aventus

PROTOCOL FOUNDATION

A Blockchain-Based Event Ticketing Protocol

June 2018 | Version 4





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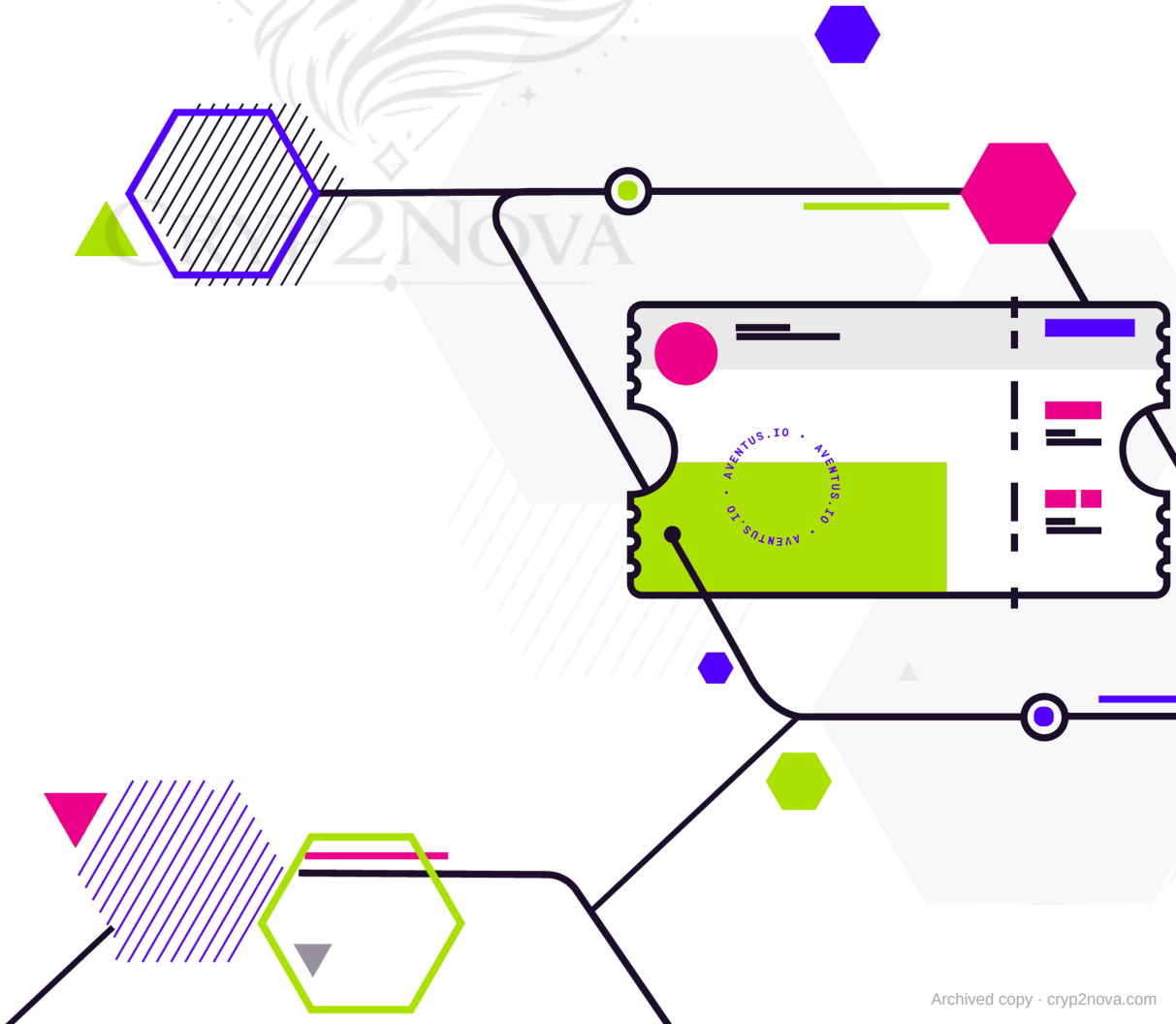
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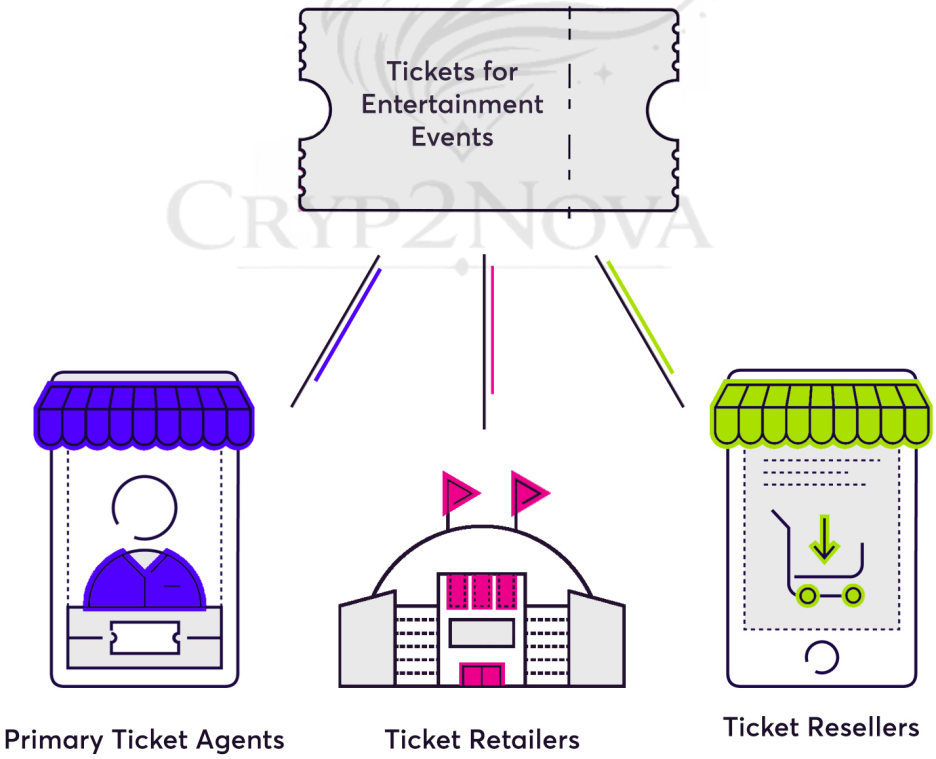
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1 Problem

1.1 Industry Overview

Tickets for entertainment events are typically available for consumers to buy via numerous sales channels. The ticketing industry defines three high level categories of seller: ticket retailers (usually the event organiser with direct responsibility for an event: for example a venue, promoter or club, selling tickets directly to consumers); primary ticket agents (appointed by an event organiser to sell tickets to consumers on their behalf); and ticket resellers (who source tickets from retailers, agents and other resellers to sell to consumers). A ticket sold for the first time is a primary ticket sale. A ticket resold by an individual, secondary agent, broker or other party is a secondary ticket sale (though the term "secondary" is misleading, as a ticket may theoretically have passed through any number of hands before it reaches the person who actually attends the event).



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Globally, the ticketing landscape is complex and fragmented. Not only does it depend upon multiple interactions within the ticketing ecosystem (event organisers, venues, promoters, bookers, primary and secondary agents), but standard practice between these parties differs between geographies. For example, in the US, venues typically control the inventory for an event. In Europe the promoter typically controls the inventory. In the UK, exclusivity is rare, with ticketing inventory split between the venue and the promoter, who each have their own preferred agent(s). Practices also differ dependent upon event type: for example, sporting teams often own the venue.

Within the primary market, inventory rights holders typically control the ticket price, revenue-splits and methods of ticket sale distribution (e.g. to select groups via third parties, with certain promoters or through certain outlets like TicketMaster) [1]. Pricing of tickets within the primary market takes place in a variety of ways, including at fixed value, in an open auction, or using dynamic pricing based on demand on a per-seat basis[1]. In the primary market, tickets are often sold at below market value, for a variety of reasons: for example, so that artists can increase customer loyalty and prioritise fan experiences, or because event organisers and promoters prioritise revenue through in-event advertising and merchandise sales [2].

The secondary market exists to facilitate the resale of tickets originally purchased on the primary market, allowing buyers and sellers to come together in order to transact, often via a resale marketplace. While often pilloried by the media and consumer watchdogs, the secondary market fulfils a necessary function by enabling greater consumer choice. Indeed, in his 2016 UK government-led review of the secondary market, Professor Michael Waterson concluded that "consumers and the economy benefit in various ways from the existence of a well-functioning secondary ticket market. [1]"

Ticket pricing is far more demand-driven on secondary platforms than on primary platforms, with tickets finding their own market value. Unsurprisingly though, pricing dynamics within the primary market directly affect the volume and transactional-value in the secondary market. Secondary platforms profit by taking a percentage of secondary sales, typically at around 25-30% [1]: this, allied with the high market value for 'big ticket' items, means that secondary platforms enjoy higher revenue margins per ticket than primary platforms.

To take advantage of the additional revenue available from reselling tickets, there is a growing trend for primary agencies to launch their own affiliated secondary markets (for example, Ticketmaster's *GetMeIn* [3]), further complicating the already fragmented ticketing landscape. Primary agents with their own secondary platform (or with their platform integrated with an existing resale platform), can deliver greater control and transparency over ticketing transactions – as well as allowing them to benefit from a proportion of resale revenues.

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1.2 The Current System is Broken

Event organisers, artists and managers often price tickets at below market-value to maximise fan attendance, increase customer loyalty and earn more revenue from in-event sales [2]. As a consequence, large economic potential exists for the formation of secondary markets, with resellers making large profits by pricing tickets at closer to 'real' market-value [1]. However, ticketing rights-holders in the primary market have very limited control over inventory sales in secondary markets. This means artists, organisers and primary ticketing agents cannot control who can resell their inventory and how they can sell it, enforce minimum or maximum price caps, or derive any revenue from these secondary sales.

The unregulated nature of secondary markets opens up potential for industry malpractice, unethical touting behaviours and other bad actors [1]. Secondary platforms are consequently prone to being pervaded by fraudulent counterfeits, duplicate tickets that have been already used or sold, or tickets that have been bulk-purchased by touts and re-listed at extortionate prices [4].

Touts regularly circumvent platform terms & conditions by employing software programmes known as "bots" to automate bulk purchase of tickets, which are then listed across multiple secondary sites (often at inflated prices, averaging 49% above their face-value in the primary market, but with some margins exceeding 1000%) [8]. According to TicketMaster, such purchases contribute to around 60% of sales to popular shows [6]. Listing on multiple secondary sites can lead to the same ticket being purchased multiple times on different secondary sites (as duplicate or counterfeit tickets) [8]. The Telegraph has estimated that Britons squandered over £5 million on counterfeit tickets in 2015 [9].

In some cases, touts engage in "speculative buying": a practice which consists of automatically reserving tickets in bulk on primary sites. As the secondary seller does not yet technically 'own' the ticket, the ticket may be released back into the primary inventory pool before the secondary purchaser has completed their purchase – leading to inability for secondary sellers to fulfil sales.

Bulk purchase of tickets by bots has the result that popular events can appear to sell-out on primary sites in minutes [6]. Primary market platforms earn initial revenue from each primary ticket sale, so these platforms maximise their revenue by maximising the number of tickets sold. This means these platforms are positively incentivised to not prevent the use of bots to bulk-purchase tickets. There are also extra benefits for promoters, who may use primary sales to gauge overall consumer demand for events in order to make decisions about extending tours or adding extra event dates.

While the practice of speculative buying and bulk purchase consumes the economic potential created by the pricing inefficiencies within the primary market, it is felt by many to be fundamentally unfair on fans and audiences. This phenomenon prevents

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price-sensitive fans from attending an event and causes regular fans to pay higher-than-intended prices for tickets, resulting in customer dissatisfaction and poor brand publicity for the artist, club or venue [7].

The complex and fragmented nature of the ticketing landscape means that lines between markets are blurred, resulting in consumer confusion. Research has shown that consumers fail to differentiate between primary and secondary markets; 1 in 4 customers admit they do not know where they are buying their tickets from, be it primary, secondary or even fraudulent outlets [1]. The often time-sensitive nature of many ticket sales often compounds this issue, meaning consumers fail to interrogate purchasing decisions fully due to a pressure to act quickly in order to secure a ticket.

1.3 Existing Solutions

Attempts to address these key challenges (improving consumer experience through tackling unethical behaviours, and improving rights-holder and primary seller controls over secondary markets), are generally being made via three different routes: technology, legislation and self-regulation. The overarching goal is to develop ways which determine the legitimacy of tickets listed on secondary sites, in order to deliver fairer practices and greater consumer confidence upon purchase.

1.3.1 Technology

Some primary markets such as Resident Advisor [11] or fan-to-fan transfer marketplaces like Twickets [12] target extortionate pricing and unethical touting behaviour through mechanisms which only allow the resale or other transfer of a ticket at its primary market face-value or lower. Other platforms, such as Songkick[1][13] and Dice.fm[14], have developed data-driven techniques to distinguish touts at the point-of-purchase and identify tickets on secondary market websites. Dice.fm prevents resale of its tickets altogether.

Unfortunately, these technological methods fall short of solving the challenges previously outlined:

- Outright prevention of ticket resale removes consumer choice, preventing genuine fans who for legitimate reasons cannot attend the given event from reselling their tickets;
- Mandating that resales are only permitted to take place at face-value or less creates incentives for black-market activities (for example, additional offline monetary transactions taking place on top of legitimate online transactions);
- Identification of touts using machine-learning techniques is a losing battle, as scalpers have a vested interested in keeping ahead of current algorithmic techniques and changing their behaviour accordingly.

[1] Songkick's ticketing commerce platform and anti-scalping algorithm were acquired by Live Nation in January 2018 [15]

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More effective than the above technologies are solutions which focus on platform integration and creating visibility across inventory. For example, Eventim's secondary market, FanSale, offers a Ticketcheck functionality [16] which allows consumers to confirm the legitimacy of a ticket being resold via its Eventim barcode. For obvious reasons, primary platforms who run their own secondary markets have the most success with this technique; however, drawbacks remain due to the siloed nature of the ticketing industry, with no standardised method of checking a ticket's legitimacy.

1.3.2 Legislation

Authorities have recognised unfair practices within the secondary market, with some countries – including France and Italy – outlawing touting altogether [17]. Consumer watchdogs the world over are warning against unethical behaviours facilitated secondary platforms, with The UK's *Advertising Standards Agency (ASA)* [18], Australia's *Competition and Consumer Commission* [19], New Zealand's *Consumer NZ* [20] and Ireland's *Advertising Standards Authority* [21] conducting investigations in the last year alone.

In the UK the reselling of tickets to football matches [22] without the permission of the relevant club is illegal, and use of automated technologies to bulk-buy tickets was outlawed by the UK government in January 2018. As of April 2018, secondary platforms must also include the unique ticket number (UTN) allocated to a ticket by the primary agent in any resale listings [23].

Fundamentally, however, it is very difficult to control or constrain black-markets: despite football clubs maintaining authorised-reseller lists, tickets still regularly appear on unofficial platforms. At sports matches and concerts globally, black-market sales continue to occur (often immediately outside of the venue itself [18]).

Within the US, legislative controls are determined on a state-by-state basis. This has limited impact, though, as many resellers exploit loopholes by selling tickets in the nearest state where the practice is legal. For example, the majority of brokers operating in New York – where use of ticketing bots has carried a hefty fine since 2016 – have registered offices in New Jersey and Connecticut. Industry supporters of such laws acknowledge their constraints, with Jeffrey Seller (lead producer of Hamilton on Broadway) stating, "Is it imperfect? Of course. Is it better than nothing? You bet." [24]

In the UK, the West End production of Hamilton has taken a different approach by introducing an entirely paperless ticketing system. [25]

1.3.3 Self-regulation

With growing pressure from fans, consumer watchdogs and artists themselves, many secondary platforms are investing in self-regulatory endeavours in order to rehabilitate negative views of the secondary market and help restore consumer confidence.

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Many secondary platforms have put guarantees in place to protect consumers by offering replacements for tickets that do not arrive or refunds on fraudulent tickets [1]. However, while providing a refunding on ticket that is void on the door offers some degree of recompense, it does not protect attendees from extra costs incurred (such as travel, accommodation, time, and disappointment).

Large artists (such as Ed Sheeran, Adele and Taylor Swift [26]) are actively working to raise anti-touting awareness and circumvent damaging behaviours, trialling a range of methods to prevent touting. While this approach can be immediately effective for large artists with a lot of clout who have the will and resources to go the extra mile on behalf of their fans, fraudulent ticketing and unethical touting practices continue to harm smaller artists and their fans.

However, big-name awareness does serve to increase pressure upon secondary resellers; for example, StubHub stated in March 2018 that they would support "any measures which make ticket buying easier, more convenient and more transparent for fans" [27].

As a result, secondary platforms increasingly choose to commit to codes of ethics and conduct [1]; for example, by becoming members of The Society of Ticket Agents and Retailers (STAR), whose Code of Practice aims to set high standards for customer service in the industry and provide an approved dispute resolution service. Other industry consortiums have been founded with the express aim of promoting a culture of ethical practice, including FanFair Alliance (made up of members of entertainment community to lobby on behalf of consumers), and the newly-created Fair Ticketing Alliance (made up of secondary ticketing brokers with the goal of rehabilitating the ticketing industry) [28].

Criticisms are also levied against secondary platforms regarding their higher revenue margins, which often mean they have the financial capability to invest more deeply in online advertising spend (via SEO, SEM and targeted social media marketing) than primary markets. In turn, this increased discoverability gives secondary agents greater access to potential consumers, allowing them to out-compete primary markets in both margins and visibility. This can contribute to the consumer's lack of ability to differentiate between primary, secondary and illegitimate sellers.

According to The FanFair Alliance, consumers have "three recurring complaints: they were directed via Google advertising towards these sites, they thought they were purchasing from an authorised seller, and they were misled on pricing" [29] Some advertising channels and now taking steps to redress the balance, with Google cracking down on language used within AdWords to increase transparency for consumers. Secondary sites who imply they are a primary marketplace will be denied 'certification', and therefore not permitted to leverage paid ads within the channel [30].

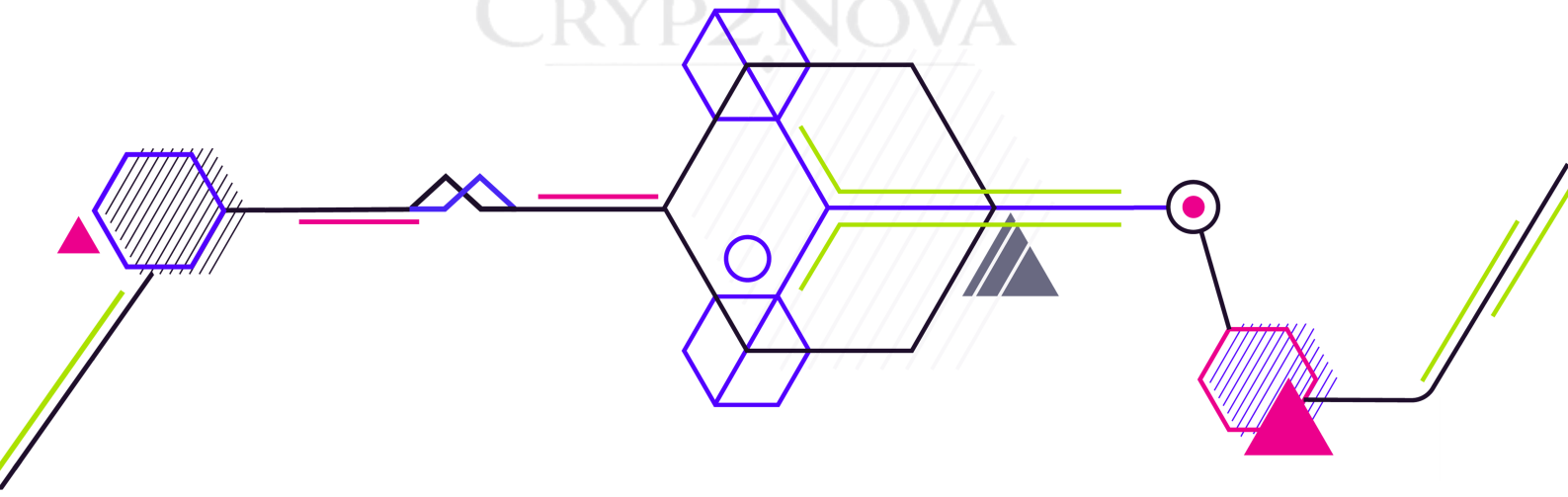
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1.4 Conclusion

Since the challenges in the ticketing industry have not yet been comprehensively addressed by technology, legislation, or self-regulation, stakeholders have understandably become pessimistic as to whether the ticketing market will ever change for the better [31].

- Event organisers and rights-holders need greater controls and internal transparencies over the lifecycle of their ticketing inventory - including over how and who can interact with their inventory as secondary sellers;
- Consumers are increasingly demanding a fairer and more positive experience, with more transparency over who and how they are purchasing tickets, and less chance of refused entry on the door due to fraudulent or duplicate tickets;
- Artists, managers and promoters need more say in how their inventory is priced and how that pricing is perpetuated throughout the ticketing lifecycle, right up to when it is presented by the ticket-holder for access to the event;
- Secondary ticketing platforms need to be better incentivised to act as 'good actors' within the ticketing ecosystem, providing better consumer experience and driving repeat custom.

We believe that the problems highlighted in this paper point to a need to re-build the industry from the bottom-up, replacing the current, siloed, architecture to create a new, fair, secure and transparent economic model under which event organisers and inventory rights-holders would have greater control.



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2 The Aventus Solution

2.1 Overview

The Aventus solution aims to remove siloes and create an open ticketing ecosystem where all parties in the ticketing supply chain can work together with more control, more internal operational transparency, and more security. It is designed as a modular toolset which will enable ticketing organisations to exert more control over their inventory and processes, engage more directly with other players within the supply chain and with consumers, and explore new methods of monetisation.

This solution will be underpinned by the Aventus Protocol, a global open standard for the exchange of tickets built upon the Ethereum blockchain, and the subject of this paper. The Protocol is designed to support and facilitate events organisers and inventory holders, giving them the tools to set controls around how their tickets are transacted and resold. Through use of Ethereum smart contracts, the Protocol enables a secure and controlled supply-chain that can eliminate counterfeiting and prioritises rights-holder needs. The Aventus Protocol is open source and available for all developers to leverage of build upon.

As tickets held on the blockchain each have a unique identifier, the Protocol facilitates greater security, control, internal traceability and proof-of-ownership, making it possible to track a particular tickets UTN as it travels through the supply-chain. It allows event organisers to create, manage and promote their events and tickets with dramatically reduced costs, even letting them set price controls and receive commissions on ticket resales. Consumers within the ecosystem are rewarded for identifying fraudulent activity, creating a self-governing community.

It is important to note that Aventus itself remains objective and agnostic when it comes to the setting of parameters for ticket sale and resale, which are selected and set by inventory holders to best fit their business models. Aventus does not own, sell or distribute inventory, or dictate rules to players within the ecosystem.

To help bring blockchain ticketing to the consumer, the Aventus Protocol Foundation will also work with, support and endorse the creation of B2B SaaS tool-sets, applications and APIs created by third-party service providers, ticketing agencies and developers. These services will provide a critical function in bridging the gap between the Protocol and the existing tech stacks of traditional ticketing industry entities.

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2.2 The Aventus Ecosystem

Despite the fact that the primary innovation discussed in this paper is the Protocol itself, it is worth explaining wider Aventus ecosystem (as depicted in Figure 1) and how industry players act within it (see 2.2.2).

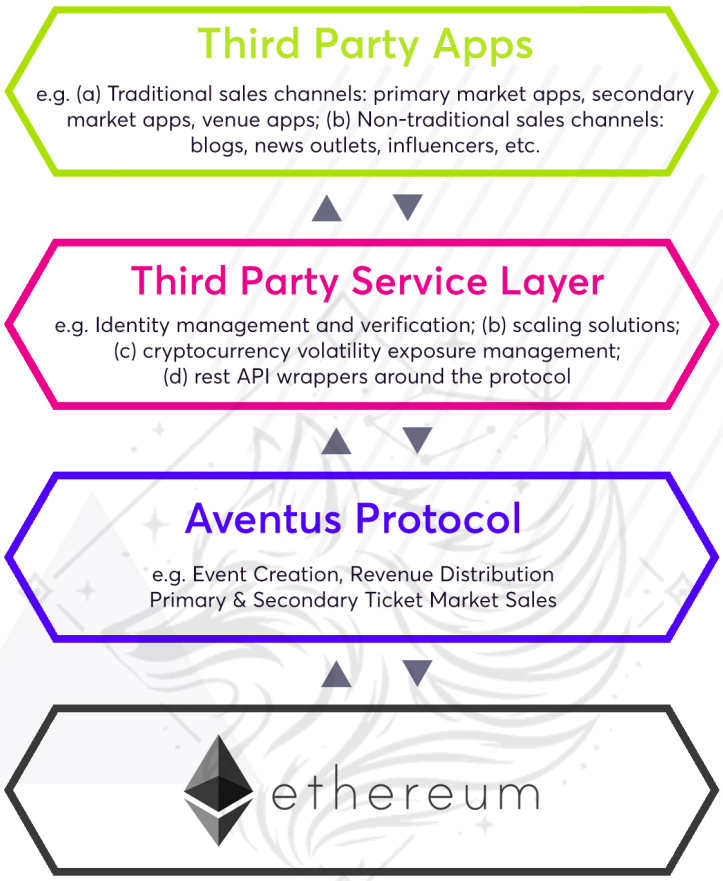


Figure 1: The Aventus Ecosystem

2.2.1 The Ethereum Blockchain

Bitcoin is the most widely-known use-case for the blockchain: a network designed for decentralised, peer-to-peer monetary transactions, with no need for a centralised bank or intermediary.

Money has a distinct difference from assets such as media, documents, and message content: ownership. Money can only be owned by one party at once (it cannot be double-spent), and we need to track how it is moved between parties in order to "prove" ownership. As a distributed, immutable (tamper-proof) ledger, blockchain provides a solution to this: a single source of truth which allows all parties to see the provenance and transaction history of each token of currency.

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The Ethereum blockchain extends this functionality through digitally-enforceable agreements – known as "smart contracts".

These smart contracts can be applied to core business processes where security, control, traceability and proof-of-ownership are necessities: in this case, within the ticketing supply chain. That's where the Aventus Protocol comes in.

2.2.2. The Aventus Protocol

The subject of this paper. The Aventus Protocol is open source, and provides a backbone of interoperability which will lower barriers to entry for developers in the ticketing industry.

This layer is entirely composed of Ethereum smart contracts that allow for the creation and validation of events, the issuance, sale and distribution of tickets in primary and secondary ticket markets (under parameters designed and customised by inventory holders and event organisers), and the allocation of defined proportions of ticket sale revenue and market/event fees between the event organisers, ticket promoters, artists, secondary resellers, etc.

2.2.3. The Service Layer

Services built on top of the Aventus Protocol are designed to make using the Protocol as efficient and accessible as possible, and will offer a potential source of revenue for developers looking to build mainstream, blockchain-ready ticketing applications. These services are expected to include scalability solutions, integration with synergistic entertainment token environments, optimisation of purchasing time through use of market-feed oracles, and interoperability infrastructure such as SDKs and APIs.

As the Protocol itself is (and will remain) open source, this low barrier to entry will guarantee a competitive services layer environment that will drive cost-efficiency for ticketing agencies wishing to take advantage of the business benefits of the Protocol. Agencies wishing to develop apps and services built upon the Protocol can partner with third-party developers, existing third-party service providers in the ecosystem, or utilise their own in-house technical resources to build direct-to-Protocol apps.

2.2.4 The Application Layer

The Application Layer consists of end-user applications that build on top of the Services and Protocol layers, making blockchain-based ticketing apps available within a commercial environment for the entertainment industry and its consumers. This will incorporate inventory management solutions, blockchain ticket wallets and access control solutions, along with apps enabling the creation of promotional schemes for encouraging more ticket sales. Aventus encourages and supports the work of third party developers to create applications on top of the Service Layer.

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2.3 Use Cases

Actors within the ecosystem:

- Ticketing retailers (primary agents, secondary agents)
- Event organisers (venues, promoters, clubs, artists)
- Consumers (ticket buyers)
- Ticketing software providers
- AVT holders
- Aventus technical team
- Third-party developers

The Aventus Protocol is designed to resolve the industry challenges highlighted earlier in this paper, making ticketing processes more efficient and effective for all parties in the supply chain.

1. **Increased Control Over Inventory**

The Aventus Protocol gives event organisers, inventory-holders and artists the tools to set and enforce rules around how their tickets are transacted and interacted with within the ticketing supply chain.

This includes setting of minimum and maximum price caps, whitelisting of approved resellers, and even defining processes which entitle artists, organisers and primary sellers to a proportion of secondary market resale revenues.

- Tickets have a unique identity associated with them on the blockchain; usually a barcode or a QR code. The validation mechanism chosen is determined by the event organiser, and added at the point of purchase in the primary market. No personal data is ever held in clear text on the blockchain; while identities linked to tickets are securely verifiable, any personal data is obfuscated and encoded in a cryptographically-secure manner, ensuring no sensitive information is ever publicly visible and that the Protocol is fully compliant with General Data Protection Regulation (GDPR).

- The identity associated with the relevant ticket will be checked upon entry by Access Control and compared to the obfuscated data held on the blockchain. Changes to identities associated with a ticket (thus changes to the "owner" of the ticket) can only take place if the ticket is resold through an approved secondary market and meets with the rules and controls enforced by the event organiser or inventory-holder.

For artists actively trying to eliminate or restrict touting (for example Beyonce and Jay-Z, Ed Sheeran, Stormzy), these controls give the promoter the ability to outlaw resale of tickets altogether, or to set price caps that prevent extortionate charges for fans. Actors wishing to explore new monetisation opportunities can set up microtransactions that allow various entities in the

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supply-chain (promoters, venues, artists, managers) to be allocated a proportion of resale revenues from the secondary market.

2. Increased Security & Decreased Fraudulent Behaviour

The Aventus Protocol offers consumers a fairer and more positive experience by enabling inventory holders to prohibit unauthorised resale on the blockchain, thereby eliminating counterfeit or duplicate tickets and vastly decreasing the possibility of fraudulent behaviour.

Should an event itself be fictitious or fraudulent, the economic model underpinning the Aventus Protocol incentivises network participants to report it as such, creating a self-governing ecosystem. The community of users of the Aventus Protocol (or the 'Aventus Community') determines the legitimacy of an event or a third-party seller using a decentralised consensus mechanism on the blockchain.

Given the transparent nature of the blockchain, many of the oversight issues discussed in Section 1.2. can be resolved. Consumers will be able to find a validated list of outlets selling tickets on the blockchain, making it simpler for them to differentiate between types of platform. Meanwhile, duplicate and counterfeit tickets will be impossible within the Aventus ecosystem due to each ticket's unique identifier, and fraudulent behaviours will be vetted and rejected by the Aventus community.

3. Increased Internal Transparency and Consumer Insight

The Aventus Protocol gives ticketing agents the tools to derive more internal insight into the supply chain, allowing them to understand and target existing consumers more effectively and to discover new audiences. By analyzing and reporting on data held on the Protocol and combining this data with internally-held consumer data-sets, agents can tell who bought tickets, how many times each ticket was transacted, whether a ticket was redeemed on the door and the identity of the redeemer. Going further, it becomes possible to analyze, audit and support counter-claims against charge-backs – avoiding unnecessary revenue losses – and even to implement tighter access controls and blacklist undesirable attendees.

4. **New Revenue Opportunities**

The Aventus Protocol will support artists and event organisers by enabling events to reach a wider and more targeted audience:

- Event organisers can whitelist or blacklist chosen promoters and sales channels, giving them full curated control over the audience their inventory reaches. Inventory can also be opened up to everyone, creating a global pool of events which can be sold through any ticketing application, incentivised via commission – overturning the current siloed nature of the industry and encouraging mutual participation to drive increased sales.

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- Event organisers will be able to reward promoters or ticketing software providers with a commission on ticket sales they are responsible for generating. These commissions can be controlled by the event organiser to be as dynamic or complex as desired, since each individual promoter can receive a different set commission.

2.4 AVT Utility Tokenomics

The Aventus Protocol Token (AVT) is critical to the functioning of the Aventus ecosystem as a decentralised, self-regulating environment. By aligning the economic incentives of participants, it addresses the challenges highlighted in Section 1 of this paper.

2.4.1 Purpose

The main purposes of AVT as a utility token are:

1. To provide an incentive layer that enables self-regulation of the Aventus Protocol. By creating and curating a network of due-diligence reporters on events and applications held on the Protocol, the ecosystem is secured and fraud is minimised.

   This is implemented through stake-weighted voting mechanisms (further explained in section 3.1) which allow the Aventus Community to determine:

   a. Legitimacy of apps/DApps using the Aventus Protocol (section 3.1.1) so that unethical behaviours and bad actors are disenfranchised.
   b. Legitimacy of events on the Aventus Protocol (section 3.1.2) so that apps/Đapps do not lose users by selling tickets for fraudulent events, and consumers do not experience disappointment.
   c. Governance of the future parameters of the Aventus Protocol, so that the Protocol can constantly evolve to remain competitive and best serve the ticketing community.

2. To reward early adopters of the Aventus Protocol, thereby enabling it to benefit from network effects. Network effects apply to the Aventus Protocol: as the number of events stored on it grows, the greater value it has to third-party applications; and the greater the value it represents to third-party applications, the more the number of events stored on it will grow. .

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2.3.2 Mechanics

There are three primary use cases envisaged for AVT:

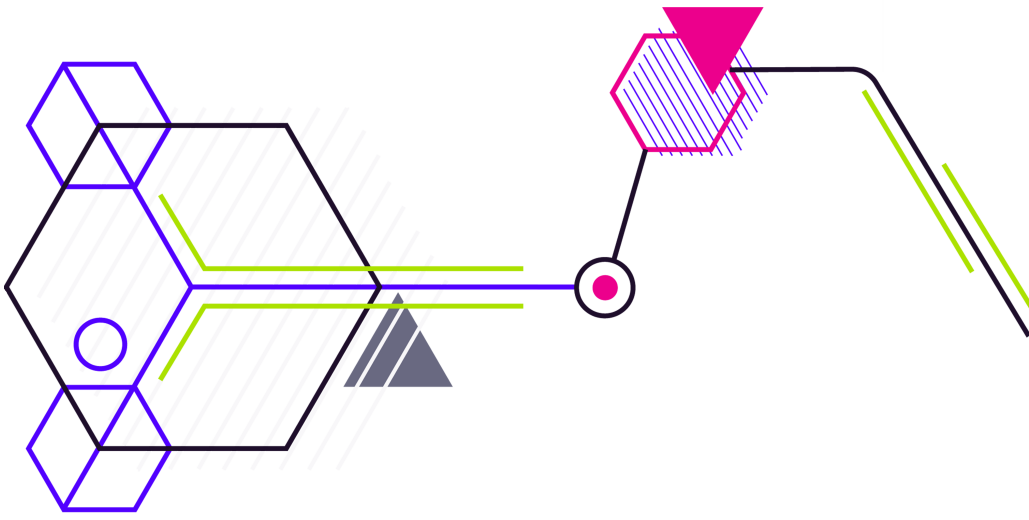
Event hosting: Event organisers must purchase AVT to pay the event-creation fee. This cost will be proportional to the number of events deemed fraudulent in the Protocol. To ensure that the cost remains stable, the volatility of AVT will be tempered by accounting for the fiat currency exchange rate.

Community stake: Events can be reported as being suspected of being fictitious or fraudulent through a voting mechanism which involves putting up a deposit of AVT, which is detailed in section 3.1. below. This economically incentivises third-parties using the Aventus Protocol not to sell fictitious or fraudulent tickets. Third-party ticket-sellers on the Protocol go through a similar process of being validated by the network in order to guarantee their legitimacy and eliminate fraudulent resellers.

Matching: Tickets sold on the Aventus Protocol in the secondary market will be matched with buyers who have previously registered a firm intent to purchase. Matching is an on-chain calculation that members of the Aventus community can run to pseudo-randomly match buyers and sellers; this ensures that sellers do not know who they are selling to, preventing touts or bad actors demanding additional off-chain monetary transactions on top of the on-chain transaction.

It should be noted that non-determinism is not possible on a blockchain, therefore (even when 'randomly' choosing who receives which tickets), the outcome can be known before the matching transaction is entered into the system. However, as long as the block rewards and transactions fees are not less than the matching reward, the system is secure.

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3 Future Vision

An Alpha version of the Protocol providing scaled-down functionality was released on the Rinkeby Public TestNet in July 2017 for community review and comment. In November 2017, an advisory voting module was made available on the Ethereum MainNet as proof-of-concept, allowing community members to create and vote on proposals.

Full source-code for the Beta release was initially made available to the public in May 2018.
An in-depth audit of this source-code was carried out by Solidified.io, the leading technical auditing service for Ethereum smart contracts, whose 150+ community of Solidity experts has previously audited over 40 companies (including Polymath, Melonport, Bankera and Spring Role).

After undergoing a successful auditing process which exposed zero critical issues, the Protocol was deployed in Beta onto the Ethereum MainNet in June 2018. Developers can now access the Protocol and accompanying source-code, giving them the tools to begin building (or expanding existing) ticketing applications and services to take advantage of the benefits of blockchain.

Within beta, some elements of the ecosystem remain centralised while we iterate and develop the Protocol (for example, see Section 4.1.3). From Version 1.0 onwards, once use of the Protocol has been established, control over system parameters will be handed to the AVT community, creating a fully decentralised solution.

The future vision for the full version of the Protocol is detailed in the sections below:

3.1 Aventus Registry

The Aventus Registry is the entry point to the Aventus Protocol. It keeps track of:

1. A list of the legitimate third party applications using the Protocol
2. A list of the non-fraudulent events within the Protocol
3. Algorithmic parameters determining system deposits and time periods.

Each of the above variables will be determined and consistently updated through stake-weighted voting by the Aventus Community. The voting process is similar to that proposed by Colony [32], whereby:

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1. A deposit is put forward to initiate the voting process (the origin of these funds is explained below for each particular variable).
2. Votes are cast confidentially by the Aventus Community in secret by staking AVT. Once the Vote Reveal Period begins, voters' stakes are locked.
3. Once votes are revealed, voters' stakes are unlocked.
4. When the challenge is ended, the winning party's deposit is returned and the losing party's deposit is distributed amongst the winning party (10%), the challenge-ender (10%) and the winning voters (the remaining AVT, distributed proportionately according to stake).

The following sections explain the application of the voting process to each of the variables mentioned above:

3.1.1 Legitimate third party applications using the Protocol

A third party application that wishes to use the Protocol must create a proposal in the Aventus registry, requesting to be added to the official list of legitimate applications, if they wish to sell tickets for an event. Along with the proposal, a deposit is submitted which will power the Aventus Community's vote regarding the application's legitimacy. This is necessary to give better oversight to consumers so that they can know where they are buying their tickets, and can be reassured that the outlets are not fraudulent.

3.1.2 Non-fraudulent events within the Protocol

Events are only added to the official event-listing on the Protocol if the organiser has paid the necessary event-creation deposit. Following an event being added to the Aventus Registry, the Aventus Community has a period within which to report it as fictitious or fraudulent by submitting a deposit, as previously described. The voting process outlined above occurs to determine the validity of the event, ensuring the legitimacy of events on the platform.

3.1.3 Algorithmic parameters

All parameters in the system (such as the application-listing deposit, the event-creation deposit or the time period in which an event can be reported) affect the economic behaviour of Protocol participants. Since the parameters are strongly affected by usage data of the Protocol itself (e.g. the rate of fraudulent events or the number of fraudulent applications using it), they will be re-calibrated algorithmically at the point of event creation to ensure platform stability.

Since the algorithms themselves have parameters (such as deposit floors, ceilings, and scaling values), these will also be open to be voted upon by the Aventus Community. Community members can put forward proposals (along with a proposal deposit, in order

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to avoid spam proposals) to alter an algorithmic parameters. After the community votes to determine the winning proposal, the deposit is returned to the community member.

3.2 Event

Events are listed by paying the event-creation deposit and uploading the event's details (date, location, description, etc). The event creator can then define a series of addresses associated with ticketing agencies and resellers for the purposes of selling and refunding tickets.

It should be noted that the event-creator will be able, if desired, to define the revenue-split from ticket sales between the venue, artist, management company etc.

The Protocol supports different event options, such as:

- Private events: the creators must sign off on any ticket sold.
- Approved merchant events: the event's tickets can only be sold or re-sold exclusively via whitelisted sellers.

Before ticket sales for an event can begin, a reporting period occurs during which the event can be challenged, as detailed in section 3.1. The full life-cycle of an event is depicted in figure 2.

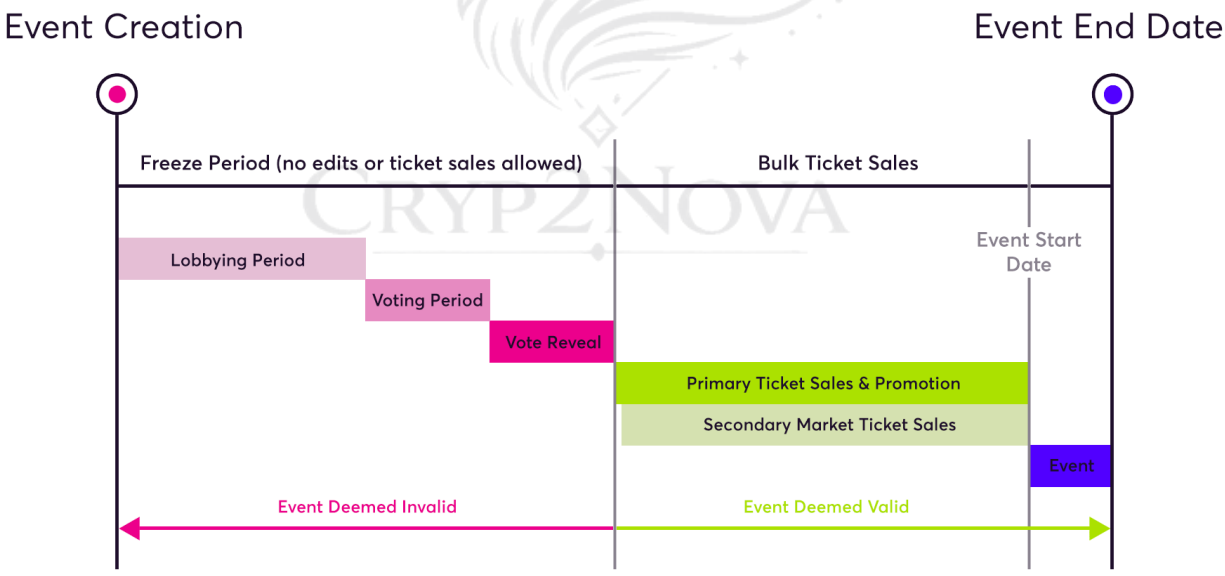


Figure 2 - The timeline of an event

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3.3 Ticket Sales

When tickets are registered on the blockchain via the Protocol, a hash (or unique identifying series of characters) is generated for that ticket – encoded with the specific details of that ticket, e.g. ticket type, seat number, etc - which is then associated with the public key of the ticket owner.

A ticket can then only be transacted (e.g. from event organiser to primary ticketing agent, from primary agent to secondary reseller or to consumer) with the consent of both parties (via their digital signature on the blockchain). The unique identifier of that ticket is then re-associated with the public key of its new owner.

A variety of access control solutions can be implemented on top of this process, the most simple of which is simply using the digital signature to prove the attendee's ownership of the public key and thus the associated ticket. The Protocol aims to support a wide variety of access control needs, giving event organisers and venues the choice and control that is critical to them. For example, if extra confidence and security is required upon the door, specific identity validation requirements (for example facial recognition, voice analysis, fingerprinting) can be tied to the ticket owner's public key (as long as the data can be obfuscated and encoded on the Protocol).

3.3.1 Secondary Market

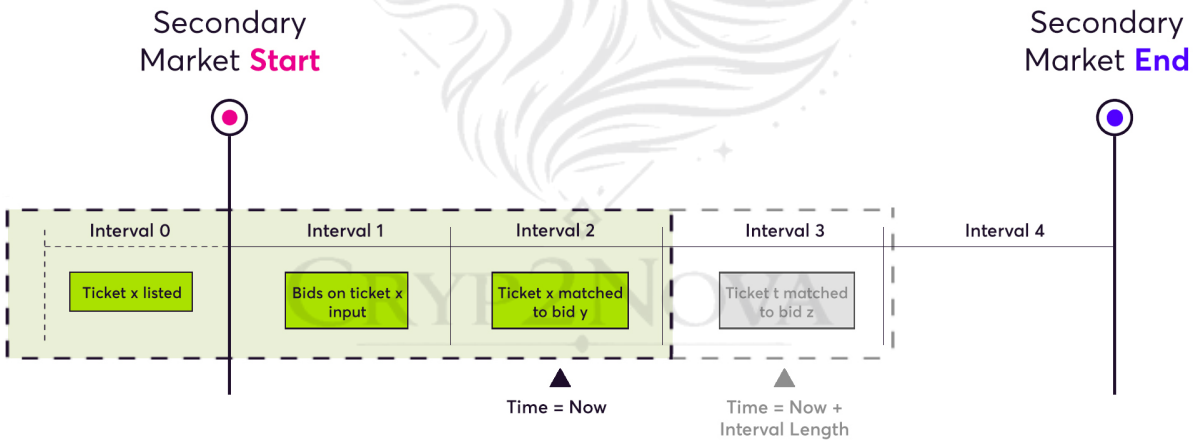


Figure 3: The Secondary Ticket Market

The secondary market's functionality within the Aventus ecosystem is depicted in figure 3 and works as follows:

- **Listing:** Listing a ticket requires specifying the ticket ID. A listing remains until the inventory is sold or the sale is cancelled by the seller.

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- **Buying:** Users register an interest in buying various combinations of tickets listed with secondary sellers.

- **Matching:** The Aventus community matches buyers with tickets in a pseudo-probabilistic manner.

- **Selling:** The seller submits the address of the new Ticket Owner to the Protocol, which is then recorded against the Ticket ID.

3.4 Promotion

Since the event listing and ticket selling process has been de-siloed, any validated third-party application will be able to make sales for any of the event brought to the Protocol residing in the event pool. This will mean that listing an event on the Aventus Protocol means all parties can start making sales in a completely secure and transparent manner, without unregulated touting, counterfeits or oversight issues.

Furthermore, the event creator can choose (on a per-ticket basis), to create a rewards' scheme giving a commission to promoters and primary ticket sellers. Commissions can be as complex, granular and dynamic as desired, based on off-chain determinations of the business value of the commissioned party.

This mechanism helps reduce marketing-costs and increases reach into target- markets (by decreasing the barriers to entry of becoming a sub-promoter, and allowing for the monetisation of word-of-mouth awareness-building). It also minimises the administrative overhead associated with managing compensation, since this can be completely automated by smart contracts.

There are a couple of possible attack vectors here:

Promoters cannot receive commission on their first sale, mitigating the risk that ticket-buyers could gain unfair discount through becoming a "promoter" and purchasing the ticket "through" themselves.

Tickets sold in the secondary market are not eligible for promoter commission, eliminating the risk that a promoter bulk-purchases tickets "through" themselves to re-sell on the secondary market, generating unfair commissions and unwarranted high promotional ranking.

3.5 Market Price Oracle

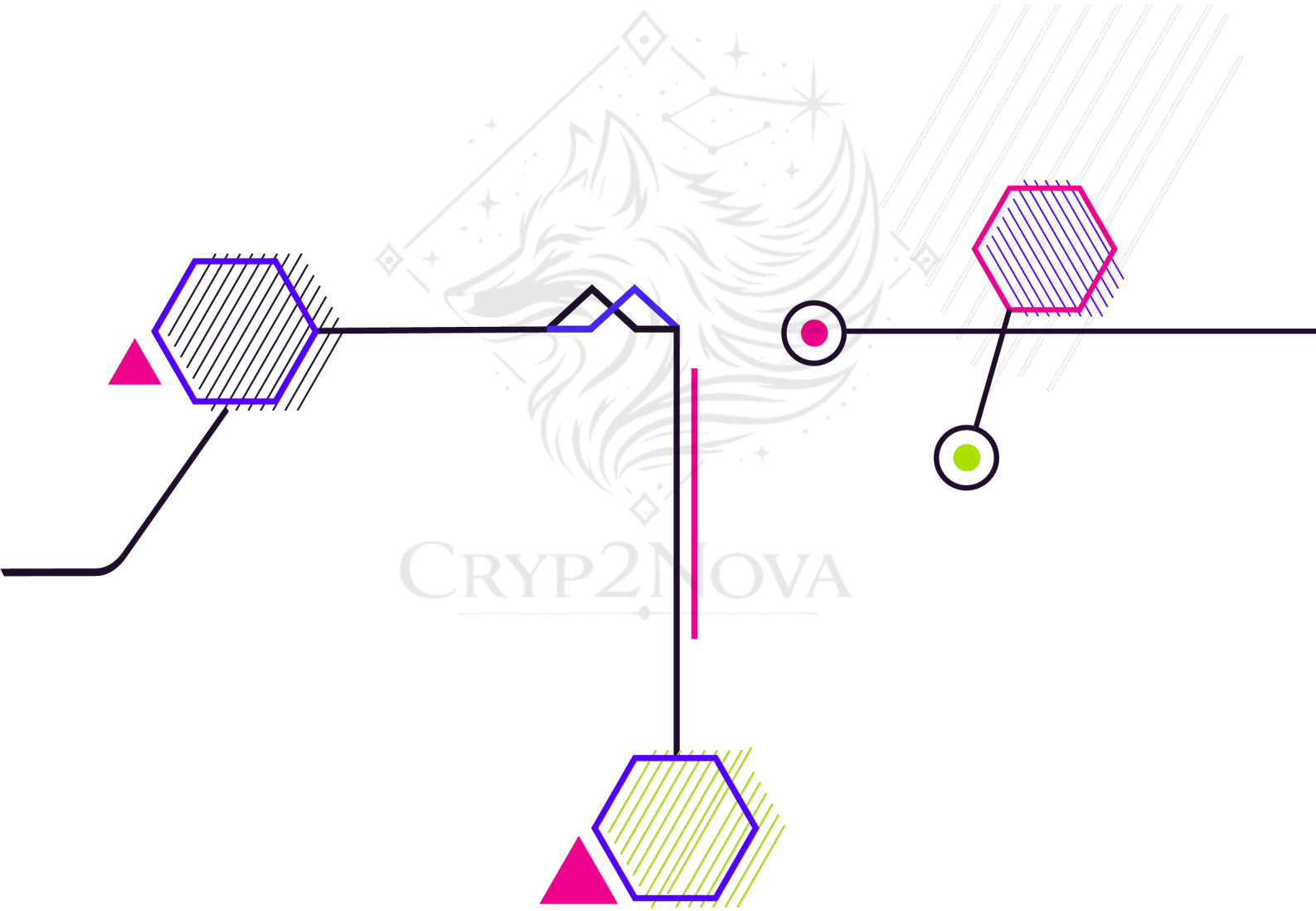
Blockchains cannot access information not contained within them. Therefore, additional data required by the Aventus Protocol must be inserted into the Blockchain.

Problem: The party controlling the data sent into the system can affect the Protocol's behaviour.

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Solutions:

1. We will use existing trusted solutions (such as Oraclise) and provide our own oracle smart-contract. We will allow event-hosts to decide which oracle to use for the market price-feed from a list of options approved by the Aventus Community.
2. AVT is listed on a number of decentralised exchanges, including AirSwap and SharkRelay. By averaging the price across these exchanges, we will be able to derive a reliable price.



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4 Beta Release (June 2018)

As a first iteration of the Protocol, the beta release provides the first set of functionality toward a more secure, more efficient way to control the supply and transaction of tickets.

The sections below will detail how current functionality differs from the future vision of the Aventus architecture, with subsections corresponding to those above in Section 3:

4.1 Aventus Registry

Within the beta version of the Protocol, the Aventus Registry tracks:

- A list of the legitimate third party applications using the Protocol
- A list of the non-fraudulent events within the Protocol
- Challenges to the legitimacy of events stored on the Protol, and votes on these
- Parameters determining system deposits and time periods
- Proposals for changes to system parameters, and votes on these
- Deposits and voting stakes of community members

Currently, only the legitimacy of events on the Protocol can be challenged by the Aventus Community.

4.1.1 Legitimate third party applications using the Protocol

A third party application that wishes to use the Protocol must make an AVT deposit from the address they wish to use, and then submit this address to Aventus to be added to the approved list of legitimate applications. Upon receipt and verification of a request and its accompanying deposit details, Aventus will add the address to the approved list, which is held on the Protocol.

4.1.2 Non-fraudulent events within the Protocol

Current functionality is as described in 3.1.2.

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4.1.3 System parameters

All parameters in the system (such as the application-listing deposit, the event-creation deposit or the time period in which an event can be reported) are currently fixed. Community members can put forward proposals to change these parameters. In the beta version of the Protocol, these proposals are non-binding and are implemented at the discretion of Aventus.

4.2 Event

Upon paying an event-creation deposit in AVT, the event creator (usually a promoter or event organiser) uploads the event details to the Protocol, together with a URL which references all supporting information for the validity of the event. This generates an Event ID on the blockchain.

As detailed in 3.2., event creators have the option to create private events (wherein they must sign off on any ticket sold), or to whitelist approved primary market sellers to interact with their inventory. Within the beta version of the Protocol, event creators cannot currently define revenue-split from ticket sales between different parties within the supply-chain.

The reporting period and life-cycle of the event occur as outlined in 3.2.

4.3 Ticket Sales

The current definition of a ticket within the Protocol consists of:

- **Ticket ID:** A sequential identifying number for each ticket per event.
- **Event ID:** A sequential identifying number for each event submitted to the Protocol.
- **Ticket Details:** information unique and specific to a particular ticket, such as seat number, entrance gate, ticket type.
- **Ticket Owner:** the blockchain address of the ticket owner, who can be granted access to the ticketed event.
- **Ticket Status:** an indicator showing whether the ticket is valid or not.

As outlined in 3.1, the Ticket Details are sent to the Protocol along with the Event ID and Ticket Owner. The Protocol then generates a unique Ticket ID, which is stored on the blockchain and associated with the Ticket Owner.

4.3.1 Secondary Market

Within the current version of the Protocol, it is not yet possible for users to register an interest in buying a particular type of ticket, and no matching calculations have yet been implemented.

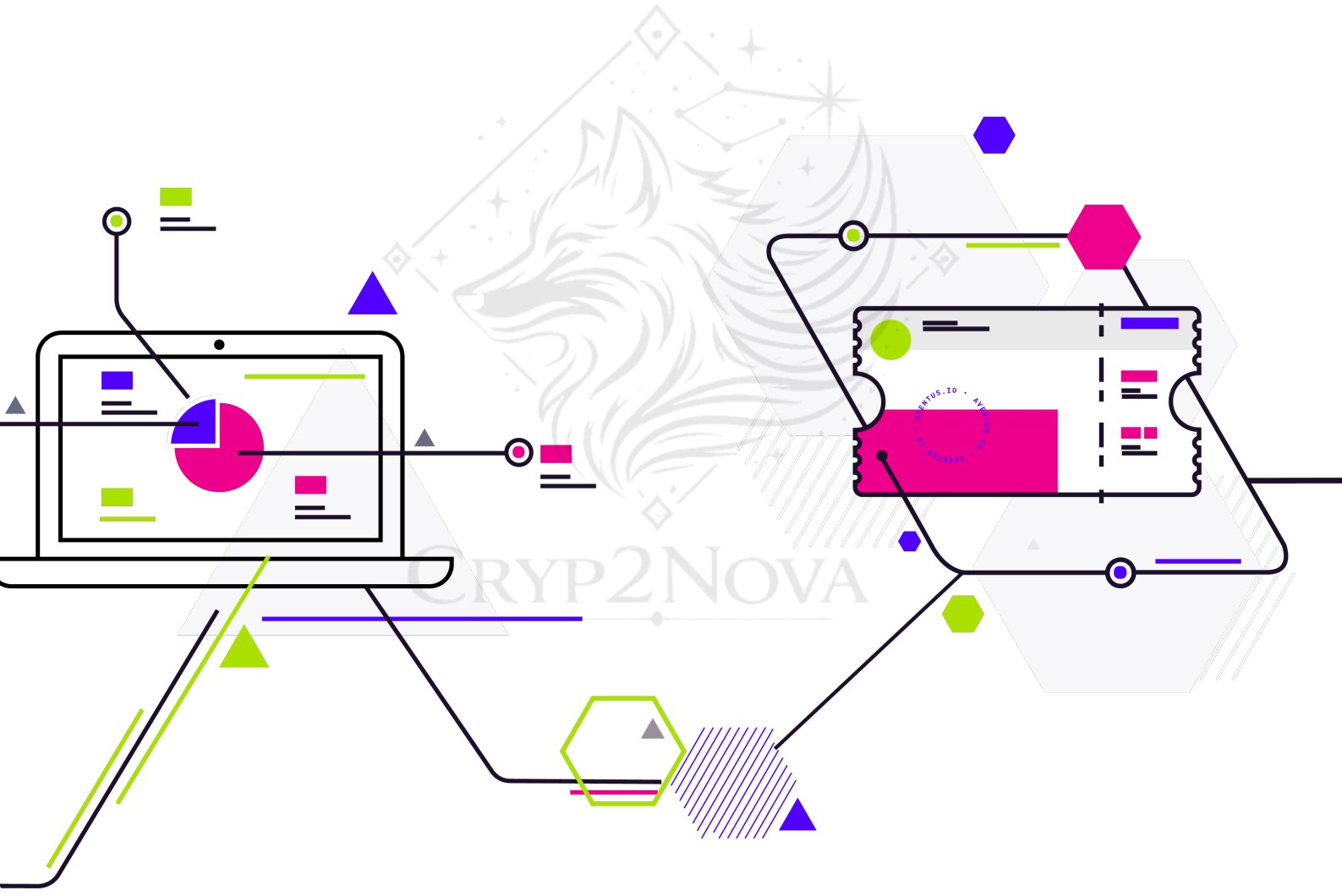
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4.4 Promotion

The commissioning capabilities discussed in 3.6 have not been implemented in the beta version of the Protocol.

4.5 Market Price Oracle

No market price oracle has been integrated in this version; this process is currently carried out manually.



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5 Roadmap

5.1 The Story So Far

An Alpha version of the Protocol providing scaled-down functionality was released on the Rinkeby Public TestNet in July 2017 for community review and comment.

Full source-code for the Beta release was initially made available to the public in May 2018.
An in-depth audit of this source-code was carried out by Solidified.io, the leading technical auditing service for Ethereum smart contracts, whose 150+ community of Solidity experts has previously audited over 40 companies (including Polymath, Melonport, Bankera and Spring Role).

After undergoing a successful auditing process which exposed zero critical issues, the Protocol was deployed in Beta onto the Ethereum MainNet in June 2018. Developers can now access the Protocol and accompanying source-code, giving them the tools to begin building (or expanding existing) ticketing applications and services to take advantage of the benefits of blockchain.

Within beta, some elements of the ecosystem remain centralised while we iterate and develop the Protocol (for example, see Section 4.1.3). From Version 1.0 onwards, once use of the Protocol has been established, control over system parameters will be handed to the AVT community, creating a fully decentralised solution.

5.2 Looking to the Future

Rather than define a precise and time-bound product roadmap, Aventus is working actively and collaboratively with the ticketing industry to create an agile approach to the Aventus ecosystem based on client feedback and constant iteration. We believe this is the right way to test and challenge assumptions (both the industry's and our own), educate (and learn from) key industry players, and ultimately drive blockchain adoption at a business and consumer level. We believe this demand-driven, business-led approach means that the Protocol will become something of true value, which can revolutionise the ticketing industry from the bottom up.

However, there are a number of services and solutions that we are currently working on and expect to implement as user-demand dictates. Some of these will be free-at-the-point-of-use, whereas others will incur additional costs. Our current vision for the future and function of the Aventus solution architecture is detailed below, in Figure 4. The future solution architecture builds upon the Aventus ecosystem as detailed in

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Section 2.1, by exploring ways to make the Protocol more scalable, accessible and performant.

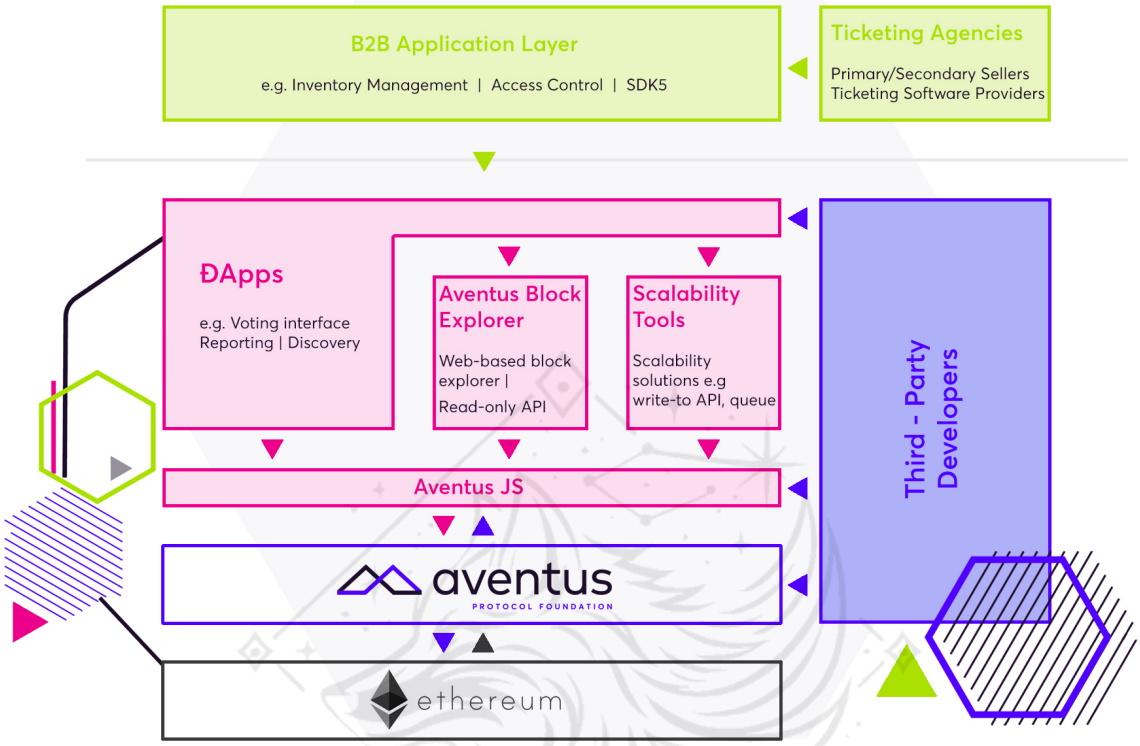


Figure 4: Potential Future Architecture

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The function of the Protocol itself and of the underlying Ethereum blockchain has already been covered in detail in this paper, so will not be repeated here.

5.2.1 AventusJS

AventusJS is a JavaScript library which uses web3js to enable Đapps to interact with the Aventus Protocol. It exposes APIs for all of the functionality of the Protocol without having to directly interact with the Ethereum blockchain using web3js or JSON RPC. By providing more familiar tools to work with, AventusJS lowers the barriers to entry for traditional developers (both internal and third-party) wishing to build blockchain-enabled ticketing apps and services, by making it far easier to communicate with the Aventus Protocol.

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5.2.2 Scalability Tools

A common criticism of the blockchain is that it is very slow (in computing terms), and difficult to scale. This is by design, due to its very nature as a distributed, peer-to-peer network requiring consensus between all nodes. Co-founder of Ethereum, Vitalik Buterin, co-founder of Ethereum said earlier this year that "the Ethereum community, key developers and researchers and others have always recognized scalability as perhaps the single most important key technical challenge that needs to be solved in order for blockchain applications to reach mass adoption." [33]

Third-party professional service provider Artos Systems currently utilises a write-to API to handles this issue off-chain, by holding all transactions within a queueing system and pushing them to the Protocol incrementally. The API also monitors current gas prices on Ethereum, and utilises this information to optimise the flow of transactions based on cost.

While this process is currently handled centrally, third-party service providers are actively exploring cutting-edge decentralised solutions, both by developing internal proof of concepts and evaluating new externally-developed options.

5.2.3 Aventus Block Explorer

The Aventus Block Explorer is an open-source web tool that provides a detailed overview of events and ticketing data stored on the Aventus Protocol via a read-only API. This allows users to get an easily accessible view of information on the Protocol for reviewing, reporting and analytical purposes, direct from the browser, without needing to interact directly with the Protocol itself.

5.2.4 ĐApps Application Layer

The ĐApp layer is concerned with the creation of decentralised applications which optimise use of the Protocol and enable it to better fulfil its function. These will allow the Aventus ecosystem to better fulfil its capacity as a decentralised due-diligence mechanism for the entertainment industry, by more easily enabling the Aventus community to engage with, analyse, and vote upon proposals.

ĐApps will include elements such as:

- Voting interfaces for issuing of and interaction with proposals and challenges.
- Reporting and analytics functionality built upon Aventus Block Explorer.
- Support for off-chain payments.
- Automated matching processes for the secondary market on the Protocol (see Section 2.3.2).
- Template user interfaces for third-party developers creating their own applications.

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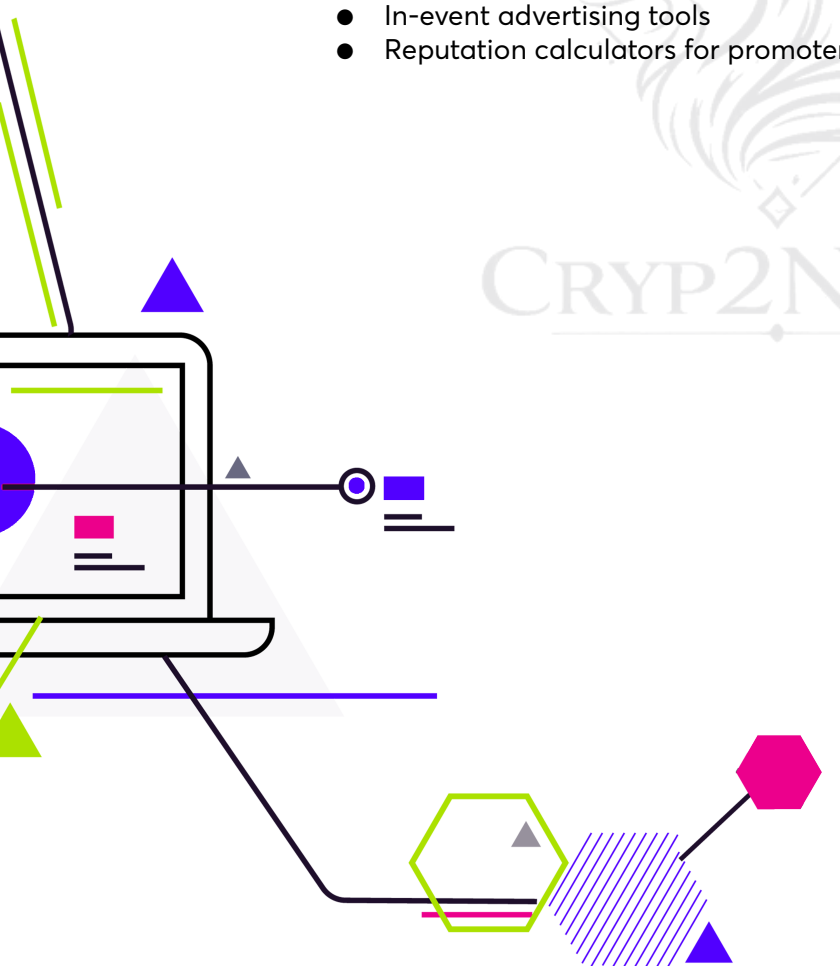
5.2.5 Third-party B2B Application Layer

The Aventus Protocol is open-source and freely available for all in the industry to benefit from. Third-party professional service providers, ticketing agencies and developers will be able to work with the Protocol to develop consumer-led, blockchain-ready ticketing applications. Ticketing providers wishing to engage with the Aventus Protocol can choose to:

- Utilise their own in-house technical resources to build directly upon the Protocol, utilising the modules and toolkits provided by Aventus in on open source capacity.
- Partner with third-party service providers and developers to leverage their internal expertise and existing services, in order to integrate with the Protocol more rapidly and effectively - for example by optimising processes around scalability, cryptocurrency volatility, and key management.

Some of the B2B apps currently being developed by third-parties, or with potential to be developed in the future, include:

- Inventory management solutions
- Consumer-ready, whitelabel blockchain ticket wallets
- Ethereum account management platforms
- SDKs and REST APIs enabling faster integration with existing internal software and processes (already available)
- Integration with micro-sales channels (e.g. social media, music streaming platforms)
- Access control solutions incorporating a range of identification criteria
- In-event advertising tools
- Reputation calculators for promoters to aid commissioning decisions



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