CS581 - Assignement 3 Technical Infrastructure
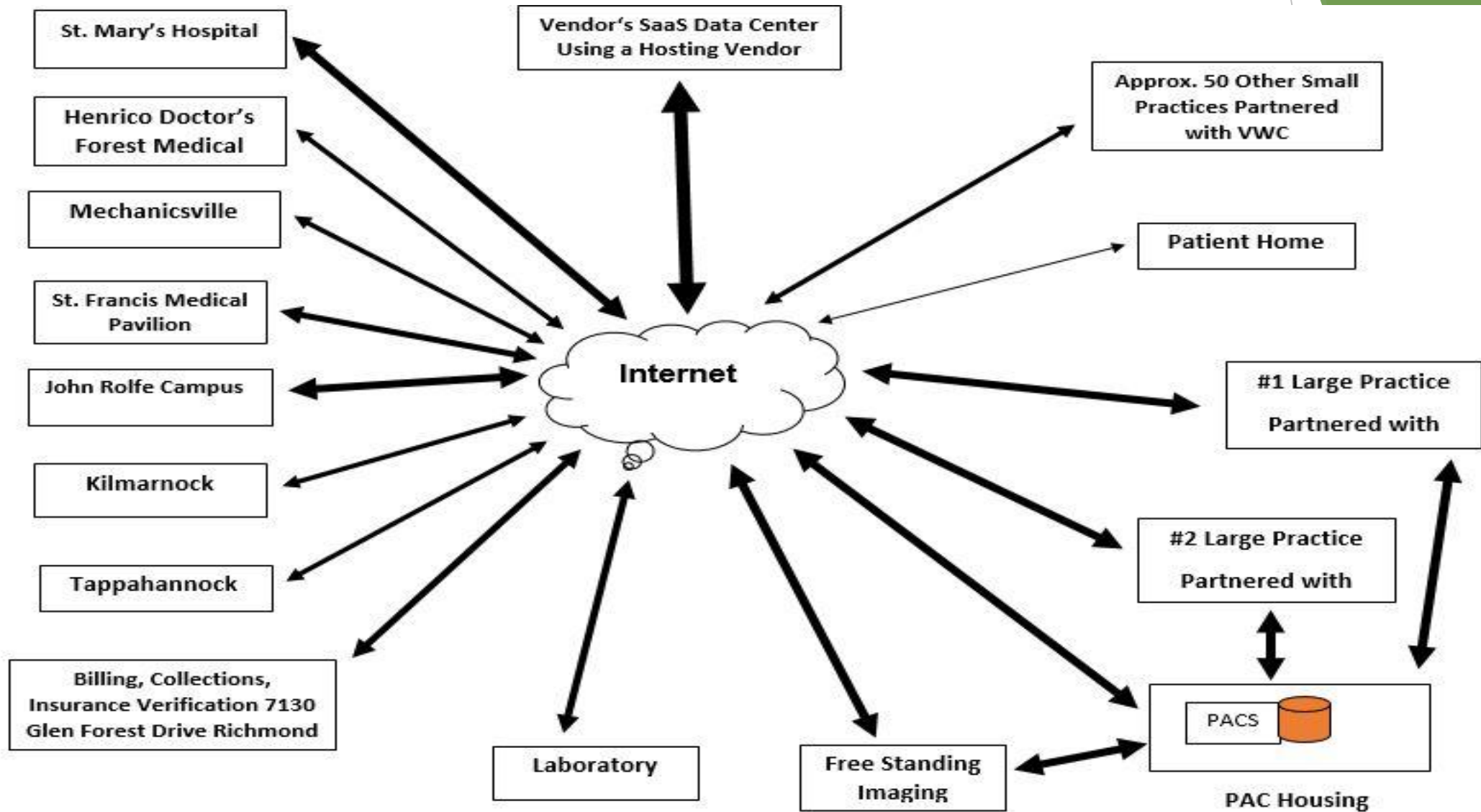
Virginia Women's Center's (VWC) deployment of an EHR system

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Spring1 2018

Technical Areas for of the high-level infrastructure design for Virginia Women's Center's (VWC) inclusive five area:

- ▶ Network
- ▶ Processing
- ▶ Storage
- ▶ Database Management Systems
- ▶ Security

Virginia Women's Center – High Level Network in a Glance:

Hybrid Network Topology

- Hybrid topology is the combination of two or more topologies. In this case each part of VWC has access to data center and each other through the internet (star topology). First & second Large Practice Partnered with VWC and Free Standing Imaging Center have direct access to PAC housing center which indicates different type of network topology (point to point).

- Each part of VWC like small and large practice partner, laboratory, other campus and office using wireless local area network (WLAN) to connect computers and devices to the router, and in turn to one another and the Internet.

- Most of interconnected Wireless Local Area Network connect to data center (EHR System) and each other through the internet by the Wide Area Network (WAN).

- In addition, First & second Large Practice Partnered with VWC and Free Standing Imaging Center due the critical access to imaging data have a direct connection to PAC housing center.

Recommended Bandwidth

- **Small Practices Partnered with VWC (2-4 physicians) – 10 Mbps**
- Supports practice management functions, email, and web browsing
- Allows simultaneous use of EHR and high-quality video consultations
- Enables non real-time image downloads
- Enables remote monitoring
- Makes possible use of HD video consultations

- **Single Physician Practice – 4 Mbps**
- Supports practice management functions, email, and web browsing
- Allows sim
- Short term use of electronic health record (EHR) and high-quality video consultations
- Enables non real-time image downloads
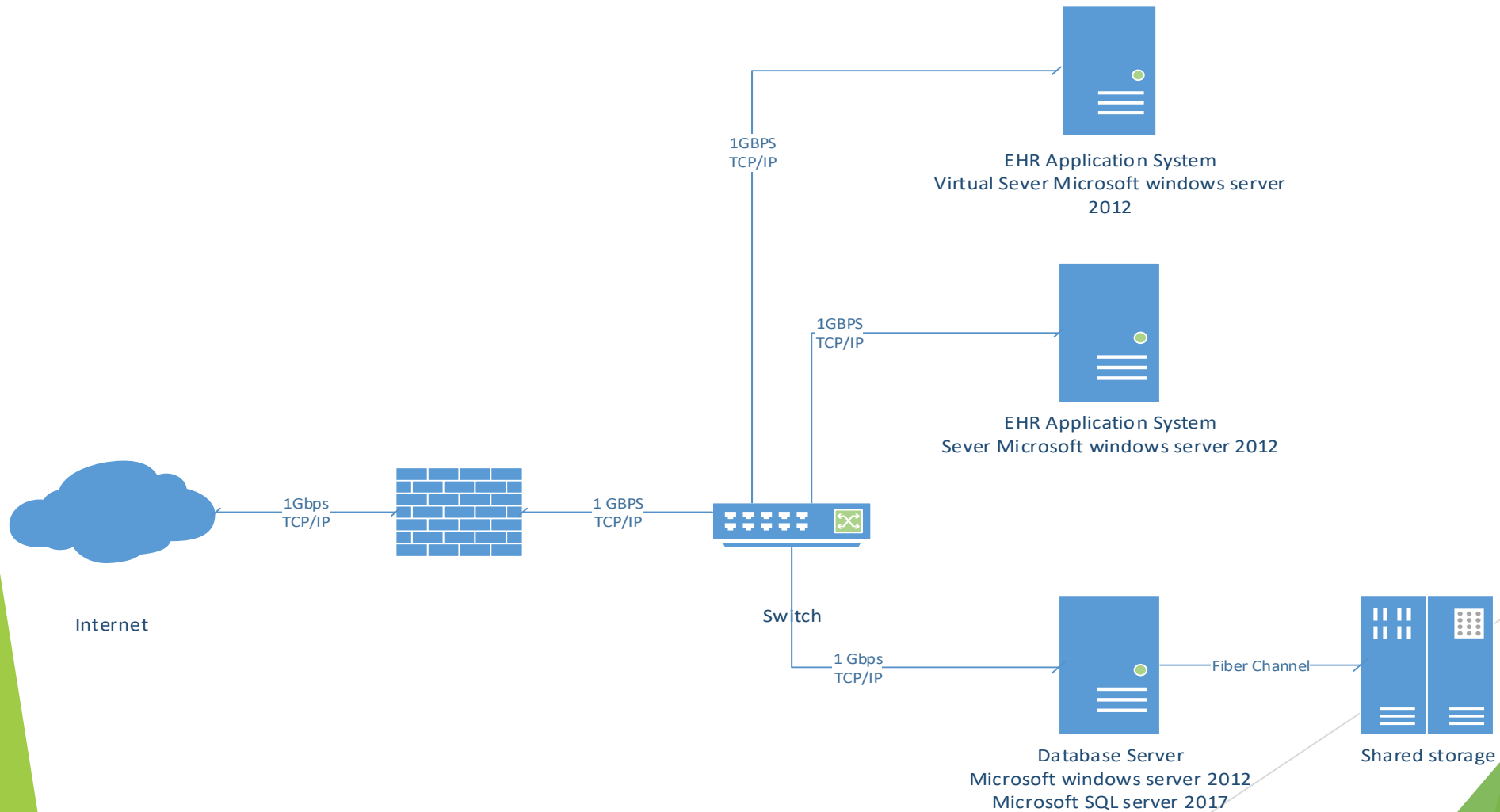- Enables remote monitoring

Recommended Bandwidth

- **Rural Health Clinic (approximately 5 physicians) – 10 Mbps**
- Supports clinic management functions, email, and web browsing
- Allows simultaneous use of EHR and high-quality video consultations
- Enables non real-time image downloads
- Enables remote monitoring
- Makes possible use of HD video consultations

- **Large Practice Partnered with VWC (5-25 physicians) – 25 Mbps**
- Supports clinic management functions, email, and web browsing
- Allows simultaneous use of EHR and high-quality video consultations
- Enables real-time image transfer
- Enables remote monitoring
- Makes possible use of HD video consultations

Recommended Bandwidth

- **Hospital – 100 Mbps**
- Supports hospital management functions, email, and web browsing
- Allows simultaneous use of EHR and high-quality video consultations
- Enables real-time image transfer
- Enables continuous remote monitoring
- Makes possible use of HD video consultations

- **Medical imaging – 100 Mbps**
- The biggest demands on bandwidth are with images. Medical images such x-rays often are digitally stored in huge files and therefore the technology to access these files is challenged by bandwidth concerns.

EHR Application System Server Side

EHR Application System
Virtual Sever Microsoft windows server 2012

1GBPS
TCP/IP

EHR Application System
Sever Microsoft windows server 2012

1GBPS
TCP/IP

1Gbps
TCP/IP

Internet

1 GBPS
TCP/IP

1 GBPS
TCP/IP

Switch

1 Gbps
TCP/IP

Database Server
Microsoft windows server 2012
Microsoft SQL server 2017

Fiber Channel

Shared storage

Vendor 's SaaS Data Center Using a Hosting Vendor

▶ Putting EHR Application System on private cloud removes the need for VWC organization to install and run EHR application on their own computers or in their own data centers. This eliminates the expense of hardware acquisition, provisioning and maintenance, as well as software licensing, installation and support. Other benefits include:

▶ **Flexible payments**

▶ **Scalable usage**

▶ **Automatic updates**

▶ **Accessibility and persistence**

Wireless Local Area Network
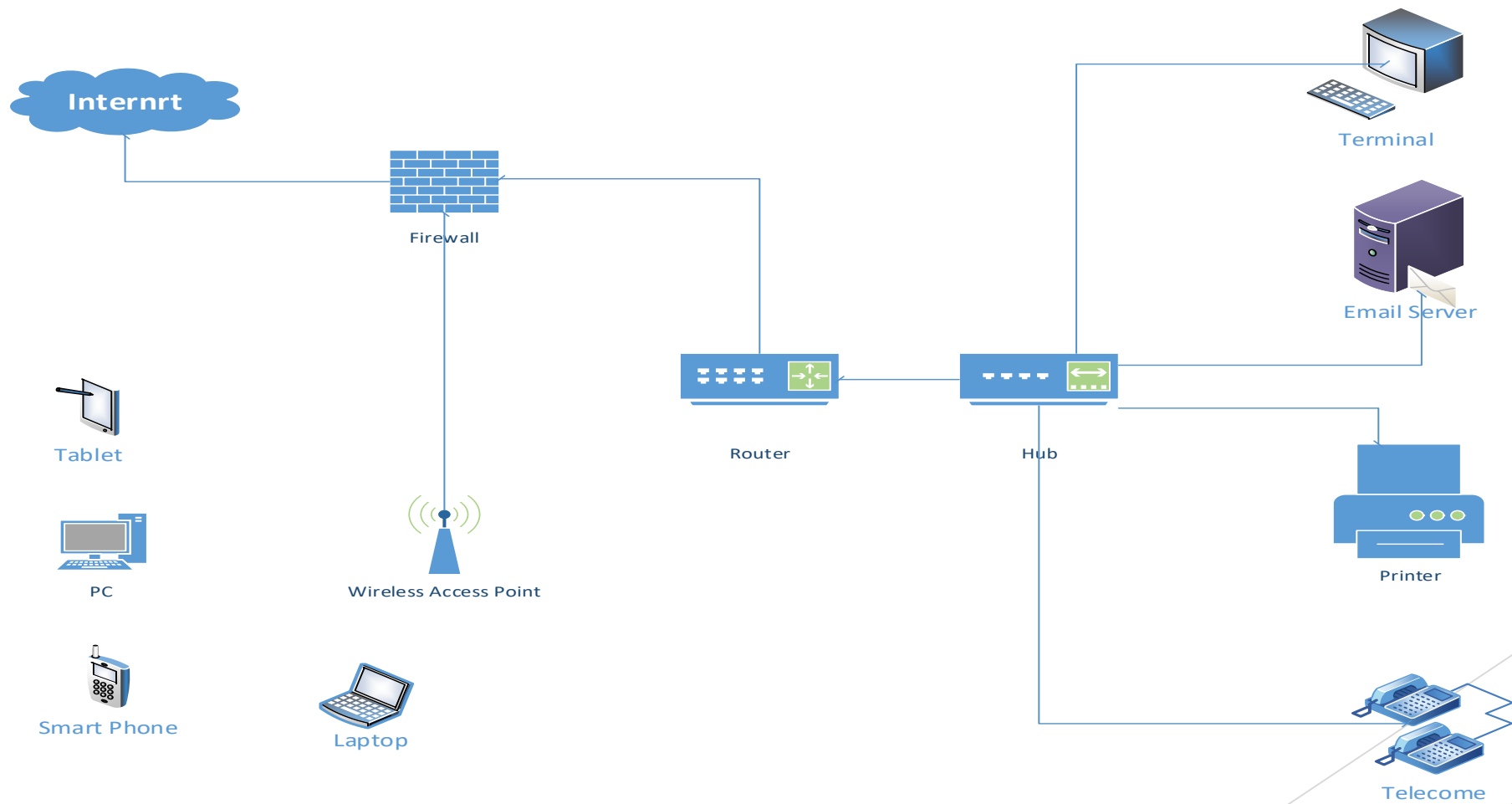
Capacity Management

▶ Avg patient clinical record = 250 KB

▶ Avg image size (Xrays & CTs) = 15 MB

▶ Avg VWC site sees: 100 patients / day 24,000 patient visits / year

▶ Avg patient clinical record: 25 MB /day 6000 MB / year 30 GB 5 years

▶ Avg image size (Xrays & CTs): 1500 MB /day 360000 MB /year 1.8 TB 5 years

▶ Theses calculate indicates for a five years period, VWC needs at least 30 GB for storing patients clinical record and 1.8 TB for medical imaging.

Business Continuity

- Virtualization and backup enhance business continuity.

- For achieving to appropriate technical infrastructure with lower patient risk, there are variety solutions inclusive using:

- Network equipment redundancy

- Application redundancy

- Implement multiple levels of system redundancy

EHR backup plan

- VWC group make a daily back up for safety medical data. There are some factors where VWC should consider when developing an EHR backup plan:

- **Have accessible data backups**

- **Test the back-up plan**

- **Train and drill**

Processing

Requirements & Specifications

▶ Operating System: Windows 10

▶ Speed of processor: Core i5 Processor, ideal for using moderate to heavy healthcare office usage requiring a lot of multitasking, such as keeping an e-mail program while browsing the internet or working with large database files or other clinical devices. Also a prime choice for graphic to see medical imaging.

▶ Amount of memory: Ram memory for routine healthcare use on a Windows 10 computer, is 4 - 8 GB.

▶ Size and type of hard drive: Hard drives come in two basic physical sizes: 2.5-inch drives are used for laptops while 3.5-inch drives are used for desktop computers. Ideal hard drive capacity for using in healthcare office is 500 Gig to 1 Terabyte.

Processing
Requirements & Specifications

- Speed of graphic processor: graphics processing units (GPUs), most commonly known as the engines that render rich, dynamic graphics for variety of medical imaging technologies. The 3D images produced by CT, ultrasound, MRI and PET scans are computationally intensive. A GPU can be present on a video card or it can be embedded on the motherboard. Ideal Speed of graphic processor for using healthcare industries is AMD Radeon RX 480 (8GB).

- Screen Size and Resolution: The size of the screen is often referred to as a screen real state. Medical grade resolution generally refers to 3, 4 or 5 megapixel (MP). More radiologists report that this resolution is sufficient for diagnostic purposes.

- User interface: For data retrieval and data capture in order to making documentation, need interactions between humans and computers.

Database Management

- Each healthcare organization like large physician groups, hospitals, and health systems rely on a large number of databases. For each healthcare organization can consider following applications which related to database:

- Practice management system

- EHR

- Costing system

- Patient satisfaction

- Ambulatory surgery

- Radiology

- Pathology

- Financial system

- HR system

Database Management

- A database is any collection of data organized for storage, accessibility, and retrieval.

- A healthcare database serves to replace the paper documents, file folders, and filing cabinets of old.

- Huge data stores can be used to inform better, more cost-effective care.

- Data can be stored externally and backed up in a secure place to prevent data loss.

Security

▶ Security is always the main concern and Information security and patient privacy are fundamental components of a well-functioning healthcare environment.

▶ Virtual Private Networks (VPNs) can connect two networks together as well as connect a device to a network securely.

▶ VWC with different departments and locations could benefit from a single VPN that covers the entire network. VPN allows

▶ the easy sharing of electronic health records, and centralized control over who has access to the network.

Security

- Some advantages of using VPNs in VWC are:

- **Scalability:** Many of users can connect to a VPN at the same time.

- **Cost:** Compared to older methods such as leased lines, VPNs take most hardware out of the equation.

- **Centralized resources:** IT has control over the network, monitoring and administrating from one central location.

- **Easy sharing:** Users can connect and share faster, getting responses sooner which is critical in a healthcare environment. External portals can also be established temporarily or permanently for partners.

- **Remote access:** Users traveling or accessing data outside the office have uninterrupted, secure connections.