Motivation

Digital loyalty programs are common business strategies employed by retailers such as Starbucks, to drive profitable behaviours and cultivate long-term brand affinity. However, the sheer volume of loyalty programs impressed upon consumers has led to "loyalty fatigue" prompting the development of "Coalition Loyalty Programs" such as Frequent Flyer programs. While these coalitions have benefited members, there exist two interoperability pain points:

1. High contractual overhead for businesses in joining, running and leaving the programs.
2. Lack of interoperability between digital loyalty systems leading to a wide array of siloed collaborative efforts.

Objectives

Our goal was to assess applicability of blockchain in the domain of digital loyalty. To do this we had two main objectives:

1. To investigate the feasibility of using blockchain and smart contract technology in the digital loyalty domain.
2. To evaluate if blockchain offers systems greater interoperability over the current state of practice of using REST APIs.

Blockchain

Blockchain is an emerging technology that allows participants in an ecosystem to transact with each other, without relying on a central trusted authority to record transactions. Blockchain ensures the integrity of a distributed ledger which is replicated across the ecosystem. Bitcoin uses a blockchain for financial transactions, but next-generation systems such as Ethereum also allow programs ("smart contracts") to run as transactions, that enable the digital enforcement of agreements and clauses between parties, without the need of a trusted intermediary.

Why is it applicable?

At present, the current state of practice for interoperations between digital loyalty system is through REST API. We suggest in this thesis that blockchain technology offers a higher degree of interoperability, over using REST APIs alone.

There are several key qualities of blockchain that lend it to system interoperability:

- **Transparent and Immutable**: allows for the storage of data that is freely accessible to all participants in the network.
- **Distributed**: security and enforcement behind collaboration agreements between parties by distributed computational investment in solving cryptographic challenges.
- **Non-Repudiable**: no single party can unilaterally make changes or vetoes to the ledger, while allowing valid changes to be recorded.
- **Smart Contracts**: enable terms of collaboration to be codified, deployed and recorded on the blockchain.

Blockchain Driven Digital Loyalty System network

In our network we have businesses and users. Merchants have an application to facilitate point redemption and distribution. Users have wallet applications that give them access to their digital memberships. Both operate through REST APIs to loyalty system backends.

Loyalty systems communicate with each other via REST APIs and through operations on smart contracts in the blockchain.

Loyalty systems operate as DApps in our network, with the frontend serving as a GUI for smart contract deployment.

What can the system do?

Unilateral functions it performs are:

- Membership creation
- Loyalty token setup
- Token distribution and redemption

While not examples of interoperation, our system does replicate a basic digital loyalty system.

Point conversion is a bilateral function of the system. Two businesses with their own loyalty systems can setup an exchange rate between their points, enforced by the blockchain network.

To demonstrate a trilateral interaction, we developed the Reward Mile Contract: shop at least once at each of three participating businesses and be rewarded extra points. Each business in this scenario has its own digital loyalty system.

System Interoperability Models

We compared the state-of-practice for system interoperability – REST APIs – and blockchain against two widely recognised system interoperability models: LISI and LCIM. The LISI and LCIM models have 5 and 7 levels respectively. Blockchain rated higher in both models.

Evaluation

Based upon our evaluation we do suggest that blockchain and smart contracts are technologies that could be used to power digital loyalty systems. We have evaluated through implementation that it is feasible to create a basic system, and also offers an alternative solution to the structural problem of "point fatigue" in the domain. Smart contracts allow for the formation of more ad-hoc coalitions between digital loyalty systems with substantially greater flexibility in joining, running and leaving them.

Through comparison against interoperability models, we argue that blockchain and smart contracts do afford systems a higher degree of interoperability. REST APIs were designed to make systems blackboxes. Whereas blockchain's capacity as a shared piece of infrastructure for running code, allows systems not only the ability to collaborate on data but also logic.