France, Italy, Germany, Greece, Poland, Spain, UK, Switzerland), PickupPal (global), flinc (Germany), Better Taxi (Germany), Zebigo (USA)	**Taxi apps** **Services including integrated real-time apps to order and pay for taxis** MyTaxi (Germany, Austria, Switzerland, Spain, USA), Hailo (UK, Ireland, Spain, Japan, Canada, USA), TaxiPal (Europe, USA, Canada), Kabbee (UK)

F5

Mobility experience in the past

Separate planning, booking, usage and billing processes for each mode of transportation – A fragmented mobility chain

- **Separate customer relationships with each service provider**
- **Static route planning**
- **Premium prices/add-on fees charged or tickets voided if changes have to be made**
- **Billing in all shapes and sizes**
- **Transaction/coordination costs charged to the user**
- **Separate transactions for each mode of transportation: planning, booking and usage processes each time**

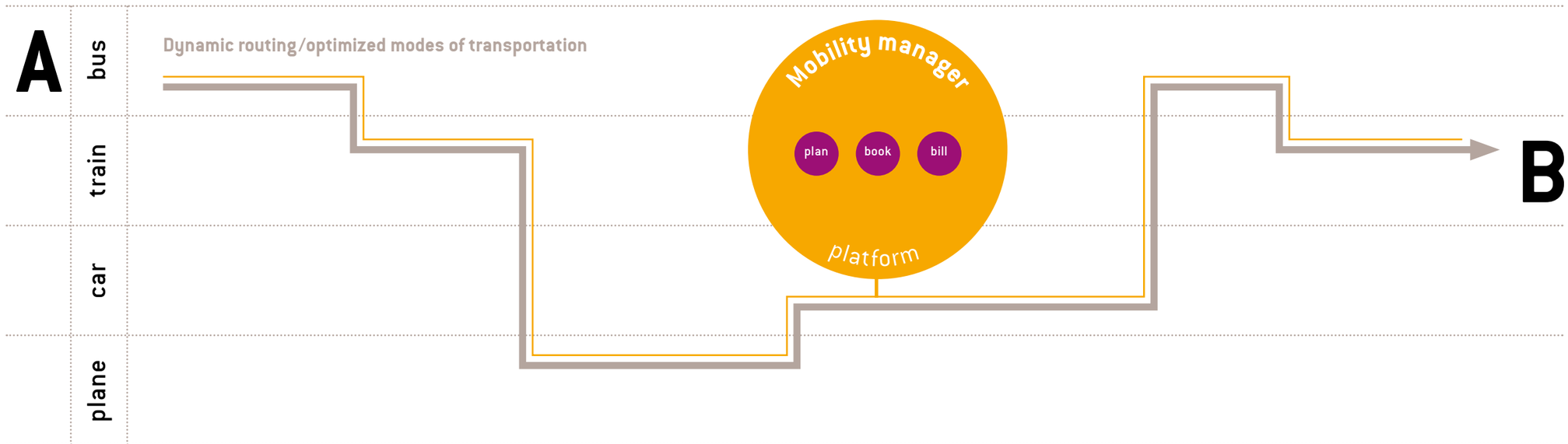


F6

Mobility experience in the future

For customers, integrated mobility means one booking and a single invoice – Coordination is handled by the "mobility manager"

- **Integrated mobility across all modes of transportation**
- **Dynamic/intelligent links between different pieces of information**
- **Greater convenience**
- **Superior fulfillment thanks to flexibility in the chain of modes of transportation**
- **Transaction costs borne by the mobility manager**



BUSINESS STRATEGIES TO FACILITATE CHANGE

WHO WILL TAKE CENTER STAGE IN THE CONNECTED MOBILITY ARENA?

Who is most likely to assume the pivotal function of mobility manager? If connected mobility revolves around the power to compete on the ability to orchestrate the mobility chain, we have to ask: what is more important? Is it the infrastructure owned by incumbent players – to which the market has no alternative – or is it the services provided by the intermediaries, as the individual modes of transportation in the integrated mobility chain see their importance decline in relative terms?

AUTOMOTIVE OEMS

The nucleus of personal mobility

For many customer groups, the private car will remain at the heart of personal mobility. Mature markets are showing signs of a shift away from the car as a status symbol and toward the intelligent use of its benefits. In emerging markets in particular, however, cars will remain the epitome of personal mobility for a long time to come.

Yet vehicle users are becoming more demanding. It is no longer enough merely to make vehicles more comfortable and connected and to fit them out with modern driver-assistance systems. Tomorrow's cars must accommodate far more extensive demands in terms of mobility. The drivers of the future will want to use their vehicles as efficiently as possible – and genuine efficiency can mean doing without the car and using some other mode of transportation at times, depending on the traffic situation and current mobility needs.

OEMs symbolize mobility more clearly than almost any other market player. Few other market players can boast so many strong brands that successfully manage to remain distinctive – something will remain a prominent customer requirement in future, too. Nevertheless, OEMs must not repeat their past mistakes and try to do everything themselves using proprietary systems. They must adopt open interfaces and standards[13], giving third parties access to their vehicles and enabling all kinds of data to be exchanged, thereby offering added value to their customers. One example involves integrating smartphones into in-vehicle infotainment (IVI) systems, which optimizes the place of cars in the mobility chain. Integrating new kinds of mobility packages under a single brand will enable OEMs to accommodate customers' emerging demands and, by doing so, cement their long-term loyalty.[14]

Add-on services that bind customers to the vehicle are just as important as innovative technology. A monthly invoice for mobility services could look something like this: The vehicle itself (leasing or credit installments, repair costs) would account for 80%, 10% would go on the use of other vehicles of the same brand, and the remaining 10% would be a flat fee for mobility services including regional public transit. Some OEMs are already beginning to extend their value chain in this direction. For example, BMW and its partners are joining forces to sell an extended range of services: smartphone-based car-sharing services that are not bound to one location (DriveNow with Sixt) and the cashless sale and billing of parking spaces in multistory facilities (ParkNow with Metric).[15]

OEMs benefit from the powerful ability to manage the alliances that they have cultivated in vehicle development and production. In car sharing, they bundle skills rooted in an array of disciplines, such as vehicle distribution and maintenance, billing and Internet expertise. The power of their brand lies at the center of this strategy: first, to lend weight to a given promise of mobility, and second, to secure customer loyalty – ultimately becoming a credible mobility manager for connected mobility.

OEMs are ideally placed to set themselves apart strategically. However, a premium-brand promise of mobility, for example, is exposed to threats from external factors that are hard to quantify. Especially in conurbations, it may only be possible to achieve a seamless mobility service if customers are also willing to make use of public transit options that have little that is "premium" about them, but that do offer other advantages – subway trains being a classic example. OEMs therefore face the danger of targeting conflicting objectives.

A brand promise – at either the premium or discount end of the market – is honored if customers' key expectations are met. The intelligent processing of relevant data in the mobility chain plays an important part in this process. That is why strategic partnerships are as vital as they are promising. As things stand, OEMs are thus well placed to assume the role of mobility managers.

MULTIMODE PUBLIC TRANSIT NETWORKS

Regional roots

Regional public transit companies play a dominant role in their regions and have nothing to fear from competitors. In theory, they have the option of keeping their customer and operating data under lock and key instead of opening it up via technical interfaces. It would then be up to them to simplify booking and payment services, or to deliver real-time information about bus and rail services via their own portals.

The regional nature of a portal – that of a multimode public transit network in an urban agglomeration, say – is not necessarily a drawback. On the contrary, the regional focus of the portal can be marketed as a strong point and enhanced by information such as calendars of local events, sports, concerts, movies and so on. Hong Kong's Octopus Card[16] – an electronic cash system shared by a network of mobility providers – is an example of how this idea can be put into practice. Isolationism is not the way to go: differentiation coupled with the logical expansion of service offerings is the much more promising option, opening up a wider catchment area and attracting more customers. This is the way forward, provided that a region's identity – and hence its relevance – is not threatened as a result.

To achieve this goal, regional mobility providers must cooperate with an aggregator. This aggregator should incorporate regional public transit data into its platform, offering users wide coverage and the option to compare transparent data. Public transit companies benefit as utilization of their bus and train capacities improves, while they also have to spend less on marketing and sales. On the downside, there is the risk that the aggregator will walk away with their customers and keep part of the profit margin for itself. This is where it is important to strike a profitable balance. Either way, connected mobility poses no fundamental threat to the business model of public transit companies – transportation for money – because competitors would be able to gain a foothold in regional markets only at inordinate expense. It also makes sense for regional public transit companies to concentrate on their core competencies of operation and maintenance. All of this leaves them well placed to take on the role of mobility manager in collaboration with a strategic partner.

RAILROAD COMPANIES AND AIRLINES

Strong mobility brands

On long-haul routes, supraregional transportation service providers occupy a strong position. Depending on the market, many operate within an oligopolistic to monopolistic situation and are therefore difficult to substitute. For this reason they normally have a strong brand, although servicing local needs can be a weak point. This has to change, as regional public transit companies may begin sharing their data and supraregional providers supplying their own apps, both of which also give access to subway and mass transit connections. Supraregional transportation service providers that combine their skills with strong technological expertise put themselves in a position to deliver on an attractive promise of mobility. This is underscored by both their ability to offer mass service provision and the fact that they specialize in managing capacity and the utilization thereof. The strength of their brands varies, so these brands must be optimized and strategically positioned. Thus, by gradually expanding their core brand, railroad companies and airlines can credibly position themselves as mobility managers.

TELECOMS PROVIDERS

More than just connectivity

Telecommunications providers face strategic challenges in the mature markets found in many industrialized nations. Their core markets, such as voice and data transmission, are at best stable and at worst in decline in both the landline and mobile segments. They also face the growing challenge of financing heavy investment in infrastructure. In this market environment, former monopolists in particular, as well as alternative providers, are now sizing up various future growth markets. The "Internet of things", the connected vehicle and, more generally, machine-to-machine (M2M) communication offer attractive potential sources of growth, especially in mobile communication, because the number of SIM cards in machines will far exceed the number in cell phones.

Telecoms providers (and cell-phone companies in particular) are already plunging into this attractive market in a variety of ways. There is no question about the core product: the high-bandwidth connectivity that is needed to build networks. The nascent global spread of the new Long Term Evolution (LTE) generation of mobile communications will also play its part.

Above and beyond the technical issue of transmission capacity, telecoms providers must also find answers to questions of a strategic nature. Do they want to stay (ultimately commoditized) component suppliers for mobile bandwidth? Or do they have what it takes to successfully build and market other capabilities, too? The interface with the customer is a key aspect in this regard. The battle between telecoms providers and Internet companies (over-the-top or OTT players) has not yet been universally won: telecoms providers can still score, especially with services such as billing and security. Their end-customer management skills can be marketed in the context of connected mobility. And these skills in turn are rooted in a more fundamental ability, one that few traditional players in the mobility ecosystem possess: the ability to provide, deliver and bill services on a large scale (i.e. mass transactions) and efficiently resolve any issues that arise in the process.

No automotive OEM or component supplier today has a comparable set of tools that can handle and bill individual transactions for millions of customers. In other words, telecoms providers do indeed have what it takes to play a prominent role in connected mobility. Beyond merely providing connectivity, they can position themselves as management platform operators, be it as white label suppliers for another mobility manager or with their own interface with end customers.

INTERNET COMPANIES

Maximum scalability

Social networks, search engines, e-commerce companies and Internet startups alike apply their technological expertise to leverage their interface with customers. These companies are fast (focusing on time to market), have a tremendous reach and therefore have every chance of being able to scale up their mobility business. Conflicts could arise from the fact that most of them want to integrate the services of third parties, who have their own business models. That is what they already do with news offerings from media companies: shifting volume in return for margins and funding their business with advertising revenues or transaction fees. A similar power struggle could also ensue in passenger transportation.

Be that as it may, Internet companies will undoubtedly pitch aggressively for the role of mobility manager. Their business model is mobile and is inherently oriented toward geo-commerce: local advertising, local search hits and local transactions. They will seek to establish themselves in the perceptions of end customers as "your mobile companion in every life situation", adding geo-based mobility offerings to their existing geo-based entertainment, shopping and communication services. Internet companies themselves generally have little mobility expertise of their own, so they often bundle the skills of other market players. Their brand promise is flexible. Larger companies in particular can add in new services at any time, thereby automatically assuming the role of mobility managers. A new personal transportation function will become widespread on social networks: A button entitled "take me to" will take its place alongside "like", "share" and "tweet".

TECHNOLOGY PROVIDERS

Strong on systems integration

IT companies build and operate the platform but do not usually operate on the end-customer market, preferring to concentrate on technical system realization. Their strength is supplying and operating hardware and software or serving as outsourcing providers. They enable other companies to deliver and scale their services and products. However, this narrow role virtually precludes them from becoming mobility managers for end customers. Even so, IT companies will stay in the frame as key white label or outsourcing providers for mobility platforms. One of the reasons why they are so very important is that customer demand constantly drives technical innovation, which in turn fuels fresh demand – a virtuous cycle.

Above we have considered six different types of players and their suitability for becoming mobility managers: automotive OEMs, multimode public transit networks, railroad companies and airlines, telecoms providers, Internet companies, and technology providers. We can make our evaluation even more systematic by applying the following criteria to all six groups. The outcome of this exercise is a set of specifications for mobility managers:

1. Can the company provide integrated mobility services? How well does it understand the conditions that govern value creation in passenger transportation?
2. Can relevant technologies be integrated?
3. Are mobility and digital expertise part of the brand profile?
4. Can strategic cooperation partners be integrated?

F7 Qualitative assessment of these criteria gives an indication of where the connected mobility manager is most likely to come from. We find that different types of market players have the potential to make this strategic function their own:

SUMMARY

▶ **OEMs**, because they are the epitome of personal mobility – and because they are forging many and varied partnerships to enhance their powerful core brands by adding extra services that offer more value for their customers.

▶ **Supraregional transportation companies**, because they have long since understood the mobility value chain and possess advanced technological expertise. Like the OEMs, they must seek to profitably manage their customer interface in the role of mobility manager.

▶ **Large Internet companies** with strong brands whose pronounced technological skills are often linked to a powerful ability to integrate third-party services.

▶ **Telecoms providers**, if they can successfully market their ability to handle and bill transactions for millions of customers, whether they position themselves as white label suppliers for other mobility managers or target their own customer base.

And what about new competitors? Automobile clubs, insurance companies, credit card firms and retail organizations are all tapping into new lines of business. One or two players from these segments are stepping into the ring with strong brands, high-profile customer management, special areas of expertise and, in some cases, sufficient resources to invest in new business models. On the whole, however, these players are less well suited to becoming mobility managers.

Following on from these evaluations, we identify – in the final section below – five factors for achieving success in connected mobility, and make recommendations on how this can be done.

13) The Car Connectivity Consortium (CCC), which counts 60% of cell phone manufacturers and 70% of automotive OEMs among its members, has established MirrorLink, a common industry standard for accrediting apps and mobile devices and connecting smartphones and vehicles.

14) Examples of this strategy already exist. Mercedes is collaborating with Apple, for instance: Under the name Drive Kit Plus, the automaker is opening up its A-class models to the iPhone. The smartphone and the vehicle's own IT are merged on the navigation system display and controlled by voice input or via the console on the dashboard.

15) Video: "Parking spot in your pocket", https://www.park-now.com/customerWeb/

16) www.hong-kong-travel.org/Octopus/

F7

Supraregional transportation companies fit best with the concept of connected mobility, but OEMs have advanced furthest

Model for evaluating the corporate fit with the mobility value chain

	Understanding of mobility	Technical skills	Relevant brand profile	Ability to integrate partners	Examples
Automotive OEMs	◔	◑	●	◕	Car-sharing companies operated by OEMs
Regional public transit networks	◔	◔	◔ 1)	○	Chicago Transport Authority, Massachusetts Bay Transportation Authority et al.
Supraregional transportation co's	◕	◕	◑	◕	Airlines, railroad companies
Telecoms providers	◔	◕	◑	◔	Mobile communication providers
Internet companies	◔	◕	◕	◕	Social networks, search engines
Technology providers	◔	●	◔	◑	Hardware & software manufacturers

Source: Roland Berger

1) But strong local brands

● Fully compliant

○ Not compliant

COMPETITION:
THE FIVE SUCCESS FACTORS

HOW TO RECOGNIZE AND MASTER CHANGE

Berlin/Germany – Tokyo/Japan

*Hitoshi Watanabe is a businessman from Tokyo. His smartphone wakes him up at his Berlin hotel. He has a meeting outside the city, and his smartphone had calculated how long the journey would take by cab. But one of the main roads is blocked because of an accident. So the phone has worked out an alternative route using public transit. Hitoshi picks up the train ticket on his cell. Entering his destination is enough to calculate the price. The smartphone knows his preferences. As he enters the station, a geo-fencing technology validates his ticket. The meeting takes longer than expected, so Hitoshi's phone books a car-sharing vehicle for the trip to the airport. The fact that his flight will be ready for boarding later than scheduled is factored into the calculations. Shared vehicles for hire can be found on almost every street corner, so Hitoshi has no trouble making his flight. Back in Tokyo, his navigation system guides him via an alternative route that features a green wave. His travel expenses automatically added up, Hitoshi e-mails the receipts to his employer for settlement.**

Connected mobility will bring fundamental change to passenger transportation as we know it. The important thing is to identify and master the changes ahead. Roland Berger Strategy Consultants has defined five success factors.

1

Network capabilities

Suitable online platforms featuring functions that integrate products, services and technology are a necessary prerequisite. Strategic partnerships between specialists will be useful in this context, as upscaling will enable complex technological requirements to be mastered and will create networked economies of scale.

2

Meeting individual customer needs

The companies that thrive in the connected mobility ecosystem will be those that master the art of mass customization. Their products and services will be tailored to the precise individual needs of each and every customer, but will be standardized from a production perspective. The aim is for products and services across the mobility experience – from planning through travel itself to billing – to be integrated as closely as possible with each other in order to maximize the benefit to the customer.

3

Strong brands

Market players must position their brands clearly and in a way that adds value. This will involve mapping their brands' core values onto new products and services, as not only vehicles but mobility itself becomes a consumer commodity. Complemented by add-on services, a well-known product brand can be developed into a well-known mobility brand. Premium brand promises can set a provider's offerings apart from those of its competitors and satisfy its customers' need for status and prestige. In the context of connected mobility, "premium" will take on a wider meaning: Quality and convenience will flourish and grow where a brand succeeds in optimizing the integration of different modes of transportation in its mobility offerings.

4

Reliable legal framework

In their legislation, governments must try to strike a healthy balance between data security and data protection (i.e. privacy) on the one hand and data transparency on the other. The rule of thumb should be: Liberalize wherever possible and harmonize wherever necessary – especially in the context of cross-border markets. Business opportunities must be aligned with the interests of individuals in such a way that no unilateral competitive disadvantages arise.

5

Management of infrastructure bottlenecks

Intelligent traffic management based on economic and ecological criteria (such as emissions of CO_2 and particulate matter) seeks to optimize utilization of the transportation infrastructure. The function of "mobility manager" will become the interface for regulatory intervention by government.

Of course, we don't have answers to all the questions yet. Question marks remain with regard to technology, markets and values. For instance:

- What mobile devices equipped with which apps will we be using in 2025? What will they be able to do?
- What CO_2 targets will climate change require us to set? And what will be the most effective way to promote innovation, research and development?
- Where could new players in the connected mobility market come from? And what will existing players do to prepare for the onslaught?
- How can we resolve – or at least get a handle on – the potential conflict between data protection and data transparency? How are we to meet the security and compliance requirements?

The attraction of this model is obvious: It opens up new business opportunities for companies while offering travelers greater flexibility and convenience coupled with maximum efficiency. The model also creates the infrastructure and technology conditions needed to drive crucial advances in electromobility. Stable factors that are unaffected by the increasing volatility of cargo markets are contributing to the development of intelligently networked multimodal transportation. Connected mobility is a plausible scenario for the future of passenger transportation – not only in the conurbations of the world's advanced economies, but wherever population growth, urbanization and climate change make smart traffic management an urgent imperative.

The success of connected mobility hinges to a crucial degree on new interaction and networking between market players who have long been accustomed to a silo mentality. Technological progress, ever more demanding customers and, above all, economic potential are sharpening market players' focus on integrated mobility offerings. Companies will start opening up – technologically, but also with regard to their entire business strategy – in order to craft a seamless, modern passenger transportation experience. If they do a smart job of either bundling the services of many market players or strengthening their own mobility brands by expanding their offerings, they have every chance of asserting themselves in tomorrow's market.

Connected Mobility 2025 shows the direction in which passenger transportation will develop in the world's major conurbations. The vision of integrated mobility has long since begun to take on concrete shape. The business opportunities are vast – and now is the time to seize them.

Flexible, networked, multimodal, intelligently managed and tailored to the individual: the vision of passenger transportation in the future

AUTHORS OF THE STUDY

Carsten Rossbach
Partner, Frankfurt
InfoCom

carsten.rossbach@rolandberger.com

Thomas Reinhold
Senior Economist, Frankfurt
Roland Berger School of Strategy
and Economics

thomas.reinhold@rolandberger.com

Gerrit Remané
Consultant, Hamburg
InfoCom

gerrit.remane@rolandberger.com

Marc Winterhoff
Partner, Detroit
Automotive

marc.winterhoff@rolandberger.com

Peter Boekels
Consultant, München
Automotive

peter.boekels@rolandberger.com

CREDITS

Page 2: Tim Driven/panos
Page 8: Stefan Boness/panos
Page 9: Richard Perry/laif
Page 10: Qi Laoye Gz/laif
Page 11: Martin Parr/Magnum Photos
Page 12: Dieter Telemans/panos
Page 13: Bloomberg/Getty Images
Page 17: Lonely Planet/Getty Images
Page 18: Palash Khan/laif
Page 43: Adam Hinton/laif

FURTHER READING

Roland Berger (2011)
Automotive landscape 2025:
Opportunities and challenges ahead

World Bank (2010)
Cairo Traffic Congestion Study

IBM (2011)
Commuter Pain Index

GSMA (2012)
Connected Cars: Business Model Innovation

Roland Berger (2012)
Connected Vehicle

Economist Intelligence Unit (2012)
Country Data

United Nations (2011)
Department of Economic and Social Affairs:
World Urbanization Prospects, the 2011 Revision

Deutsche Bank (2011)
Electromobility - Falling costs are a must

World Energy Council (2011)
Global Transport Scenarios 2050

Shell (2009)
Shell PKW-Szenarien bis 2030

Roland Berger/SAP (2011)
Survival of the fittest – Wie Europa in der Cloud
eine führende Rolle übernehmen kann

Sustainalytics (2011)
Sustainable Mobility: 100 Investment Ideas

The APEC Center for Technology Foresight – National Science and Technology Development Agency (Bangkok, Thailand) (2000)
Sustainable Transport for APEC Megacities:
Issues and Solutions

American Society of Civil Engineers (2012)
Sustainable Transportation Systems: Plan, Design,
Build, Manage, and Maintain

Roland Berger (2012)
Telco 2020: How Telcos transform the
smartphone society

Transport Canada (2006)
The High Cost of Congestion in Canadian Cities

Roland Berger (2011)
The way into the Cloud Economy

Texas Transportation Institute (2011)
The 2011 Urban Mobility Report

Victoria Transport Policy Institute (2012)
Transportation Cost and Benefit Analysis II –
Congestion Costs

Roland Berger (2012)
Trend Compendium 2030

Institut für Mobilitätsforschung (ifmo) (2010)
Zukunft der Mobilität – Szenarien für das Jahr 2030

** Richard Hammer (p. 15), Regula Kolmer (p. 25) and Hitoshi Watanabe (p. 39) are fictitious characters. "Travel Integrated" and "Transit Paris" are ficticious companies.*

For more information, please visit:
www.rolandberger.com/globaltopics

If you have any questions, please contact us at:
Global_Topics@de.rolandberger.com

Roland Berger Strategy Consultants GmbH
HighLight Towers, Mies-van-der-Rohe-Str. 6, 80807 Munich, Germany

Think of a two-word phrase in which the first word is "traffic".
What is the first thing that springs to mind?
Traffic jam? Traffic congestion? Or traffic flow?