Securing Campus Wireless LANs

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Abstract

Most KENET member institutions of higher learning have deployed a campus WLAN. The campus WLAN is deployed in areas across campus where most students have access, including lecture halls, hostels and social areas. However, the campus WLAN is not secure and in most campuses is open (not secured) or uses a shared secret. Some universities have used mac address authentication on a campus WLAN, a solution that does not scale and mac addresses can be easily spoofed.
KENET has deployed campus WLANs in over 25 member institutions campuses. This paper will document the lessons learned from previous WLAN deployments focusing on campus WLAN design, autonomous versus lightweight access points, WLAN security, 802.1x, AAA and migrating to eduroam.

Keywords: campus WLAN, eduroam, Authentication, challenges, AAA, BYOD, network monitoring, open source tools, access points

1. Introduction

Kenya Education Network, (KENET), is the National Research and Education Network (NREN) of Kenya. KENET provides affordable and low-congestion Internet services to educational institutions in Kenya. KENET is licensed by the Communications Authority of Kenya (CA) as a not-for-profit operator serving the education and research institutions. KENET provides affordable, cost-effective and low-congestion Internet bandwidth to member institutions in Kenya. Bundled with the Internet connectivity, KENET provides to its members Shared service such as web-hosting, training and capacity building, and VPNs. KENET also provides Research services such as Identity provision, digital certificates, web conferencing and eduroam.

KENET has deployed safe and secure campus WLANs in over 25 member institutions. The solution seeks to provide end-to-end security, protecting WLAN endpoints, infrastructure and client communications.

2. WLAN Design Considerations

This section discusses some items that should be considered when designing wireless networks.

a) Site survey

Site surveys should be performed in order to determine the optimal access point for the location and to identify the possible access point locations to minimize interference while maximizing the range.

b) Regulatory domains

Devices that operate in the unlicensed band do not require a formal licencing process by the end user. However, equipment designed for operating 802.11 in the ISM bands is obligated to follow government regulations for the region it is to be used. WLAN devices must comply with the specifications of the relevant governing regulatory body within the country.

c) Capacity

Capacity here does not refer to the bandwidth, but rather the ability of the WLAN to provide reliable and available connectivity to the clients in the coverage area. During design, the number of eventual clients and the application traffic requirements needs to be anticipated – this will influence the number of access points to be deployed.

d) Infrastructure

The wired LAN infrastructure needs to be able to support the traffic generated by the wireless devices. The available bandwidth needs to be sufficient to support the clients. KENET deploys eduroam on a separate VLAN. This allows for flexibility when applying policy to the different network segments.

e) Power

Power requirements of the access points and for the client devices needs to be taken into consideration. If access points support Power over Ethernet, make provision for PoE switches. Otherwise use the power injectors.

f) Monitoring

Monitor the wireless infrastructure nodes to ensure that any downtimes are promptly resolved. Inter-switch trunk links and ports connecting to access points should be monitored for clear visibility of traffic consumption.

3. WLAN Security Mechanisms

The main issue with wireless communication is unauthorized access to network traffic, by sniffing the network. Unlike the wired networks, where a hacker would need to be physically located at the premises, with a wireless network, the intruder can access the network from a location outside the building.
The most common security mechanisms for WLAN networks are:

I. Open authentication with no encryption

Open authentication provides no way for the access point to determine whether the client is valid. It is therefore an insecure way to deploy WLANs and is not recommended.

II. Wi-Fi Protected Access (WPA)

WPA uses Temporal Key Integrity Protocol (TKIP) for encryption and dynamic encryption key generation with either a pre-shared key or a RADIUS/802.1x-based authentication. WPA provides more robust security to WEP.

III. Wi-Fi Protected Access 2 (WPA2)

WPA2 provides certification in both Enterprise and Personal classifications.
The Enterprise classification requires support for a RADIUS/802.1x-based and EAP for authentication. Personal classification requires only a common key shared by the client and the AP. WPA2 uses Advanced Encryption Standard (AES) and TKIP for encryption.

4. 802.1x

IEEE 802.1x is a standard for authentication on wireless and wired networks. It provides WLANs with strong, mutual authentication between a client and an authentication server. It also provides dynamic per-user encryption keys, removing the administrative burden and security issues surrounding static encryption keys.

With 802.1x, the authentication credentials are encrypted then transmitted over the wireless network. TKIP or AES are used for the encryption.

After mutual authentication has been successfully completed, the client and RADIUS server each derive the same encryption key, which is used to encrypt all data exchanged, resulting in a per-user encrypted session.

802.1x has three layers:

1. The supplicant software which runs on the client device
2. The authenticator which is the access point in WLANs
3. The authentication server which is the RADIUS server

5. eduroam

5.1 What is eduroam

eduroam stands for education roaming. eduroam is a safe and secure service that employs WPA2 Enterprise security mechanism, with AES and TKIP encryption and 802.1x and EAP for authenticated access to the network. The eduroam service was developed for the international education and research community, offering wireless internet access without the need of multiple logins and passwords, in a safe, fast and simple way.

5.2 eduroam Topology and Requirements

KENET has deployed safe and secure campus WLANs in over 25 member institutions. The solution seeks to provide end-to-end security, protecting WLAN endpoints, infrastructure and client communications.

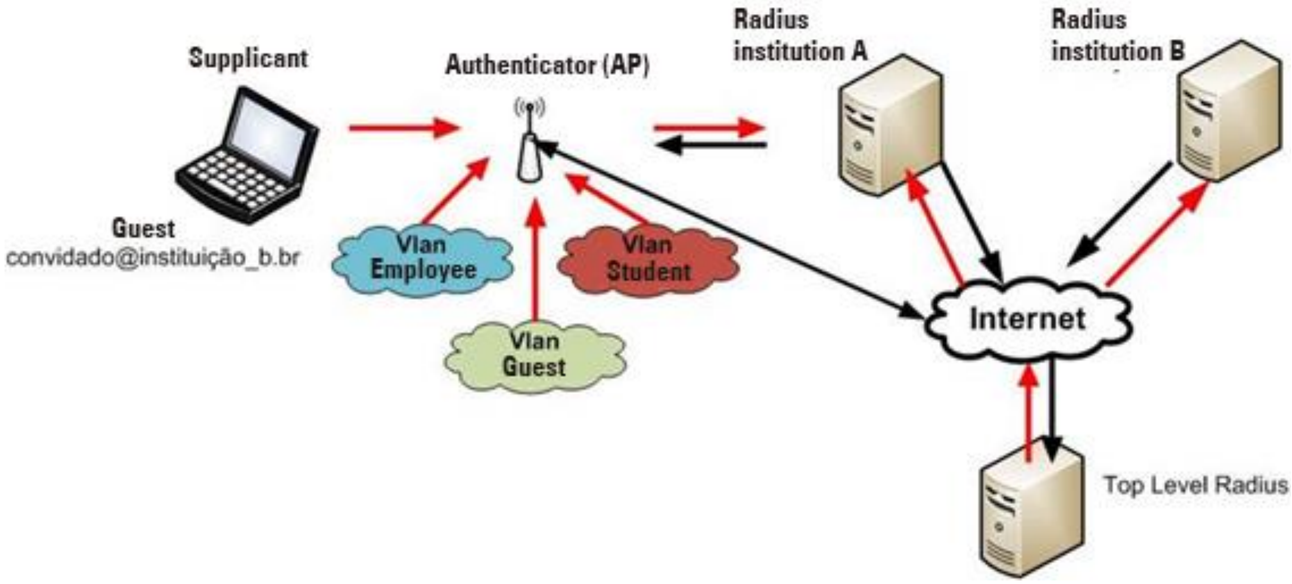

Figure 1: How eduroam is deployed

The WLAN topology is made up of the following components;

1. Access points and wireless LAN controller
2. WLAN clients with 802.1X supplicant software
3. RADIUS protocol carrying extensible authentication protocol (EAP) packets between client and the authentication server
4. Authentication server (Authentication, Authorization and Accounting (AAA) server)

KENET deploys eduroam on a separate VLAN. This makes it easier offers flexibility in applying policies to the various segments of the LAN.

5.3 Previous eduroam Projects

In the year 2013, KENET received funding under the KTCIP/Kenya ICT Board infrastructure grant and successfully implemented WLANs in ten member institution campuses. Most of the institutions did not have proper campus WLANs at the time and the project was designed as a template on how to deploy WLANs for the institutions to build upon. Each campus was allocate a Cisco 5508 wireless LAN controller, a server, Cisco 1552e outdoor access points and Cisco 3500 indoor access points.

KENET deployed more WLANs in 2014 and 2016. The 2014 project targeted nine campuses, deploying a Hp Unified solution. In 2016, WLANs were deployed in seven campuses, using Ubiquiti Unifi access points.

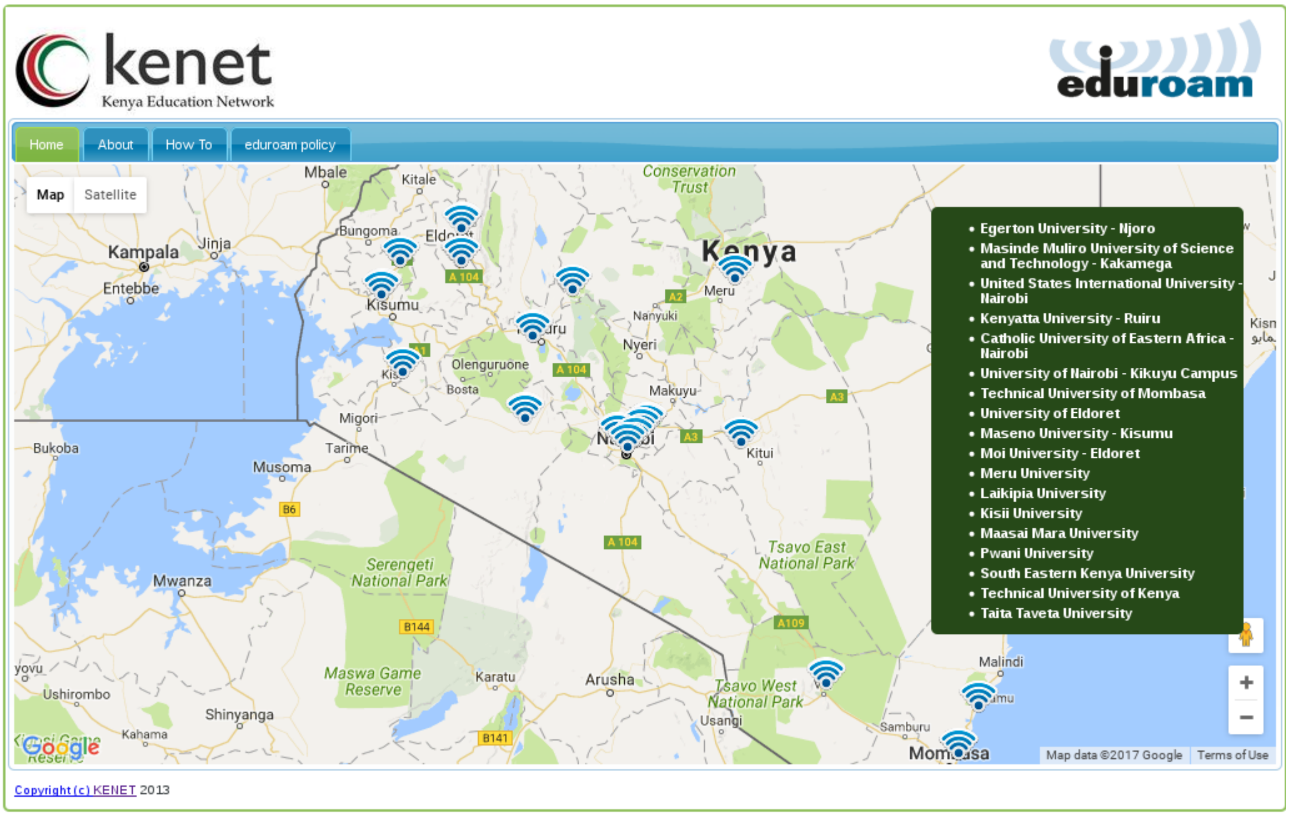

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Figure 2: KENET eduroam sites

Conclusion

The WLAN deployments implemented by KENET have not gone without challenges. Some of the challenges faced include theft of access points and challenges in updating the database of users for each campus.

eduroam was successfully implemented in the campuses of various Universities. Students, staff and researchers have access to safe and secure Internet.

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Biographies

Joan Masai is a Network Administrator at KENET. She has been working at KENET since 2012, working at on network operations, network development and campus network direct engineering support. She holds a Bachelor of Science in Networks and Communication Systems from the University of Eastern Africa, Baraton. She is a member of the IETF Africa chapter. Her current interests are in the areas of Network Security and Cloud computing.

Maureen Wanja holds a Bachelor of Science Electronic and Computer Engineering from Jomo Kenyatta University of Agriculture and Technology and is also CCNA certified.

Maureen joined KENET in 2008 as an intern and was eventually employed as an Assistant Systems Administrator. Maureen mainly focuses on Campus networks design and implementation. This includes both LAN and Wireless LAN design and implementation. Maureen is the lead in implementing eduroam in Kenya and also is the lead in the training services offered by KENET to member institutions. Maureen is also the lead in the KENET training program.