



Information on ubitricity.

System, Components, Use-cases, Milestones, Company.
July 2016



The Next Generation of Charging.
Realising Intelligent EV Charging – Everywhere.

Introduction

Governments, cities and organisations are facing the challenge of finding sustainable solutions to significant problems such as rising urbanisation, climate change and resource scarcity. The transport sector plays a crucial role as it will continue to represent one of the main emission and pollution sources if we keep relying on the existing technologies. Electric mobility concepts offer a silent, emission and pollution friendly way of driving and thus represent the key solution for sustainable smart cities of the future. The market of Electric Vehicles (EV) has large growth potential and is estimated to reach up to 16 million vehicles in Europe by 2020¹.

The Problem: Dilemma of Charge Point Providers

Yet, the lack of comprehensive charging infrastructure still remains one of the main obstacles. In 2014, only 22,240 public charging spots had been installed for 94,410 EVs in Europe.

The problem of public charging infrastructure in residential areas starts with the installation. Grid conditions have to fulfil certain requirements in order for AC as well as DC charging infrastructure to be installed. Those conditions are not always favourable and depend heavily on the location and the general layout of the city. Also, the installation requires extensive ground works which can molest neighbours as well as hold up traffic.

Once installed, conventional public charging infrastructure as another piece of city furniture is spacious and affects the general image of a city severely – possibly also resulting in residents rejecting the concept of electric mobility as a whole.

Also, conventional public charging infrastructure requires drivers to plan “refuelling trips” into their daily routines. This means that either the charge spot provider has to lay out sufficient charging spots per vehicle (which is both effortful and expensive) or drivers have to wait in line in order to charge, intensifying traffic frequency – which again is a burden to local residents. This is particularly the case for DC charging infrastructure.

Furthermore, public charging infrastructure requires high investments:

- Roughly £5,000 for stand-alone AC charging infrastructure including installation and grid connection
- > £10,000 for DC fast-charging infrastructure excluding installation and grid connection

In addition, operating costs range from at least £750 for AC charging to £3,000 p.a. for DC fast-charging due to the services required. Transaction costs per charging process therefore vary between £5 and £25. The high costs mainly stem from the fact that the applied logic does not answer to mobile consumers’ requirements: communication, metering technology and related services are installed in every single charging station. As a result, potential charge spot providers such as cities refrain from installing charging infrastructure.

1. The Solution: Enabling Public Charging with ubitricity’s Mobile Metering System

ubitricity has developed the first SmartCable with integrated metering and communication technology, reducing the charging spot to an identifiable and switchable SimpleSocket. The system architecture ensures that the technology that is needed most - the charging spot - becomes the cheapest component.

¹ Source: McKinsey, 2014. Evolution Electric vehicles in Europe; gearing up for a new phase?

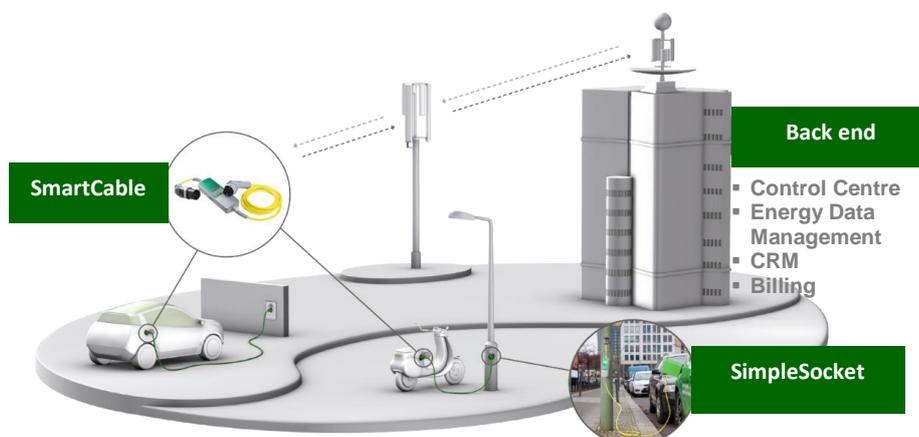
The charging spot can be integrated into existing infrastructure, i.e. where the electricity grid is accessible. That is to say at building walls or street light columns in private, semi-public or public locations. Particularly on-street charging for residents becomes reality as street light integrated SimpleSocket makes additional city furniture for charging unnecessary. As SimpleSockets are affordable and will thus be installed in various locations, traffic frequency is reduced to a minimum.



The SmartCable is the EV driver’s mobile device to access all SimpleSockets with secure authorisation. The charged electricity is directly allocated to the driver and not to the charge spot provider (CPP). View an overview of the ecosystem in the figure below.

Further advantages of the mobile metering system:

- Scalability and flexibility: installation of SimpleSockets in private, semi-public and public locations (e.g. street light columns).
- Sustainable cities: The SmartCable also allows for full smart grid services which serve to integrate renewable energy sources (RES) into the transport sector.
- Fulfilling the EU’s sustainability and electricity liberalisation targets: ubitricity’s mobile metering system is an open distribution platform for energy suppliers. EV users can choose between a set of green mobile electricity tariffs. The contract is directly attached to the SmartCable – green electricity becomes available at every SimpleSocket.
- Flexible cost allocation: the charge point provider, e.g. the City, can decide to take over the costs for the SmartCable and services or to pass it on to the EV user.
- Interoperability: The SmartCable is fully interoperable with other charging systems and works with existing standard charging infrastructure.



2. The Components: SimpleSocket and SmartCable

The following pages provide detailed technical information on series SimpleSockets and SmartCable. The components are available from January 2016 onwards.

ubitricity SimpleSocket

The ubitricity SimpleSocket provides all functions of an intelligent charging spot without being equipped with a smart meter and means for back-end communication. These are integrated in the SmartCable that the user brings along with the electric vehicle.



Functionality

Authorisation / Power Release	The SimpleSocket is activated by the SmartCable after successful authorisation via mobile communication to the backend system.
Metering of Consumption	Consumption is metered by the ubitricity SmartCable, not by the SimpleSocket. ⁽¹⁾
Automated Billing	The amount of energy consumed at the SimpleSocket is billed to the user of the SmartCable. Detailed transaction data is provided via an online portal. ⁽¹⁾⁽²⁾
Data Security / Cryptography	Certificate-based authentication is enabled by use of a public key infrastructure (PKI) and encrypted communication within the system.
Controlled Charging	Mobile Metering allows for controlled charging processes enabling future smart grid integration and energy storage. ⁽³⁾

Technical Information

Materials and Dimensions	Dimensions: 410 x 129 x 104 mm (HxWxD) Material: metal / PC-ABS Weight: 2.5 kg Safety class: IP 44
Mounting	Wall mounting (cable exposed or concealed)
Protection Technology	Upstream installation of overcurrent protection and RCD is required
Plug Connection	Type-2 IEC 62196-2 (VDE-AR-E 2623-2-2) with automatic connector locks
Charging capacity	max. 4.6 kW (230 V, single-phase, 20A) ⁽⁴⁾
Charging mode	Mode 3 in accordance with IEC 61851-1

(1) The calibration approval necessary for the consumption billing was granted.
 (2) Prerequisites for automated billing are a contract between an energy supplier and the user for mobile electricity as well as a service contract for the infrastructure provider with ubitricity.
 (3) Prerequisite for controlled charging is a mobile reception in the surrounding of the SimpleSocket.
 (4) Max. charging capacity at a single-phase installation in Germany: 20A. The max. capacity may be reduced due to conditions on the connection

ubitricity SimpleSocket for Urban Furniture (street lighting columns)

The compact dimensions of ubitricity SimpleSockets allow for full integration into street light columns or other pieces of street furniture. The sockets provide all functions of an intelligent charging spot without being equipped with a smart meter and means for back-end communication. These are integrated in the SmartCable that the user brings along with the electric vehicle.



Functionality

Authorisation / Power Release	The SimpleSocket is activated by the SmartCable after successful authorisation via mobile communication to the backend system.
Metering of Consumption	Consumption is metered by the ubitricity SmartCable, not by the SimpleSocket. ⁽¹⁾
Automated Billing	The amount of energy consumed at the SimpleSocket is billed to the user of the SmartCable. Detailed transaction data is provided via an online portal. ⁽¹⁾⁽²⁾
Data Security / Cryptography	Certificate-based authentication is enabled by use of a public key infrastructure (PKI) and encrypted communication within the system.
Controlled Charging	Mobile Metering allows for controlled charging processes enabling future smart grid integration and energy storage. ⁽³⁾

Technical Information

Housing	Suitable even for small light poles with diameter of 115 mm Material: stainless steel / synthetics Safety class: IP 54
Installation	Integrated into lighting columns and street furniture, different options possible
Protection Technology	Upstream installation of overcurrent protection and RCD is required
Plug Connection	Type-2 IEC 62196-2 (VDE-AR-E 2623-2-2) with automatic connector locks
Charging capacity	Standard version: max. 4.6 kW (230 V, single-phase, 20 A) Slim version: max. 3 kW (230 V, single-phase, 13 A) ⁽⁴⁾
Charging mode	Mode 3 in accordance with IEC 61851-1

Prerequisites
Prerequisite for modifying the street lighting column into a charging spot is the ability for unswitched individual power at the column. This can be achieved by installing a remote control device.

(1) The calibration approval necessary for the consumption billing was granted.
 (2) Prerequisites for automated billing are a contract between an energy supplier and the user for mobile electricity as well as a service contract for the infrastructure provider with ubitricity.
 (3) Prerequisite for controlled charging is a mobile reception in the surrounding of the SimpleSocket.
 (4) Max. charging capacity at a single-phase installation in Germany: 20 A. The max. capacity may be reduced due to conditions of the connection.

ubitricity SmartCable

In combination with the ubitricity SimpleSocket, the SmartCable offers full functionality for charging electric vehicles and billing the costs to the user. Mobile electronics enable metering and billing processes (including communication and authorisation), reducing the charging spot to a cost-effective SimpleSocket.



Mobile Metering <small>Component</small>	1,23 <small>MID-certified Electricity Meter (MID)</small>	 <small>Automated billing</small>	SMART <small>Controlled charging</small>	Norm Conformity <small>Safety and EMC Conformity</small>
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Functionality

Authorisation / Power Release	The SmartCable initiates user authorisation via mobile communication to the backend system and enables the SimpleSocket to begin charging.
Charging at Conventional Charging Stations	SmartCables can be used like conventional charging cables at all conventional, standard compliant charging stations. Billing conditions of the respective supplier will apply.
Consumption Measuring	The SmartCable is equipped with an MID-certified electricity meter for measuring the consumption.
Automated Billing	The amount of energy consumed is billed to the user of the SmartCable. Transaction data is provided online. ⁽¹⁾
Data Transfer	All consumption data is transferred to the backend system via mobile communication in a secure manner. If a mobile connection is not available at the time of charging, offline authorisation is enabled. Transaction data is stored temporarily and transmitted to the back-end once a connection can be established.
Data security / Cryptography	Certificate-based authentication is enabled using a public key infrastructure (PKI) and encrypted communication.
Remote Charging Control	Mobile Metering allows for remote control of charging processes enabling future smart grid integration and energy storage. ⁽²⁾

Technical Information

Materials and Dimensions	Dimensions of measuring unit: 270 x 89 x 56 mm (HxBxD) Material: PC/ABS; Protection class: IP 55 Weight: 2.35 kg; Cable length: ca. 5.5m (7m upon request)
Infrastructure Based Plug Connector	Type 2 IEC 62196-2 (VDE-AR-E 2623-2-2)
On board Plug Connector	Type 2 IEC 62196-2 (VDE-AR-E 2623-2-2) or Type 1 IEC 62196-2 (SAE J1772)
Charging Power	max. 4.6 kW (230 V, single-phase, 20 A) ⁽³⁾
Charging mode	Mode 3 in accordance with IEC 61851-1
Standard	IEC 61851-1
MID-meter	according to EN 50470-1/3

⁽¹⁾ Prerequisites for automated billing are a contract between an energy supplier and the user for mobile electricity as well as a service contract for the infrastructure provider with ubitricity.

⁽²⁾ Prerequisite for controlled charging is an active mobile connection.

⁽³⁾ Max. charging capacity at a single-phase installation in Germany: 20 A. The max. capacity may be reduced due to conditions of the connection

3. Different Use-Cases with High Customer Value

ubitricity focuses on the following customer segments: Private EV drivers (B2C) and corporate e-fleets (B2B) - who require SmartCables and SimpleSockets - as well as public and private infrastructure providers demanding SimpleSockets. The table below illustrates the needs per customer segment and ubitricity's respective USPs.

 <p>Public Charge Point Providers/Cities</p> <p>Need</p> <ul style="list-style-type: none"> ▪ Develop sustainable mobility concepts ▪ Improve image - offer innovative solutions ▪ Large-scale and low-cost charging infrastructure for EVs <p>ubitricity's USP</p> <ul style="list-style-type: none"> ▪ SimpleSockets easy to integrate anywhere to realise comprehensive charging network ▪ Facilitate planning and permission process ▪ SimpleSockets are a low-cost solution, EV users carry their respective costs directly 	 <p>Private Charge Point Providers</p> <p>Need</p> <ul style="list-style-type: none"> ▪ Real estate: offer tenants charging opportunities, save costs ▪ Retailers: differentiate from competitors, save costs <p>ubitricity's USP</p> <ul style="list-style-type: none"> ▪ SimpleSockets are a low-cost solution, EV users carry their respective costs directly ▪ SimpleSockets are easy to scale up, depending on the tenant/customer demand
 <p>B2B: Corporate E-Fleet Operators</p> <p>Need</p> <ul style="list-style-type: none"> ▪ Reduce CO2 emissions ▪ Cost-efficient charging spots ▪ Direct allocation of electricity costs to fleet vehicles (e.g. when charging en route) ▪ Improve image as attractive and green employer <p>ubitricity's USP</p> <ul style="list-style-type: none"> ▪ Fleet vehicles are directly supplied with green electricity everywhere they charge ▪ SimpleSockets significantly decrease overall costs in comparison with competitive solutions ▪ Charging costs are directly allocated to fleet vehicles via the SmartCable 	 <p>B2C: Private EV Users</p> <p>Need</p> <ul style="list-style-type: none"> ▪ Charge green electricity everywhere ▪ Image and status as green consumer ▪ Low-cost charging facilities <p>ubitricity's USP</p> <ul style="list-style-type: none"> ▪ Fleet vehicles are directly supplied with green electricity, anywhere ▪ First SmartCable with integrated mobile meter, Cleantech innovation ▪ SimpleSockets significantly decrease overall costs in comparison with competitive solutions

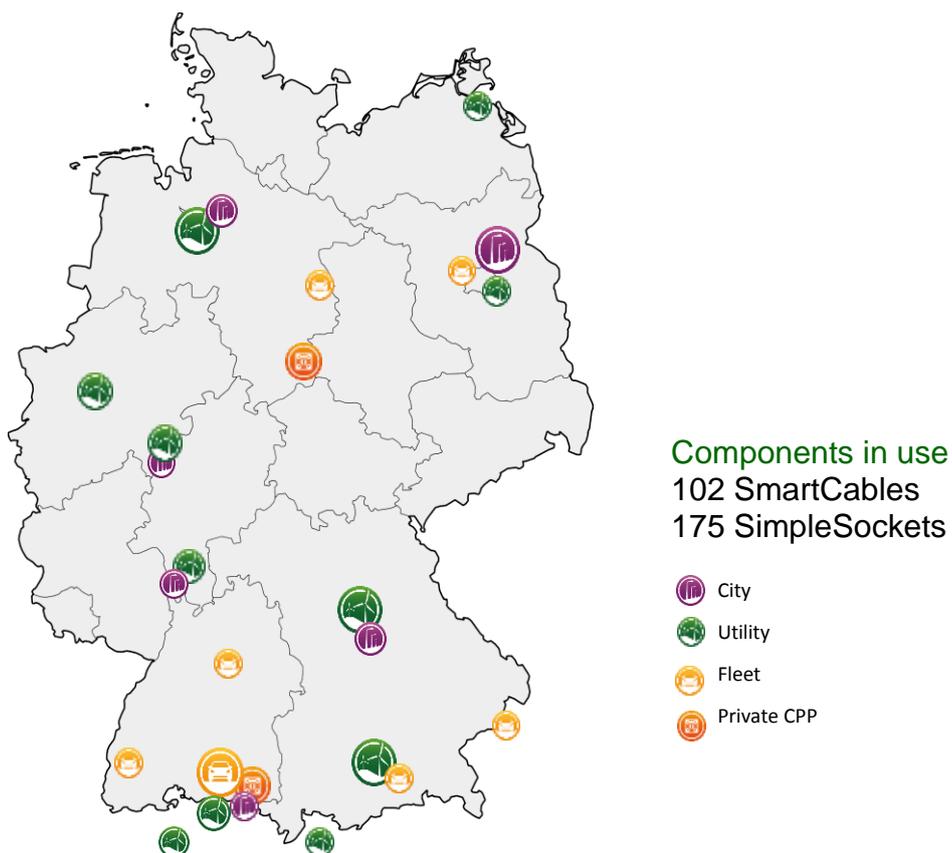
4. Current Projects of Relevance: Successful Testing in Europe

Starting in 2012, ubitricity has extensively tested its mobile metering technology. Currently, 130 EV users all over Europe are equipped with SmartCables which can be used at 213 SimpleSockets and other conventional charging stations.

Components are continuously used in Germany, France, Ireland and Switzerland. The largest region is Germany, currently hosting 102 SmartCables and 175 SimpleSockets.

The largest projects in Germany are listed below:

- Public Charging in Berlin: ubitricity has installed 25 publically accessible streetlight-integrated SimpleSockets which are fully operational. ubitricity plans to equip up to 100 SimpleSockets by 2016. Project partners are the City of Berlin, Vattenfall Distribution and Stromnetz Berlin (DSO).
- ubitricity's largest city projects including local stakeholders such as the city, local energy supplier, local businesses and CPPs are Iserlohn, Bremen and the Lake Constance Area. The overall objective is to equip minimum 25 EV users with ICMs and to install 50 SSOs for each region until end of 2015.
- International projects: EDF and ubitricity are testing the mobile metering system with customers in France and the UK. Commercial and technical operation works well, common product bundles will be defined in Q1/2016.



Below is a more detailed list of the most relevant projects of ubitricity:

Example	Description and Size	Main Partners	Photos
<p>Public Charging in Berlin</p>	<p>25 Street Lights equipped with SSOs, up to 100 to follow by mid 2016</p>	<p>City of Berlin, Vattenfall Distribution, Stromnetz Berlin (DSO)</p>	 <p><i>ubitricity founders with Helmar Rendez, CEO of Vattenfall Distribution GmbH</i></p>
<p>Region Bremen (Private, Semi-Public and Public Charging Spots)</p>	<p>10 SmartCables and 20 SimpleSockets</p>	<p>Stadtwerke Bremen (Municipal Utilities Bremen, 550 k inhabitants) and their mother company EWE (5th biggest energy supplier in Germany), private test users (B2B/B2C)</p>	 <p><i>Dr. Torsten Köhne, CEO Stadtwerke Bremen</i></p>
<p>Region Iserlohn (Private, Semi-Public and Public Charging Spots)</p>	<p>15 SmartCables and 30 SimpleSockets</p>	<p>City and municipal utility of Stadtwerke Iserlohn (95k inhabitants), private test users (B2B/B2C)</p>	 <p><i>White Label SmartCable by Stadtwerke Iserlohn</i></p>
<p>Region Bodensee (Private, Semi-Public and Public Charging Spots)</p>	<p>10 SmartCables and 15 SimpleSockets</p>	<p>Different cities and municipal utilities, local businesses, private test users (B2B/B2C)</p>	 <p><i>CEO Frank Pawlitschek with Gerd Burkert, CEO Energy Agency of Konstanz</i></p>
<p>Customer Testing in France and the UK</p>	<p>Test of 15 ubitricity components and commercial offers to EDF customers (e-fleet, condominium, private parking)</p>	<p>EDF (5,5 m. customers) Borough of Hounslow</p>	 <p><i>First street light integrated SimpleSocket in London Hounslow</i></p>

5. Achieved Milestones and Next Steps

Proof of Concept Completed in Successful Field Tests

The prototypes have been tested in several field projects since 2012 (see above). In total, 343 components are being tested, demonstrating reliable system functionality. Important field test partners include:

- OEMs such as BMW (Alphabet), GM/Opel, Audi and Volkswagen,
- Utilities such as Electricité de France (EdF), E.ON and Vattenfall,
- Telcos including Deutsche Telekom, Vodafone and Swisscom.

The basic commercial assumptions have been largely confirmed in extensive evaluations and interviews with test users (50 test users have been interviewed from July 2014 to June 2015). Test users further confirmed that they require more than one charging spot per EV and that parking and charging should coincide in daily routines. Users are content with the economic advantages of the system and with its functions and usability.

Successful Integration into the German Electricity Market

The implementation of the system has been successfully achieved and approved by the Federal Network Agency (BNetzA), Federal Ministry of Economics and Energy (BMWi), all four Transmission System Operators (TSO) and various Distribution System Operators (DSO). ubitricity acts as Mobile Metering System Operator (MMSO), securing that all market communication follows the national market communication standards.

Patents Defended

A European patent for the Mobile Metering system was granted in 2011 and successfully defended in 2013. The patent covers the concept of secure and authorised charging based on a mobile metering device used on identifiable, switchable sockets. The patent has also been granted in other key markets, further patents against fraudulent actions and for inductive charging have been added to the patent family.

Improvement Potential over Time in Relation to Competition

The components' manufacturing costs are expected to decrease over time as technology matures and knowledge of organisational and economic processes increases. ubitricity will maintain its cost advantage over competitors thanks to significantly lower operating and running costs for the SimpleSockets as opposed to conventional charging stations. ubitricity will develop full smart grid functionalities by allowing the integration of solar energy and steering charging processes according to grid conditions. EV users will be able to charge their home generated RES power (such as solar power from their rooftop) at their working place.

6. About ubitricity

ubitricity Gesellschaft für verteilte Energiesysteme mbh is a limited liability company. It was founded in Berlin in 2008 by Dr Frank Pawlitschek (CEO) and Knut Hechtfisher (Supervisory Board Member). ubitricity now works with an international team of around 40 people at the Berlin Campus of the European Energy Forum (EUREF).

The company's key shareholders are EDF, Earlybird VC, Heinz Dürr Invest VC and IBB-Beteiligungsgesellschaft. The investors support ubitricity in improving commercial and technical development, accessing industry partners and customers and provide funding.

Key investor	Role and Description
	<ul style="list-style-type: none"> ▪ Largest French utility and European market leader, MarketCap: € 30 bn. ▪ Broad activities in the e-mobility sector ▪ Strategic investor ▪ Provides operational, commercial and technical support ▪ Common commercial activities for France and UK planned
	<ul style="list-style-type: none"> ▪ Established European Venture Capital Company ▪ Manages US\$ 1 bn. in assets ▪ Financial and operational support
	<ul style="list-style-type: none"> ▪ Private Venture Capital investor specialised in mobility sector ▪ Large industry network in Germany, Austria and Switzerland, particularly in the automotive and energy sector
	<ul style="list-style-type: none"> ▪ Venture Capital company owned by the State of Berlin ▪ Manages € 130 m., stakes in 150 companies ▪ Focus on Berlin

The name ubitricity – derived from the words *ubiquitous* and *electricity* – implies the company’s mission: enable charging everywhere you go with mobile meters. ubitricity operates the mobile metering system. This entails providing charging components, metering, billing and portal services to EV users and infrastructure partners.

ubitricity develops its ecosystem with experienced industry partners. All of them are established key players in their respective fields and have been in partnerships with ubitricity for several years. Since the Mobile Metering system consists of several technological and organisational aspects of high complexity (developing and optimising hardware as well as software components, ensuring compliance with domestic and international technological standards, winning pilot project partners and support within the industry, to name only a few), cooperation with established partners has been and will be crucial for ubitricity. Key partners and their role are shown in the table below.

ubitricity Strategic Partner Network

