Summary of Patent Portfolio

Transparent Wireless Systems, LLC (TWS)

August 14, 2020

Overview and commercial importance of subject matter

TWS develops innovative, smartphone apps for parking payment, leveraging its founders' decades of R&D experience in wireless technologies, spanning cellular and satellite. One of the founders, Dr. Nils Rydbeck, ex-CTO of Ericsson Mobile Phones, is the conceptual inventor of Bluetooth, founder of Ericsson Mobile Phones and recipient of The Royal Swedish Academy of Engineering Science Gold Medal, among other honors. The other founder, Dr. Santanu Dutta, is the Chief Engineer and SVP Technology Research at Ligado Networks with over 3 decades of wireless R&D experience spanning cellular, satellite, Bluetooth, high precision location and secure mobile payments. Together, they hold over 100 patents in wireless technologies. They have applied their combined wireless knowledge to improve user/checker experiences and security in parking payment applications.

In the US, parking is a $18 B industry[1]. It has been overwhelmingly demonstrated by the proliferation of mobile payments and the myriad of smartphone apps that ***users will pay for convenience***. Several "pay-by-cell" parking payment systems, like Parkmobile, are already in service. However, these systems are still at a nascent stage relative to harnessing the full potential of modern wireless technologies, fueled by trillion-dollar global markets, such as Internet of Things (IOT) and higher precision GPS.

TWS applies these technologies to both on-street and off-street (gated garage) parking. It measures user convenience by the number of screen touches and avoidance of burdensome user actions. Examples of the latter are: entering parking zone numbers on the phone, telling the phone which car the user is in, lining up at payment kiosks to validate a paper ticket, and inserting credit cards into card readers while seated in a car. The present portfolio improves user convenience and transaction security in many other cases, as described herein.

Also included are methods/systems to improve Enforcement Officer productivity. In large cities like Washington DC, fine revenues are over $370 K per day[2] but a large fraction (e.g. approximately 50% in LA[3]) remains uncollected because of lack of

[1] Parking in Perspective The Size and Scope of Parking in America, National Parking Association Report, May 2011.

[2] In [http://www.washingtonpost.com/local/trafficandcommuting/dc-sets-record-with-parking-ticket-revenue/2012/03/04/gIQAVIxWtR_story.html] it is reported, "the District takes in an average of $370,000 in parking fines every working day of the year".

[3] http://articles.latimes.com/2011/apr/27/local/la-me-parking-20110427

manpower. TWS technologies not only aid Enforcement Officer productivity but also helps well-intentioned users avoid inadvertent fines. This is done, for example, by enabling auto-renewal of parking sessions and avoiding payment for unconsumed session time. None of these features are available in existing systems.

Our innovations extend beyond on-street parking to gated garage (off-street) parking. This is an area that has seen far fewer applications of mobile payment – those that *have deployed* are mostly clumsy adaptations of on-street parking. We have facilitated garage parking with two main offerings: (1) Enabling the use of the smartphone as an ID token, whereby the user can enter the garage by executing a few screen touches on the phone, without winding down the window. (2) Some garages are hugely invested in paper tickets, whose biggest negatives from a user perspective are lining up at payment kiosks and loss of ticket. Our patent improves user experience in (2) without forcing the garage to rip and replace the existing paper ticket infrastructure. The user experience is improved by avoiding the kiosk line and recovering a lost ticket by two screen touches by the user.

Our inventions have been developed keeping the potential of in-car integration in mind. Some aspects of the inventions work even better when integrated into the car's infotainment system as many of the inventions utilize the location of the user, which is better determined by the car, owing to the integration of additional sensors than a standalone smart phone. The autonomous driving initiative is already on a course to improve the car's location awareness from 1 – 10 m today to better than 10 cms using high precision location technology.

TWS has also patented a smartphone app for enabling secure access control, which may be deployed independently of payment applications. One use case is authenticated access to secure facilities. The app uses Public Key Infrastructure (PKI) technology, acknowledged to be the apex of present security technologies (used in business-to-business e-commerce), supported on a user's smartphone. We have adapted PKI for high security user authentication based on a smartphone app, leveraging BLE and wi-fi for local connectivity. The encryption keys (Private and Public) are contained in secure storage on smart cards in the phone, for which technology support is currently available.

Granted Patents

1. **METHODS AND SYSTEMS FOR ELECTRONIC PAYMENT FOR PARKING USING AUTONOMOUS POSITION SENSING**

   Inventors: Nils Rydbeck, Santanu Dutta
   Patent No. US9123034
   Application Number US13/862619
   Application Date 15 Apr 2013
   Publication Number US9123034
   Publication Date 01 Sep 2015
   Issue Date 01 Sep 2015
   Estimated Expiry Date 04 May 2033

2. **Methods and systems for electronic payment for on-street parking**

   Inventors: Santanu Dutta, Nils Rydbeck
   Patent No. US9373197
   Application Number US14/800355
   Application Date 15 Jul 2015
   Publication Number US9373197
   Publication Date 21 Jun 2016
   Issue Date 21 Jun 2016
   Estimated Expiry Date 15 Apr 2033

3. **Methods and systems for electronic payment for on-street parking**

   Inventors: Santanu Dutta, Nils Rydbeck
   Patent No. US10096172
   Application Number US14/482369
   Application Date 10 Sep 2014
   Publication Number US10096172
   Publication Date 09 Oct 2018
   Issue Date 09 Oct 2018
   Estimated Expiry Date 06 Nov 2035

4. **METHODS AND SYSTEMS FOR ELECTRONIC PAYMENT FOR PARKING IN GATED GARAGES**

Inventors: Santanu Dutta, Nils Rydbeck, Partha Chakrabartti
Patent No. US10,068,386
Application Number US14/483218
Application Date 11 Sep 2014
Publication Number US10068386
Publication Date 04 Sep 2018
Issue Date 04 Sep 2018
Estimated Expiry Date 17 Feb 2035

5. **METHODS AND SYSTEMS FOR ELECTRONIC PAYMENT FOR PARKING IN GATED GARAGES**

Inventors: Santanu Dutta, Nils Rydbeck
Patent No. US10,235,816
Application Number US14/806758
Application Date 23 Jul 2015
Publication Number US10235816
Publication Date 19 Mar 2019
Issue Date 19 Mar 2019
Estimated Expiry Date 23 Dec 2033

6. **METHODS AND SYSTEMS FOR ACCESS CONTROL TO SECURE FACILITIES**

Inventors: Santanu Dutta, Partha Chakrabartti
Application Number US15/248486
Application Date 26 Aug 2016
Publication Number US20170061410A1
Publication Date 02 Mar 2017
Notice of allowance received:

Core Innovations & Stakeholder Benefits: On-Street Parking

Innovation relative to present systems	Benefit	Beneficiary(ies)	Comments
Parking location identified by GPS, with optional user-provided context-based corrections. US9123034	No need to enter zone ID or scan a bar/QR code	User	Substantially greater user convenience.
	No on-street signage is required	Parking Authority (e.g. City Department of Transportation)	Enables competitive benefit of multiple parking payment service providers in one market, unrestricted by signage real estate
		Parking payment service provider	Cost burden of posting zone ID signage is removed. Lower costs enhance service provider competitiveness.
	Conducive to in-car implementation	Car manufacturers	Accuracy substantially improved over cellphone GPS owing to inertial assist (already common today). Obviates need for user corrections in urban canyons. *Enables One touch parking*.
Automatic sensing of vehicle ID by user's smartphone US9123034	User does not have to enter vehicle ID when he changes vehicle	User	Linking phone to vehicle is automatic and transparent to the user. *Eliminates several user steps relative to present payment transactions.*
EO's[4] terminal indicates location/status of parked vehicles and performs BLE based session status validation. US9123034 US10096172	Rapid and facile validation (targeted enforcement)	Parking Authority	Potential for significant cost saving and EO productivity enhancement.
Automatic Parking Session Renewal US9373197	Reduces steps required in entering pre-committed parking time	User	Greater user convenience
	Encourages user to close session	Parking Authority, User	Potential for user to pay only for consumed session time. Provides unambiguous information to EO about still-parked vehicles. Reduces EO workload.
Automatic detection of parking session closure US9123034	Obviates need for user to manually close a session	Parking Authority, User	Potential for user to pay only for consumed session time. Provides unambiguous information about still-parked vehicles. Reduces EO workload.

[4] EO: Enforcement Officer, or Checker

Core Innovations & Stakeholder Benefits: Gated Garage (Off-Street) Parking

Innovation relative to present systems	Benefit	Beneficiary	Comments
Substitute ID Tokens with TWS smartphone app US10,235,816	Extremely facile for user (minimal user steps) There are many advantages to eliminating manual payment, including operational cost and fraud prevention.	User and garage owner	Better than cards, NFC/Optical scanning with phone
Use TWS smartphone app to make payment while using paper tickets US10,068,386	Extremely facile for user (minimal user steps) Graceful introduction of mobile payment. Avoids disruptive change of entire payment infrastructure.	User and garage owner	Much less onerous than any present system.
Facile handling of lost paper tickets US10,068,386 US10,235,816	User's session can be identified without the physical ticket.	User and garage owner	User pays for actual session time, not an arbitrarily determined penalty. Payment remains app based.
Automatic sensing of Garage/Gate ID by RF beacon US10,068,386 US10,235,816 .	No user interaction required	User	Reduces several user steps relative to legacy credit card or ID pass payment systems
	No garage rewiring	Garage owner	Significant cost savings relative to use of RFID (used in some similar applications)
Auditable trail of garage usage US10,068,386 US10,235,816	Helps avoid employee fraud.	Garage owner	Potentially significant cost savings
Secure access control US15/248486	Users are authenticated using highly secure protocols. Applications beyond payments.	Garage owner	Enables use of PKI (most secure among currently available technologies) from user's smartphone.