



Writing a Campus Numbering Plan

Objective of this Note

This Note is targeted at NRENs (and their member institutions) that are in the process of applying to AfriNIC for their autonomous system numbers (ASNs) as well as independent IP addresses. It is the numbering plan that provides evidence of the magnitude of need to AfriNIC, who are responsible for managing a scarce international resource - IP addresses. Many campuses are still small, or lack the technical resources to develop a numbering plan. In such cases, the NREN has to play a supporting role in the process, and sometimes acquire the status of a Local Internet Registry (LIR) that later allocates address blocks to the member institutions. This note provides a guide to the development of campus numbering plans.

The Note has been developed as part of a set of tools by the UbuntuNet Alliance for Research and Education Networking to support the growth of REN activity in the continent with the intent of empowering and creating global equity for Africa-based educationists and researchers.¹

1. Why you need a numbering plan for your campus

Globally routable IP numbers are scarce resources, the distribution of which is managed by the Internet community in a hierarchically structured way that ensures that each IP address is not allocated for use to more than one party, and also attempts to ensure that address space is not wastefully allocated. This applies to both IPv4 and IPv6 addresses.

Consequently when an organisation applies to AfriNIC (or any other Regional Internet Registry (RIR)) for a new allocation or assignment of IP address space, the RIR requires the application to include a numbering plan that sets out the organisation's current network topology and use of IP addresses, as well as the network's expected growth over the next two years (and the resulting extended requirement for IP addresses).

2. The campus numbering plan

A campus numbering plan comprises:

- (a) A map showing the various buildings, building switches /routers and inter-building cable runs; and
- (b) A table, with a row per subnet, indicating the number of network nodes currently and the expected number in two years' time, and hence the size (mask length) required for numbering the subnet.
- (c) An aggregation plan, leading to a single prefix for the campus, from which the required prefixes for the various subnets can be split out.

¹ We acknowledge with thanks and appreciation the role that has been played by Dr Duncan Martin, Dr Lishan Adam, Mr Victor Kyalo, and Dr F F Tsubira in the development of these notes. Note UA 153 was developed by Dr Duncan Martin.

Example: The University of Light and Darkness (ULD).

ULD has a main campus and is about to open a new satellite campus. Each campus has three buildings. ULD intends to have a WAN link installed connecting the two campuses and to connect to the Internet only at the Main Campus. They need to prepare a numbering plan and application for IP address allocation to AfriNIC.

Main Campus Numbering Plan	
Building subnet / interfaces	Smallest prefix that suffices
Main Campus: Science and Engineering Building End-user network points will grow over next 2 years to 5,500. Many of these are in major undergraduate student labs.	/19 (8,192 addresses)
Main Campus: Arts Building End-user network points will grow over next 2 years to 1,900.	/21 (2,048 addresses).
Main Campus: Administration End-user network points will grow over next 2 years to about 150.	/24 (256 addresses; minimum assignment)
Main Campus: Interfaces:	/24
Aggregation plan for the Main Campus: /18 The /18 will be split into two /19s. One of these is for Science and Engineering. The other is split into two /20s. One of these is split into two /21s, one of which is for the Arts Building. The other /21 is split into a /22, a /23 and two /24s, one of which is for the Administration Building and the other for network interfaces. Unassigned sub-prefixes: a /20, a /22 and a /23.	

Satellite Campus Numbering Plan	
Building subnet / interfaces	Smallest prefix that suffices
Satellite Campus: Building 1 End-user network points will grow over next 2 years to 800.	/22 (1024 addresses)
Satellite Campus: Building 2 End-user network points will grow over next 2 years to 300.	/23 (512 addresses).
Satellite Campus: Building 3 End-user network points will grow over next 2 years to about 50.	/24 (256 addresses; minimum assignment)
Satellite Campus: Interfaces:	/24
Aggregation plan for the Satellite Campus: /21 The /21 will be split into two /22s. One of these is for Building 1. The other is split into two	

/23s. One of these is for Building 2. The other /23 is split into two /24s, one of which is for Building 3 and the other for network interfaces. No unassigned sub-prefixes.

Conclusion: From an Internet connection perspective, the two campuses are a single network. ULD can number both campuses by splitting a single prefix. It suffices to apply to AfriNIC for a /18 IPv4 prefix. The /20 that is not required for the Main Campus can be split into two /21s, one of which can be used for numbering the Satellite Campus. This will leave a /21, a /22 and a /23 unassigned and held in reserve.

Modification 1: Instead of installing a WAN link and having a single Internet connection, ULD decides to have its ISP connect the campuses separately to the Internet. Does this alter the request to AfriNIC? **No:** The prefixes used at the two campuses will aggregate within the ISP's network, and so the same request to AfriNIC and numbering plan can be used.

Modification 2: The Main and Satellite Campuses are in different cities, and ULD may well want to employ the services of two different ISPs. Does this alter the numbering plan and the request to AfriNIC? **Yes:** From an Internet perspective the two campus networks are now distinct networks, and so the prefixes used at each campus should be aggregated within the campus network. ULD should apply to AfriNIC for a /18 for use at the Main campus and a /21 for the Satellite Campus.