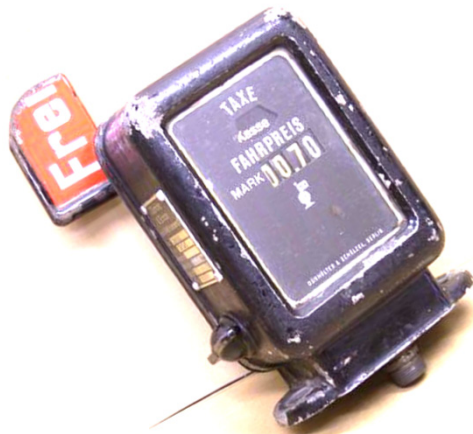


Mosiadz Michal, Puchalski Jacek,  
Szelagowski Pawel, Wojcik Jacek

# Software Separation Solutions

## - taximetr example





### AGENDA

- About us
- Possibility of ECR and taximeter cooperations
- Type aproval:
  - ☐ general requirements for devices
  - ☐ integrated device example
- Conformity assessment:
  - ☐ general requirements for devices and separations of software
  - ☐ separations problems
    - common or separate sealing
    - common or separate RTC
    - time synchronization
    - common display

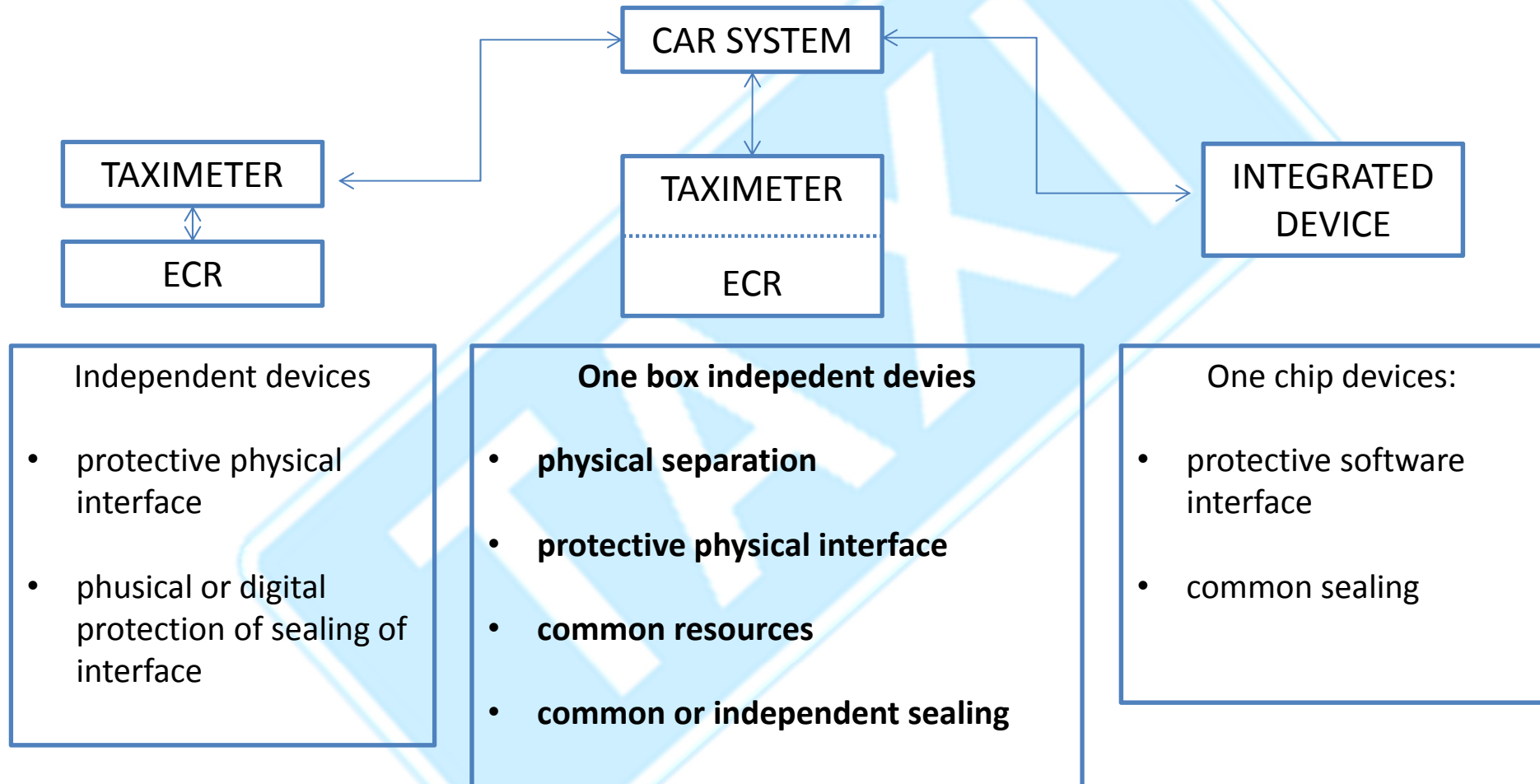


**SOFTWARE RESEARCH AND TESTING LABORATORY**



## SOFTWARE SEPARATION SOLUTIONS – TAXIMETER EXAMPLE

### SOFTWARE SEPARATION – RANGE OF SOLUTIONS





## SOFTWARE SEPARATION SOLUTIONS – TAXIMETER EXAMPLE

### TAXIMETER REQUIREMENTS FOR TYPE-APPROVAL

- GUM internal technical guides, taximeters are certified from 90's up to 2002 according to technical regulations
- Polish law regulations (2002 ÷ 2006):
  - secured metrological parameters ( $k$ -const, tariff parameters, initial fare, distance, time, fare step increment)
  - software identification (version and checksum)
  - fare calculated method S1 (single calculation method with one fare step increments with requirements for MPE: fare depend on crossover speed  $v_{gi}$  based on time for speed  $v < v_{gi}$  or based on distance for  $v \geq v_{gi}$ ,  $i = 1, \dots, 4$  – number of tariff)
  - mechanical requirements and climatic chamber (temperature) requirements
  - electrical requirements (power fails and EMC)
  - specific additional requirements in Poland: discounts, cancelation of journey, agreed price

### WELMEC WG7.2 REQUIREMENTS

**1: Realisation of software separation (S1 WELMEC 7.2)**

**2: Mixed indication (S2 WELMEC 7.2)**

**3: Protective software interface (S3 WELMEC 7.2)**

### ECR REQUIREMENTS – Poland and other fiscal countries

- ☐ embedded software without possibility of changes
- ☐ fiscal (refereces to the transaction) data protection in fiscal memory
- ☐ can not be influenced by external interfaces



## SOFTWARE SEPARATION SOLUTIONS – TAXIMETER EXAMPLE

### TYPE APPROVAL

#### TAXIMETER CONNECTED WITH FISCAL CASH REGISTER (ECR)

1994: FISCAL CASH REGISTERS


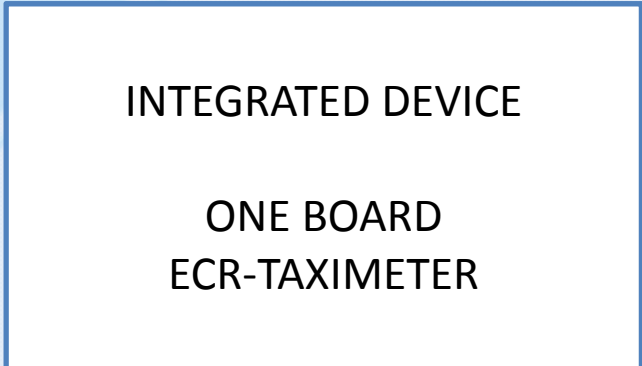
2005: REGULATIONS DEMAND CONNECTION TAXIMETER AND ECR

<b>TAXIMETER TYPE APPROVAL</b> <b>CENTRAL OFFICE OF MEASURES (GUM)</b> <b>→ 2006</b>	<b>ECR CERTIFICATION</b> <b>MINISTRY OF FINANCES (→2011)</b> <b>CENTRAL OFFICE OF MEASURES (GUM) (2011→)</b>
<ul style="list-style-type: none"> <li>• OIML D31 : during the certification of this kind of software GUM used other harmonized documents</li> <li>• metrological test: measurement site TT-2 for method of calculations S1</li> <li>• mechanical, electrical (EMC) , climatic chamber (temperature), power fail resistance</li> </ul>	<ul style="list-style-type: none"> <li>• polish law for cash register</li> <li>• <b>functional testing</b></li> <li>• from 2001 additional backup battery mounted inside the cash register in the case of power fail</li> </ul>
<p style="text-align: center;">Requirements:</p> <ul style="list-style-type: none"> <li>•taximeter must work out only with corresponding certified cash register</li> <li>•exchanging data between two paired devices is possible only by secured protocol</li> </ul>	

## SOFTWARE SEPARATION SOLUTIONS – TAXIMETER EXAMPLE

### TYPE APPROVAL

#### TAXIMETER CONNECTED WITH FISCAL CASH REGISTER (ECR)

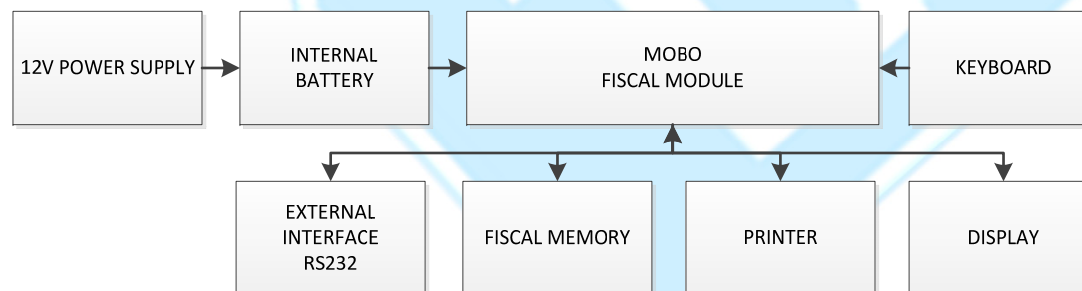
SEPARATED DEVICES	INTEGRATE DEVICE
<ul style="list-style-type: none"> <li>separated devices are connected via secured protected interfaces</li> <li>Interface is secured by sealing or digital prtoection (device identification)</li> </ul>	<ul style="list-style-type: none"> <li>one board devices (one PCB)</li> <li>integrated software</li> <li>without necessary of protection of interface</li> <li>protection interface only in the case of connection with PC</li> </ul>
	

NO SOFTWARE UPGRADE

**SOFTWARE SEPARATION SOLUTIONS – TAXIMETER EXAMPLE****TAXIMETER INTEGRATED WITH ECR EXAMPLE**

- one PCB board , one memory solution, one real time clock RTC
- common integrated software: ASM – assembler of ARM/Z-80, realize functions of ECR and taximeter
- common display ( typical simply seven segments based on liquid crystals)
- sealing independent for taximeter and for ECR
- common local keyboard (only 4-KEYS) : programming manually ECR and taximeter or by PC using service program

Metrological data can be set manually or via PC-interface only after breaking seal. Additional functionality of programing ECR is to determine ex. the fare with discounts and agreed price. Informations about new values of fares after discount and agreed price are displayed on the taximeter. Discount, agreed price setting is possible under 20 min of time and under 500 m of distance of journey



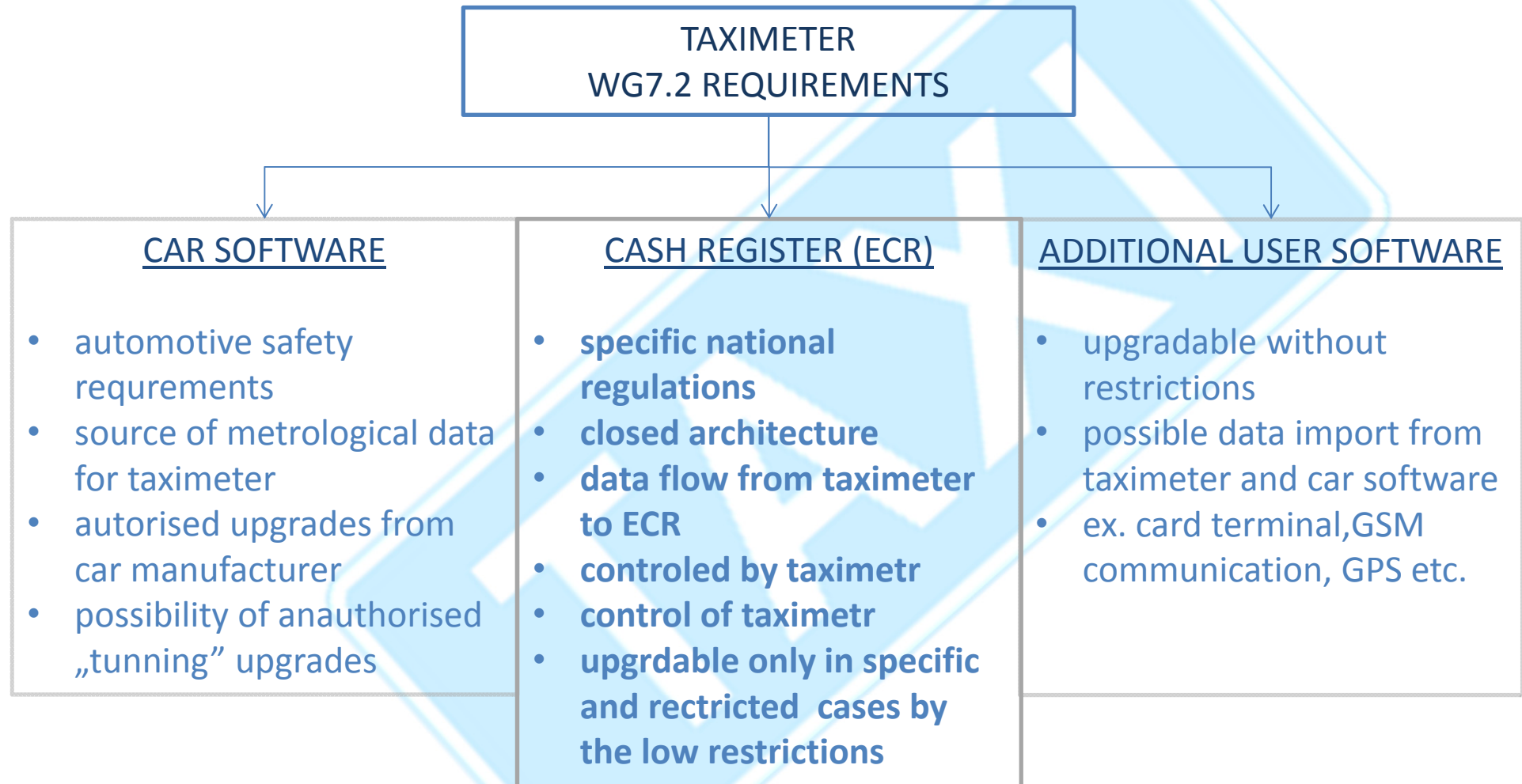
## SOFTWARE SEPARATION SOLUTIONS – TAXIMETER EXAMPLE

### CONFORMITY ASSESSEMENT TAXIMETER CONNECTED WITH FISCAL CASH REGISTER (ECR)

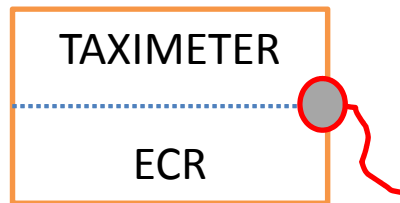
#### FISCAL CASH REGISTERS REQUIREMENTS TAXIMETER - CONFORMITY ASSESSEMENT

CONFORMITY ASSESSEMENT CENTRAL OFFICE OF MEASURES (GUM) 2006 →	ECR CERTIFICATION CENTRAL OFFICE OF MEASURES (GUM) 2011→
<ul style="list-style-type: none"><li>• OIMLR-21, <b>MID Directive, annex MI007</b>,</li><li>• polish regulations 2007</li><li>• metrological test are carried out for method of calculations S1,S2,D1,D2 on the measurement site <b>TT-2EU</b></li><li>• <b>SOFTWARE CERTIFICATION – WELMEC WG7.2</b></li><li>• mechanical M3, electrical (EMC) E3, climatic chamber (temperature) , power fail resistance</li></ul>	<ul style="list-style-type: none"><li>• polish law for cash registers</li><li>• <b>functional test</b></li><li>• construction verification</li><li>• emergency situation</li><li>• interface security verification</li><li>• source code partial analysis</li></ul>
<p>Requirements (nothing change):</p> <ul style="list-style-type: none"><li>•taximeter must work out only with correspondig certified cash register</li><li>•exchanging data between two paired devices is possible olnly by seciured protocol</li></ul>	

## SOFTWARE SEPARATION SOLUTIONS – TAXIMETER EXAMPLE



## SOFTWARE SEPARATION SOLUTIONS – TAXIMETER EXAMPLE

ONE BOX INDEPENDENT DEVICES WITH COMMON RESOURCES

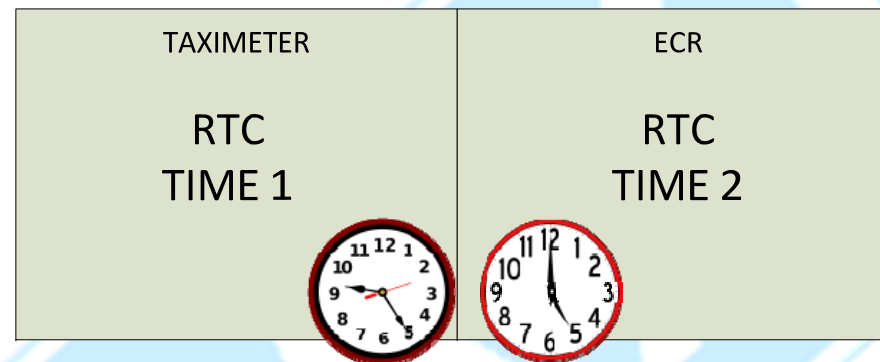
## COMMON OR SEPARATE SEALING PROBLEMS

COMMON PHYSICAL SEALING	
SERVICE PROBLEMS	<u>Service problems:</u> <ul style="list-style-type: none"> <li>breaking seal caused of ECR service = <b>new legalisation</b></li> <li>breaking seal caused by taximeter service = <b>see ECR documentation</b></li> </ul> <b>serviceman needs permission for both devices</b>
MANUFACTURER DECISION	separate sealing for devices separate electronic and inner boxes for both devices
COMMON ELECTRONIC SEALING	
POSSIBLE SOLUTIONS	digital solutions (separate password, access levels, separate electronic keys etc) – <b>possible only setting parameters by service</b> Hardware service problem – <b>see: service problem</b> Legal challenge – <b>common service permissions for ECR and taximeter</b>

## SOFTWARE SEPARATION SOLUTIONS – TAXIMETER EXAMPLE

### ONE BOX INDEPENDENT DEVICES WITH COMMON RESOURCES

#### REAL TIME CLOCK PROBLEMS



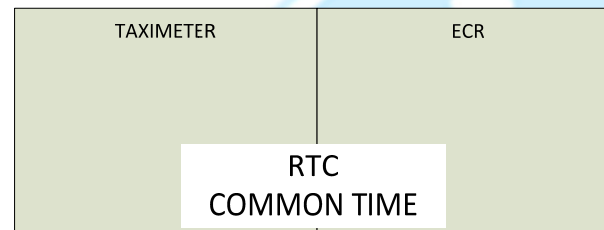
#### DEVICES REQUIREMENTS

TAXIMETER	DEVICES REQUIREMENTS
	<ul style="list-style-type: none"> <li>• requirements for accuracy and stability of RTC</li> <li>• time adjusted by service only</li> </ul>
ECR	<ul style="list-style-type: none"> <li>• without requirements for time stability</li> <li>• time adjusted by service and user (different possibility of setting time)</li> </ul>

## SOFTWARE SEPARATION SOLUTIONS – TAXIMETER EXAMPLE

### ONE BOX INDEPENDENT DEVICES WITH COMMON RESOURCES

#### COMMON REAL TIME CLOCK – SEALING PROBLEM

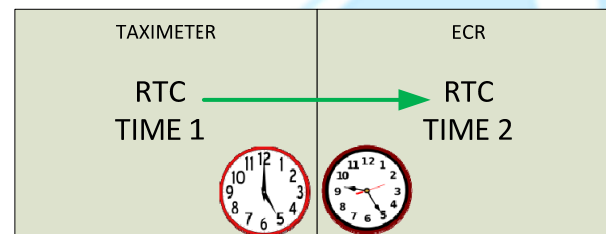


COMMON RTC	
COMMON SEALING OF INTEGRATED DEVICE	<u>Service problems:</u> <ul style="list-style-type: none"> <li>breaking seal caused of ECR service = <b>new legalisation</b></li> <li>breaking seal caused by taximeter service = <b>ECR documentation serviceman needs permission for both devices</b></li> </ul>
SEPARATE SEALING OF DEVICES COMMON SEALING OF RTC	<b>cost of additional seals</b> <b>mechanical construction problems</b>
SEPARATE RTC	
SEPARATE SEALING	<b>problems with time synchronisation</b>

## SOFTWARE SEPARATION SOLUTIONS – TAXIMETER EXAMPLE

### ONE BOX INDEPENDENT DEVICES WITH COMMON RESOURCES

#### TIME SYNCHRONISATION PROBLEM „OLD” ECR REQUIREMENTS



TIME SET BY  
1. SERVICE

TIME SET BY  
1. SERVICE (FULL RANGE AFTER DAILY REPORTS)  
2. USER (LIMITED CHANGES  $\pm 2$  HOURS)

#### SEPARATE RTC

TAXIMETER (MID-007)

requirements for RTC accuracy and stability  
(2 min/per week, 0,02%)

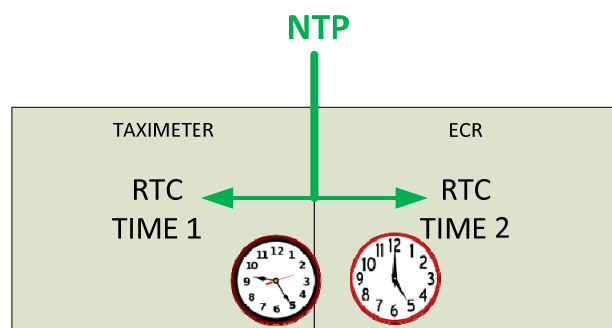
ECR

without time stability/ accuracy requirements

#### POSSIBLE SOLUTION

- ECR time synchronisation to taximeter time (more reliable time in taximeter)
- Independent time settings in both devices (problems with different time on documents)

## SOFTWARE SEPARATION SOLUTIONS – TAXIMETER EXAMPLE



TIME SET BY  
**1. EXTERNAL NTP**  
 2. SERVICE

TIME SET BY  
**1. EXTERNAL TIME SYNCHRONISATION**  
 2. SERVICE (FULL RANGE AFTER DAILY REPORTS)  
 3. USER (LIMITED CHANGES  $\pm 2$  HOURS)

### ONE BOX INDEPENDENT DEVICES WITH COMMON RESOURCES

TIME SYNCHRONISATION PROBLEM  
 „NEW” ECR REQUIREMENTS  
**EXTERNAL TIME SYNCHRONISATION**

#### SEPARATE/Common RTC

TAXIMETER (MID-007)

requirements for RTC accuracy and stability

ECR

without time stability requirements

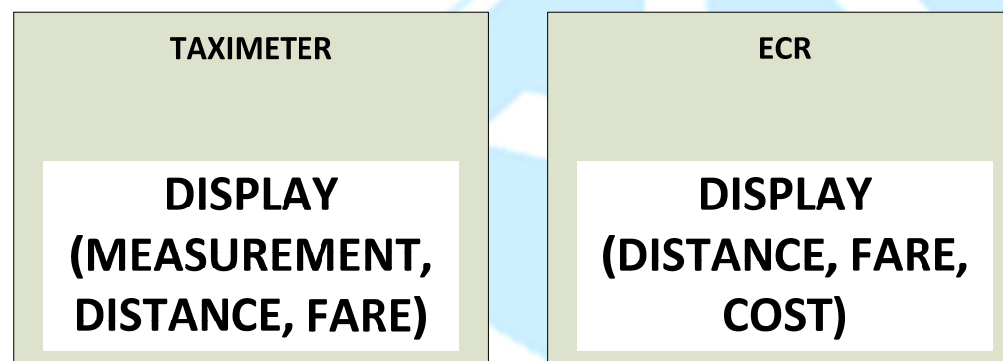
#### POSSIBLE SOLUTIONS

- ECR and taximeter time synchronisation via internet NTP -protocol (GSM ?)
  - official, reliable time source for ECR – eliminated RTC stability and errors problems
  - possibility of ECR time „hacking” and transmission errors
- Independent time settings in both devices (problems with different time on documents)



INDEPENDENT DEVICES WITH COMMON RESOURCES

DISPLAY



**CLIENT DISPLAY REQUIREMENTS**

<b>CLIENT DISPLAY REQUIREMENTS</b>	
TAXIMETER	state of taximeter: free/hired/stopped during journey: actual fare, fare with discount (percentage), fare agreed, distance, time, and measurement summary – fare/fare with discount, time, distance on the end of journey and optionally supplementary fare
ECR	end of journey ( transaction summary) Fare/ fare with discount, distance, time, fare agreed, supplementary fare, currency, - full information about the journey is printed on the documents

## SOFTWARE SEPARATION SOLUTIONS – TAXIMETER EXAMPLE

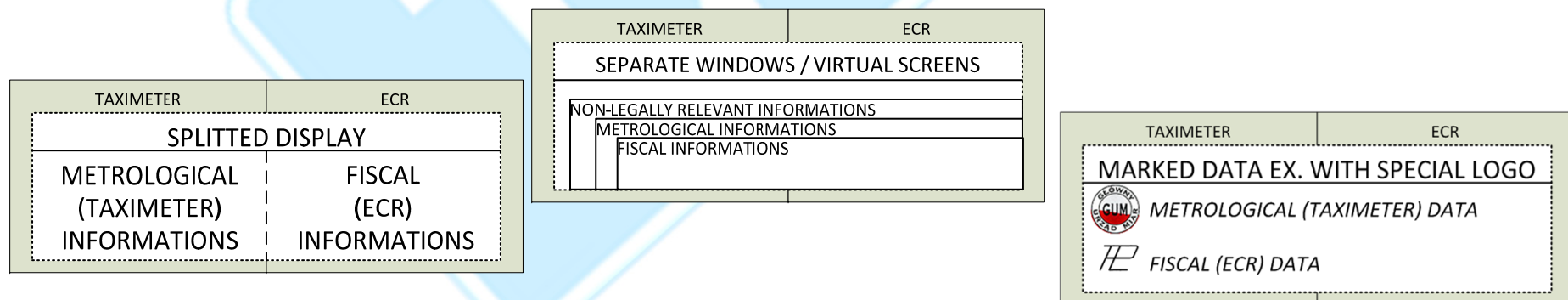
### ONE BOX INDEPENDENT DEVICES WITH COMMON RESOURCES



### COMMON DISPLAY - POSSIBLE SOLUTIONS

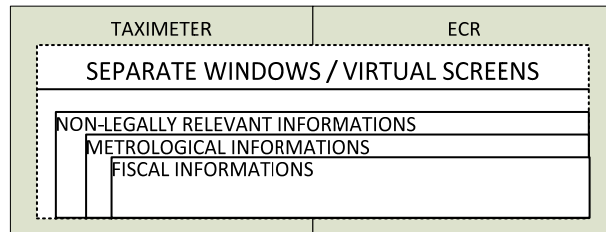
COMMON DISPLAY

separate parts of display  
special signing of ECR (fiscal data) and taximeter (metrological data)  
Special screens/skins for fiscal and metrological data



## SOFTWARE SEPARATION SOLUTIONS – TAXIMETER EXAMPLE

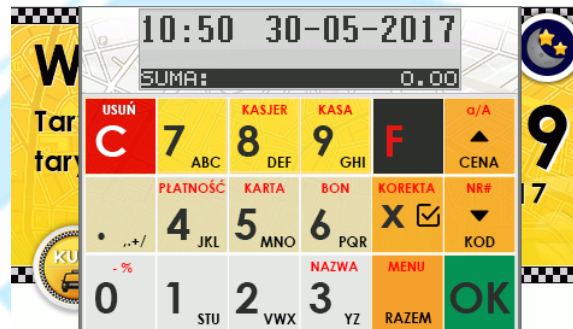
### ONE BOX INDEPENDENT DEVICES WITH COMMON RESOURCES



#### COMMON DISPLAY



**For Hire (free)**



**Hired” (Occupied)**



**Stopped (To pay)**

#### CERTIFIED SOLUTION 2016

COMMON DISPLAY CONTROLLED BY ECR (MASTER), AT ANY MOMENTS WINDOW OF ECR CAN BE DISPLAYED; START OF JOURNEY WITH DISPLAY OF WINDOW OF TAXIMETER, DURING JOURNEY DISPLAYED SPECIAL SKINS FOR TAXIMETER DATA, ON THE END OF THE JOURNEY ECR TRANSACTION SUMMARY INFORMATION WITH TAXIMETER DATA ARE DISPLAYED ON TWO WINDOWS

## SOFTWARE SEPARATION SOLUTIONS – TAXIMETER EXAMPLE

### ONE BOX INDEPENDENT DEVICES WITH COMMON RESOURCES

#### COMMON DISPLAY SOLUTION

##### SKINS PROTECTION

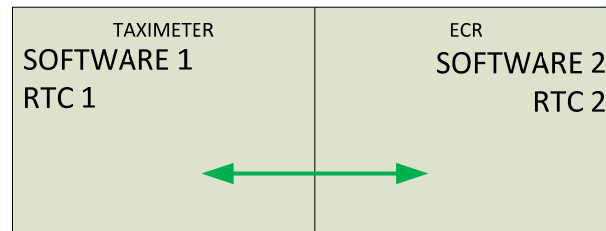
- SET OF COLOURED SKINS INSTALLED IN DEVICE – POSSIBLE TO CHOOSE BY USER
- SKINS PROTECTED BY CHECKSUM VERIFICATION
- NEW SETS OF SKINS - VERIFICATION BY NB (PROBLEM OF VISIBILITY OF FISCAL AND METROLOGICAL DATA) LOADABLE TO DEVICE AFTER BREAKING SEAL
- IMPOSSIBLE TO DEFINE INSTALL SKINS BY USER
- SKINS CREATED ONLY BY MANUFACTURER FOR TAXI COMPANIES, CAR BRANDS ETC



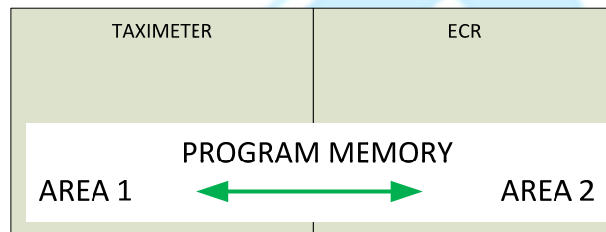
## SOFTWARE SEPARATION SOLUTIONS – TAXIMETER EXAMPLE

### FUTURE

#### FULLY INTEGRATED DEVICE ONE CHIP, ONE MEMORY, ONE SOFTWARE

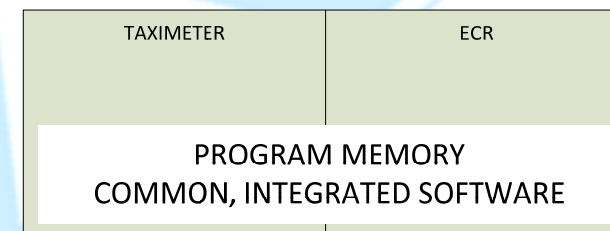


#### ONE CHIP DEVICE



1. PROTECTIVE SOFTWARE INTERFACE
2. ELECTRONIC SEAL:
  - ACCESS TO AUTO SERVICE MODE BY TAXIMETER
  - AUTOMATIC TIME SYNCHRONISATION
3. SEPARATE CERTIFICATION

#### INTEGRATED SOFTWARE



PROTECTIVE SOFTWARE INTERFACE  
ON SOURCE CODE LEVEL  
(FUNCTIONS, LIBRARIES SEPARATION)

OR

NO SEPARATION, FULLY INTEGRATED SOFTWARE  
DUAL CERTIFICATION FOR ONE SOFTWARE

CENTRAL OFFICE OF MEASURES (GUM)  
INTERDISCIPLINARY METROLOGY DEPARTMENT  
SOFTWARE RESEARCH AND TESTING LABORATORY



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**THANKS  
FOR YOUR ATTENTION**