



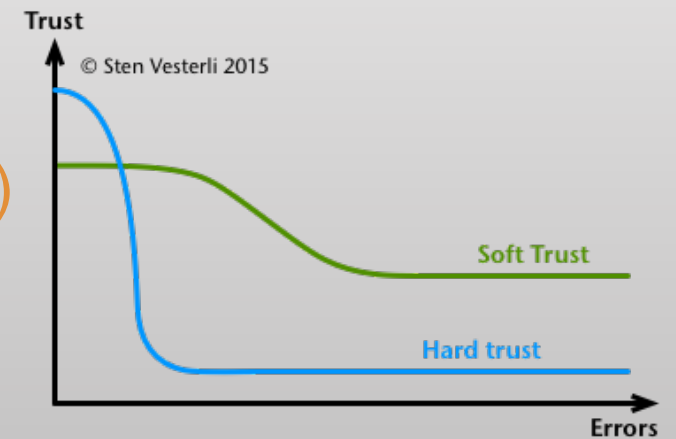
Image Based Vehicle Identification in AET

Creating Business Efficiency by Design

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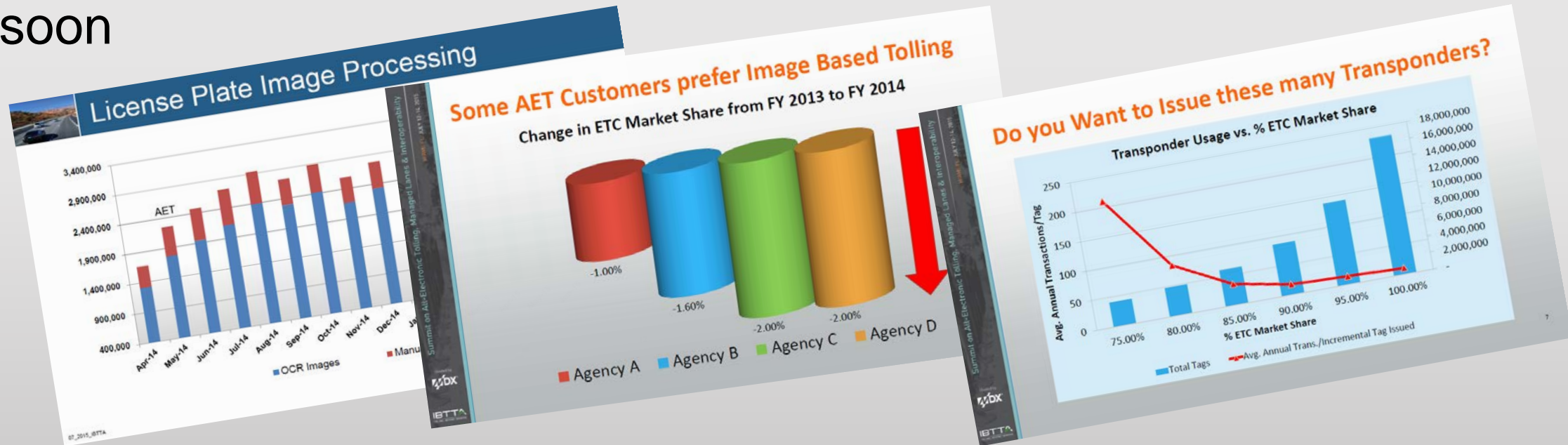
Introduction

- AET has presented us with some real operational challenges when it comes to the need for identifying a vehicle from an image
- End-customer expectations also place a particularly high burden on getting image based identifications right
 - An understandable and seamless AET experience
 - Confidence the same rules apply to everyone (trust)



Introduction

- AET's need for image based vehicle identification not going away soon

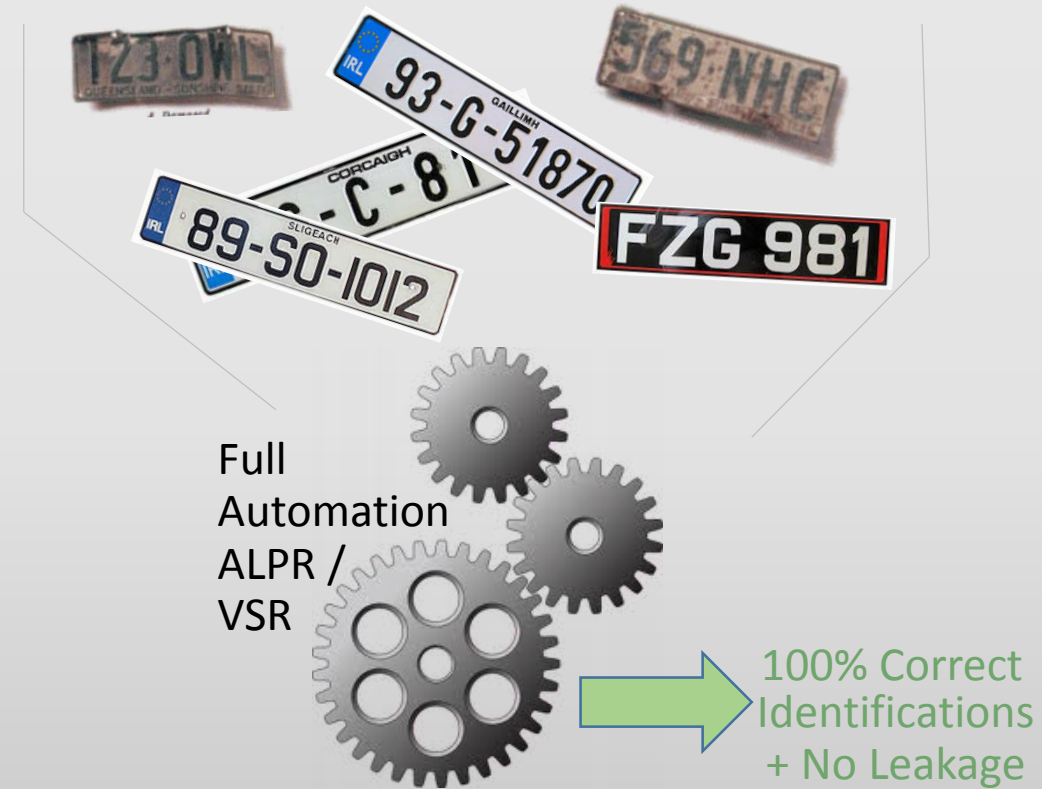


2015 Miami IBTTA: Summit on AET, Managed Lanes and Interoperability

- This presentation: Technology challenges, 'traditional' solutions and emerging approaches to create business efficiency by design

Identification by Image – Technology Limits

- Ideal technology solution
 - Full automation on all cases
 - Perfect accuracy
 - No leakage (false rejects)
 - Accept any quality image data stream
 - Scales without negative impacts
- Not (yet) technically achievable



Identification by Image – Trade-offs in Real Solutions

- Real world AET system designs: face a need to make trade-offs in the absence of an ideal technical solution
 - Directed at the best outcome their business model and technical platform will allow
- The standard trade-off is to apply some degree of manual effort (image review), in order to balance business targets for accuracy and leakage against total cost... but..
 - System design complexity and operational efficiency tuning are real challenges



Identification by Image – “Traditional” Approaches

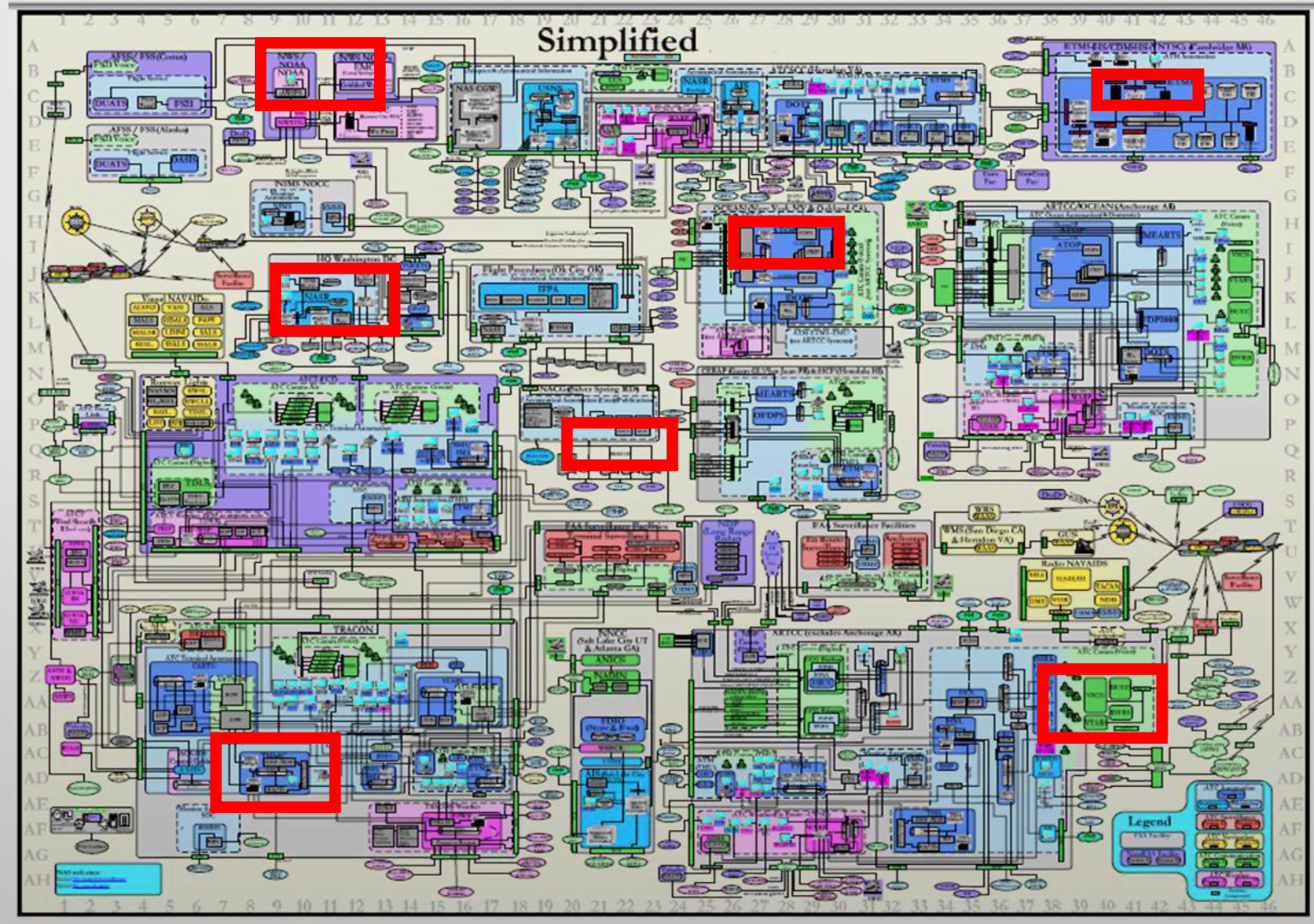
- Broad brush but .. standard approach involves rolling the whole problem into system integrator / integrated BO space
- As a turn-key ETC system supplier for over 20 years, Q-Free has learned some valuable lessons from multiple real cases as well as the progressive technology shifts toward AET & its needs
- We can share a couple of core lessons & their implication for creating business efficiency by design



Identification by Image – “Traditional” Approaches

Rolling the whole problem
into system integrator /
integrated BO space, will
work. ... however tends to
result in

My Identification by
Image system is ...
here.. ?



Identification by Image – “Traditional” Approaches

- A design/implementation assuming easy access to all parts of the system - i.e. a deep integration
- Changing ‘just the image identification’ has wider impacts, can be quite costly / risky
- Real life AET throws Operational data curve-balls (backlog data spikes, camera equipment issues, weather) at deeply integrated solutions...
 - Complex interdependencies in the solution give robustness, throughput, and operational tuning risks
 - On AET volumes, surprises can quickly lead to cascade system performance issues & MIR capacity/OPEX issues

Identification by Image – “Traditional” Approaches

PAPER BINDING DEVICE REQUIREMENTS

BACKGROUND

Global Amalgamated Worldwide Design (GAWD) has been commissioned by OmniCom International to design a device that will allow the user to hold one or more pieces of thin material (e.g. paper, transparencies, etc.) together. This document outlines the purpose of the project, the target market, as well as all functional requirements. It is intended to be read by GAWD designers, project managers, and executives, as well as OmniCom project managers and executives.

PURPOSE

The purpose of the project is to design a device that will allow the user to bind, or otherwise join, two or more sheets of thin material together. Specific requirements of the device are outlined below, in the Functional Requirements section.

TARGET MARKET

The target market for this device is anyone that has two or more sheets of thin material to bind together. This may include office workers, home users, construction workers, service personnel, or others.

FUNCTIONAL REQUIREMENTS

- * The primary requirement for the device is that it be able to bind, or otherwise join a minimum of two, and a maximum of fifteen, sheets of similar thin material together.
- * This material may be made of anything, but the thickness of the material will not exceed 0.1mm/piece. The height and width of the material shall not exceed 216mm by 279mm.
- * The device should not damage the material in any way in the binding process.
- * The user of the device should be able to use it quickly, in two seconds or less.
- * The weight of the device should not exceed one gram.
- * The device should be easily reusable at least three times.
- * The device should cost less than \$0.01 to manufacture in volume.

ADDITIONAL ITEMS

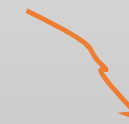
- * The scope of this project includes only the design of the device, not the design of its manufacturing process. However, designers should put some thought into the process for manufacturing, to ensure easy of manufacturing.
- * If you've read this far, you get a gold star -- but I bet you didn't!

Toll operators have seen the risks in a ‘Traditional’ solution and take steps to mitigate ... however this tends to be

Requirements & Scope Splits like



Instead of ...



PAPER BINDING DEVICE REQUIREMENTS

Design a device that binds two or more sheets of paper together without damaging them. It should be simple to use, lightweight, reusable, inexpensive and easy to manufacture.

Identification by Image – “Traditional” Approaches

- Attempts to control risks through very detailed specification / design requirements
 - Limits the ability the supplier has to apply their domain competence
 - At an extreme, becomes a model close to SW specification for outsourced SW development. Probably not the business a toll operator expects to be in?
- Attempts to control risks through splitting supply contracts (AIP / MIR)
 - In the most efficient systems, AIP and MIR closely interact for optimum outcome
 - Unless an AIP / MIR supply split is very well designed technically & commercially, it risks being sub-optimised (blame game)



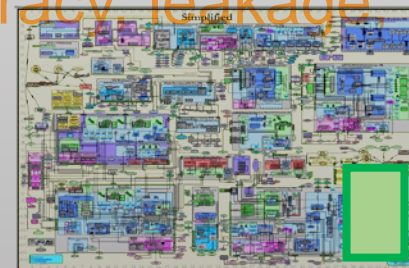
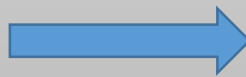
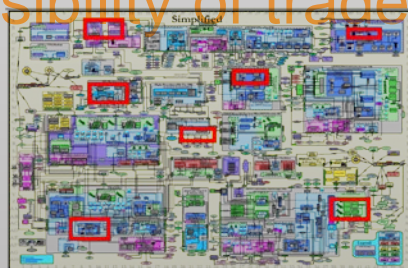
Identification by Image – We can do better!

- Think in terms of a Dedicated Image Based Vehicle Identification & Classification data processing subsystem
 - Input: Transaction data stream with images
 - Output: Fully identified/classified vehicle (LPN) or ‘not-identifiable’
- A single, easily understood, well defined scope
 - The better building block for new systems
 - Can be applied to upgrades of existing systems, with low risks
- Both technical and business advantages

Identification by Image – We can do better!

- Technical advantages

- Clean integration points – not ‘invasive’
- Addressing the complete problem can exploit a wider range of synergies
- Ability to take a holistic AIP & MIR workflow for fine grained efficiency trade-offs & control design for robustness in AET conditions
- Design can exploit statistical and pattern analysis of consolidated data for efficiencies
- Provide focused operational insight into all aspects of this critical business process (visibility of trade-offs in accuracy leakage effort/OPEX)



Identification by Image –we can do better!



- Business efficiency advantages
 - Clear, business relevant, KPIs/SLAs can be defined & applied
 - Throughput, turn-around time, identification error rate, false reject rate, data quality
 - A single sub supplier can be engaged to provide the needed capabilities
 - Toll Operator and vendor each focus on their core business
 - Enables toll operator to compare vendors “apples-to-apples”, opening up competition
 - Complete business process outsourcing is fully possible and in fact proven to work well.

Identification by Image – creating business efficiency by design

- Q-Free believe the industry can realise clear business efficiency benefits through designs based on Dedicated Image Based Vehicle Identification & Classification subsystems
- We have developed an integrated Image Based Vehicle Identification & Classification Platform (EIP) based on this philosophy
- A technical solution addressing a whole process approach to Image based Vehicle identification (AIP & MIR)
 - Close customer co-operation during implementation and adoption
 - Proven to deliver on its potential, including ability to transition
- Operationally proven at scale, delivering tangible business value

Concluding Remarks

- AET's need for image based vehicle identification not going away soon, and neither is Manual Image Review
- Evolving toward a Dedicated Image Based Vehicle Identification Subsystem approach – represents a better business efficiency outcome for all AET stakeholders, by design.
- A limited set of clear, business process relevant KPIs can be defined that promote focus on outcomes not details and open for apples-to-apples vendor comparisons
- A real world, operationally proven, approach



Thank you for your attention!

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