# Allocating Taxing Rights in the Cross-Border Supply of Digital Goods for Value-Added Tax Purposes on Blockchain

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**SUMMARY**

The main objective of this article is to explore how blockchain technology can be used to identify a consumer and, in the process, allocate to the appropriate jurisdiction the taxing rights in business-to-consumer supplies of digital goods. Assigning the taxing rights in the cross-border supply of digital goods for value-added tax (VAT) purposes to the relevant jurisdiction enables countries to impose VAT on such supplies. Generally, VAT systems use the customer's residence as a proxy to predict the jurisdiction where consumption occurs by establishing a link between the supply and the final place of consumption. For example, the Value-Added Tax Act 89 of 1991 provides that a consumer's residence can be used to determine the place of consumption. However, the use of place-of-taxation rules does not accurately establish whether a consumer is located in South Africa. If the identity of a consumer is established, the place of consumption can also be determined. This article finds that blockchain technology can be used as a tool to determine the place of consumption for the supply of digital goods. The article makes recommendations for policymakers to consider looking at blockchain to ascertain the place of consumption for the supply of digital goods.

KEYWORDS: blockchain, value-added tax, taxing rights, digital goods, place of consumption, proof-of-location

## 1 INTRODUCTION

The e-commerce landscape has revolutionised the global trade of goods and services. E-commerce enables consumers to buy goods and services seamlessly over the Internet using devices such as smartphones, laptops and tablets. These devices are very accessible and allow users to buy goods


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from anywhere around the world.[1] Moreover, these devices provide features like instant purchases, secure payments and real-time tracking, which make the shopping experience efficient, convenient and accessible while on the go.[2] The growth of e-commerce has also coincided with the development of the digital economy. The digital economy can be defined as

> "[a]ll economic activity reliant on or significantly enhanced by the use of digital inputs, including digital technologies, digital infrastructure, digital services and data. It also refers to all producers and consumers, including government, that are utilising these digital inputs in their economic activities."[3]

In simple terms, the digital economy involves the sale of digitised products (digital goods) online. For purposes of this discussion, "digital goods" refers to physical goods that can be converted into intangible or digital form. Examples include electronic books (e-books), music, software, digital art and video games. These digital goods are always available to consumers, making it easier to purchase them. Since the digital economy transcends borders, businesses and online platforms reach consumers around the world seamlessly. The global reach has opened new markets and opportunities for businesses to expand their customer base and increase sales.[4] Customers have a wide catalogue of products that are now easily accessible for consumption.

There is a high level of mobility in the digital economy. Users are mobile because advances in information communication technology (ICT) increase connectivity, meaning that commercial activities can take place across borders.[5] This makes it easier for individuals residing in one country to purchase an intangible good or a service while staying in another country and to use the product in a third country.[6] Moreover, consumers have the capability to use virtual private networks (VPNs) to encrypt their data and mask their Internet Protocol (IP) addresses. They can also use VPNs to avoid providing sensitive information online. While using a VPN, a consumer can access services or digital goods that are not ordinarily available in the resident jurisdiction. The content provider is often unaware of the place of consumption, making it difficult to identify the consumer.[7]

Customer identification remains a key component of the digital economy. This is because businesses must identify the customer to determine the country of residence or the country in which consumption of the intangibles

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1 TechnologyRecord "Smartphones Are the Most Popular Devices for Online Shopping" (undated) https://www.technologyrecord.com/article/smartphones-are-the-most-popular-devices-for-online-shopping (accessed 2024-08-18).

2 *Ibid*.

3 OECD "A Roadmap Toward a Common Framework for Measuring the Digital Economy: Report for the G20 Digital Economy Task Force" (2020) https://www.itu.int/en/ITU-D/Statistics/Documents/publications/OECDRoadmapDigitalEconomy2020.pdf (accessed 2024-12-19) 35.

4 Subscribed.fyi "E-Commerce Characteristics: Understanding the Basics" (2024) https://subscribed.fyi/blog/e-commerce-characteristics-understanding-the-basics/ (accessed 2024-12-16).

5 OECD *Addressing the Tax Challenges of the Digital Economy, OECD/G20 Base Erosion and Profit Shifting Project, Action 1: 2014 Deliverable* (2014) 85.

6 *Ibid*.

7 *Ibid*.

occurs. Without this information, businesses are left with the burdensome task of trying to establish the country in which consumption takes place.[8] This lack of information poses challenges for value-added tax (VAT) systems because it often results in no or inappropriately low amounts of VAT being collected, which creates potential competitive pressures on domestic suppliers.[9] If VAT is imposed on the supply, the consumption of the digital goods or services is subject to value-added tax (VAT) in the jurisdiction where the digital goods and services are consumed. Tax authorities have the difficult task of ensuring that VAT rules provide for adequate cross-border taxation of digital goods and services. If the rules are not properly administered, it results in erosion of the tax base. In addition, e-commerce transactions relay information on electronic media rather than on paper. Tax authorities do not have access to these forms of electronic media. Instead, tax authorities rely on information provided by entities that are located outside the tax authority's jurisdiction. While such an exchange of information is a viable option, it requires knowledge of the supplier's origin and dissemination of valuable information to the tax authority where the consumption took place.[10] If the relevant information is lacking, VAT cannot be collected and remitted to the relevant tax jurisdiction. If the relevant information is not forthcoming, enforcement in terms of VAT laws remains unrealistic.

Owing to the challenges mentioned above, the allocation of taxing rights in the cross-border supply of digital goods remains difficult. Ordinarily, place-of-supply rules are implemented to determine the jurisdiction in which the supply will be subject to VAT and the place of consumption.[11] Place-of-supply rules act as proxies to ascertain whether taxation took place and where the goods or services are consumed.[12] However, the place-of-supply rules are not applied uniformly around the world, while in some jurisdictions, the place-of-supply rules are not explicit in VAT legislation. In addition, the place-of-supply rules do not accurately depict the location of a consumer.

Recent developments in technology offer an opportunity to simplify, modernise and strengthen the place-of-supply rules to ensure the allocation of taxing rights in the cross-border supply of digital goods or services. This article considers whether blockchain is a viable tool to identify the consumer in terms of the place-of-supply rules contained in section 7(1)(*a*) and (*c*) of the South African Value-Added Tax Act[13] (the VAT Act). The article is organised into three main sections. The first section looks at the rules that determine the place of consumption. The second section discusses the current place-of-supply rules for the cross-border supply of digital goods under the VAT Act. The third section examines the role of blockchain in

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8 OECD *Addressing the Tax Challenges of the Digital Economy* 138.

9 OECD *Addressing the Tax Challenges of the Digital Economy* 135.

10 OECD *Addressing the Tax Challenges of the Digital Economy* 138.

11 Fryer *The VAT Implications of E-Commerce Goods and Services Imported to South Africa* (MCom mini-dissertation, North-West University) 2014 78.

12 De la Feria "Place of Where the Supply/Activity Is Effectively Carried out as an Allocation Rule: VAT vs Direct Taxation" (2009) *Oxford University Centre of Business Taxation Working paper 09/06* https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3481357 (accessed 2024-12-19) 2.

13 89 of 1991.

allocating taxing rights in the cross-border supply of digital goods. For purposes of this article, the terms “digital goods” and “electronic services” are used interchangeably. This article only discusses the cross-border supply of digital goods in business-to-consumer (B2C) transactions.

## 2 DETERMINING THE PLACE OF CONSUMPTION

### 2 1 The destination principle vs the origin principle

The origin principle taxes exports, and VAT is levied at the rate of the jurisdiction where the goods originate. It also implies that imports are zero-rated. This means that the seller collects VAT at the point of origin of the e-commerce sale.[14] In contrast to the destination principle, the origin-based principle of taxation is easier to administer and enforce because the tax administrators are in the same jurisdiction as the seller.[15] Moreover, the seller is subject to audit by the tax officials, meaning that the compliance rate with origin-based rules is expected to be high.[16] This is not the case with a destination-based tax system because the seller and consumer are in different jurisdictions. The seller requires a nexus to the destination jurisdiction to ensure that VAT is paid. Since it is likely that the seller does not have a physical presence in the destination country, the nexus is the consumer. Therefore, enforcement in a destination-based taxation system is more challenging because it relies on the seller’s ability to establish efficiently and accurately a nexus to the consumption jurisdiction. Without a nexus, it can be argued that VAT collection remains difficult.

In terms of the destination principle, VAT is levied on imports. In other words, VAT is collected in the jurisdiction where the goods or services are consumed. The destination principle allows governments to collect revenue in the jurisdiction where the goods or services are used or consumed.[17] The destination principle implements zero-rating on exports. This means that the supply of exports is taxed at a rate of 0 per cent and no output tax is charged.[18] Under the destination principle, jurisdictions collect the same tax on domestic and foreign production.[19] The benefit of adopting the destination principle is that it is less likely to distort the location of economic activity as compared to the origin-based principle of taxation.[20] Basu argues that another benefit of the destination-based principle of taxation is that taxing consumption is more favourable because it benefits public services, since the origin principle promotes a production tax.[21]

The Organisation for Economic Co-operation and Development (OECD) prefers the application of the destination principle in VAT systems because it

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14 Basu *Global Perspectives on E-Commerce Taxation Law* (2007) 269.
15 Basu *Global Perspectives on E-Commerce Taxation Law* 270.
16 *Ibid*.
17 Ebrill, Keen, Bodin and Summers *The Modern VAT* (2001) 176.
18 Silver and Beneke *Deloitte VAT Handbook* 10ed (2019) 16.
19 Basu *Global Perspectives on E-commerce Taxation Law* 268.
20 Basu *Global Perspectives on E-commerce Taxation Law* 267.
21 Basu *Global Perspectives on E-commerce Taxation Law* 268.

achieves neutrality in international trade.[22] According to the OECD's tax neutrality principle: a) businesses should not bear the burden of VAT except where explicitly provided for in legislation; b) businesses in similar situations carrying out similar transactions should be subject to similar levels of taxation; c) VAT rules should be framed in such a way that they are not the primary influence on business decisions; d) foreign businesses should not be disadvantaged nor advantaged compared to domestic businesses in the jurisdiction where the tax is due and payable; e) foreign businesses should not incur irrecoverable VAT; and f) where specific administrative requirements for foreign businesses are deemed necessary, they should not create a disproportionate or inappropriate compliance burden for the businesses.[23]

Since the destination principle is adopted by the OECD, the remainder of the article discusses the rules associated with determining the place of consumption in jurisdictions that apply the destination principle.

## 2 2 Place-of-supply rules

According to the OECD, VAT neutrality in international trade is achieved by implementing the destination principle.[24] To apply the destination principle, jurisdictions use place-of-supply rules to determine the place of consumption. Place-of-supply rules are rules that determine whether the necessary connection exists between the jurisdiction whose law is being applied and the subject matter of the tax.[25] Each jurisdiction has its own place-of-supply rules in its respective legislative framework. Where explicit place-of-supply rules are lacking, proxies are used to anticipate the place where the goods or services are consumed. Proxies aid suppliers by predicting the country where the goods or services are consumed. For example, the importation of physical goods uses the location of goods or the destination of the goods as a proxy to predict where the goods will be consumed.[26] VAT from imports is collected at the same time as customs duty when goods arrive at the destination country for the first time.[27]

The collection of VAT from intangibles is not so straightforward. Since intangible goods are difficult to track, it is difficult to predict where these intangible goods will be consumed. To aid suppliers in predicting the place where the intangibles will be consumed, determining the customer's residence is the most appropriate approach used to determine the place of taxation.[28] This is because residence provides a nexus to an identifiable

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22 OECD "International VAT/GST Guidelines" (2017) http://dx.doi.org/10.1787/9789264271401-en (accessed 2025-01-08) 16.

23 OECD "OECD International VAT/GST Guidelines Draft Commentary on the International VAT Neutrality Guidelines" (2012) https://web-archive.oecd.org/pdfViewer?path=/2013-02-20/200993-50667035_ENG.pdf (accessed 2026-08-18) 4.

24 OECD "International VAT/GST Guidelines" 38.

25 Millar "Jurisdictional Reach of VAT" (2008) *The University of Sydney Law School Legal Studies Research Paper No 08/64* https://papers.ssrn.com/sol3/papers.cfm?abstract_id=1162510 (accessed 2025-01-08) 175.

26 Millar "Jurisdictional Reach of VAT" 182.

27 OECD "International VAT/GST Guidelines" 17.

28 OECD "International VAT/GST Guidelines" 66.

place. This approach allows for the presumption that the consumer consumes intangible goods at their usual place of residence. It also allows supplies made by foreign businesses to be taxed at the same rate as domestic supplies to ensure VAT neutrality.[29]

Against this backdrop, where the supply of services is physically performed at a set time and place where the services are also consumed in the presence of both the person performing the supply and the person consuming it, the OECD recommends a place-of-taxation rule based on the place of performance.[30] These types of supplies are referred to as "on-the-spot" supplies and often consist of restaurant and catering services, hairdressing, tickets to a cinema and attendance at sports competitions. Consumption requires both parties to be physically present in the same jurisdiction. The allocation of taxing rights goes to the jurisdiction where the consumer is located when the supplies are consumed, and to the location of the person performing the supply at the time of consumption.[31]

Where a supply of intangible goods occurs and the supplier and the consumer are not physically present in the same jurisdiction, the place of taxation is the customer's residence.[32] Here, it is possible that the time of performance and time of consumption differ. As a result, the allocation of taxing rights goes to the jurisdiction where the consumer usually resides. Examples of these kinds of supplies include online gaming, supplies of digital content, supplies of software and telecommunication broadcasting services.[33]

It remains important to establish the residency of the consumer. According to the OECD, the residency of a consumer is generally where the customer regularly lives or has a home. A consumer is not deemed to be a resident of a country if they visit a jurisdiction or attend a conference in another jurisdiction.[34] The supplier relies on information from the transaction, such as the type and value of the supplies and the circumstances related to the delivery of the supplies.[35] To aid suppliers, proxies such as the billing address, credit-card details, bank information and even telephone number are used to establish the residence of the consumer. This information is often provided by the consumer during the ordering process.[36]

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29 *Ibid*.
30 *Ibid*.
31 OECD "International VAT/GST Guidelines" 67–68.
32 *Ibid*.
33 OECD "International VAT/GST Guidelines" 68–69.
34 OECD "International VAT/GST Guidelines" 69.
35 *Ibid*.
36 OECD "International VAT/GST Guidelines" 70.

# 3 THE PLACE-OF-SUPPLY RULES IN SOUTH AFRICA

## 3 1 The VAT Act 89 of 1991

In South Africa, VAT is levied at a prescribed percentage – presently 15 per cent. Statutorily, VAT is levied on: a) the supply of goods or services by a vendor in the course or furtherance of any enterprise by them; b) the importation of any goods into South Africa by any person; and c) the supply of any imported services by any person subject to exemptions, exceptions, deductions and adjustments provided for in the Act.[37] VAT liability rests on the vendor where they make a supply in the course of or furtherance of any enterprise. If a person imports any goods into the country, they are responsible for levying and paying VAT. Lastly, the recipient of the imported services is responsible for paying VAT on that supply.[38] Although not explicitly stated in the VAT Act, South Africa follows the destination principle because VAT is levied on imports.[39]

The discussion that follows only considers the place-of-supply rules where a person imports services into South Africa and where a vendor supplies goods or services in the course or furtherance of an enterprise.

## 3 2 Place-of-supply rules in terms of section 7(1)(*a*) of the VAT Act

As mentioned above, section 7(1)(*a*) of the VAT Act provides that a vendor must levy VAT at 15 per cent on the supply of goods or services in the course or furtherance of any enterprise. To determine the place-of-supply rules in terms of section 7(1)(*a*) of the VAT Act, it is important to analyse the definitions of "vendor", "enterprise" and "electronic services".

### *3 2 1 The definition of "vendor"*

A vendor is any person who is, or is required to be, registered under the VAT Act.[40] A person who carries on an enterprise and is not registered is liable to register at the end of any month where the total value of taxable supplies made by the person exceeds R1 million in any consecutive 12-month period.[41] In practical terms, a foreign supplier who supplies electronic services to a South African consumer becomes liable to register in South Africa after the supplies exceed R1 million in a 12-month period. The foreign supplier is required to levy VAT at 15 per cent and remit the VAT collected to the South African Revenue Service (SARS). This also implies that

37 S 7(1) of the VAT Act.

38 S 7(2) of the VAT Act.

39 S 11(1) read with the definition of "export" in s 1 of the VAT Act; see also Van Zyl *The Collection of Value-Added Tax on Online Cross-border Trade in Digital Goods* (unpublished LLD thesis, University of South Africa) 2013 69.

40 See s 1 of the definition of "vendor" in the VAT Act.

41 S 23(1A) of the VAT Act.

determining the place of supply is closely linked to whether a person[42] is a vendor and whether they are carrying on an enterprise in South Africa.

### *3 2 2 The definition of "enterprise"*

Section 1 of the VAT Act defines "enterprise" as follows:

> "In the case of any vendor, any enterprise or activity which is carried on continuously or regularly by any person in the Republic or partly in the Republic and in the course or furtherance of which goods or services are supplied to any other person for a consideration, whether or not for profit, including any enterprise or activity carried on in the form of a commercial, financial, industrial, mining, farming, fishing, municipal or professional concern or any other concern of a continuing nature or in the form of an association or club."[43]

This definition implies that a supplier must have some form of physical presence in South Africa for them to be carrying on an enterprise. If the supplier has a physical presence in South Africa, it is much simpler to determine the jurisdiction where the economic activities are taking place. If, however, the supplier has no physical presence in South Africa but supplies electronic services to South Africa, then it becomes difficult to associate the transactions with a specific location.[44] As a result, a deeming provision was inserted in the VAT Act to ensure that foreign suppliers of electronic services to South Africa are deemed to be carrying on an enterprise in South Africa.

In terms of the VAT Act, a foreign supplier is deemed to be carrying on an enterprise in South Africa if they make a supply of electronic services from a location outside South Africa and at least any two of the following three requirements are present: a) the recipient of the electronic services is a resident of South Africa; b) the payment for the electronic services originates from a bank registered in South Africa in terms of the Banks Act 94 of 1990; and c) the recipient has a business address, residential address or postal address in South Africa.[45]

The effect of this provision is that the foreign supplier must ensure that they establish the identity, and by implication, the residency, of the consumer of electronic services. The foreign supplier must use available resources at its disposal to ascertain the jurisdiction where the goods are consumed. Therefore, the foreign supplier must use information supplied by the consumer, such as the latter's physical address, postal address, and credit-card details, to determine the country of consumption. Two of the proxies mentioned in the VAT Act must be present to arrive at a conclusion that consumption occurred in South Africa. Information that the foreign supplier can retrieve by itself, such as the IP address (if possible), can be used in addition to the addresses to determine the location of the consumer.

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42 A "person" is defined as including: "any public authority, any municipality, any company, any body of persons (corporate or unincorporated), the estate of any deceased or insolvent person and any trust fund". See s 1 of the definition of "person" in the VAT Act.

43 S 1(*a*) of the definition of "enterprise" in the VAT Act.

44 See Kabwe and Van Zyl "Value-Added Tax in the Digital Economy: A Fresh Look at the South African Dispensation" 2021 42(3) *Obiter* 499 510.

45 Par *(b)*(iv) of the definition of "enterprise" in the VAT Act.

Whether the proxies in the VAT Act are sufficient for accurate identification of the consumer or to establish the location of the consumer is questionable. Since the place-of-supply rules are not clearly stated in the VAT Act, the foreign supplier relies on the proxies to determine the place of consumption. Zulch makes the following argument: considering that the place-of-supply rules are closely linked to the definition of "enterprise", and the location of the enterprise is linked to the customer's location, it can be deduced that the place of supply of the cross-border supply of electronic services by a foreign supplier is the customer's location.[46]

### *3 2 3 The definition of "electronic services"*

The VAT Act does not specifically define the term "digital goods", but its definition can instead be inferred from the definition of "services" and "electronic services". Services are defined as:

> "Anything done or to be done, including the granting, assignment, cession or surrender of any right or the making available of any facility or advantage, but excluding a supply of goods, money or any stamp, form or card contemplated in paragraph *(c)* of the definition of goods."[47]

The definition of "electronic services" is not contained in the VAT Act. The definition can be found in the Regulations under the VAT Act.[48] The Regulations define "electronic services" as:

> "any services supplied by means of an electronic agent, electronic communication or the Internet for any consideration, other than – a. educational services supplied from a place in an export country and regulated by an educational authority in terms of the laws of that export country; b. telecommunications services; or c. services supplied from a place in an export country by a company that is not a resident of the Republic to a company that is a resident of the Republic if – i. both those companies form part of the same group of companies; and ii. the company that is not a resident of the Republic itself supplies Electronic services it exclusively discovered, devised, developed, created or produced for the purposes of consumption of those services by the company that is resident of the Republic; d. services supplied from a place in an export country by a person that is not a resident of the Republic where such services are supplied solely to vendors registered in the Republic in terms of section 23 of the Act ."[49]

The definition of "electronic services" is broad enough to include all digital goods supplied over the Internet. However, Kabwe and Van Zyl note that there are instances where double taxation could arise owing to the interpretation of the term "electronic services". The authors give the example of a simultaneous broadcast of a live concert that physically takes place in the United Kingdom (UK), and which may be subject to VAT in both the UK

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46 Zulch *South African Value-Added Tax: Place of Supply Rules for Cross-Border Supplies of Services – A Comparative Analysis With Chapter 3 of the OECD's International VAT/GST Guidelines* (MCom research paper, Stellenbosch University) 2017 33.

47 S 1 of the definition of "services" in the VAT Act.

48 "Regulations Prescribing Electronic Services for the Purpose of the Definition of 'Electronic Services' in Section 1(1) of the Value-Added Tax Act, 1991" GN 5993 in *GG 52293* of 2025-03-14.

49 Reg 2 of the Regulations Prescribing Electronic Services.

and in South Africa if viewed in South Africa.[50] This can be resolved by inserting a provision that clearly considers the place of supply to be the place where the services are used and consumed.[51]

### *3 2 4 The definition of "intermediary"*

The VAT Act defines an "intermediary" as

> "[a] person who facilitates the supply of electronic services supplied by the electronic services supplier and who is responsible for issuing the invoices and collecting payment for the supply."[52]

For VAT purposes, an intermediary can be an online platform that supplies digital goods to consumers in South Africa on behalf of a foreign supplier. Should this be the case, the intermediary will be carrying on an enterprise in South Africa.[53] Moreover, the intermediary is deemed to be supplying digital goods to the recipient and, as such, will be liable to account for and remit VAT to SARS. The VAT Act does not state specifically whether the intermediary is responsible for establishing the identity of the consumer or the place of consumption. It can be argued that since the intermediary will be carrying on an enterprise in South Africa, the onus rests on them to use the proxies in the VAT Act to ascertain the place of consumption.

## 3 3 Place-of-supply rules in terms of section 7(1)(*c*) of the VAT Act

The taxation of digital goods under section 7(1)(*c*) applies where the provisions of section 7(1)*(a)* are not applicable – for example, when a South African consumer imports services (digital goods) from a foreign supplier who is registered for VAT purposes but fails to collect or remit VAT.[54] "Imported services" is defined as

> "a supply of services that is made by a supplier who is resident or carries on business outside the Republic to a recipient who is a resident of the Republic to the extent that such services are utilised or consumed in the Republic otherwise than for the purpose of making taxable supplies."[55]

In terms of the definition, a consumer must be a resident of South Africa. Since the VAT Act does not expressly define the term "resident", the meaning can be found in the Income Tax Act.[56] In terms of the Income Tax Act, a person is resident in South Africa if they are ordinarily resident or if

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50 Kabwe and Van Zyl 2021 *Obiter* 506–507.

51 See Van Zyl "Determining the Place of Supply or the Place of Use and Consumption of Imported Services for Value-Added Tax Purposes: Some Lessons for South Africa From the European Union" 2013 25(4) *South African Mercantile Law Journal* 534 549–550.

52 S 1 of the definition of "intermediary" in the VAT Act.

53 Par *(b)*(vii) of the definition of "enterprise" in the VAT Act.

54 See Kabwe and Van Zyl 2021 *Obiter* 516.

55 S 1 of the definition of "imported services" in the VAT Act.

56 58 of 1962.

they meet the physical presence test.[57] The second requirement is that the recipient must utilise or consume the services in South Africa and must not use the services to make taxable supplies.[58]

The issue regarding whether a consumer has "utilised" or "consumed in South Africa" is difficult to ascertain because the terms are not specifically defined in the VAT Act. A comprehensive discussion on use and consumption is not necessary for the purposes of this article.[59] Generally, where services are physically rendered outside South Africa but consumed in the Republic, a practical approach should be used to determine whether services are utilised or consumed in South Africa.[60] A consumer who purchases digital goods and consumes the goods in South Africa is liable to pay VAT if the foreign supplier does not or fails to account for VAT to SARS. In this instance, Zulch correctly argues that the place of the cross-border supply of digital goods is the consumer's residence, being South Africa, insofar as the digital goods are used or consumed in South Africa. Thus, it can be argued that the consumer's residency acts as a proxy for determining the location where the digital goods are consumed.[61]

## 4 BLOCKCHAIN

### 4 1 Definition and characteristics

Blockchain can be defined as a digital database that records transactions. Finck defines blockchain as

> "a distributed digital ledger that uses cryptographic algorithms to verify the creation or transfer of digital records in a distributed network."[62]

Blockchain is often described as a ledger because it functions as an online registry of transactions. For this reason, blockchain has been used interchangeably with the term "distributed ledger technology" (DLT). Distributed ledger technology is a ledger that is stored in a distributed

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57 S 1 of the Income Tax Act defines "resident" as any: "*(a)* natural person who is (i) ordinarily resident in the Republic; or (ii) not at any time during the relevant year of assessment ordinarily resident in the Republic, if that person was physically present in the Republic – *(aa)* for a period or periods exceeding 91 days in aggregate during the relevant year of assessment, as well as for a period or periods exceeding 91 days in aggregate during each of the five years of assessment preceding such year of assessment; and *(bb)* for a period or periods exceeding 915 days in aggregate during those five preceding years of assessment, in which case that person will be a resident with effect from the first day of the relevant year of assessment."

58 The definition of "taxable supplies" is: "a supply of goods or services which is chargeable with tax under section 7(1)*(a)*, including tax chargeable at the rate of zero per cent under section 11." See s 1 of the definition of "taxable supplies" in the VAT Act.

59 For a comprehensive discussion, see Van Zyl 2013 *South African Mercantile Law Journal* 534–554; Van Zyl "The Place-of-Supply Rules in Value-Added Tax: Commissioner, South African Revenue Service v De Beers Consolidated Mines Ltd" 25(2) *South African Mercantile Law Journal* 255–266.

60 *CSARS v De Beers Consolidated Mines Limited* [2012] ZASCA 103 par 37.

61 See Zulch *South African Value-Added Tax* 36.

62 Finck "Blockchain: Regulating the Unknown" 2018 19(4) *German Law Journal* 665 667.

manner across a peer-to-peer network.[63] Based on the definition, it is quite clear that blockchain is a DLT if it is used as a data structure to record transactions. If a blockchain is stored in a centralised manner, then it is not a DLT because it is not distributed.[64] As such, blockchain is a type of DLT and the two are not the same thing.

Blockchain has often been incorrectly used as a synonym for cryptocurrency. Blockchain is the technology that enables the transfer and exchange of cryptocurrencies. In fact, blockchain is the technology that enabled bitcoin[65] transactions on a peer-to-peer network, thereby making bitcoin as we know it today popular.[66] Blockchain's features have aided the development and spread of bitcoins. One important feature is blockchain's distributed nature. Since blockchain is distributed, bitcoins can be created, stored and sent on the blockchain network to anyone around the world, provided they have access to the network. Blockchain's distributed nature means that anyone can operate a node – essentially a computer that has access to the network – to store data in a distributed manner.[67] Storing data in a distributed manner has certain benefits. For example, no single party can tamper with the data stored on the network. Secondly, there is no single point of failure on the network to perform a denial-of-service attack (DoS).[68] Since there are multiple nodes, the failure of a single node does not affect the remaining nodes. Lastly, a blockchain is less susceptible to an attack since there is no master copy[69] on the ledger to target.[70]

A second distinct feature of blockchain is decentralisation. In essence, a decentralised blockchain is a network that has no central authority. The decision-making process is distributed and decentralised to all the nodes on the network. Since blockchain can be decentralised, the databases operate globally and extend across national borders.[71] There are challenges associated with a decentralised blockchain. The lack of a single authority to control the network translates to interjurisdictional issues that cannot easily be resolved.[72] For instance, the absence of a central authority removes a central point of access, which can burden the determination of jurisdiction and the imposition of legal obligations and responsibility.[73] Another difficulty

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63 Bacon, Michels, Millard and Singh "Blockchain Demystified: A Technical and Legal Introduction to Distributed and Centralised Ledgers" 2018 25(1) *Richmond Journal of Law & Technology* 1 6.

64 Bacon *et al* 2018 *Richmond Journal of Law & Technology* 6.

65 Bitcoin is a type of cryptocurrency or digital cash that operates on open-source software.

66 See Finck 2018 *German Law Journal* 668.

67 Bacon *et al* 2018 *Richmond Journal of Law & Technology* 21.

68 A denial-of-service (DoS) attack is an attempt to overload a website or network, with the aim of degrading its performance or even making it completely inaccessible. A DoS attack will result in loss of availability of part or all of a system and consume time and money to analyse, defend and overcome. See National Cyber Security Centre "Denial of Service (DoS) guidance" (date unknown) https://www.ncsc.gov.uk/collection/denial-service-dos-guidance-collection# (accessed 2025-01-15).

69 A master copy is the original creation of a file, document, recording or film.

70 Bacon *et al* 2018 *Richmond Journal of Law & Technology* 21–22; Finck *Blockchain Regulation and Governance in Europe* (2019) 18.

71 De Filippi and Wright *Blockchain and the Law: The Rule of Code* (2018) 34.

72 See Finck *Blockchain Regulation and Governance in Europe* 19.

73 *Ibid*.

lies in blockchain's inherent nature as an open-source software. As with all software, a blockchain can contain bugs. Without any formal governance structure, blockchain developers can struggle to rectify errors at a sufficiently high rate, resulting in a potentially unreliable system.[74]

Since a copy of the blockchain can exist simultaneously on all the nodes around the world, a mechanism is required to ensure that all the nodes hold a consistent and up-to-date copy of the blockchain.[75] This mechanism, referred to as "consensus", ensures that the network system functions the way it is supposed to and that the participants' behaviour is valid and appropriate.[76] From a blockchain perspective, a participant is a person who has access to the blockchain network. To achieve consensus, a node downloads the most recent version of the ledger on its computer. Then, the system rules decide when a new block should be added. If the rules are followed correctly, each node will know when to add the same new block to its copy of the ledger.[77] These rules, referred to as consensus protocol, provide consistency among all copies of the ledger on the blockchain network.[78] Of importance are the actors who generate new blocks by grouping transactions into blocks before adding them to the network.[79] These actors are known as miners, and they ensure that the new blocks are generated according to the consensus protocol. Once miners have validated the transactions and assembled them into blocks, they are rewarded with new coins in the form of a block reward and transaction fees.[80]

There are several different kinds of consensus mechanisms. For purposes of this discussion, the author limits the discussion to two. Proof-of-work (PoW) is a consensus mechanism that is most famous for its use and application in the Bitcoin blockchain. In a PoW consensus mechanism, the nodes contribute computing power to secure and maintain the system. The nodes solve a computationally difficult puzzle before the blocks containing the solution to the puzzle are accepted.[81] The consensus protocol adjusts the difficulty of the mathematical puzzle to ensure consistency in the transaction processing.[82] The PoW consensus mechanism is renowned for consuming vast amounts of electricity owing to the competition associated with solving the puzzle in the least amount of time. This requires computational resources that are relatively expensive to acquire in order to solve the puzzles.[83] On average, it takes 10 minutes to mine a block on the Bitcoin blockchain.[84]

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74 De Filippi and Wright *Blockchain and the Law* 34.

75 Bacon *et al* 2018 *Richmond Journal of Law & Technology* 22.

76 *Ibid*.

77 *Ibid*.

78 Finck *Blockchain Regulation and Governance in Europe* 20.

79 *Ibid*.

80 *Ibid*.

81 Bacon *et al* 2018 *Richmond Journal of Law & Technology* 23–24; Finck *Blockchain Regulation and Governance in Europe* 20.

82 Finck *Blockchain Regulation and Governance in Europe* 20.

83 Bacon *et al* 2018 *Richmond Journal of Law & Technology* 24–26; Finck *Blockchain Regulation and Governance in Europe* 21.

84 See Kabwe *The Use of Blockchain for Collecting Value-Added Tax on Online Cross-Border Trade in Digital Goods* (LLD thesis, University of Pretoria) 2024 67.

As a result of the expenses related to the PoW consensus mechanism, other mechanisms were developed. One such consensus mechanism is proof-of-stake (PoS). The PoS consensus mechanism uses validators to validate transactions and create new blocks. The validators are chosen based on the number of staked coins they hold. While PoW requires miners to solve puzzles, PoS requires validators to hold and stake coins or tokens for the privilege of earning transaction fees. When one block is added, the next block is added by a randomly selected validator with the largest stake position.[85] The benefit of using PoS is that it is less costly and more energy efficient than a PoW consensus mechanism.

The next feature of blockchain that must be discussed is blockchain's immutability. Blockchain's design is such that the transactions are stored in blocks. Once a block is full, it is appended to the network in a sequential manner. Each block is tied together using a hash. For blockchain purposes, a hash can be defined as

> "[a] mathematical function that converts an input of arbitrary length into an encrypted output of a fixed length."[86]

Simply put, a hash stores large amounts of data in a smaller, compact size.[87] A hash is created using a cryptographic hashing function.[88] A hash function creates a persistent, tamper-evident record of relevant transactions.[89] This process protects the integrity of the data and makes it difficult for anyone to change the data.

Blockchains promote transparency by ensuring that each node has a copy of the blockchain. Depending on the set-up of the blockchain and the access rights, transactions are visible to all participants.[90] Thus, transparency is limited to those who have the resources to access the data on the network. It can be argued that the transparency feature is one of the reasons that the participants trust the network.

## 4 2 Blockchain and smart contracts

Owing to deficiencies with the Bitcoin blockchain, software developers and programmers began exploring alternative applications that could run on blockchain. The Bitcoin blockchain was primarily designed to transfer currency (bitcoins) on a peer-to-peer network and, as a result, the system had built-in functionalities necessary to support financial transactions.[91] Following on from this, the Ethereum blockchain was created with additional

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85 The Investopedia Team "What Does Proof-of-Stake (PoS) Mean in Crypto?" (2024) https://www.investopedia.com/terms/p/proof-stake-pos.asp (accessed 2025-01-16).

86 The Investopedia Team "What is a Hash? Hash Functions and Cryptocurrency Mining" (2024) https://www.investopedia.com/terms/h/hash.asp (accessed 2025-03-18).

87 Kabwe *The Use of Blockchain* 33.

88 De Filippi and Wright *Blockchain and the Law* 22.

89 Bacon *et al* 2018 *Richmond Journal of Law & Technology* 9–11.

90 Richter "Blockchain Regulation" in Artzt and Richter (eds) *Handbook of Blockchain Law: A Guide to Understanding and Resolving the Legal Challenges of Blockchain Technology* (2020) 132.

91 Werbach *The Blockchain and the New Architecture of Trust* (2018) 65.

capabilities, such as allowing developers to create arbitrary consensus-based applications that are easier to develop.[92] This is achieved by using a "Turing-complete"[93] programming language, which allows anyone to write smart contracts and decentralised applications.[94]

A smart contract is a self-executing program that runs on blockchain. Smart contracts execute once all the predetermined conditions are met. The conditions are programmed, and parties to the smart contract agree on the nature of the conditions. Once the parties agree to all the conditions, the agreement is converted into code.[95] The code is placed inside a block on the blockchain system, and the participants assess the smart contract to determine if the conditions have been met. During this process, the smart contract is authenticated to ensure that it is authentic.[96] Thereafter, and once all the conditions have been met, the smart contract is executed on the blockchain system. The outcome of the terms associated with the smart contract is stored on the blockchain system.[97]

## 4 3 Blockchain oracles

Smart contracts are not "smart" in the strict sense. Smart contracts do not have the capability of learning new information like artificial intelligence (AI) systems. Smart contracts cannot access information that is stored outside the blockchain network.[98] Moreover, smart contracts cannot independently verify if an execution has taken place correctly.[99] Once a smart contract has been executed, it cannot be reversed. If new information must be added to the blockchain system to give effect to the parties' initial agreement, smart contracts can be designed to accommodate input from external sources for executing a specific code.[100]

Blockchain oracles have been defined as

> "[e]ntities that connect blockchains to external systems thereby enabling smart contracts to execute based upon inputs and outputs from the real world."[101]

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92 Buterin "A Next-Generation Smart Contract and Decentralized Application Platform" (2014) https://ethereum.org/content/whitepaper/whitepaper-pdf/Ethereum_Whitepaper_-_Buterin_2014.pdf (accessed 2025-01-20) 13.

93 Turing-complete is a concept in computer science that allows a programming language to implement any algorithm. See Gruhn "What Makes a Programming Language Turing Complete?" https://dev.to/gruhn/what-makes-a-programming-language-turing-complete-58fl (accessed 2025-01-20).

94 *Ibid*.

95 Kabwe *The Use of Blockchain* 69.

96 *Ibid*.

97 *Ibid*.

98 Beniiche "A Study of Blockchain Oracles" (2020) https://arxiv.org/pdf/2004.07140 (accessed 2025-01-22) 1.

99 Kabwe *The Use of Blockchain* 70.

100 Weston "Top 10 Blockchain Oracles" (2023) https://101blockchains.com/top-blockchain-oracles/ (accessed 2025-01-21).

101 Chainlink "What Is a Blockchain Oracle" (2024) https://chain.link/education/blockchain-oracles#:~:text=Blockchain%20Oracle%20Definition-,DEFINITION,outputs%20from%20the%20real%20world. (accessed 2025-01-21).

In this context, "entities" include persons, a group of persons or a program.[102] Blockchain oracles can obtain information from physical hardware, such as monitors and keyboards and from software programs such as applications (Apps). Blockchain oracles can provide information such as data updates, price variations, temperature changes and successful payment transactions.[103] Some oracles are centralised, while others are decentralised. A centralised oracle is an oracle that is controlled by a single entity and provides information for smart contracts from an external source.[104] Decentralised oracles rely on multiple external sources as opposed to a single source. Decentralised oracles are faster than centralised oracles but are less secure.[105]

Multiple types of blockchain oracle are used on the blockchain network. Human oracles are individuals with specialised skills in a particular field. Their role is to conduct research and verify the authenticity of information from different sources and interpret the information into a smart contract.[106] A hardware oracle is an oracle that retrieves information from hardware, such as reading devices, computers or electronic sensors, in order to make it available to smart contracts. A hardware oracle performs this function by deciphering real-world events into digital values so that they can be understood by a smart contract.[107] A software oracle interacts with online sources of information from servers or websites before transmitting the data to the blockchain. Since the data is retrieved from the Internet, the transmission of the information occurs in real time.[108] A consensus-based oracle is one that relies on multiple oracles to obtain data and reach consensus. For this to work effectively, the majority of oracles in a selected pool can determine the most relevant and correct data to be used.[109] Computation oracles do not request or deliver data. Instead, they perform computation on a set of inputs and return a calculated result that could be difficult to calculate on the network.[110] Inbound/outbound oracles transmit data from external sources to smart contracts, while outbound oracles send data from smart contracts to the external world.[111] Lastly, a contract-specific oracle is designed for a single smart contract. In other words, these oracles are designed to serve a specific case.[112]

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[102] Kabwe *The Use of Blockchain* 70; Werbach *The Blockchain and the New Architecture of Trust* 213.

[103] Chainlink https://chain.link/education/blockchain-oracles#:~:text=Blockchain%20Oracle%20Definition-,DEFINITION,outputs%20from%20the%20real%20world.

[104] Sharma "Centralized vs. Decentralized Oracles" (2025) https://www.blockchain-council.org/blockchain/centralized-oracles-vs-decentralized-oracles/ (accessed 2025-02-15).

[105] *Ibid*.

[106] Beniiche https://arxiv.org/pdf/2004.07140 1.

[107] *Ibid*.

[108] *Ibid*.

[109] Beniiche https://arxiv.org/pdf/2004.07140 2.

[110] *Ibid*.

[111] *Ibid*.

[112] *Ibid*.

## 5 BLOCKCHAIN-BASED PROOF OF LOCATION

A "proof of location" is a blockchain-based digital certificate that attests to someone's presence at a certain geographic location at a certain time.[113] The proof-of-location system authenticates the geographic location of a user while maintaining a high level of privacy. Privacy is maintained by eliminating the central authority responsible for knowing the geographic location of users and the information that they exchange. Instead, proof-of-location relies on a decentralised scheme that is independent of infrastructure.[114] The proof-of-location mechanism uses a location-based service (LBS) to authenticate the location of a user. An LBS can be defined as

> "[a] software service for mobile device applications that requires knowledge about where the mobile device is geographically located. The application collects geodata, which is data gathered in real-time using one or more location tracking technologies."[115]

Ordinarily, an LBS obtains data from sources such as cellular tower pings, global positioning system (GPS) satellites, global navigation satellite systems (GNSS) and short-range positioning beacons to provide services based on the user's precise geographical location. For LBS services to operate successfully, the following is required: a) a mobile network to transmit and receive data; b) a positioning mechanism to collect geodata; c) an application that uses LBS; and d) analytics software running on a remote server to compute and deliver relevant data to the user based on geographic location.[116]

Proof of location uses an LBS-oriented peer-to-peer network with mobile nodes that are connected to the Internet through Wi-Fi or a cellular network. A mobile node is a smartphone or tablet that can connect to a blockchain network while being capable of moving from one location to another.[117] The mobile nodes exchange information with other nodes using short-range communication technologies[118] such as Bluetooth.[119]

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113 Amoretti, Brambilla, Medioli and Zanichelli "Blockchain-Based Proof of Location" (2018) https://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=8431966&casa_token=5Vx2OwYxt28AAAAA:qyOp9rXBAj-sPnYVXgVownxVOXUB5OJyy-q2zYnut9V28uTI0zFrVmGtyJFo0Ae_JOW-FpsivA&tag=1 (accessed 2025-01-22) 146.

114 *Ibid*.

115 Froehlich "Location-Based Service (LBS)" (date unknown) https://www.techtarget.com/searchnetworking/definition/location-based-service-LBS#:~:text=A%20location%2Dbased%20service%20(LBS)%20is%20a%20software%20service,or%20more%20location%20tracking%20technologies (accessed 2025-01-22).

116 *Ibid*; see also Shaw "Location-Based Services Are Unseen Guides" (2024) https://www.gpsworld.com/location-based-services-are-unseen-guides/ (accessed 2025-02-01).

117 UEEx "Mobile Node" (undated) https://blog.ueex.com/crypto-terms/mobile-node/ (accessed 2025-01-30).

118 Short-range communication technologies include Bluetooth, Wi-Fi, Zigbee, near-field communication (NFC), ultra-wideband (UWB), infrared (IR), radio frequency identification (RFID), EnOcean, 6LoWPAN, LoRaWAN, NB-IoT and SigFox.

119 Amoretti *et al* https://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=8431966&casa_token=5Vx2OwYxt28AAAAA:qyOp9rXBAj-sPnYVXgVownxVOXUB5OJyy-q2zYnut9V28uTI0zFrVmGtyJFo0Ae_JOW-FpsivA&tag=1 147.

Proof of location uses two important nodes, namely a "prover" and a "witness". A prover is a node that collects proof of location from neighbouring devices. A witness is a node that authenticates or provides proof of location to the prover.[120] The witness verifies the proof of location by following a set of predefined rules. According to the rules, the request must originate from a node that is situated on the network. In addition, the request must be digitally signed by the prover, and the request must contain an admissible geographic location. Once accepted, the request appends to the end of the blockchain, where, through consensus, it is added to the blockchain. Then, the prover verifies the transaction by ensuring that the response comes from one of the nodes to which the request was sent and that the response was digitally signed by the node that produced it. Lastly, the prover verifies that the response contains an admissible geographic location. Once the response has been correctly verified, it is recorded into blocks on the blockchain.[121] The new block is broadcast on the network, where the nodes decide to add the block to the end of the blockchain through consensus.

## 6 APPLYING BLOCKCHAIN-BASED SOLUTIONS TO MODERNISE THE ALLOCATION OF TAXING RIGHTS FOR VAT PURPOSES

### 6 1 Blockchain oracles and place of consumption

Blockchain oracles can be used to determine the place where digital goods are consumed. To start with, a blockchain network must be set up between the tax authority and the supplier. Any oracle can be used depending on preference and availability of resources. Once a transaction occurs, the supplier retrieves information regarding the place of supply from the consumer. This can include the billing address, the IP address or credit-card details. A human oracle can be used to verify the information provided. The specialist conducts research to establish whether the information provided by the consumer matches the location where the consumer ordinarily resides. If confirmed, the human oracle interacts with the smart contract, and the smart contract sends confirmation to the supplier, after which the supplier signs the transaction with a private key before adding it to the network. If a software oracle is used, information can be retrieved from an online database or server connected to the Internet. In this scenario, a tax official can use databases to verify that the information provided by the consumer aligns with the data in the database. If the information provided by the consumer matches data from the database, the information is sent back to the network, confirming the place of consumption.[122] A consensus oracle requires that a majority of the oracles on the network reach consensus regarding the information supplied by the consumer. Once consensus has been achieved, the data is recorded on the network. A computation oracle

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120 *Ibid*.

121 Amoretti *et al* https://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=8431966&casa_token=5Vx2OwYxt28AAAAA:qyOp9rXBAj-sPnYVXgVownxVOXUB5OJyy-q2zYnut9V28uTI0zFrVmGtyJFo0Ae_JOW-FpsivA&tag=1 148.

122 Kabwe *The Use of Blockchain* 161.

works efficiently if the correct input has been presented to it. If the input or data is incorrect, then the result, after calculation, is likely to be incorrect. For example, if the IP address and the billing address are provided and the computation oracle concludes that the data does not match, then the output will be incorrect. As a result, the information provided by the consumer will be deemed incorrect, and no data will be recorded on the network.

It is difficult to use a hardware oracle in this context because a hardware oracle obtains information using barcode scanners or electronic sensors. If there is no instrument or device from which to scan externally, then no data can be retrieved. A tax authority can create a contract-specific oracle to verify the authenticity of data provided by the consumer. The downside to a contract-specific oracle is that it can only be used once. This means that a contract-specific oracle must be created each time a transaction takes place.

It is possible to use different oracles at the same time. For example, a computation oracle can be used simultaneously with a human oracle to improve the chances of getting accurate information.

## 6 2 Blockchain-based proof of location and place of consumption

Blockchain-based proof-of-location can be applied to determine the place of consumption and the precise physical location of a consumer. A tax administrator can set up a blockchain network with participants having the necessary access rights. Participants include the suppliers and mobile-phone network providers. It should be noted that access to the network will be granted to participants after a vetting process has been concluded.

Depending on the set-up, a private or consortium blockchain can be used. For enhanced security and privacy, a private blockchain can be used. With a consortium blockchain, multiple actors work together to achieve a common goal. The collective maintains control of the network while ensuring a high level of privacy and efficiency. Since a consortium blockchain is essentially a hybrid model, the collective shares access control and governance among themselves, meaning no single entity controls the network.[123] Since suppliers, mobile-network providers and tax administrators are expected to work collectively to determine the location of a consumer, a consortium blockchain is preferred.

As already discussed, the mobile nodes connect to the blockchain network using Bluetooth or any short-range communication technology. This way, information can be transmitted to the nodes on the network. The interaction takes place using an algorithm that generates proof of location for a user device following a verification process that is based on the maximum distance that is set and adopted by the communication technology.[124] When

[123] Kaleido "Consortium Blockchain: Architecture, Governance, and Real Deployment Tradeoffs" (2023) https://www.kaleido.io/blockchain-blog/consortium-blockchain (accessed 2025-01-30).

[124] See Post and Cipollini "Fundamental Elements of a Blockchain-Based Tax System – When to Use Blockchain for Tax?" 2022 14(4) *World Tax Journal* 519 567; see also Amoretti *et al* https://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=8431966&casa_token=5Vx2OwYxt2

a supply takes place, the supplier (prover) obtains initial information, such as billing address or bank-card details, regarding the place of consumption. The supplier sends a request for proof of location to a witness on the network. In this context, a witness can be a mobile-phone-network service provider. The role of the witness is to verify the validity of the proof of location request according to the rules already mentioned above.

As discussed, the supplier must be on the same network as the network service provider. The foreign supplier's request must contain an acceptable geographic location of the consumer. For example, the supplier can use the billing address, as provided by the consumer, which contains the town or city where the consumer resides. The consumer can also share their location on the mobile device using the Internet or via Bluetooth. Once the supplier obtains this information, the request is digitally signed using their private key. The mobile-network service provider checks to ensure that all the rules have been complied with. Thereafter, the mobile-network service provider authenticates the request and verifies that the information provided by the supplier corresponds to its information. For example, the witness can verify the address provided by using neighbouring nodes or wireless access points and a round trip to confirm if the device is located at the suggested place. If the outcome is positive, a digital certificate for the proof of location is issued by the witness, guaranteeing the location of the consumer.[125]

Once the proof of location has been produced, the witness sends a message containing the geographic location, an identifier and a signature to the prover. The supplier verifies that a) the response from the witness ensures that it comes from one of the nodes to which the request was made, b) the response is digitally signed by the node that sent the request, and c) the geographic location is admissible or similar to the one initially provided. After it has been established that the nodes are geographically close to each other, the proof of location is recorded on the blockchain after validation has taken place. Since the tax authority has access to the blockchain network, it can check that all processes have been followed correctly.

The use of blockchain-based proof of location ensures that consumption occurs at a specific geographic location and that the taxing rights are accurately allocated to the jurisdiction where the digital goods are consumed.

## 7 RECOMMENDATIONS

To facilitate a successful implementation of blockchain-based solutions for the allocation of taxing rights, the blockchain oracle network should be protected from cyber-attacks. This is because if a single oracle is hacked or compromised, the smart contract linked to the oracle is also compromised.[126]

8AAAAA:qyOp9rXBAj-sPnYVXgVownxVOXUB5OJyy-q2zYnut9V28uTI0zFrVmGtyJFo0Ae_JOW-FpsivA&tag=1 146–153.

[125] See Post and Cipollini 2022 *World Tax Journal* 568.

[126] Cointree "What Is an Oracle?" (undated) https://www.cointree.com/learn/what-is-an-oracle/ (accessed 2025-02-01).

It stands to reason that if a smart contract is compromised, the reliability of the data becomes questionable, which can undermine the whole blockchain network.

To minimise the risk of security attacks, reputation systems can be used to identify trustworthy nodes.[127] In a reputation system, nodes rate each other based on experiences. The more positive the ratings a node receives, the more likely it is to be trusted. Moreover, the data storage and location of nodes should be decentralised to increase the chances of protecting the oracle networks.[128] By doing this, an attack on the blockchain network does not negatively impact the oracle network because the latter is located at a different location.

Cryptography techniques can be used to safeguard any data stored on the networks. Symmetric cryptography uses an encrypted code to encrypt and decrypt a message. Asymmetric encryption uses two separate encrypted codes. One is used to encrypt a message, while the other decrypts the message. Lastly, cryptographic hashing is a technique that converts plain text into an irreversible ciphertext.[129]

Legislative amendments are required to make provision for blockchain-based place-of-consumption mechanisms. The amendments are necessary to ensure that suppliers use the mechanisms to determine the place of consumption. Tax authorities can track and verify the activities on blockchain to ensure compliance with the legislative changes. For example, where proof of location is used, suppliers should be required to act as provers and should broadcast proof-of-location requests to mobile service providers to confirm the IP address of a consumer.[130] The supplier must be required to sign a request with their private key. This ensures that there is accountability on the network, and it confirms the origin of the transaction. The process of signing a request can also protect the integrity of the network.[131]

If a blockchain oracle is used, the supplier should send a request to an oracle using a smart contract to establish the accuracy of the information provided. The smart contract interacts with the oracle to confirm whether the information is correct. Once verified, the supplier will be required to sign and send information pertaining to the supply to the network for verification. The tax officials on the network check to ensure compliance with all processes.

A consumer may be required to share their location using their mobile devices to aid suppliers and tax officials in confirming their location. As discussed above, proof of location relies on short-range communication technologies such as Bluetooth, near-field communication (NFC) and Wi-Fi. Once a purchase has been made, the consumer may be requested to share their location using any short-range technology.

One of the major commercial banks in South Africa, First National Bank (FNB), requires access to user locations for certain payments made via its

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127 *Ibid*.

128 *Ibid*.

129 Kabwe *The Use of Blockchain* 32–33.

130 See Post and Cipollini 2022 *World Tax Journal* 568.

131 Cointree https://www.cointree.com/learn/what-is-an-oracle/.

mobile banking App. The prompt comes before the customer transfers funds to another person. According to FNB, the location requirement was implemented as an additional security measure when performing transactions to prevent fraud.[132]

It can be argued that a similar set-up can be used to ensure the efficacy of the proof-of-location mechanism.

## 8 CONCLUSION

Determining the place of consumption remains an important aspect in the administration of VAT. If the place of consumption is not ascertained, the supplier of intangibles cannot remit VAT in the jurisdiction where consumption takes place. Policymakers insert place-of-supply rules in their respective legislations to determine the place of consumption. Often, these rules are unclear, while some are non-existent. If the place-of-supply rules are non-existent, proxies are applied to establish the place of consumption. The VAT Act, as it currently stands, uses proxies, and it remains the responsibility of suppliers to ascertain the jurisdiction of the consumer recipient of digital goods.[133]

Blockchain technology provides opportunities to modernise the way the place of consumption is established. First, assuming that proof of location is used, it provides a two-step verification process in which the burden shifts from suppliers to the network service providers or tax officials in the consumption jurisdiction to authenticate information provided by the consumer. The IT infrastructure in the consumer's purported country of residence is used to verify the location of the consumer in real time. Alternatively, blockchain oracles can be used to verify the location of a consumer.

Secondly, if used correctly, the technology can provide a more accurate and reliable system to determine the place of consumption. This process has the potential to reduce the compliance burden on foreign suppliers of digital goods and provide a more efficient way to administer VAT.

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[132] Staff Writer "Why the FNB App Needs Your Location Data for Payment" (2020) https://mybroadband.co.za/news/banking/372672-why-the-fnb-app-needs-your-location-data-for-payments.html (accessed 2025-02-19).

[133] Kabwe and Van Zyl 2021 *Obiter* 527.