Effect of ticket validation models on bus operations

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metrobus

What if shops operated like most buses…

- Queue to get in
- Go to the checkout first before you can buy anything
- No prices advertised – you have to ask how much things cost
- But must have (correct) change to pay
- Hard to get refunds if product doesn't work or is unavailable

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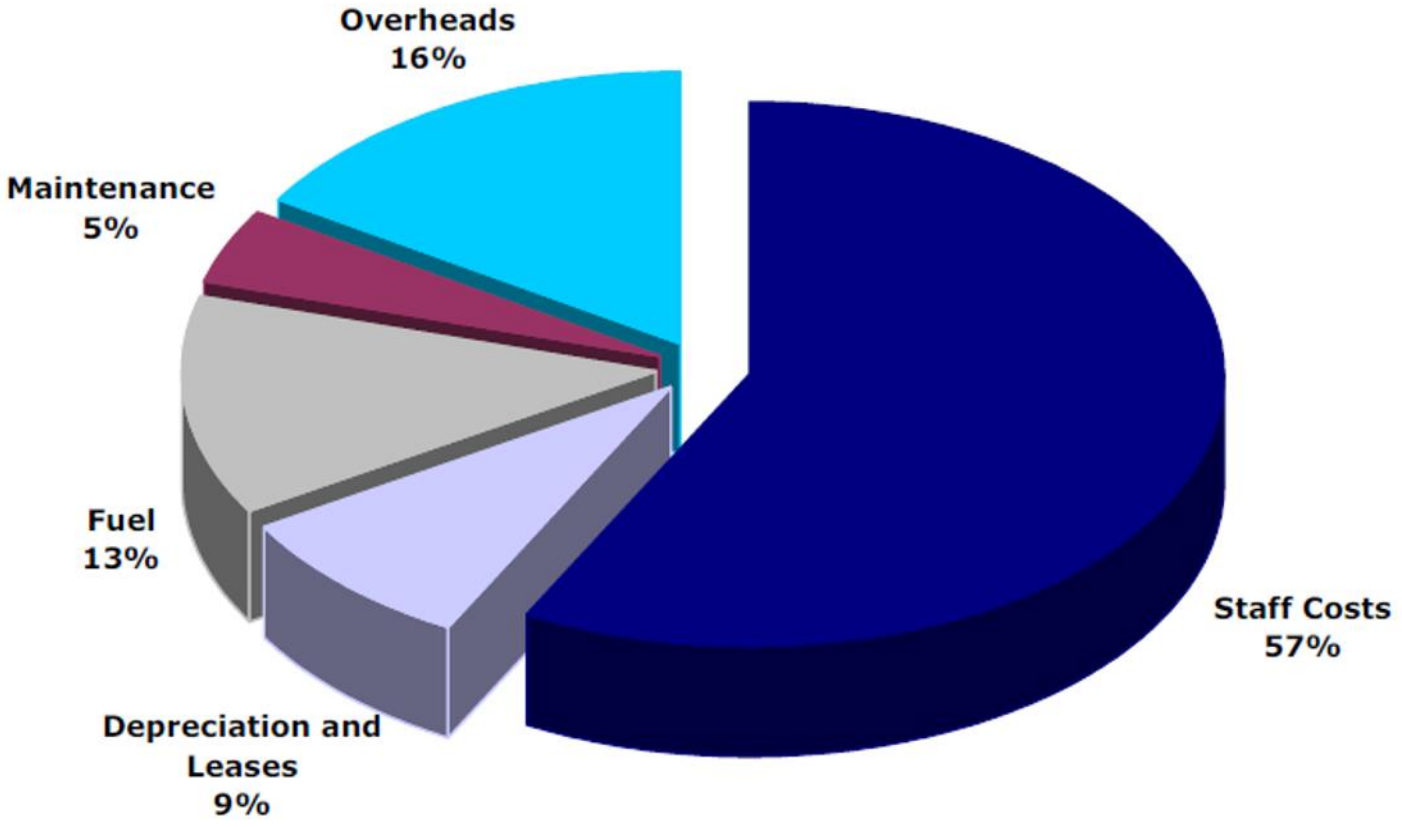
(dwell) time is money

Variable operating costs model



Source: Nexus operating cost model, TAS Partnership

Money is time

- Existing bus network – heavily cash-based
- Pricing review created more demand for single and one-day tickets – only available from the driver - **s l o w**
- Recent investment by dominant operator (First) in m-ticketing, including reduced price tickets, in attempt to reverse the trend.

Money is time

- E
- P single a the d
- R ice tickets, in attempt to reverse the trend.

But…

no-one knows how much it costs to sell a cash ticket on a bus

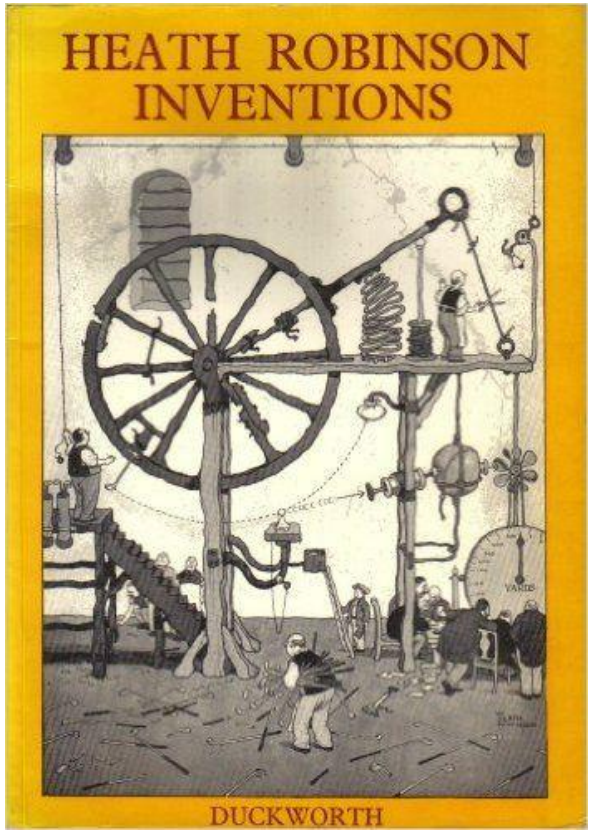
our understanding of the cash-dependent bus customer is poor

- Cash payments don't necessarily slow down the bus
- Enter any bus… insert coin… take ticket… job done!

MetroBus Roma – time limited ticket

But…

- UK ‘bus culture’ requires every ticket to be validated at time of boarding
- Multi-function ETMs
- Stovepipe systems



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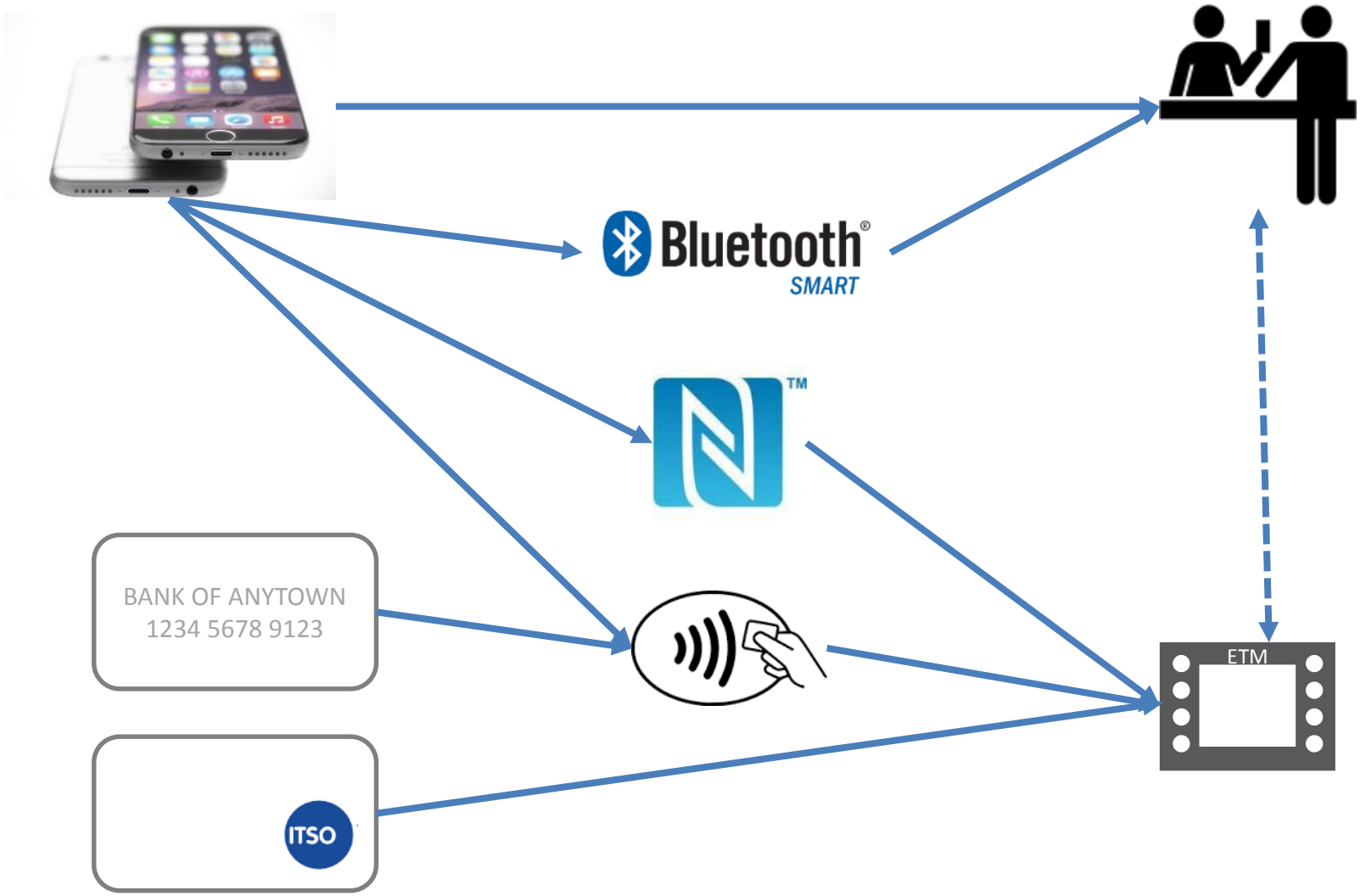
Smart ticketing



Four ticketing models

Where are tickets sold?
Where are tickets validated?

UK bus model (outside London)

Driver sells tickets	Passenger purchases tickets away from driver
Driver checks all tickets	Passengers responsible for validating their own tickets

surveys

TfL / BRT (inc MetroBus)

Driver sells tickets	Passenger purchases tickets away from driver
Driver checks all tickets	Passengers responsible for validating their own tickets

European bus (& some BRT)

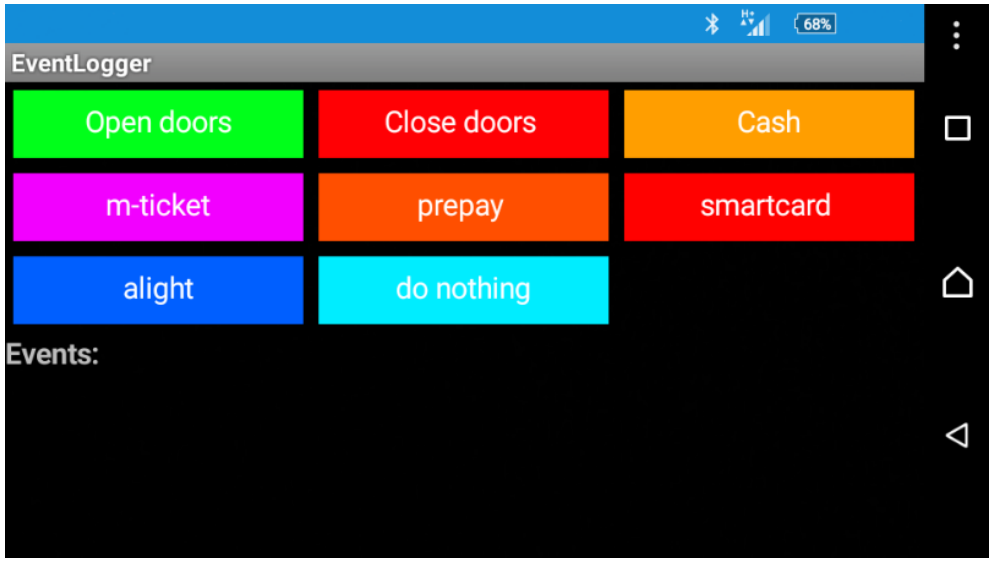
Driver sells tickets	Passenger purchases tickets away from driver
Driver checks all tickets	Passengers responsible for validating their own tickets

LRT (and rarely, bus/BRT)

Driver sells tickets	Passenger purchases tickets away from driver
Driver checks all tickets	Passengers responsible for validating their own tickets

Transaction surveys

- 600 boardings/alightings surveyed on buses in Bristol (before and after migration to new ticket machines)
- 159 stops, 21 journeys, 14 routes
- Customised "EventLogger" app
- Data includes period where ticket machines were upgraded
  - Cannot draw conclusions on any transaction time differences



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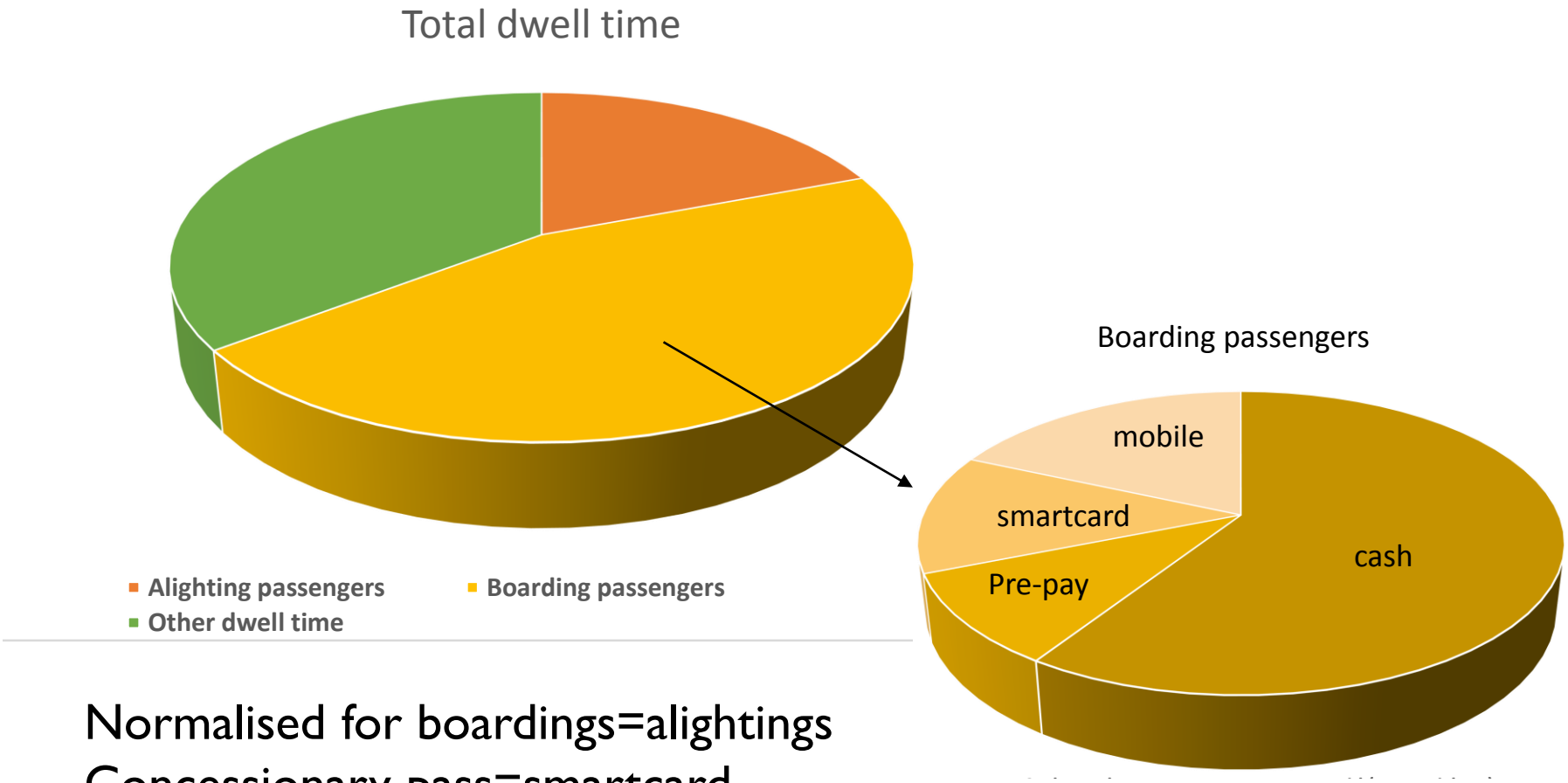
Transaction surveys

Journey interaction		Number per stop	Mean transaction time (s)	CI (s)	% of dwell time	% of journey time
Dwell time*		-	31.2	±6.4	-	22.1%
Alighting passengers		2.1	2.8	±0.3	19.2%	4.2%
Boarding passengers		1.8	8.1	±1.1	45.4%	10.0%
of which:	*Cash purchases*	0.5	16.1	±2.8	*26.9%*	*5.9%*
``	*Pre-paid (paper tickets)*	0.4	3.1	±0.5	*4.4%*	*1.0%*
``	*Smartcard (pre-paid)***	0.3	6.5	±1.4	*5.8%*	*1.3%*
``	*Mobile ticket*	0.5	5.0	±1.3	*8.3%*	*1.8%*
Other dwell time (eg driver changeover, waiting out time at stops, passengers preparing to board)		-	11.1	±8.4	35.4%	7.8%

Transaction surveys



Normalised for boardings=alightings

Concessionary pass=smartcard

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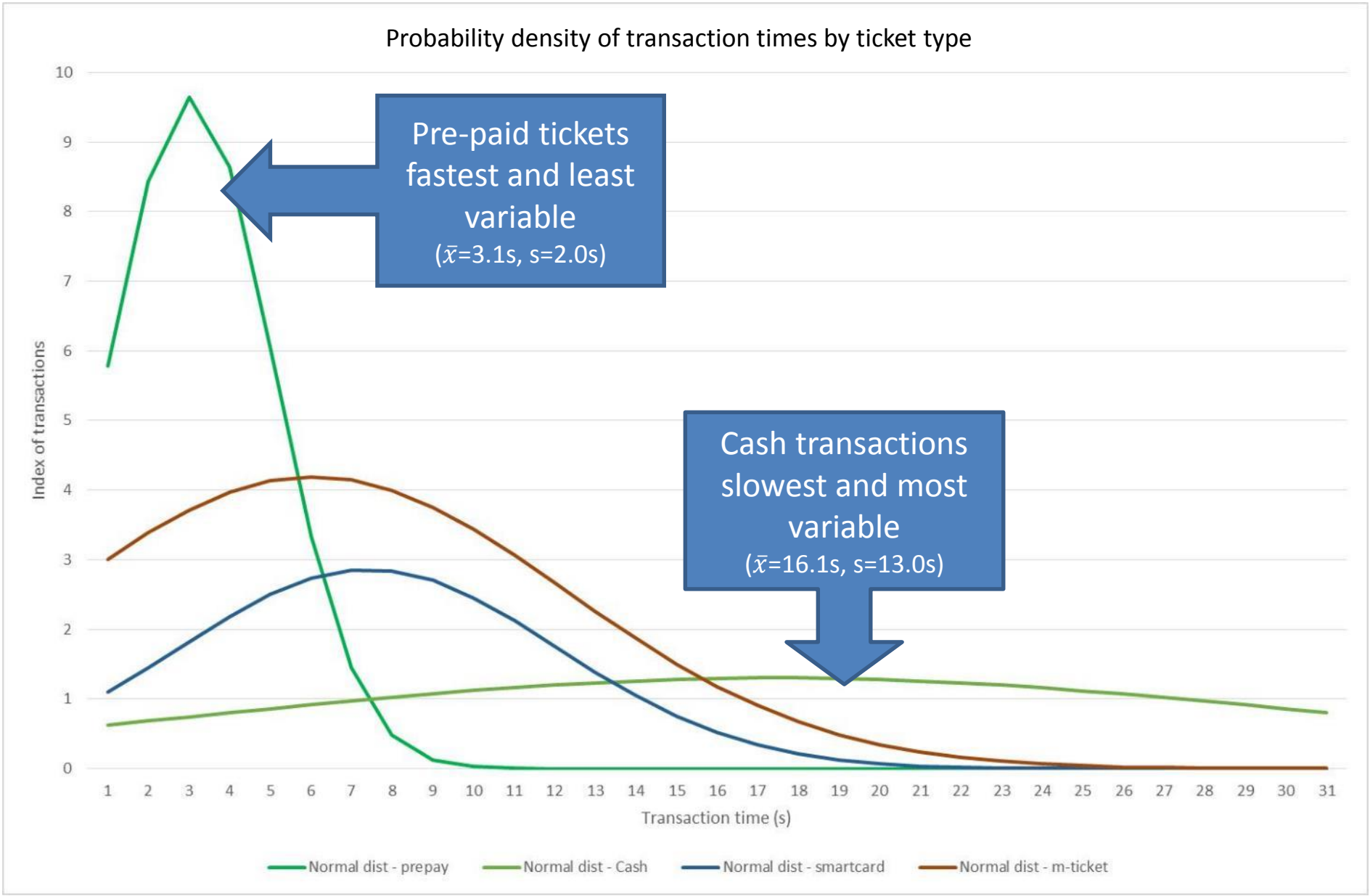

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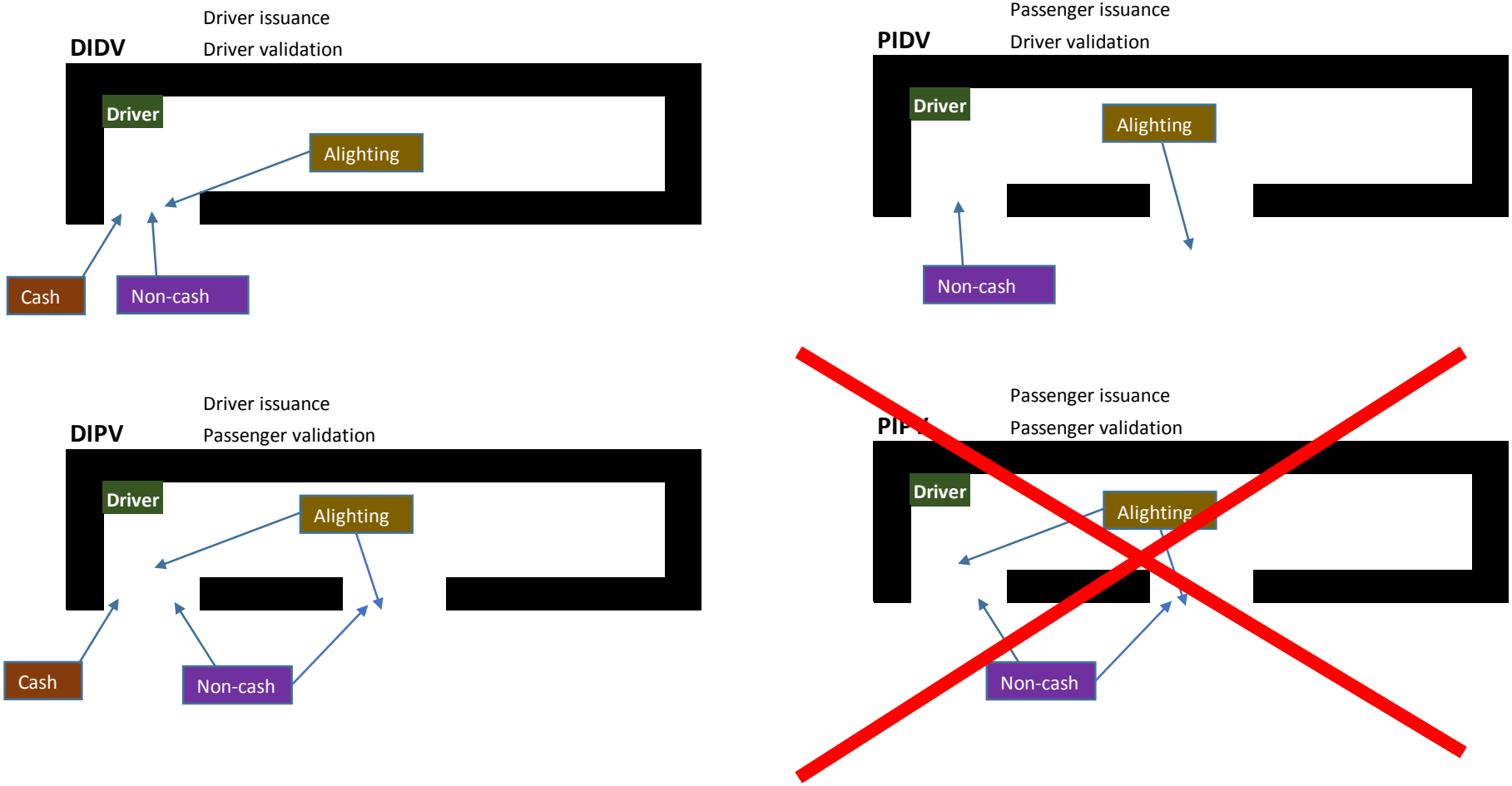
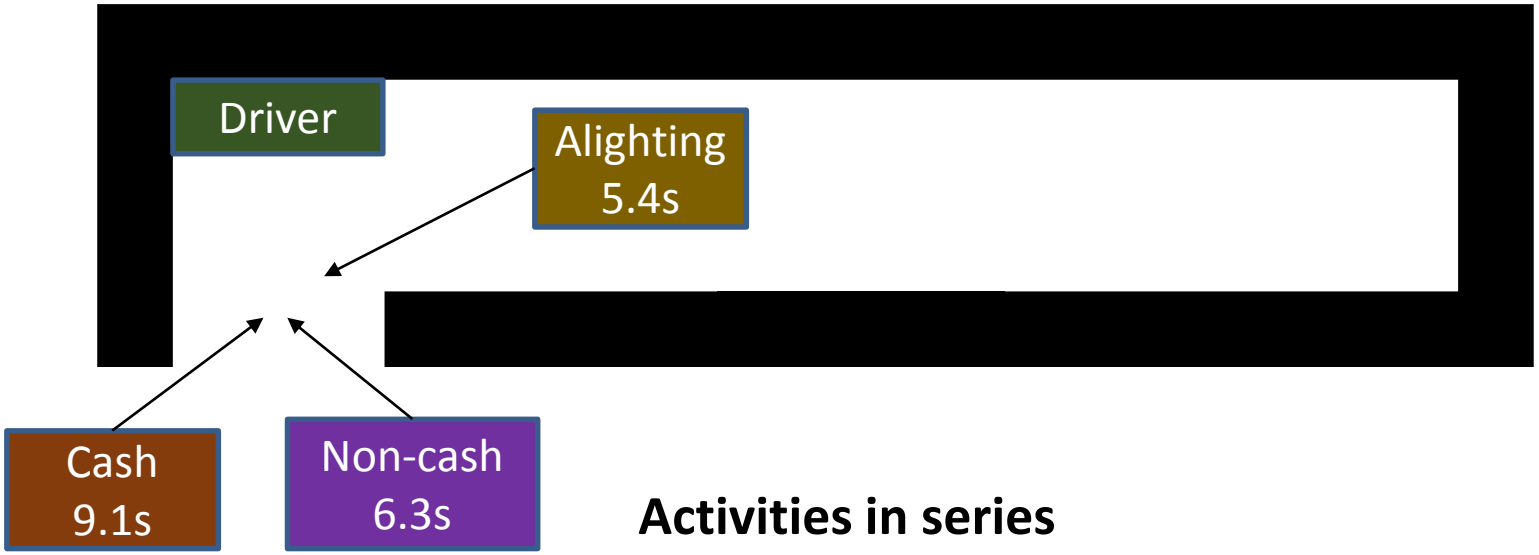
Passenger movements reassigned for the other ticket validation models



Effect of ticket validation models on bus operations

DIDV (driver issuance, driver validation)



Activities in series

DIDV (driver issuance, driver validation)

0 – 5.4s

DIDV (driver issuance, driver validation)
5.4 – 14.5s

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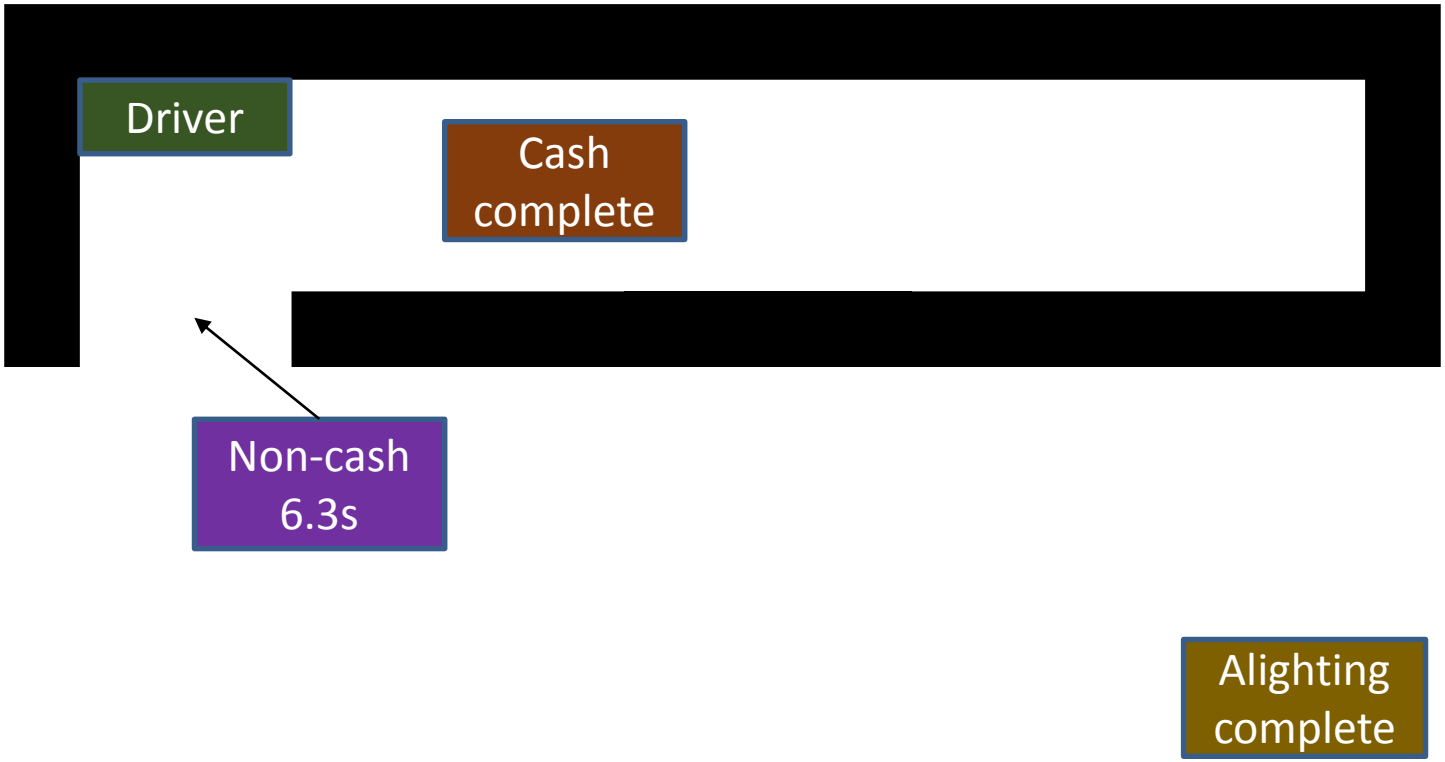
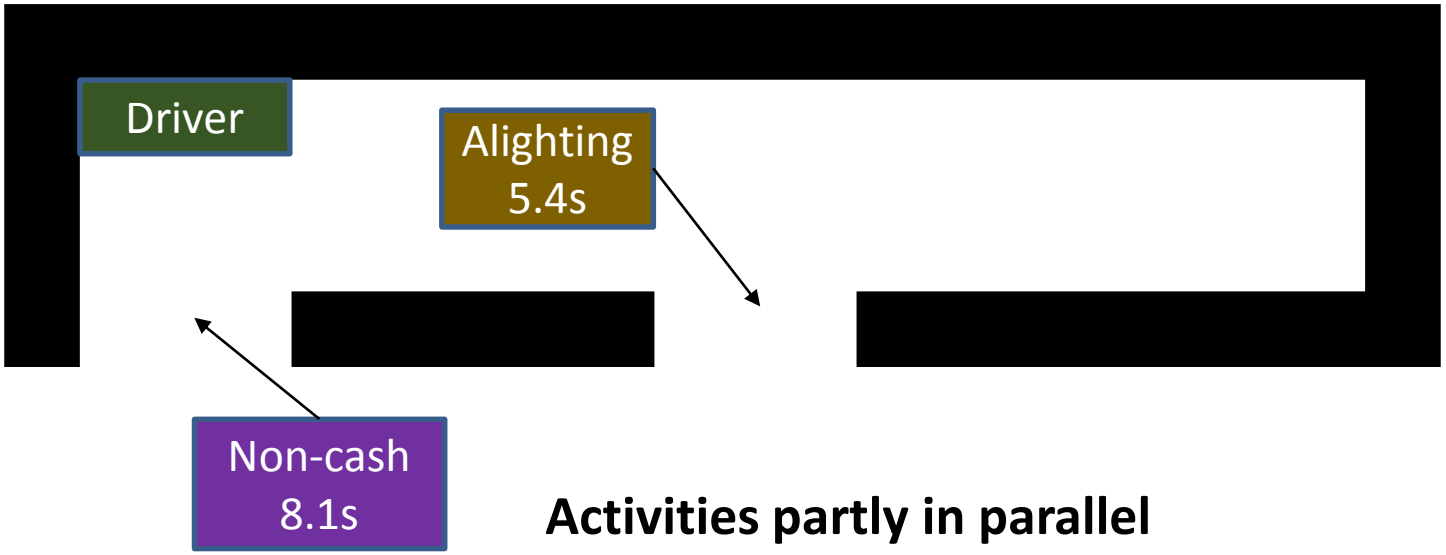
DIDV (driver issuance, driver validation)

14.5 – 20.9s



Effect of ticket validation models on bus operations

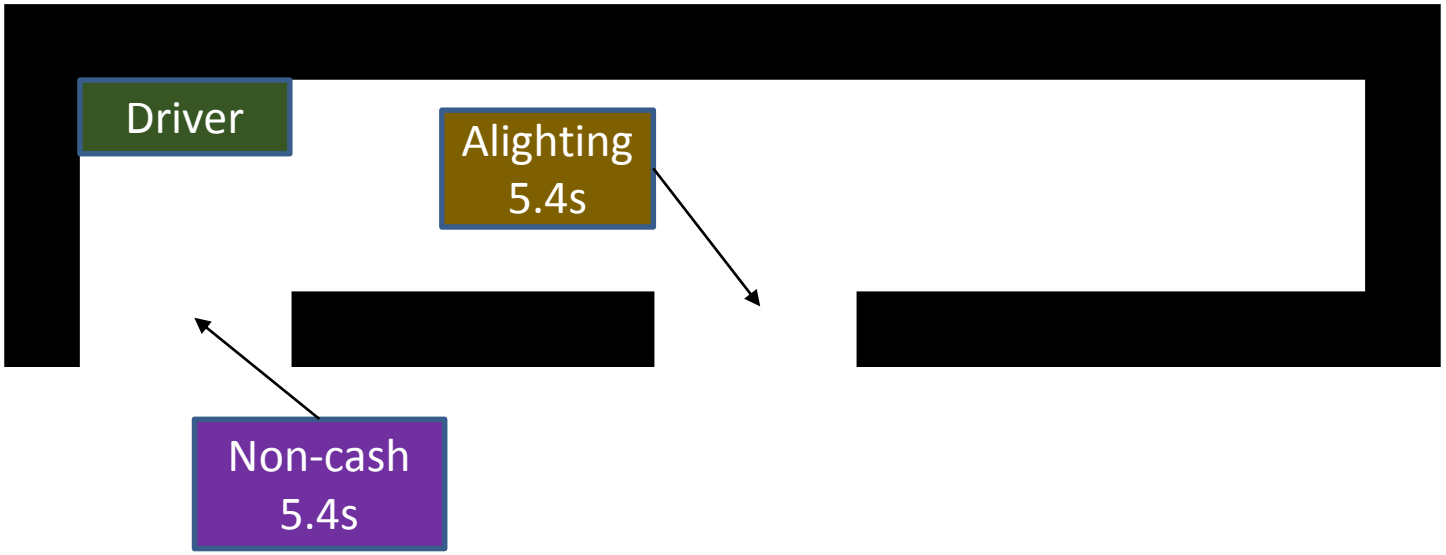
PIDV (passenger issuance, driver validation)



Activities partly in parallel

Effect of ticket validation models on bus operations

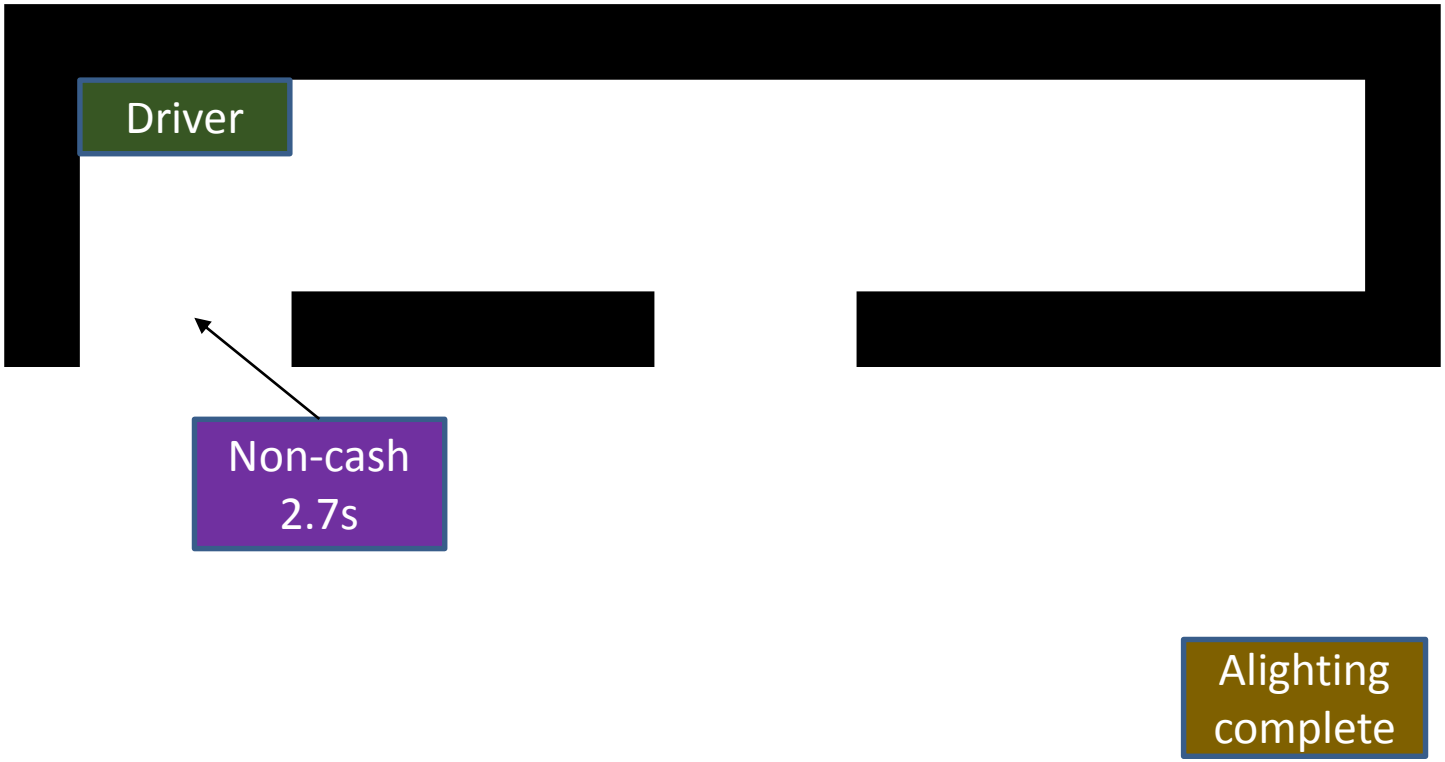
PIDV (passenger issuance, driver validation)
0 – 5.4s



Effect of ticket validation models on bus operations

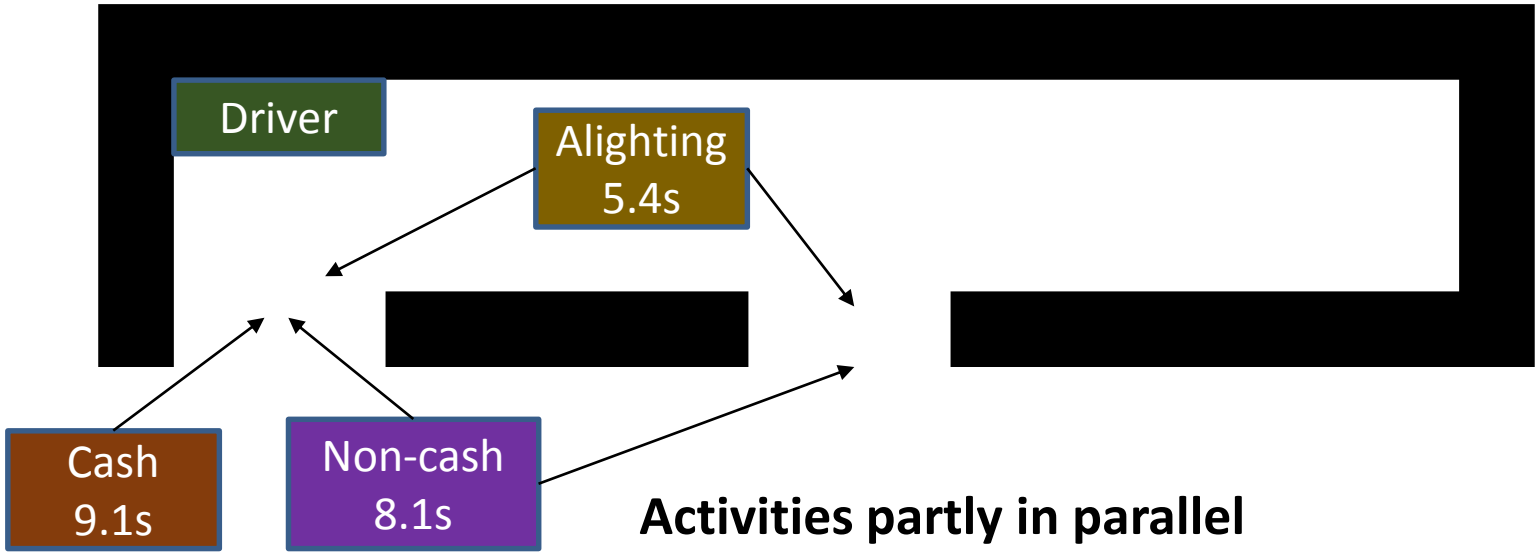
PIDV (passenger issuance, driver validation)

5.4 – 8.1s



Effect of ticket validation models on bus operations

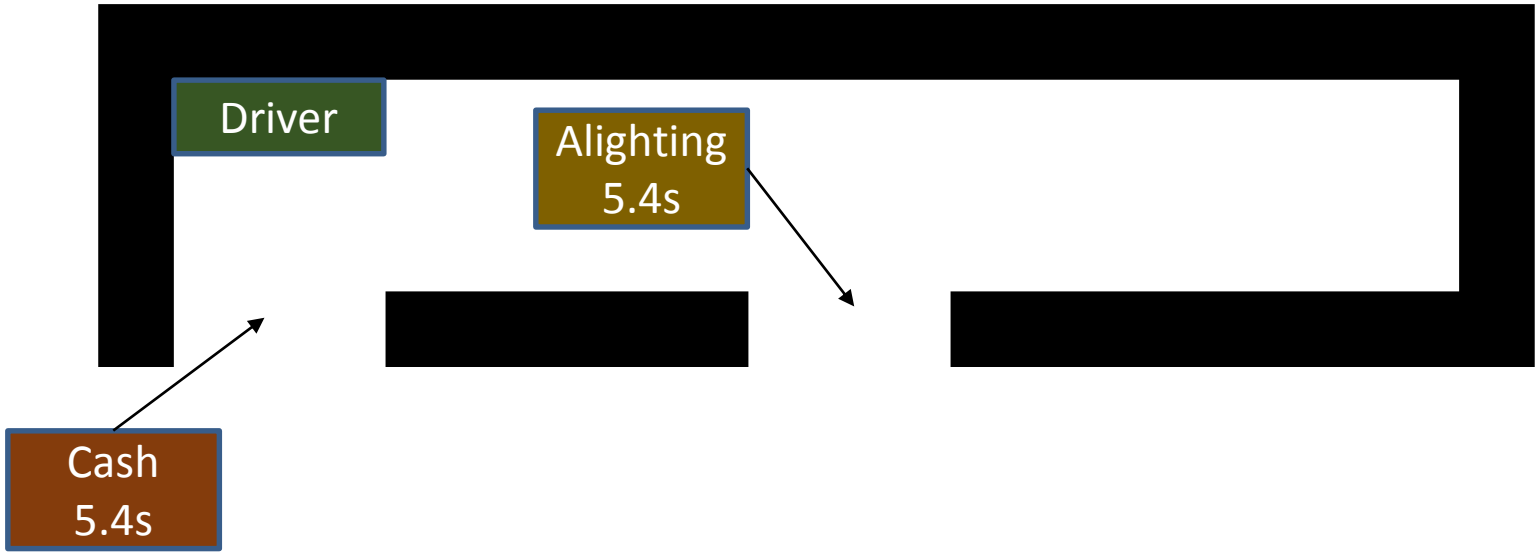
DIPV (driver issuance, passenger validation)



Activities partly in parallel

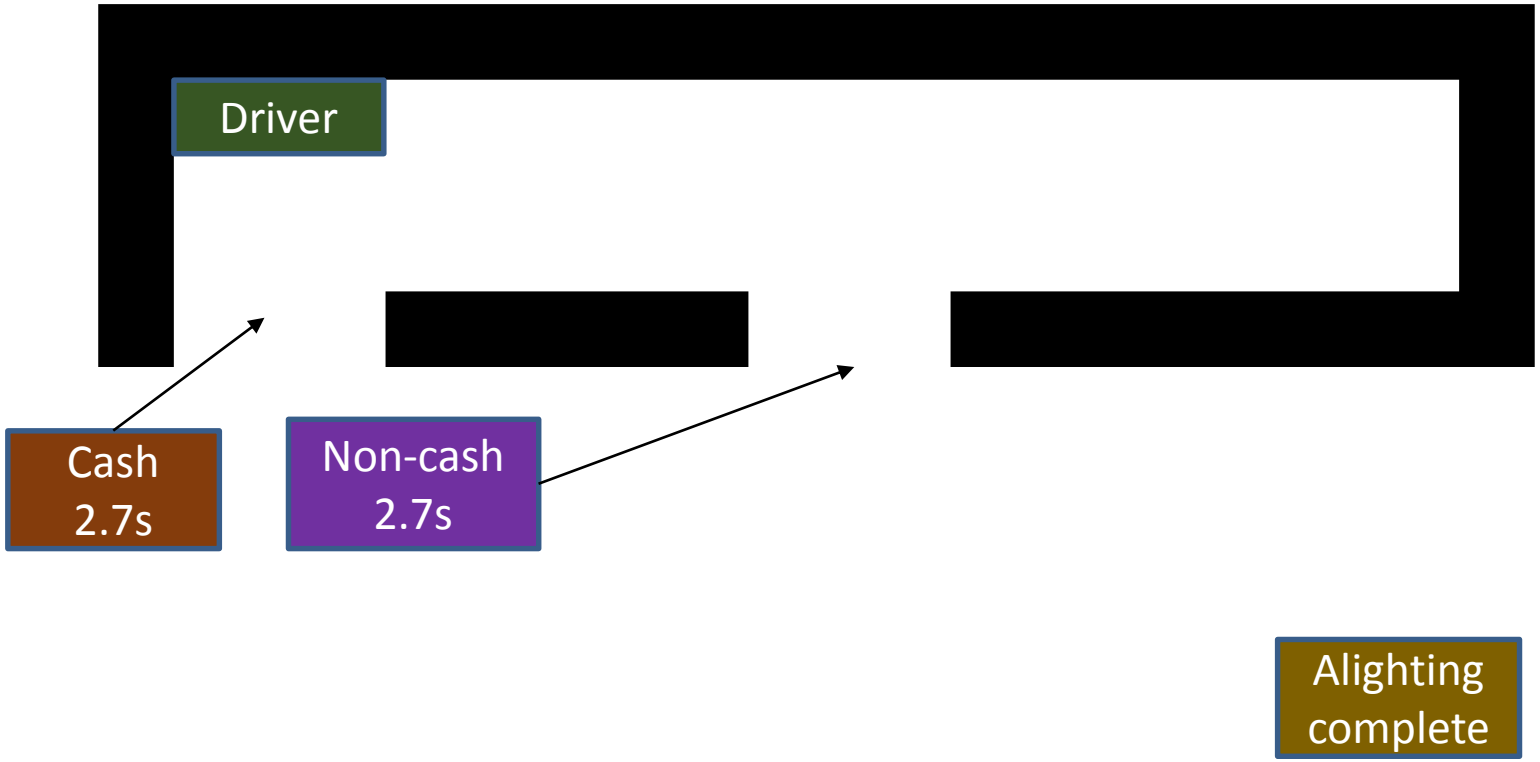
Effect of ticket validation models on bus operations

DIPV (driver issuance, passenger validation)
0 – 5.4s



Effect of ticket validation models on bus operations

DIPV (driver issuance, passenger validation)
5.4 – 8.1s



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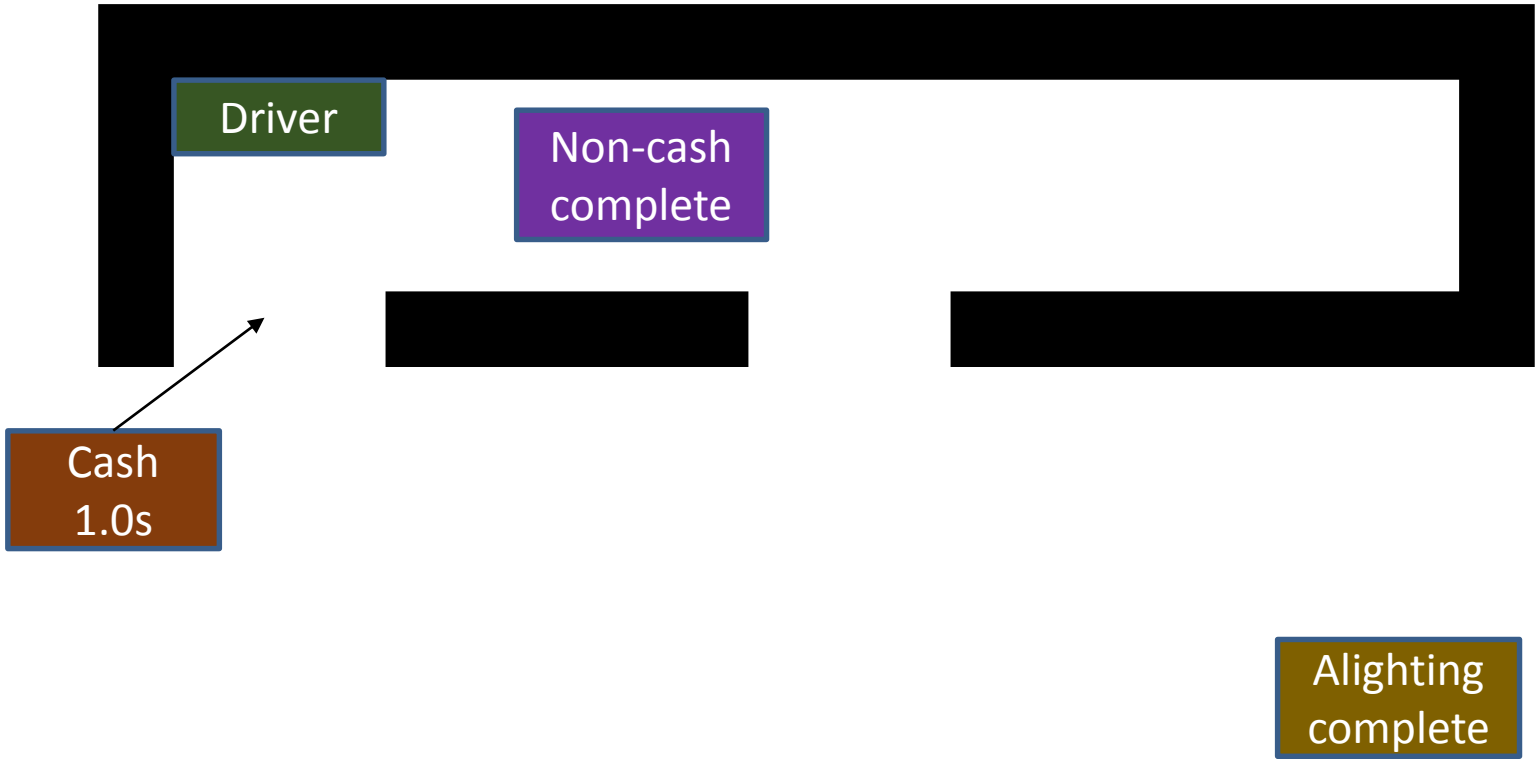
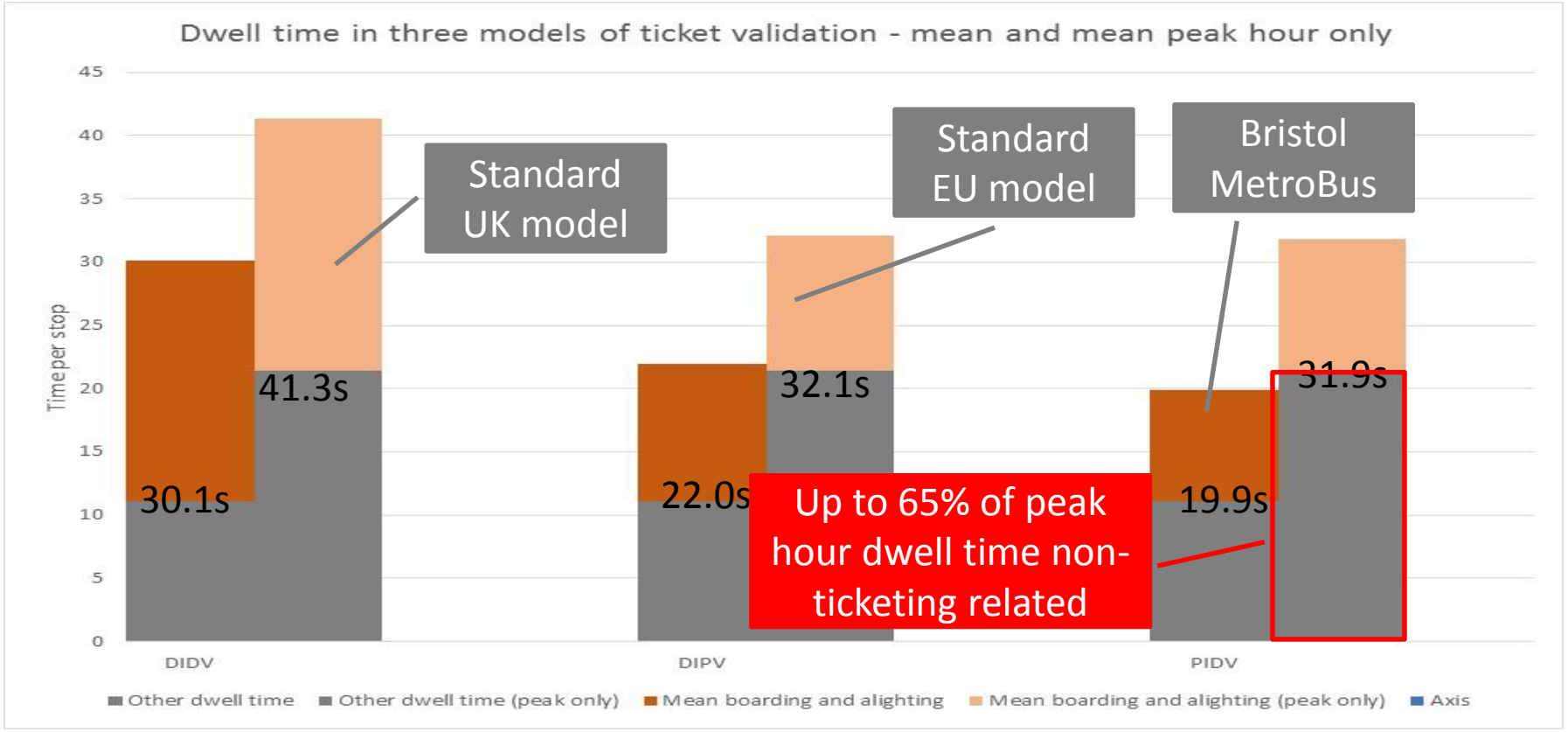
DIPV (driver issuance, passenger validation)

8.1 – 9.1s



Effect of ticket validation models on bus operations

Ticket validation

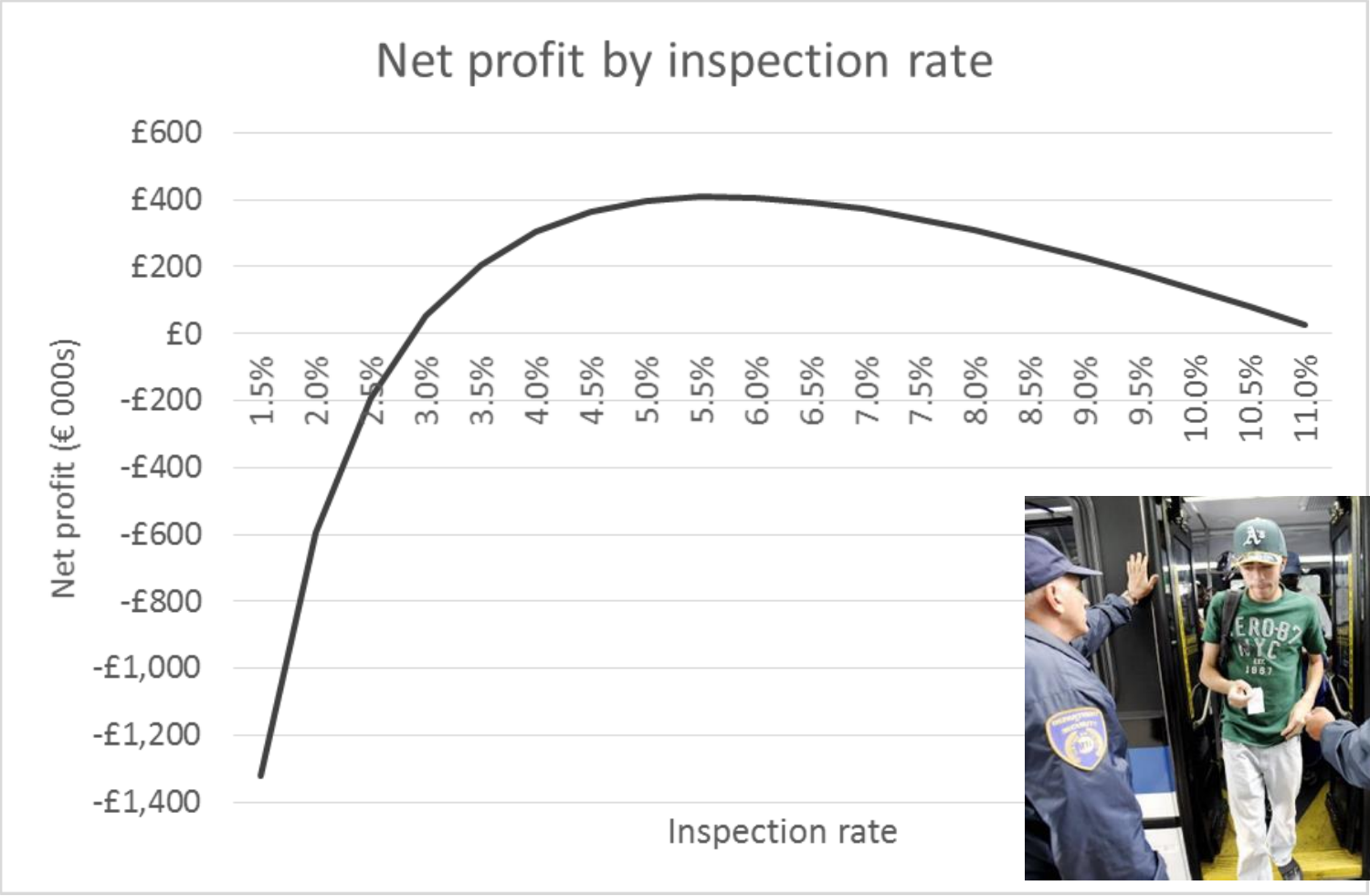


"Grey" dwell time

- Stairs
- Waiting for passengers to find a seat (esp elderly, infirm)
- Wheelchairs, buggies, pushchairs
- Conflict – passenger starts to buy ticket then has to step off to allow alighting
- Journey planning / chats
- Arriving at stop early
- Drivers counting change
- etc…

Set enforcement rate to recoup lost revenue

Boyd et al (1989) – but see Guarda et al (2016) – for alternatives to fining customers



Conclusions

- Truly "cashless" systems are expensive and not necessarily the best value
- We don't understand the cost of cash in any case
- The bus as a chaotic environment – addressing this is key to dwell time reliability
- 2nd set of doors key factor – but difficult to introduce if no inspectors to support drivers.
- Proof-of-payment systems may be cheaper and easier than cashless…
- …but cultural barriers are significant