

The experience of Ascendi in design and implementing a Multi-Lane Free-Flow Tolling System (MLFF)



IRF World Meeting 2010 – 16th World Meeting

Pedro Pinto

Lisboa, May 25 - 28, 2010

AGENDA



- Ascendi
- Framing
- Project organization
- MLFF architecture solution
- System functioning

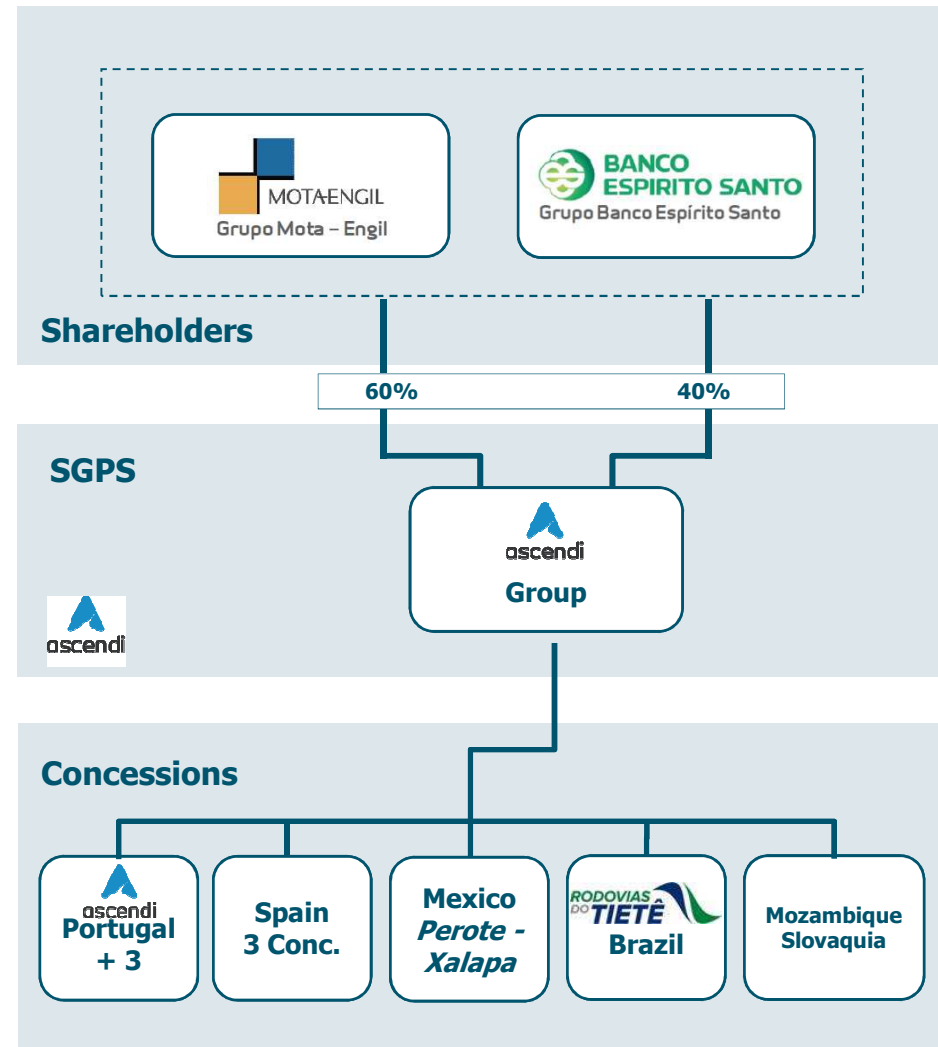
Ascendi is a Portuguese Company who operates in the transport sector.

The major shareholders are Mota-Engil (construction company) and BES (bank sector).

Road Concessions:

- **Portugal: 7 + 3 Concessions > 1425 km's**
- **Spain: 3 Concessions > 290 km's**
- **Mexico: 1 Concession > 60 km's**
- **Brazil: 1 Concession > 400 km's**
- **Presences in Mozambique and Slovaquia**

More than 2150 km's of roads under operation.

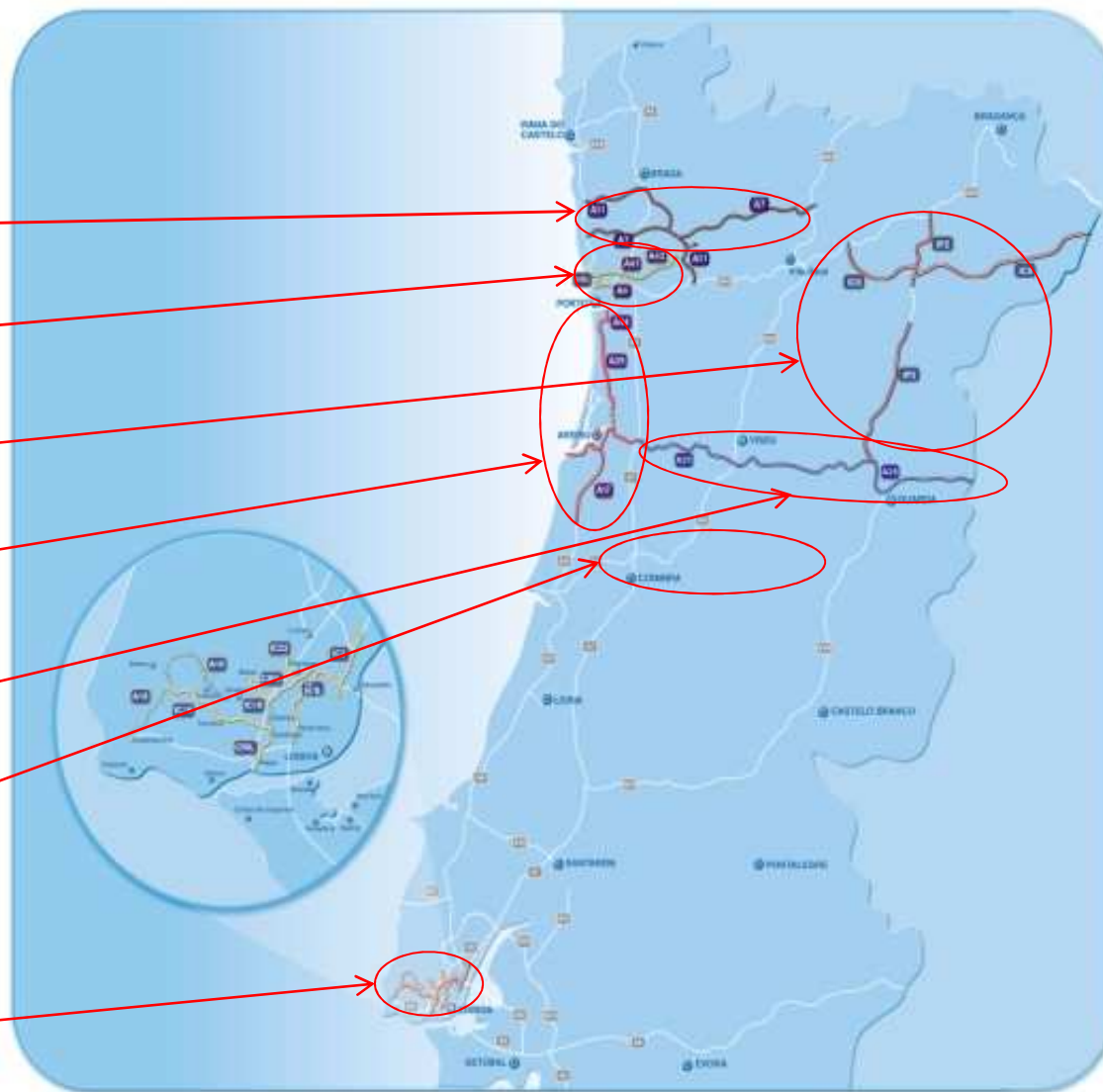


11 years building and operating new roads



Location :

- North Concession
- Grande Porto
- Douro Interior
- Costa da Prata
- Beiras Litoral e Alta
- Pinhal Interior
- Grande Lisboa





AGENDA

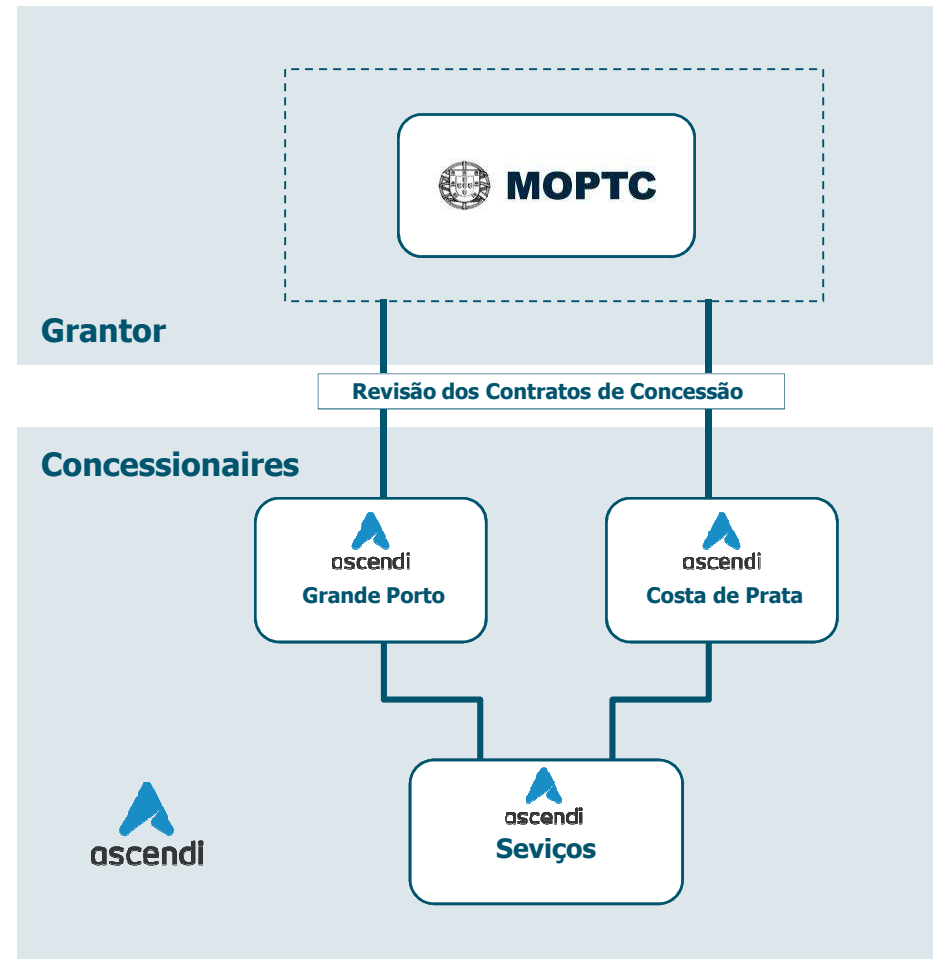


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MLFF TOLL SYSTEM

Ascendi is closing an agreement with the Portuguese Government to change two Concessions working in shadow toll schema to a real toll schema (Grande Porto and Costa da Prata).

Due to the technical characteristics of these concessions a *Multi-Lane Free-Flow* (MLFF) system was considered to be the best solution.





THE MLFF TOLL SYSTEM

Main features of MLFF System

MLFF System characteristics, under the agreement established in December 2008

- Fully automated system requiring no human intervention for collection;
- Open System with main road Charging Points (CP) in selected sub-stretches:
 - Costa de Prata – 22 CP
 - Grande Porto – 26 CP
- Each CP will collect a toll rate corresponding to its predefined influence area;
- Vehicle identification through ELP (*Electronic License Plate*) reading or photograph with License Plate Recognition using OCR technology;
- The CP transactions comprised in a journey will be clustered in a single business transaction that is in everyway similar to that of a closed system transaction, in which the toll amount charged is determined by the entrance and exit interchange.



MLFF TOLL SYSTEM

Vehicles' Electronic Identification System (VEIS)

System functioning characteristics derive from the implementation of a Vehicles Electronic Identification System (VEIS), accordingly with PT legislation (May 18th 2009)

- **All vehicles to be equipped with Electronic License Plate (ELP)**
[OBU with DSRC technology compatible with existing toll collecting system]
- **Payment systems available:**
 - **Primary collection to be available by CTCE (Certificated Toll Collecting Entities, eg: Via Verde)**
 - **Payment system under contract (direct debit)**
 - **Pre-payment anonymous system**
 - **Pre-payment system with user's identification**
 - **Secondary collection to be available in CTT (Portuguese Post Office Company)**
 - **Post payment anonymous system**
- **Enforcement collection model previewed for non payments;**
- **Previewed a schema to apply to foreign cars.**



Sharing the road
16th World Meeting
International Road Federation

MLFF TOLL SYSTEM

TOLL Collection processes

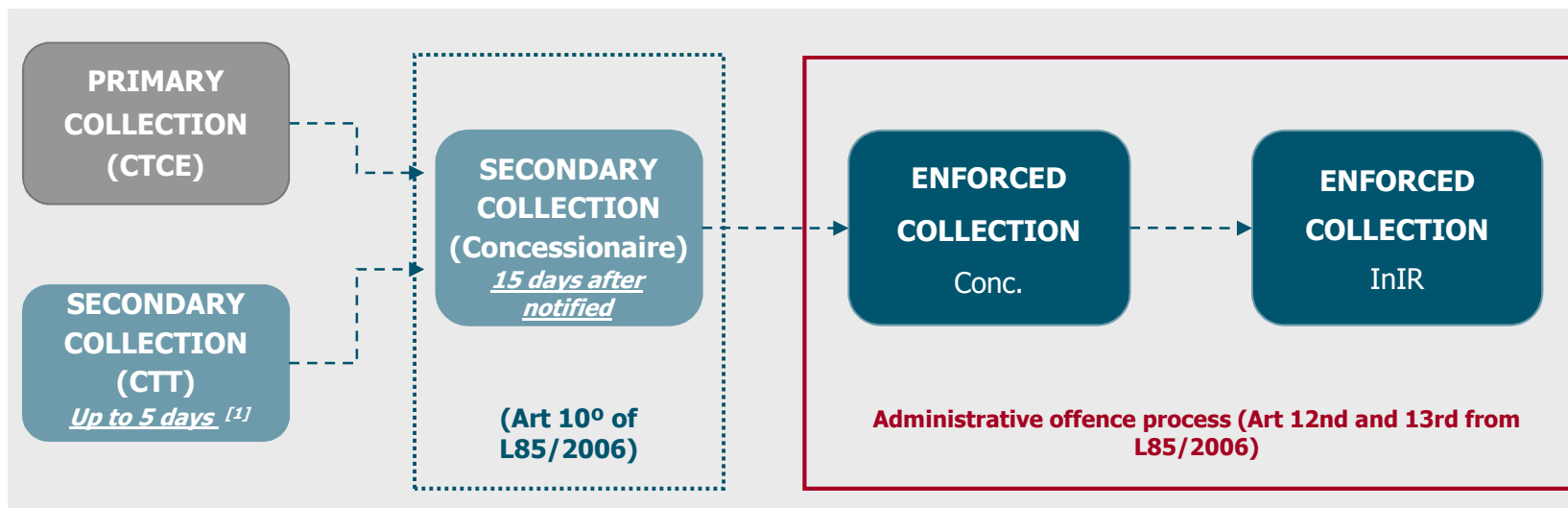
CP



TRANSACTIONS COLLECTION

Collection Entities

CONCESSIONAIRES



PRIMARY COLLECTION

Electronic toll collection through the system of direct debit or pre-payment

SECONDARY COLLECTION

Electronic toll collection through the system of payment after use of toll services (post-payment), with **consequent payment of administrative costs**

ENFORCED COLLECTION

Toll collection through the appeal of an administrative offence regime, **with payment of administrative costs and fine**

[1] From 00:00 of the day following the passage



MLFF TOLL SYSTEM

Milestones

June 1st 2009: Contract date for the beginning of the project

September 1st : 1st System Release

10 CP

Send transactions to Via Verde and CTT (Post-Payment)

July 1th: Global Operation

48 CP

Support to processing of manual verification (ALPR)

Send transactions to Via Verde and CTT (Post-Payment)

All collecting processes available (primary, secondary e enforcement)



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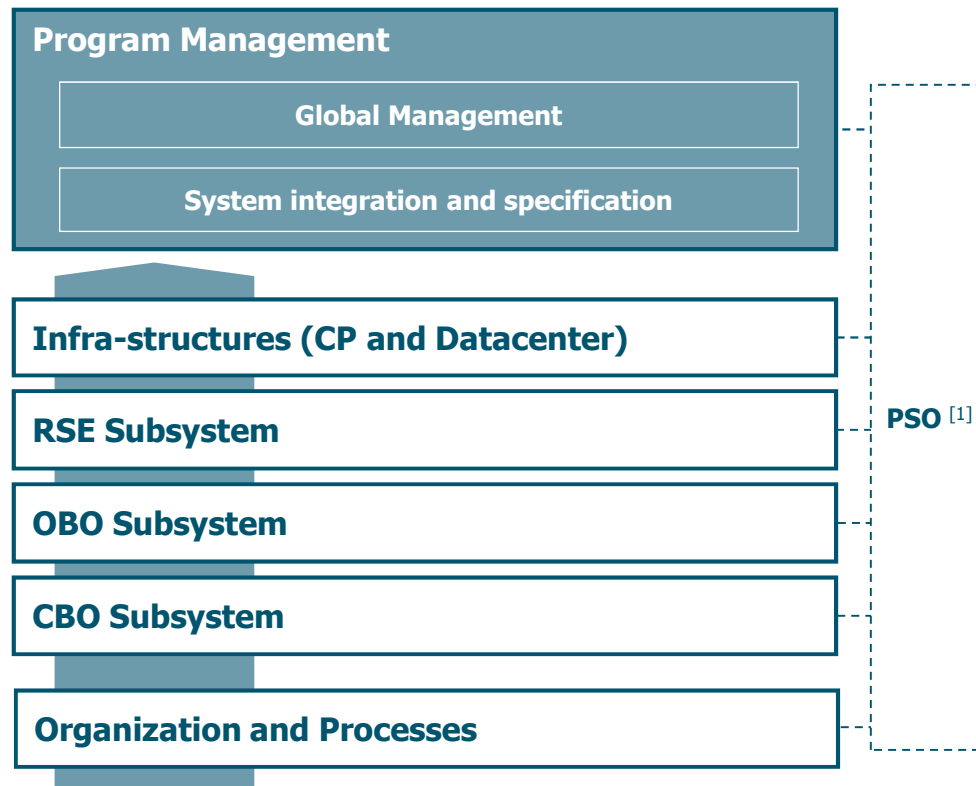
PROJECT ORGANIZATION

Organization model

The Organization Model to support the project management is based on the following principles:

- Five parallel Working Lines coordinated by a common Program Management team.
- Each Working Line deals with specific subsets of the system.

ORGANIZATION MODEL

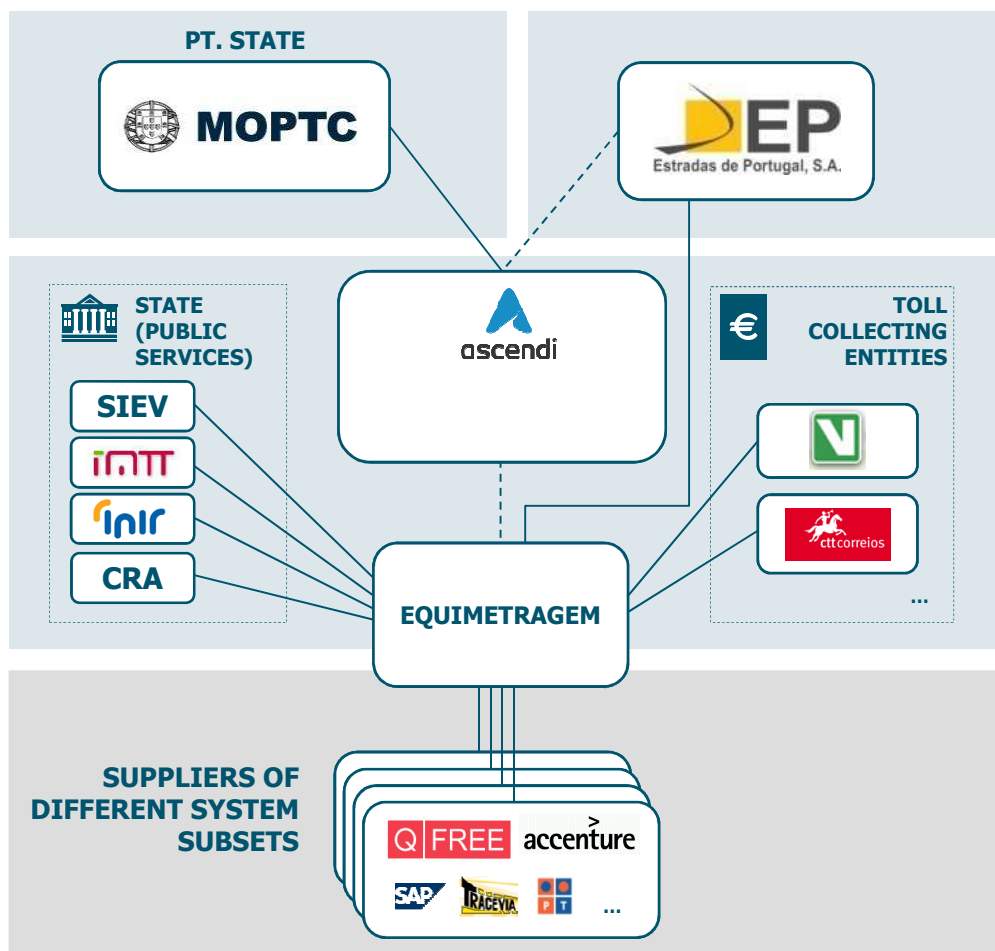


^[1] Project Support Office

PROJECT ORGANIZATION

Involved Entities

ECOSYSTEM of ENTITIES INVOLVED IN THE MLFF SYSTEM IMPLEMENTATION AND OPERATION



PT STATE

Grantor of the Concession Contracts

EP

Publicly owned private company entitled to the toll income.
Grantor of the Tolling Service Contracts

EQUIMETRAGEM

Private Company owned by Ascendi assuring the implementation, operation and maintenance of the MLFF System

STATE (Public Services)

Entities that exchange the necessary information for the operation of MLFF system

TOLL COLLECTING ENTITIES

Certified entities by SIEV to assure toll collecting services in the system:
Primary Collection – Via Verde, or others
Secondary Collection - CTT

RSE & OBO

Q FREE

Software CBO

SAP

Civil Works, Inf., Elec.

TRACEVIA

CBO

accenture

Communications network

P T

Civil Works, DC

manvia

PROJECT ORGANIZATION

Involved Entities

	Portuguese Consultant Supplier of Project Management Office (PMO + PSO)	References: SIRESP in Portugal; NHCC in Portugal; ELP study for PT Nacional Authorities
	Norwegian Supplier of Electronic Tolling Systems (DSRC or Satellite)	References: ETC in Portugal and Bangkok; Congestion Charging in Stockholm; Truck Tolling System in Slovakia; MLFF in Sydney; DSRC Tags
	International Consultants implementing CBO	References: Via Verde in Portugal; Dulles Greenway USA; Toll Collect (PMO) in Germany ; HGV Tolling in Chec. Rep.
	German Supplier for the CBO Software (ETC – vertical solution)	References: Via Verde in Portugal; Vespucio in Chile;
	Portuguese Telecom Supplier of the communication network	References: Telematic and Tolling Networks (NetBand) – Portugal and others;
	Portuguese Supplier for civil works and gantries	References: Telematic and Technical installations – Portugal;
	Portuguese Supplier for civil works and electricity	References: Civil works and Technical Maintenance - Portugal



AGENDA

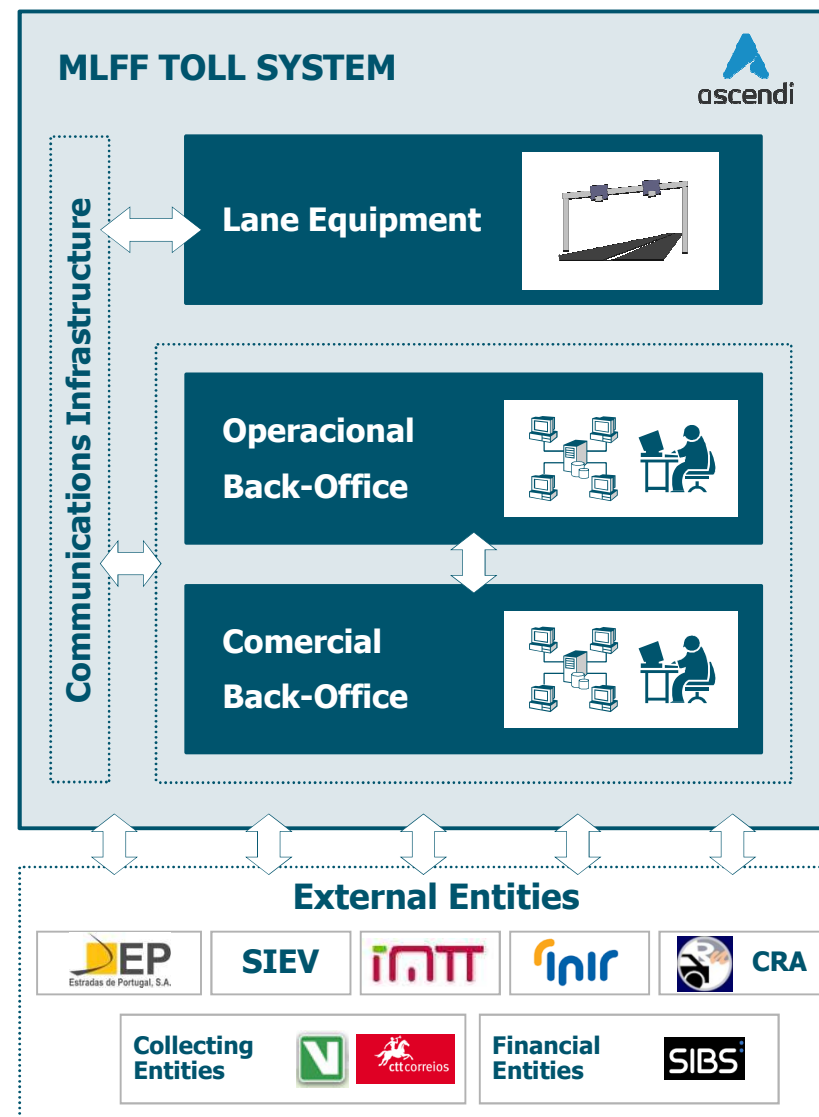
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THE MLFF TOLL COLLECTING SYSTEM

System Architecture – Main Components

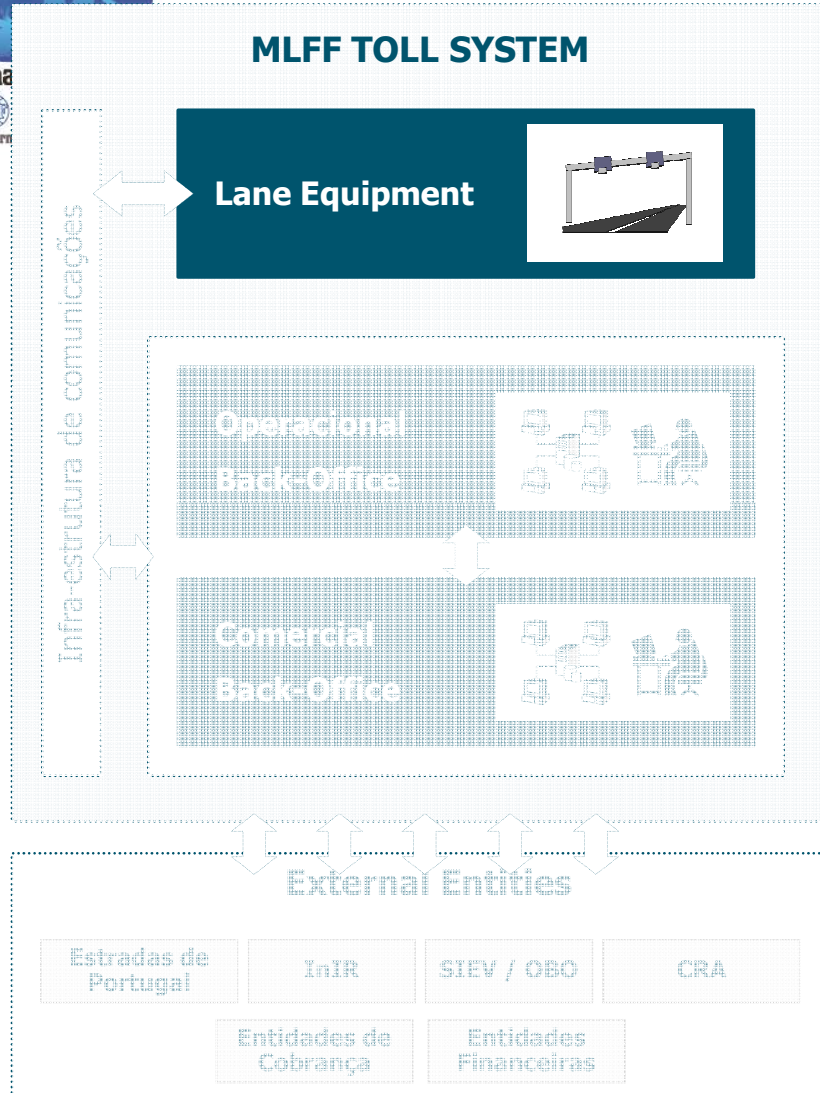
The MLFF system is structured in three major components:

1. RSE - *Roadside Equipment*
2. OBO - *Operational Back-Office*
3. CBO - *Commercial Back-Office*



SYSTEM'S ARCHITECTURE

Charging Point Functional Architecture – RSE



Vehicle Detection and Classification Subsystem



- Detection of vehicle passage
- Determination of vehicle's class through volume characteristics (height, width, length, trailer existence)

Electronic Collecting Subsystem



- Reading of vehicles' OBU

Video Subsystem



- Vehicle image capture: front, back and context
- Vehicles' Automatic License Plate Recognition

Lane controller Subsystem



- Correlation of data from different subsystems
- Transmission to Back-Office System

SYSTEMS' ARCHITECTURE

Charging Point – Gantries



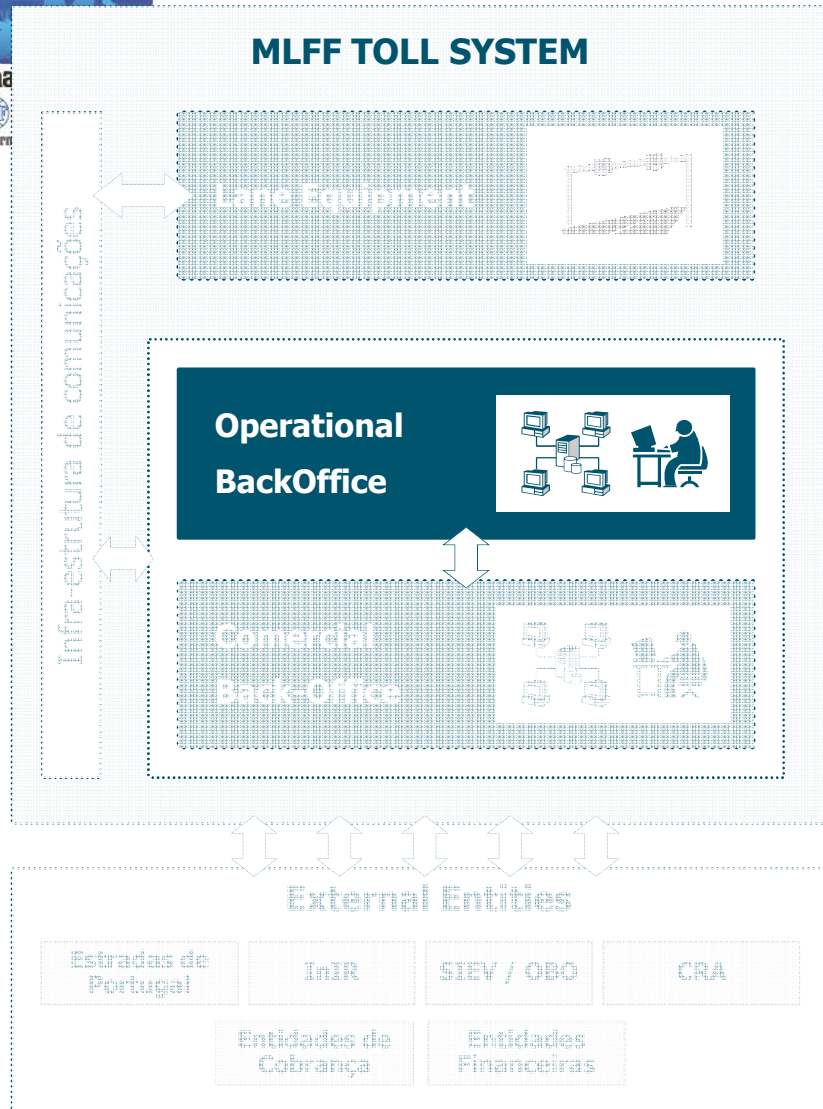
SYSTEMS' ARCHITECTURE

Charging Point – Gantries with equipments

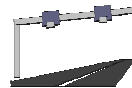


SYSTEM'S ARCHITECTURE

Functional Architecture of Operational Back-Office – OBO



Interface with Charging Points



- Transactions collection
- RSE monitoring and parameterization
- Distribution of toll rates lists and status lists

Transactions Processing



- Transaction validation (treatment of anomalies, discrepancies, offenses)
- Second level of automatic license plate recognition
- Transaction rerate process
- Consolidation of unitary transactions into business transactions (includes journey analyses, and transaction recovery)

Rate Management



- Definition of toll rates
- Simulation of toll rate application

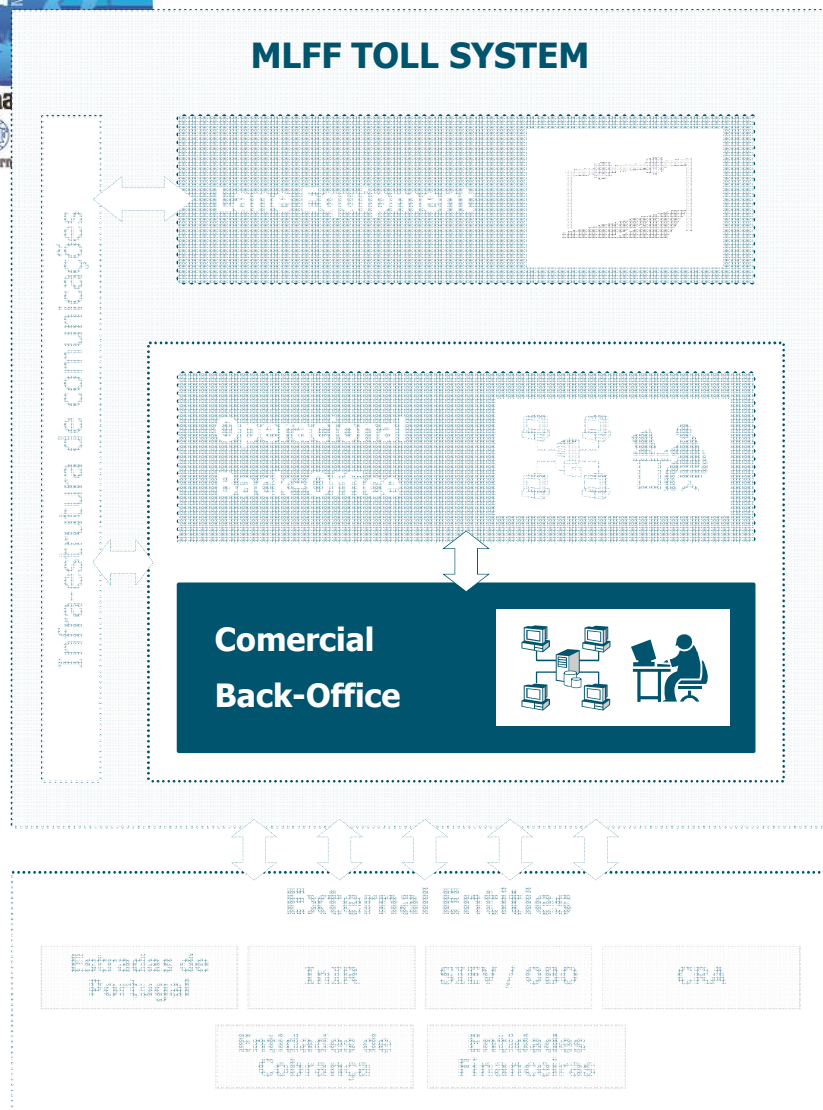
Interface with Comercial Back-Office



- Transfer of business transactions to CBO
- Support of customer data base

SYSTEM'S ARCHITECTURE

Functional Architecture of Comercial Back-Office– CBO



Processes of Secondary and enforcement collection



- Owner and Driver Identification, when necessary
- Issuance of written notices

Collection Management



- Payments reception
- Management accounts of customers
- Management of financial reconciliation processes
- Management of financial flows

Claims Management



- Treatment of Customer Claims
- CRM
- Contact Center

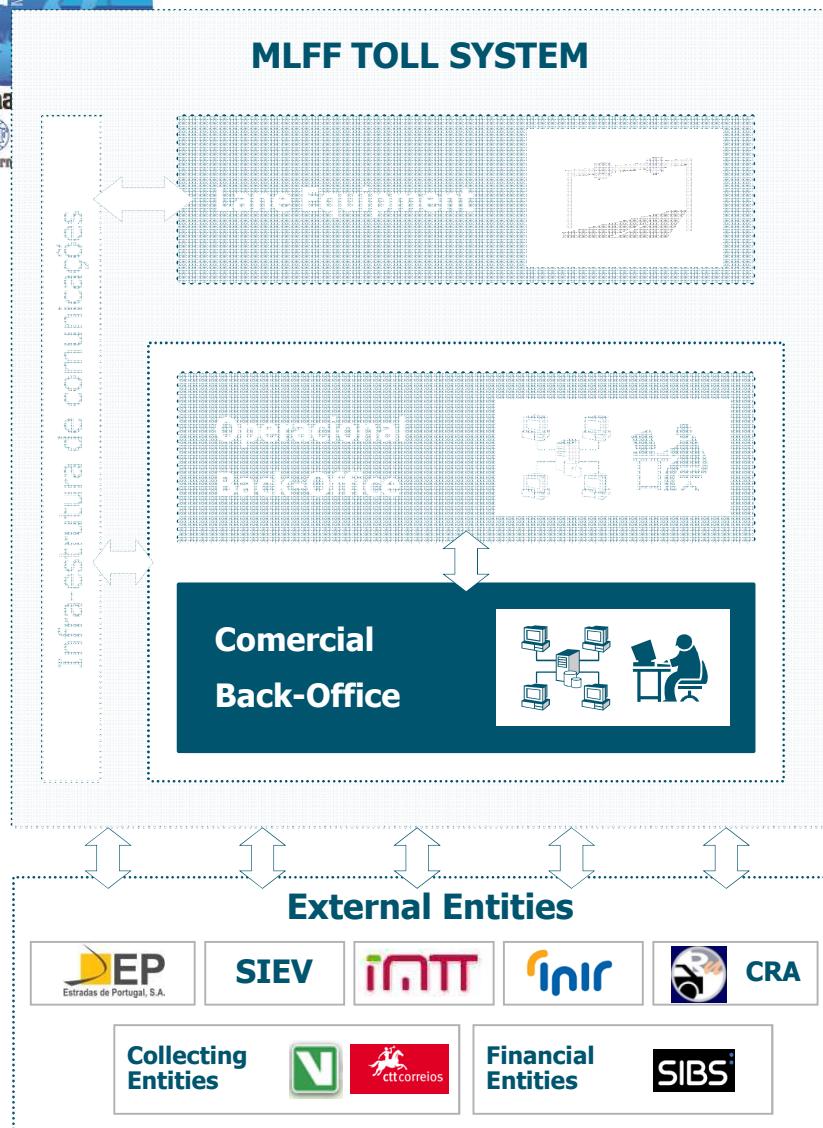
Interfaces with External Entities



- Information exchange with collecting entities (CTT, VV and others)
- Information queries to other entities (eg: IMTT, InIR, vehicle owner to CRA)

SYSTEM'S ARCHITECTURE

CBO and External Entities [1 of 2]



Estradas de Portugal



- Owner of Toll Income

Instituto de Infra-Estruturas Rodoviárias



- Enforcement collection process
- Information exchange

Instituto da Mobilidade e Transportes Terrestres



- Conventional to electronic license plates association
- ELP's issuer lists

SIEV / Back-Office Operator



- Reception of ELP's lists (lists of ECP, white lists and/or black lists)
- Sending of traffic public events

Conservatória do Registo Automóvel



- Identification of vehicle owners

Collecting Entities and others Financial Entities



- Business transaction forwarding and reception of information about payments

SYSTEMS' ARCHITECTURE

Back-Office – Data Center



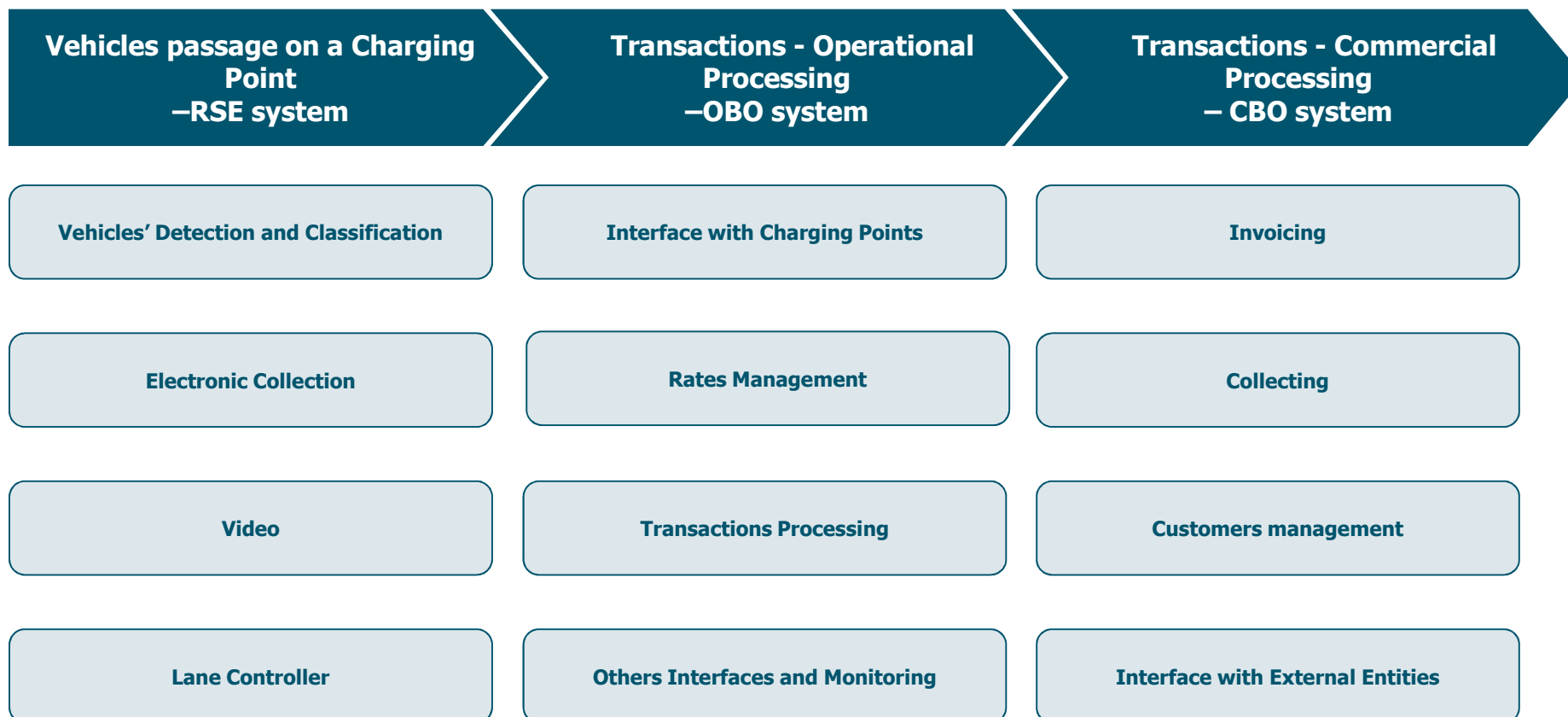


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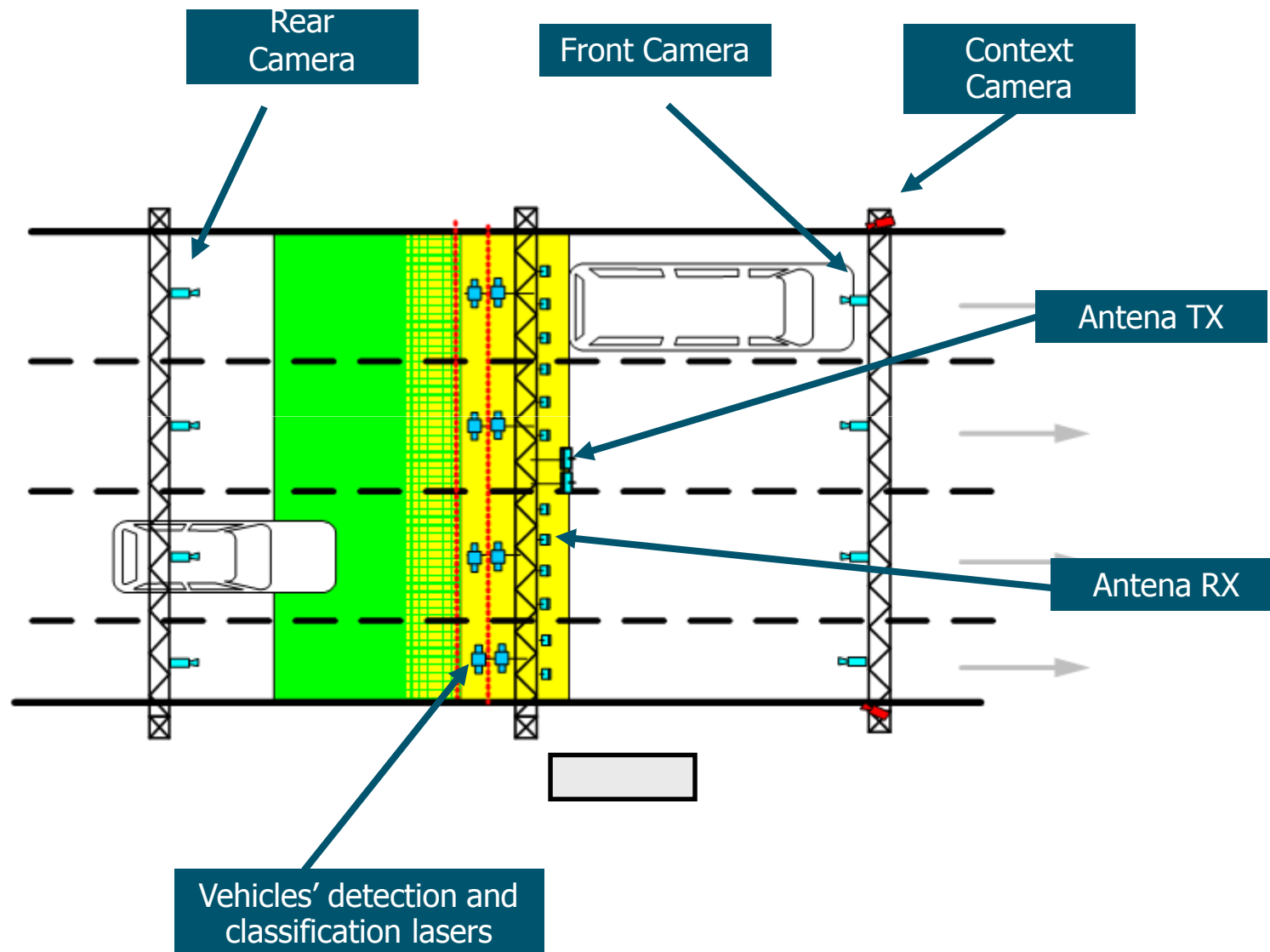
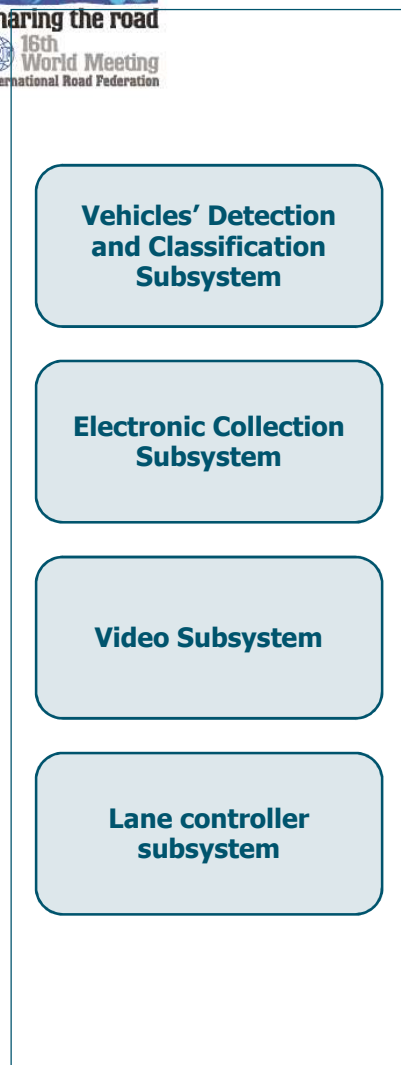
SYSTEM'S MAIN FUNCTIONALITIES

Global Vision



SYSTEM'S FUNCTIONING

Lane Equipment – RSE System



SYSTEM'S FUNCTIONING

Lane Equipment – RSE System



ascendi

SYSTEM'S FUNCTIONING

Lane Equipment – RSE System

Front Photo



Rear Photo



Context Photo



Automatic Licence Plate
Recognition (ALPR)

SYSTEM'S FUNCTIONING

System's Main features and modules – OBO – Examples

Transactions' Processing

Ex: Validation by operator

Validação Manual

Tuning

Brightness: 18
Gamma: 0
Zoom: 39
Contrast: 0

Filtros

☐ Emboss
☐ Negative
☒ Sharpen

Opções

☒ Auto zoom to LP

Passagens na fila global: 996
Passagens na fila pessoal: 0

Razão: Vehicle image error

Detalhes do veículo

Matricula frontal: LP
Matricula traseira: LP
Análise de Confiança: 0
Classe de veículo: 1
País: PORTUGAL
País: Portugal, Spain, France
Matricula: 5B IN 82

SystemMonitoring – Microsoft Internet Explorer provided by ASCENDI

SystemMonitoring

Passage Date From: Passage Date To:
Alarm Lifecycle: Alarm Priority:
AlarmType:

AlarmID	SAType	SASStatus	SASDate	MessageCode	MessageSubject	MessageText	AckBy	AckDate
5397	QFCTL VVP IntaNew	Wed Jan 10			VVP status file file load error.	Filename: status_3872.L		NaN
5398	QFCTL CBO IntaNew	Wed Jan 10			CBO PAN black list file load error	CBO file area access failure: Cox		NaN
5399	QFCTL VVP IntaNew	Wed Jan 10			VVP PAN black list file load error	VVP file area access failure: Cox		NaN
5400	QFCTL CBO IntaNew	Wed Jan 10			CBO status list file load error.	CBO file area access failure: Cox		NaN
5401	QFCTL VVP IntaNew	Wed Jan 10			VVP status list file load error.	VVP file area access failure: Cox		NaN
5402	QFCTL CBO IntaNew	Wed Jan 10			CBO Communication failure.	CBO Communication failure: Cox		NaN
5403	OBO Care	New	Wed Jan 10		Transaction File Load Error	Transaction File Load Error - Lost		NaN
5404	OBO Care	New	Wed Jan 10		Transaction File Load Error	Transaction File Load Error - Lost		NaN
5405	QFCTL CBO IntaNew	Wed Jan 10			CBO PAN black list file load error	CBO file area access failure: Cox		NaN
5406	QFCTL VVP IntaNew	Wed Jan 10			VVP PAN black list file load error.	VVP file area access failure: Cox		NaN
5407	QFCTL CBO IntaNew	Wed Jan 10			CBO status list file load error.	CBO file area access failure: Cox		NaN
5408	QFCTL VVP IntaNew	Wed Jan 10			VVP status list file load error.	VVP file area access failure: Cox		NaN
5409	QFCTL CBO IntaNew	Wed Jan 10			CBO Communication failure.	CBO Communication failure: Cox		NaN
5410	OBO Care	New	Wed Jan 10		Transaction File Load Error	Transaction File Load Error - Lost		NaN
5411	QFCTL CBO IntaNew	Wed Jan 10			CBO PAN black list file load error	CBO file area access failure: Cox		NaN
5412	QFCTL VVP IntaNew	Wed Jan 10			VVP status list file load error.	VVP file area access failure: Cox		NaN
5413	QFCTL CBO IntaNew	Wed Jan 10			CBO status list file load error.	CBO file area access failure: Cox		NaN
5414	QFCTL VVP IntaNew	Wed Jan 10			VVP status list file load error.	VVP file area access failure: Cox		NaN

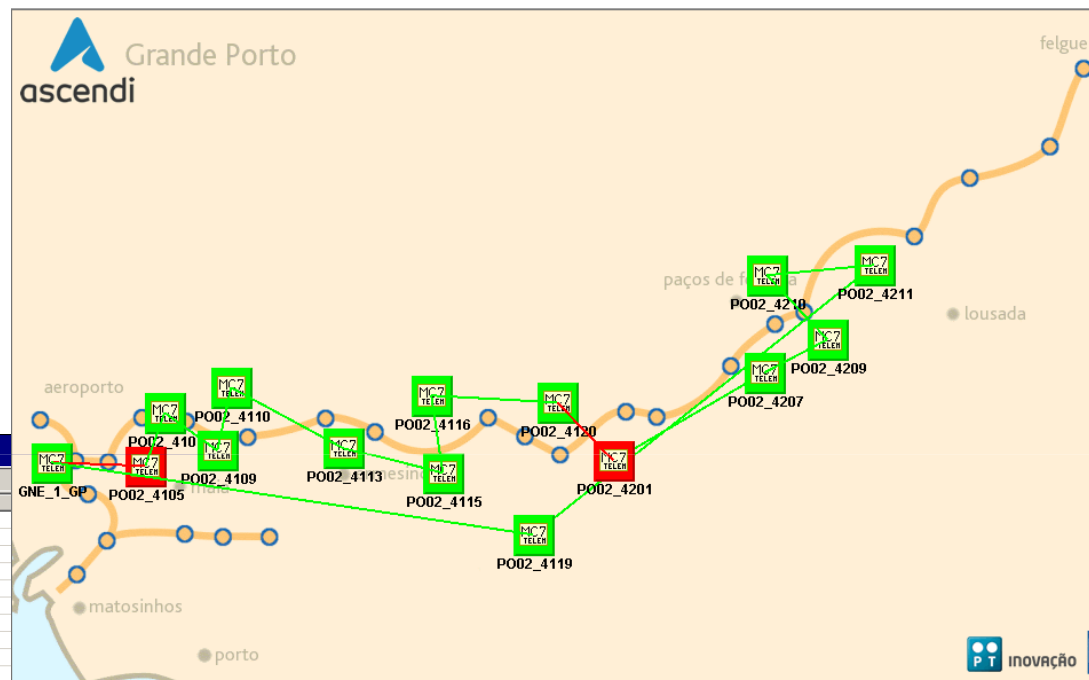
SYSTEM'S FUNCTIONING

System's Main features and modules – OBO – Examples

Others Interfaces and Monitoring

Ex: Real-Time Monitoring

Severity	State	Source	Message
Critical	Outstanding	pt02x2509tx011	MR: Application not responding
Critical	Outstanding	pt02x2509tx011	NTP: No sync
Critical	Outstanding	pt02x2509rur011	Native agent is not responding
Critical	Outstanding	pt02x2509rur031	Native agent is not responding
Critical	Outstanding	pt02x2509mlc010	Native agent is not responding
Critical	Outstanding	pt02x2509mlc010	Native agent is not responding
Critical	Outstanding	pt02x2509rur031	Node down
Critical	Outstanding	pt02x2509rur031	Native agent is not responding
Critical	Outstanding	pt02x2509rur011	Native agent is not responding
Critical	Outstanding	pt02x2509rur011	Native agent is not responding
Critical	Outstanding	pt02x2509rur031	Native agent is not responding
Minor	Outstanding	pt02x2509switch	Interface "18" changed state to DOWN (IP Addr: 0.0.0.0/0.0.0.0, IfIndex:
Minor	Outstanding	pt02x2509switch	Interface "19" changed state to DOWN (IP Addr: 0.0.0.0/0.0.0.0, IfIndex:
Minor	Outstanding	pt02x2509switch	Interface "12" changed state to DOWN (IP Addr: 0.0.0.0/0.0.0.0, IfIndex:
Minor	Outstanding	pt02x2509switch	Interface "14" changed state to DOWN (IP Addr: 0.0.0.0/0.0.0.0, IfIndex:
Minor	Outstanding	pt02x2509switch	Interface "21" changed state to DOWN (IP Addr: 0.0.0.0/0.0.0.0, IfIndex:
Minor	Outstanding	pt02x2509switch	Interface "25" changed state to DOWN (IP Addr: 0.0.0.0/0.0.0.0, IfIndex:
Minor	Outstanding	pt02x2509switch	Interface "17" changed state to DOWN (IP Addr: 0.0.0.0/0.0.0.0, IfIndex:
Minor	Outstanding	pt02x2509switch	Interface "22" changed state to DOWN (IP Addr: 0.0.0.0/0.0.0.0, IfIndex: 2
Minor	Outstanding	pt02x2509switch	Interface "23" changed state to DOWN (IP Addr: 0.0.0.0/0.0.0.0, IfIndex:
Minor	Outstanding	pt02x2509switch	Interface "26" changed state to DOWN (IP Addr: 0.0.0.0/0.0.0.0, IfIndex:
Minor	Outstanding	pt02x2509switch	Interface "20" changed state to DOWN (IP Addr: 0.0.0.0/0.0.0.0, IfIndex:
Minor	Outstanding	pt02x2509switch	Interface "22" changed state to DOWN (IP Addr: 0.0.0.0/0.0.0.0, IfIndex:
Minor	Outstanding	pt02x2509switch	Interface "13" changed state to DOWN (IP Addr: 0.0.0.0/0.0.0.0, IfIndex:
Warning	Outstanding	pt02x2509switch	MAC address for interface 25 changed from 001F28B95F79 to 000000000000
Warning	Outstanding	pt02x2509switch	MAC address for interface 25 changed from 000000000000 to 001F28B95F79
Warning	Outstanding	pt02x2509switch	MAC address for interface 3 changed from 001F28B95F63 to 000000000000
Warning	Outstanding	pt02x2509switch	MAC address for interface 3 changed from 000000000000 to 001F28B95F63
Warning	Outstanding	pt02x2509switch	MAC address for interface DEFAULT_VLAN changed from 001F28B95F40 to



SYSTEM'S FUNCTIONING

System's Main features and modules – CBO – Examples

Collecting

Dados cabeçalho p/documento cálculo fatura 100000000077

Doc.CalcFat.	DocFatmto.	Nº ext.doc.	Sistema lógico	TD	ParcNeg.	Cta.contr.	InícioPerDoc.	Fim	S	Moeda	CI	Dt.impost
100000000077	100000000031	100000000077	DRPCLNT100	B1	1000000022	102	08.09.2009	08.09.2009		EUR	01	04

Itens / Itens de imposto / Itens adicionais / Histórico de faturamento / Itens dos dados de pagamento

Doc.cálculo fatura 100000000077 (Faturado)

Posição	Item ext.	Montante	Moeda	Simulado	Estor.	RelevLcto	Rel.impr.	GrSu	Início.per.item	Fim	SA	Empr.	OperPr	Subop.	Bruto	GrIm
1	1	20,00	EUR						02.07.2009	08.09.2009		EQUI	EQ02	0101		
2	2	35,00	EUR						02.07.2009	08.09.2009		EQUI	EQ02	0101		

Criar ordem de cálculo de fatura

Periódico / Não periódico

Parc.negócios: 1000000022
Cta.contrato: 102

Ciclo liquid.: EQUI-PCE
Proced.CalcFat:
Liquid.até data: 08.09.2009
Liquid.até hora: 18:39:23
Grp.liquidação: 1

Tipo de ordem: 02
Tp.calc.fatura:
☐ Cálculo urg.fatura

Invoicing

Dados do cabeçalho para o documento de faturamento 100000000031

DocFatmto.	Proc.	TpFatmto	CtgFat.	ParcNeg.	Cta.contr.	Criado por	Data	Hora	ChvReconc.	Data lgto.	Data doc.	Vencmto.liq.	Moeda	Montante	lançado	simulado	DocE
100000000031	Z1	I1		1000000022	102	ACPCABRAL	08.09.2009	17:59:13	090908-001	08.09.2009	08.09.2009	23.09.2009	EUR	55,00			

Itens / Documentos de lançamento / Documentos de origem

Documento de faturamento 100000000031

Item	Tipo de item	Empr.	SA	Contrato	Subaplic.	OperPr	Subop.	Simulado	Estor.	TCnt	RelevLcto	Rel.impr.	Moeda	Montante	DC	Bruto	Agnt	Im	CI	DomFiscal	Dta.impos.	Base imp.	Mc
1	0INVIBILL	EQUI		1		EQ02	0101						EUR	20,00			1		L0		02.07.2009	0,00	
2	0INVIBILL	EQUI		1		EQ02	0101						EUR	35,00			1		L0		02.07.2009	0,00	
3	0TAXINCL	EQUI											EUR	0,00			1		L0			55,00	

SYSTEM'S FUNCTIONING

System's Main features and modules – CBO – Examples

Customers' management

Ex: Issue of notice with fine

ID execução progr.	Status da execução
ID de data: 02.10.2009	Parâmetro: Gravado
Identificação: EQUI01	Exec. progr.: concluído/a

Delimitações gerais	Parâm.adv.ência	Configs.técnicas	Logs
---------------------	-----------------	------------------	------

Parceiro de negócios	10682	até	
Conta de contrato		até	
Contrato		até	
Empresa		até	

Selecções livres Não foram gravadas selecções livres

Dados do cabeçalho

Data documento

16.09.2009

Tipo documento

Z3

Data lançamento

16.09.2009

Moeda

EUR

Nº doc.

410000000036

Referência

200000000054

Nº do cheque

Itens do parceiro negócios compactados

Em	Divi.	S	Parc.negóç.	Cta.contrato	Contrato	Op.	Sub.	DtVencDes	Vencmto.liq.	Montante	Nº
EQUI	0002		10682	100000640		E004	0001	16.09.2009	16.09.2009	36,00	1
EQUI	0001		10682	100000640		E004	0001	16.09.2009	16.09.2009	7,50	1
EQUI	0002		10682	100000640		E004	0001	16.09.2009	16.09.2009	24,00	1
EQUI	0001		10682	100000640		E004	0001	16.09.2009	16.09.2009	5,00	1
EQUI	0002		10682	100000640		E004	0401	16.09.2009	16.09.2009	2,40	1
EQUI	0001		10682	100000640		E004	0401	16.09.2009	16.09.2009	0,75	1

Posições do Razão compactadas

Em	Divisão	Razão	Txt.descritivo	Montante	Nº
EQUI	0002	2490000001	Coima Estado	36,00-	1
EQUI	0001	2490000001	Coima Estado	7,50-	1
EQUI	0002	7988000001	Coima Equipetragem 1	24,00-	1
EQUI	0001	7988000001	Coima Equipetragem 1	5,00-	1
EQUI	0002	7210000003	Custo Administrativo 3	2,40-	1

Histórico da advertência: síntese

ID de data	Identif.	ParcNe...	Cta.contrato	Dt.emissã	DataImpress	Empr.	NA	Moe...	Saldo adv.	Taxa 1	Nº doc.taxa 1	Chave correspond.	Nº formul.pgto.
02.10.2009	EQUI01	10682	100000640	02.10.2009	16.09.2009	EQUI	1	EUR	13,50	75,65	410000000036	DEA2AC6CC3F1EEF1B94800237DEE2EE6	100000000039

Interface with External Entities

Ex: Sending of enforced collection process to INIR

ID execução progr.	Status da execução
ID de data: 13.11.2009	Parâmetro: Gravado
Identificação: EQUI03	Exec. progr.: concluído/a

Delimitações gerais	Parâm.adv.ência	Configs.técnicas	Logs
---------------------	-----------------	------------------	------

Parceiro de negócios	10682	até	
Conta de contrato		até	
Contrato		até	
Empresa		até	

Selecções livres Não foram gravadas selecções livres

Dados do cabeçalho

Data documento

17.09.2009

Data lançamento

17.09.2009

Nº doc.

410000000039

Tipo documento

Z4

Moeda

EUR

Referência

200000000054

Nº do cheque

Itens do parceiro negócios compactados

Em	Divi.	S	Parc.negóç.	Cta.contrato	Contrato	Op	Sub	DtVencDes	Vencmto.liq.	Montante	Nº
EQUI	0002		10682	100000640		E005	0001	17.09.2009	17.09.2009	36,00-	1
EQUI	0001		10682	100000640		E005	0001	17.09.2009	17.09.2009	7,50-	1
EQUI	0002		10682	100000640		E005	0001	17.09.2009	17.09.2009	24,00-	1
EQUI	0001		10682	100000640		E005	0001	17.09.2009	17.09.2009	5,00-	1
EQUI	0002		10682	100000640		E004	0701	17.09.2009	17.09.2009	18,00	1
EQUI	0001		10682	100000640		E004	0701	17.09.2009	17.09.2009	3,75	1

Posições do Razão compactadas

Em	Divisão	Razão	Txt.descritivo	Montante	Nº
EQUI	0002	2490000001	Coima Estado	36,00	1
EQUI	0001	2490000001	Coima Estado	7,50	1
EQUI	0002	7988000001	Coima Equipetragem 1	24,00	1
EQUI	0001	7988000001	Coima Equipetragem 1	5,00	1
EQUI	0002	7988000002	Coima Equipetragem 2	18,00-	1

Histórico da advertência: síntese

ID de data	Identif.	ParcNe...	Cta.contrato	Dt.emissã	DataImpress	Empr.	NA	Moe...	Saldo adv.	Taxa 1	Nº doc.taxa 1	Chave correspond.	Nº formul.pgto.
13.11.2009	EQUI03	10682	100000640	13.11.2009	17.09.2009	EQUI	3	EUR	90,85	50,75-	410000000039		



Thank You!

ppinto@ascendi.pt



IRF World Meeting 2010 – 16th World Meeting

Pedro Pinto

Lisboa, May 25 - 28, 2010