Problems with LAN Technologies

- From previous discussions on LANs there are a variety of *networking* technologies available to facilitate communications between host computers:
  - For any given LAN implementation, host computers can only communicate with other hosts attached to the same networking technology.
- It is not unreasonable to assume that many organizations may employ a variety of *technologies*:
  - This is usually for historical reasons due to mergers and take-overs etc.

Problems with LAN Technologies

- Historically this can lead to the creation of *islands* of networks within organisations:
  - Differences in *Frame* formats, Electrical characteristics (voltages, wiring types etc.) and Addressing schemes prevented **direct** communications between hosts connected to different LAN technologies.

Problems with LAN Technologies

- Today there is a need to facilitate communication between any two hosts regardless of the type of LAN they attach to:
  - This is similar to telephone systems which facilitate communication between any two telephones. For example between a mobile phone and a fixed-line phone
  - This is known as *universal service* and is a fundamental concept within networking.

Universal Service

- With ***Universal Service***:
  - *A user on any host in any part of an organization can send messages or data to any other user without any knowledge of the underlying networking technology.*
- Whilst highly desirable *universal service* can be difficult to achieve due to incompatibilities between network technologies.
- The provision of *Universal Service* for host computers requires addressing the problems associated with heterogeneous (multiple) network technologies:
  - The introduction of *Internetworking* technology is the solution.

Universal Service through *Internetworking*

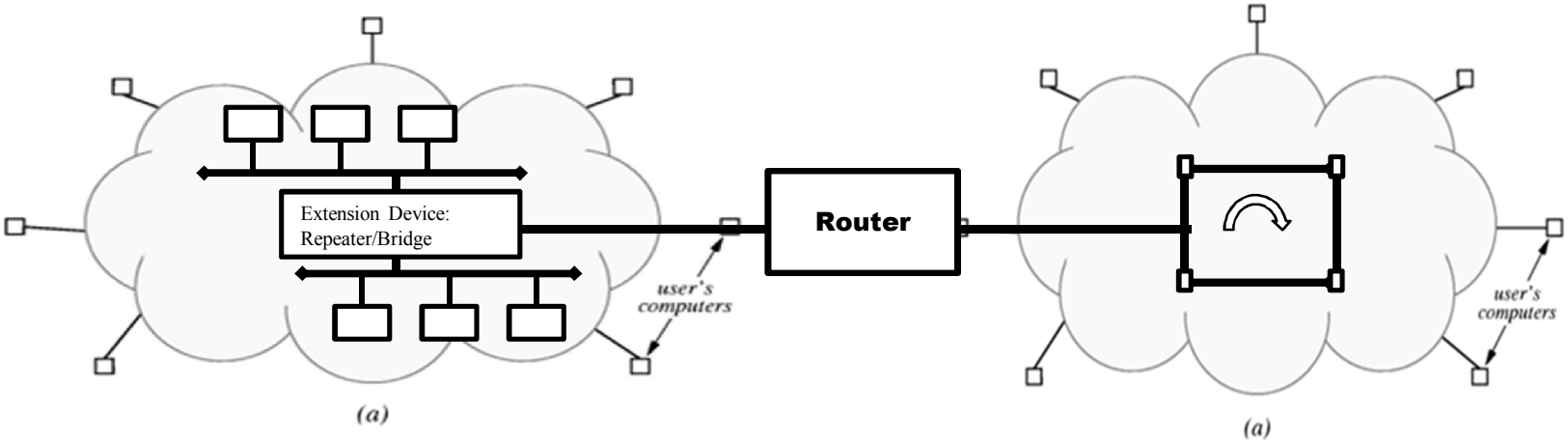
- *Internetworking* introduces a new *hardware* component and new *software* :
  - Additional *hardware* is needed to provide a physical *interconnection* between LANs for the purpose of routing traffic:
    - This hardware needs a physical connection to each LAN using the correct NIC.
    - Only then can it route and deliver traffic between LANs.
  - Additional *software* is also required to:
    - Address the lack of ***uniqueness*** when using MAC addresses,
    - Address the lack of ***summary*** routing when using MAC addresses,
    - Introduce a single, unique “framing” structure/format understood by all hosts.

Universal Service through *Internetworking*

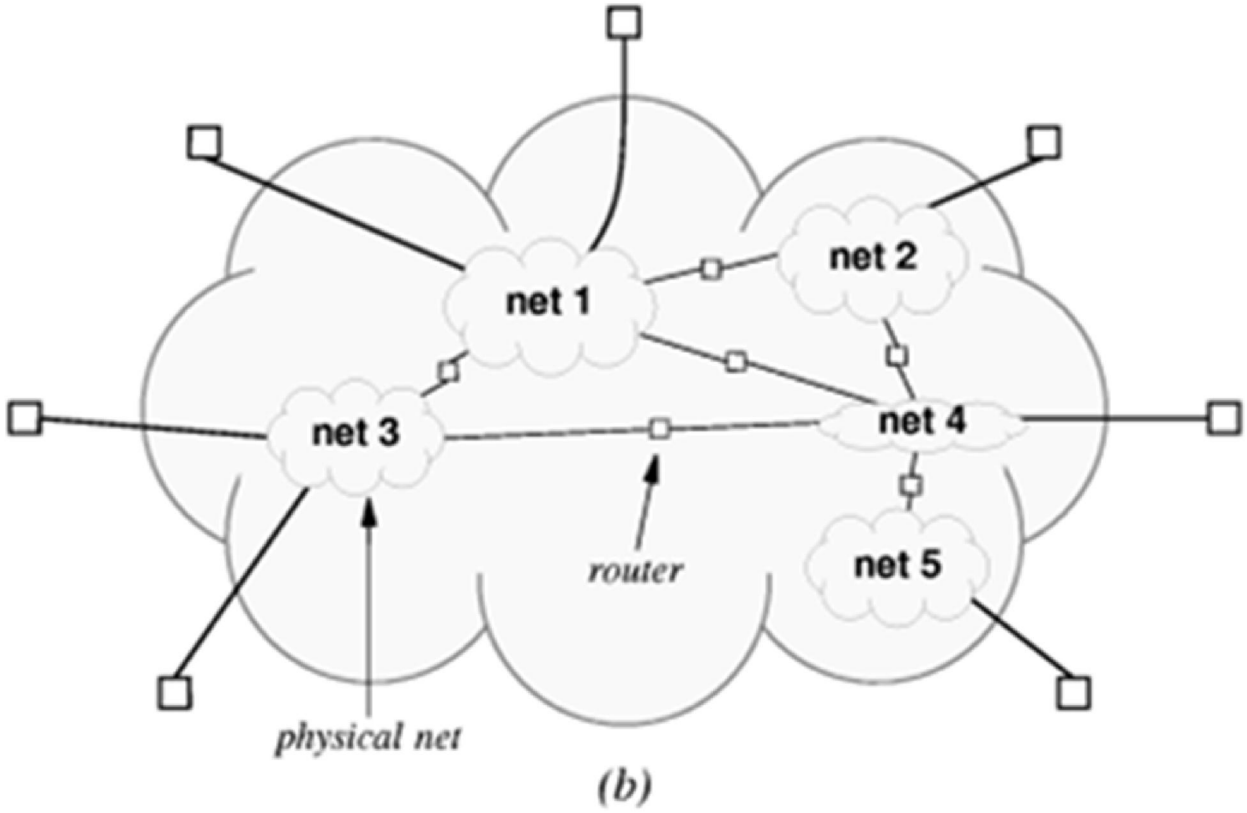
- The result is a system of connected physical networks known as an *internetwork* or *internet* as shown in the next slide.
  - There is no restriction on the size of an *internet.* However, there are reliability, efficiency and performance issues to consider when designing and/or attaching to an internet.

An example of a small internet

An internet comprised of four interconnected LANs. There is no restriction on the size of an *internet.*



An example of a larger internet



(b)

The Hardware Component - *Routers*

- The hardware component is called a *Router*.
- It is a special purpose computer used for interconnecting networks:
  - It is like any host computer in that it contains: a CPU, RAM, I/O interfaces (Network Interface Cards) etc.
- Whilst the previous diagram shows a router connecting only two networks; in practise a single router can connect many LANs.
  - Also, many organisations use multiple routers to maximise performance and to allow for *redundancy*.
- To provide *universal service* the routers must physically pass data between the LANs.

The Software Component – Internet Protocol (IP)

- As already discussed, passing data directly between different *LANs* technologies is impossible due to differing *frame formats* and *addressing schemes.*
- Internet *protocol software* addresses these issues by:
  - Introducing a single globally-unique addressing scheme:
    - This single scheme hides the underlying multiplicity of physical addressing schemes (recall static, dynamic and configurable MAC addresses) employed on each LAN.
  - Introducing a single "framing" structure called a "Packet/Datagram" that is understood by all host computers.

Internetworking technology – Providing *Universal Service* for Host Computers

- The *routers* combined with the *internet protocol software* makes universal access possible.
- However, *internets* are really an abstraction
  - No such network exists in reality consequently they are often called *virtual networks.*
- We will now examine the concepts behind interworking.
- Firstly, we will look at the globally unique addressing scheme design especially for interworks.
- Secondly, we will look at the role played by the *router* in delivering data across different network technologies.