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Transit Gate Evolution: why tap speed matters

Faster

Slower

Protocol	NFC	gate tap speed
FeliCa	NFC F / 212-424 kbps	100~200 ms
Calypso/CEPAS	NFC B / 212-424 kbps	180~300 ms
MIFARE	NFC A / 106 kbps	300~500 ms
EMV/PBOC	NFC A / 106 kbps	±500 ms

As the post COVID world slowly goes back to work, school and, hopefully normal life, managing crowds will be key in keeping people safe and healthy as they use transit again.

For commuters in Japanese metro areas managing crowds is no easy matter. Fortunately the Japanese transit gate infrastructure is a great help. FeliCa based IC transit cards (Suica, PASMO, ICOCA, etc.) with fast transaction speeds combined with open gate flap design maximizes people flow: people walk through gates at normal pace. This is very important for Japanese stations that have to make do with large crowds in limited spaces and narrow gate areas.

It's wrong however, to think that this only applies to Japan. The benefits of fast tap speed combined with intelligent transit gate design are relevant everywhere and very necessary in this day and age: fast gate tap speed is essential in keeping gate crowding at a minimum. It makes things safer not only for train operation, but also addresses crowd control health concerns in the post COVID era.

A reader sent a link to a good discussion of NFC protocols and gate tap speeds that was apparently deleted when YouTube comments were turned off. I retyped the comment in the section below from a screenshot with some light editing for clarity. If I find the author I will link to the original. The videos have already appeared in other posts but it's good have them in one place. A previous installment already covered QR transit code gate issues, this post will focus on NFC tap speeds.

While transit gates and NFC processors are found worldwide, what makes the Japanese gates different from the rest of the world is they don't use global standard ISO 14443 (never mind Type A which uses Miller bit coding, the least efficient bit coding method) protocol which is common in many transit and bank cards issued worldwide.

The tap time with ISO 14443 Type A (née Philips) and B (née Motorola) varies greatly: from 200 to 500 milliseconds (ms) with 200 ms only achievable with Type B/Calypso. But it never reaches the short as 100 ms which is only achieved with Felica developed by Sony, also designated NFC-F and NFC Tag Type 3 by the NFC Forum and compatible with ISO 18092 which is commonly found in smartphones and NFC wearables since 2013. In this following video passengers maintain their walking pace but never overshoot and trigger a gate closure nor slow down not even a bit:

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>
> — みなとみらい線 (@mm21railway) August 2, 2019

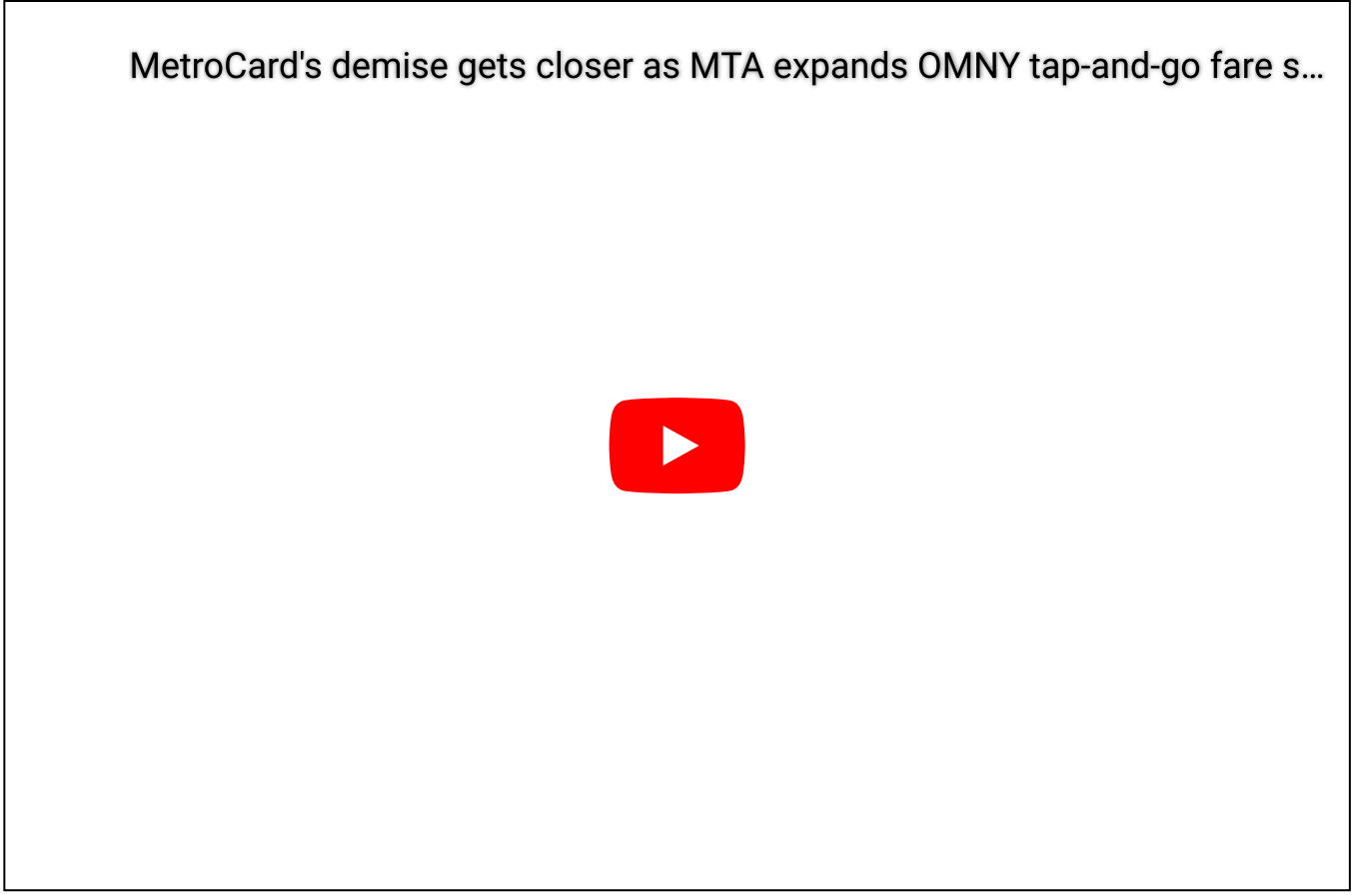
It may seem like a minor difference but due to the high volume of passengers per gate and to reduce gate maintenance requirements, tap times really matter.

Companies such as JR East have specified tap time of 200 ms but Suica is actually faster and this allows real life speed tolerances: some passengers tap faster than others due to walking pace, the higher speed tolerances are only possible with the 100 ms tap time of FeliCa. A comparison example of large crowds at gates in Malaysia and Japan below:

compared difference in Malaysia'and Japanese ticket gate of station.

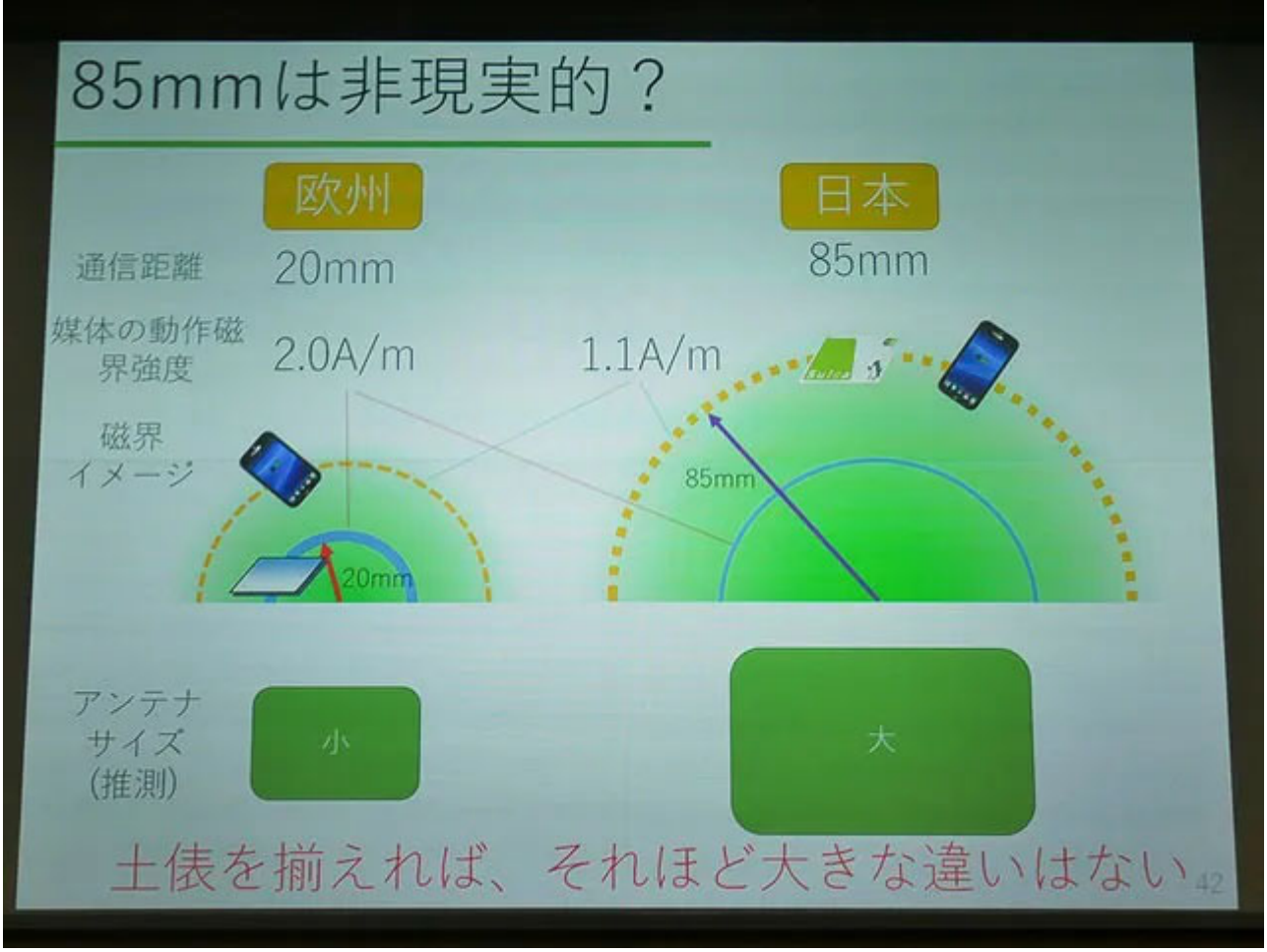
Open Loop NFC ticketing in its current form is based on EMVCo Contactless specifications adopted in contactless bank cards issued worldwide including China UnionPay QuickPass which is PBOC derived from the EMVCo Contactless spec. All of these use ISO 14443 Type A at 106 kbps only for 500 ms tap time, which is adopted in cities worldwide such as London, New York, Moscow and Rio de Janeiro where normal walking speed is never supported. Transit gate walk flow videos are surprisingly few. There were a few on YouTube comparing London and Tokyo that were unfortunately yanked from public viewing.

But as seen here, transit cards in Japan such as Suica, PASMO and ICOCA are supported for ultra hight speed and precise account verification and fare processing. Transit cards use offline Stored Fare (SF) which includes the amount of funds stored in the card's IC smart chip data storage, NOT backend on a server like a bank card, and stored commuter passes. Here is MTA OMNY Open Loop performance:



OMNY transit gate speed...

As the videos make clear, tap speed is the most important part of the total package that makes a transit gate, from NFC sensor and antenna communication distance, to fare processing transaction software to physical barrier design. Be it an antiquated turnstile, a sliding panel, or a flap. A key reason for the ultra fast performance of JR East gates is Suica speed coupled with a larger antenna + RF hit area plus the barrier-less transit gate design that doesn't impede walk flow.



Presentation slide from the NFC Forum Japan meeting, July 2016 compare the NFC RF hit areas of EMV/MIFARE (20mm) with Suica (85mm)

EMV is payment technology created for leisurely supermarket checkout, not whizzing through transit gates at rush hour. It doesn't address the needs of transit and never will in its current format because it is tailored for, and controlled by credit card companies. One example is that EMVCo certification requires a small antenna communication distance, as in store reader communication distance. This is to prevent EMV skimming out in the wild, but the restriction doesn't make sense for transit gates which operates in a controlled settings.

One hopes the NFC Forum works to increase NFC speeds and global specifications to "improve the overall user experience for NFC users," because all NFC flavors are capable of delivering FeliCa-like speed, in theory but the truth is in the tap. Improving the NFC user experience is what it is all about and what the NFC Forum can do. With the addition of Ultra Wideband to Mobile FeliCa and Mobile MIFARE it is time for the NFC Forum partners to revisit the global NFC ISO 14443 and ISO 18092 specifications.

NFC Forum partners need create a single faster more reliable NFC standard encompassing NFC A-B-F and other wireless technologies, a new standard that improves and expands the NFC user experience on mobile devices for transit, digital identity keys and payments, while making it all future-proof.

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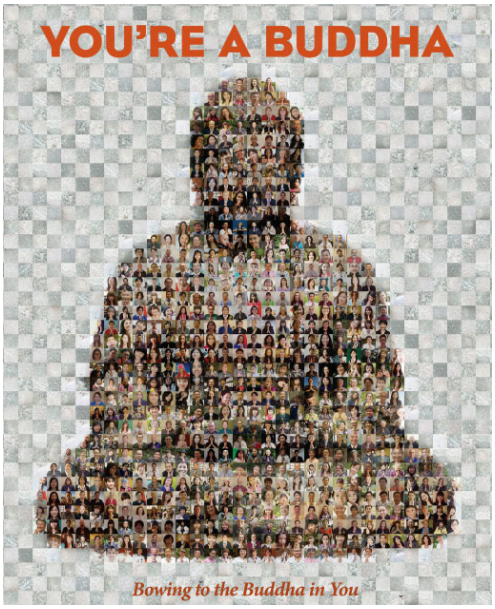

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