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Do IP Addresses Have a Value?

Introduction

Within the Classless Inter-Domain Routing protocol Deployment (CIDRD) Working Group of the Internet Engineering Task Force (IETF) during 1995 and 1996 the assertion has been made that Internet addresses are in themselves without intrinsic value, and it is the addition of routing onto these addresses, within the context of the global Internet, which is the process which adds value to the underlying numeric address. In other words the address itself just a numeric value, and as a numeric value it has no special significance or economic value.

The contrary view is that this assertion reflects an incomplete model of the role of the address space within the Internet domain, and that it does not intrinsically match the wide diversity of demand for address components of the global Internet address space. The argument presented here is that Internet addresses drawn from the global Internet address space do have an intrinsic economic value, and that the task of public distribution of this common resource should take this into account.

How much are IP Addresses Worth?

If the assertion of intrinsic value is accepted, then the immediate corollary is the quest to establish the particular value of a particular address component drawn from the global Internet address pool. It is not however possible to make such an assertion of economic value and map this to a constant unit value to which all parties will subscribe. The major point highlighted here is that each party's estimation of the economic value will vary depending on their ultimate requirement for the address space, given that address space is not an end in itself, but a means to exploit the associated internet technology and Internet connectivity environment, and the estimated value of that activity relates to the estimation of economic value of the address space itself for that party. Accordingly the valuation of any particular address component will vary.

One way to express this valuation is by the relationship:

Value of an Address Component = (Value of Uniqueness + Value of Routeability +
*Value of Contiguous Size) * Perceived Utility Factor*

This relationship attempts to capture the value components which must be considered, which include:

Value of Uniqueness:
The value ascribed to the uniqueness attribute of the address block. Here uniqueness is not only uniqueness across the global Internet, but uniqueness across the global registry environment, such that any two parties can interconnect privately or publicly and use distinct addresses as long as both parties are effective clients of the registries' service of the allocation of unique addresses.

Value of Routeability:
Recent discussions within the IETF CIDRD Working Group relating to the identification of the critical resource of scaling the Internet have highlighted:

1. the issue of the efficiency of the so called "core" - or more appropriate described as "default-free" - routers in undertaking both the support of a default-free address prefix forwarding table, and

2. the support of allowing dynamic updates to the forwarding table through the actions of the deployed routing protocols.

The conclusions from these observations are that it is no longer the case that any arbitrary address prefix can be routed across the global Internet from any arbitrary location, and that there are a set of thresholds, defined by available technologies, which limit both the number of distinct address prefixes, and which also limit the aggregate number of updates within a unit of time to the table of all such distinct prefixes. Thus the value placed on routing within the global Internet environment is dependant both on the importance (or value) of connectivity to the global Internet while using the address block as the routed entity and also the capability of the Internet routing environment to add this entry into the global routing tables.

Value of Contiguous Size:
The size of the address block also effects the ultimate value calculation. A large contiguous block can be used to service a large end client base with relative ease, while sets of small discontiguous address blocks may entail continuous renumbering or the deployment of a significantly more complex routing environment in order to achieve comparable functional outcomes.

Utility Factor:
The above-described value factors are concerned with the address space itself. For any party the ultimate value calculation also includes consideration of the nature of the ultimate function or service for which the address space is required, and this utility factor can be regarded as a multiplicative factor applied to the intrinsic value calculation for the address space itself.

The outcome of this examination of the value factors for an address component is that although a method of deriving the value of address space for any individual exists, there is no underlying constant value, in the sense that many goods have a quantifiable cost of production which can be equated to an intrinsic value of the goods. In the case of Internet addresses there is no readily quantifiable "cost of production", although there are quantifiable values of exploitation. Accordingly the local circumstances of routing configurability, connectivity cost, utilisation value, and similar deployment cost factors will determine the value of a particular address component within that context, and moving to another context with a constant address prefix, or considering a different address prefix in a constant environment may well result in a different value outcome.

Thus, these factors of valuation of an address component will vary for each party, and to assert that an address component has a particular value for one party does not imply the same valuation for all parties.

A Market Determination of Value

The market approach to valuation of a commodity indicates that market value is established by selling the commodity within an open marketplace. The current value of the commodity is effectively determined by the selling price obtained at the market.

This scenario of market-determined value is not uncommon for many marketed commodities. The value determined in a trading market will show some variation in line with individual trading transactions, where the individual transaction exhibits some of the valuation factors as seem in the circumstances of the seller and the buyer. In this environment the overall average trading price levels have some relationship to perceived levels of supply and demand within the market. In general the current price of the commodity is determined by the dynamic trading environment. In a truly open and non-manipulated market the price exhibits the basic cost of production, and also reflects the secondary factors of demand over supply and possibly exhibits scarcity factors. In such a marketplace rising demand is initially reflected in high prices which then trigger increased supply which in turn brings the price back to the basic trading cost which is directly related to the production cost of the commodity.

Within this environment there is no set price for a commodity - the market transactions set a level of expectation for the trading price of future transactions, but the ultimate determinate of value is the closure of a transaction at a nominated price.

So if I could sell addresses maybe I should hoard them instead?

In a finite resource market with escalating demand the market price starts to exhibit a scarcity premium, where the scarcity premium is related to the level of demand over supply.

The major characterisation of the Internet address space is the visibly finite nature of the resource. Some 25% of the address space has been allocated to serviced entities, and with the exponential nature of the demand for the resource some administrative control are essential to prevent a perceived scarcity-induced hoarding run on the remaining resource.

Hoarding takes the form of buying early and withholding the goods from the market in order to lift the scarcity premium. Such market manipulation is by no means a novel practice, and various attempts to control market supply have met with various levels of success and failure in other commodities in the past. Hoarding and speculative buying can be used to establish a monopoly position and thereby exert complete control over supply and hence control over the market price. As an example, this has been an historical feature of the wholesale diamond market. However the an Internet address market would be somewhat resilient against this type of attempt to exert control over supply. The relevant feature of the Internet environment is that the use of a single IP address can be multiplexed across multiple systems and applications through the deployment of application gateways and address translation technologies.

Such alternative approaches also have a cost, and do not admit to the same level of functional flexibility. However for any potential purchaser in an Internet address market if the market valuation of address space exceeds the valuation of the cost of deployment of alternative technologies, then the alternative access technology will be used. This then establishes an upper bound on the market price of Internet addresses, and makes hoarding practices a sub-optimal approach.

But there is no market in Internet Addresses today

However this market-based approach to the issue of fair distribution of the public Internet address space is certainly at odds with the current administrative structures used within the Internet. Three registries, in North America, Europe and Asia assign addresses to applicants without direct cost to the applicant. From a market perspective this practice essentially prevents the formation of a market in addresses, and, perhaps, oddly, leads to a suppression of the use of alternative technologies through this administrative structure. But as the address pool managed by these registries shrinks through their allocation of addresses to applicants the inevitable result through the increased demand is one of inevitable exhaustion of the registries' pool of allocatable addresses.

Once this occurs a market in Internet addresses will inevitably open, and there will be a somewhat turbulent period while the market stabilises into a steady state of trading supplemented by more widespread use of alternative address translation technologies. This transitional instability can be eased, or possibly completely circumvented, by a graduated introduction of a market approach to address distribution using components of the currently allocated address space as the initial market pool.

Will the next version of the Internet protocol get around this problem?

Of course there is the view that the efforts to transition to the next version of IP, version 6, will circumvent these issues through the use of a significantly larger address pool (as the address space is a 128 bit numeric value) where exhaustion of the address space is a highly remote possibility. This may be the case, but the issue remains that in the current Internet market this version of the Internet protocols is effectively yet another alternative technology, and, as pointed out above the market for alternative technologies will not mature sufficiently for broad deployment until the current Internet address space has a more rational basis for economic valuation.

And although it may appear to be contradictory at first glance, the widespread adoption of the next generation of the Internet protocols will probably be more dependant on addressing the current weaknesses in the existing administrative mechanisms relating to the distribution of current Internet addresses than it will depend on the market's perception of the maturity and robustness of this next generation of Internet technology.

Disclaimer

About the Author

Geoff Huston B.Sc., M.Sc., has been closely involved with the development of the Internet for many years, particularly within Australia, where he was responsible for the initial build of the Internet within the Australian academic and research sector. He is author of a number of Internet-related books, and has been active in the Internet Engineering Task Force for many years.
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