HOSPITAL INFORMATION SYSTEMS

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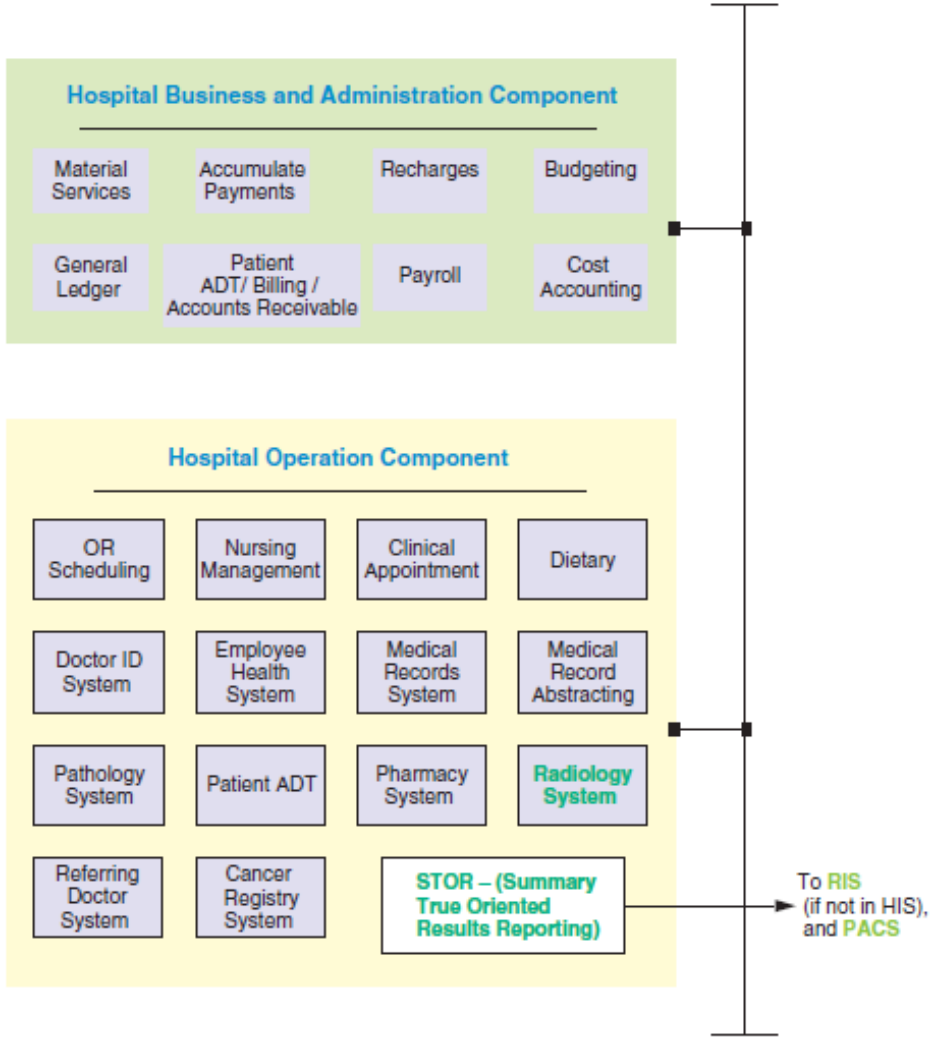
Hospital Information System (HIS)

- HIS is computerized management system for handling three tasks in healthcare environment:
  - Support clinical and medical patient care activities in the hospital
  - Administer the hospital's daily business transactions (financial, personnel, payroll, bed census, etc.)
  - Evaluate hospital performances and costs, and project the long-term forecast
- large-scale HIS consists of mainframe computers and software
  - software can be outsourced as customized HIS related packages, or it can be home-grown
  - Almost all HIS packages were developed through integration of many information systems
- Most clinical departments in healthcare center, mainly radiology, pathology, pharmacy, and clinical laboratories, have their own specific operational requirements that differ from the general hospital operations
  - Special information systems may be needed in these departments under umbrella of HIS

Hospital Information System (HIS)

- HIS supports hospital's and healthcare center's business and administrative functions
  - Provides automation for such events as patient registration, admissions, discharges, and transfers (ADT), as well as patient accounting
  - Also provides on-line access to patient clinical results (e.g., laboratory, pathology, microbiology, pharmacy, and radiology)
- Typical HIS has two categories of software packages: business and administration, and clinical operation
  - Rectangles are major components in each category
- Software package STOR provides path for HIS to distribute HL7-formatted data to outside world

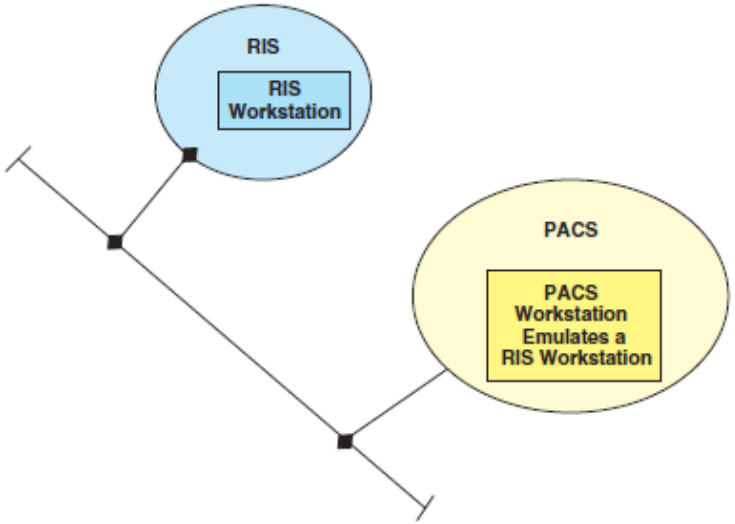


Radiology Information System (RIS)

- Designed to support both administrative and clinical operation of the radiology department, to reduce administrative overhead and improve quality of service
  - RIS manages general radiology patient information, from scheduling to examination to reporting
  - RIS configuration is very similar to that of HIS except it is smaller in scale
- RIS equipment consists of computer system with peripheral devices such as RIS workstations (normally without image display capability), printers, and network
- Maintains many types of patient- and examination-related information
  - Patient-related information includes medical, administrative, patient demographics, and billing information
  - Examination-related information includes procedural descriptions and scheduling, diagnostic reporting, patient arrival documentation, film location, film movement, and examination room scheduling

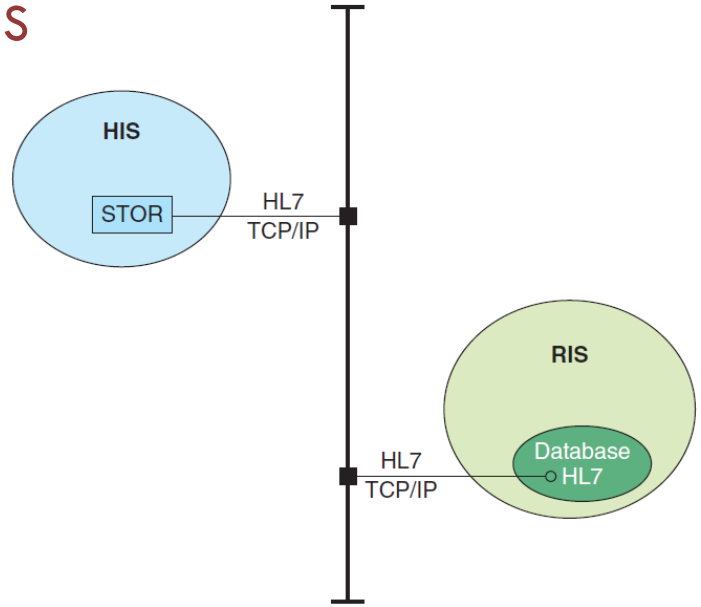
Interfacing PACS with HIS and RIS

- Workstation Emulation
  - Workstation of one information system to emulate workstation of second system so that data from second information system can be accessed by first system
  - For example, PACS workstation can be connected to RIS with simple computer program that emulates RIS workstation and perform any RIS function such as scheduling new examination, updating patient demographics, recording film (image) movement, and viewing diagnostic reports
  - Disadvantage 1: RIS or HIS workstation cannot be used to emulate PACS workstation
  - Disadvantage 2: user is required to know how to use both systems
  - Disadvantage 3: there is no data exchange between RIS and PACS



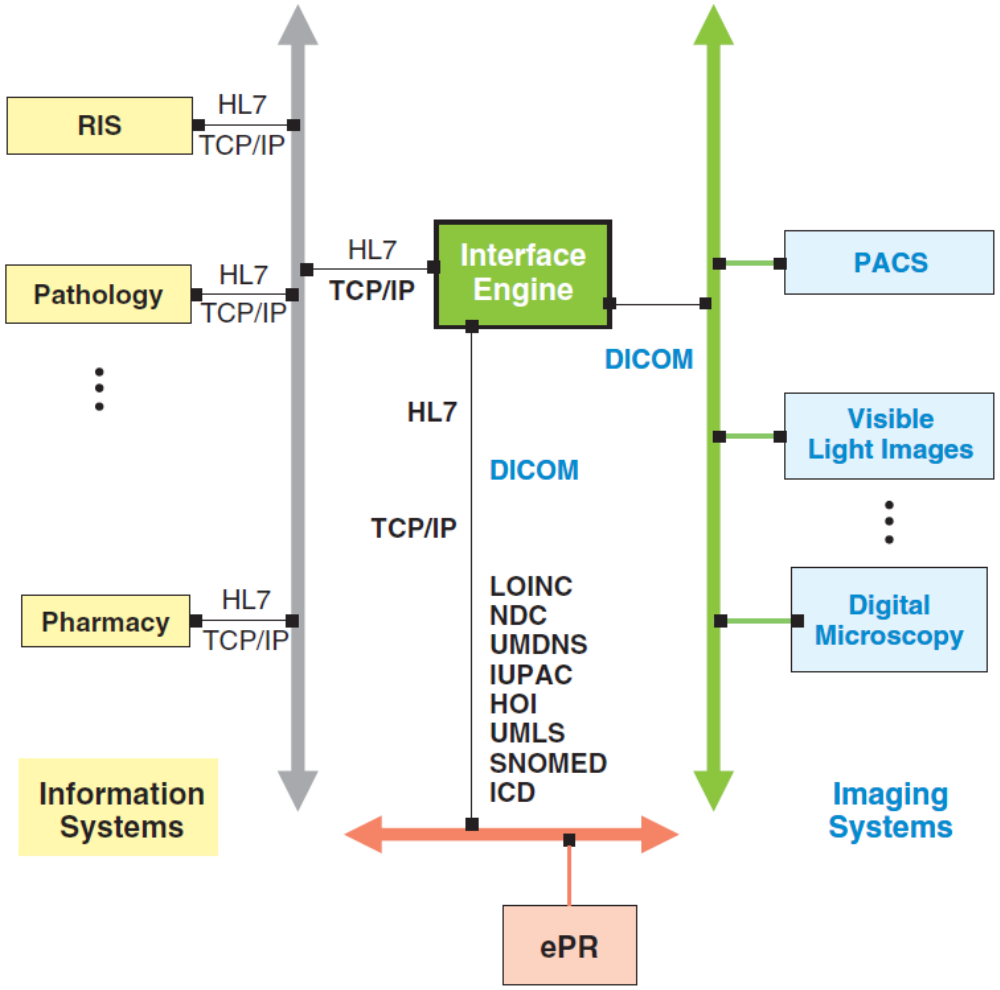
Interfacing PACS with HIS and RIS

- Database-to-Database Transfer
  - Multiple networked information systems share subset of data by storing them in common local area
  - For example, ADT data from HIS can be reformatted to HL7 standard and broadcasted periodically to certain local database in HIS
  - TCP/IP transmission can be set up between HIS and RIS, allowing HIS to initiate local database and broadcast ADT data to RIS through either pull or push operation
  - This method is most often used to share information between HIS and RIS



Interfacing PACS with HIS and RIS

- Interface engine
  - Single interface to access distributed data in networked heterogeneous information systems
  - In operation, it appears that user is operating on single integrated database from his workstation
  - In interface engine, query protocol is responsible for analyzing requested information, identifying required databases, fetching data, assembling results in standard format, and presenting them at requested workstation
  - Ideally, all these processes are done transparent to user and without affecting autonomy of each database system
  - To build universal interface engine is not simple task and hence, most currently available commercial interface engines are tailored to limited specific information systems



Reasons for Interfacing PACS with HIS and RIS

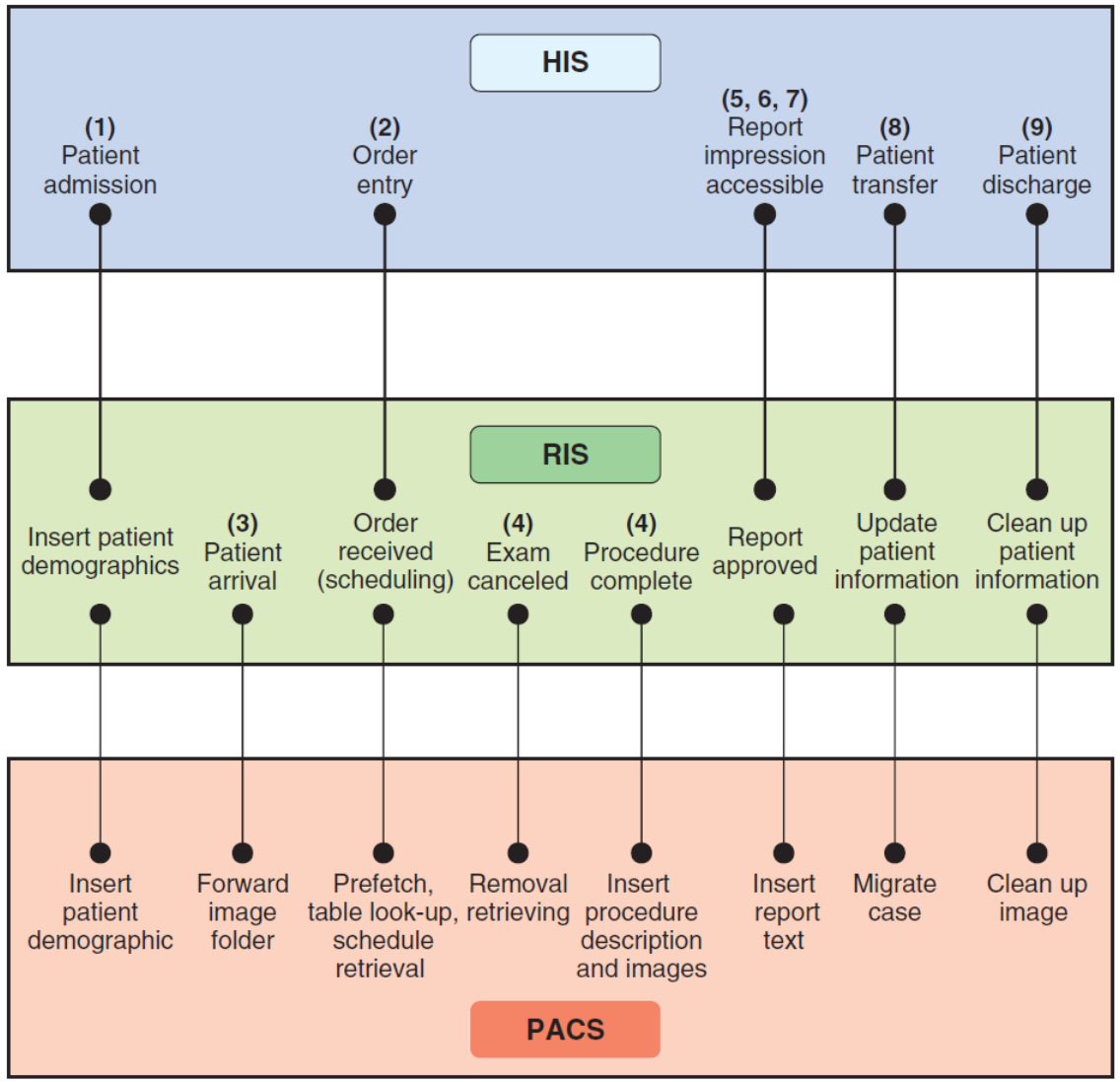
- Diagnostic process
  - Retrieval of images of interest and pertinent information about patient history and studies
- PACS Image Management
  - Some information provided by RIS can be integrated into PACS image management algorithms to optimize grouping and routing of image data to requesting locations
- RIS administration
  - Planning of radiology department requires reorganization of some administrative operations carried out by the RIS
  - PACS can provide image archive status and image data file information to RIS
  - RIS administration operations benefit from the HIS by gaining knowledge about patient ADT
- Research and Training
  - Much research and teaching in radiology involves mass screening of clinical cases and determining what constitutes normal versus abnormal conditions for given patient population
  - Diverse types of information that need to be correlated, such as image data, results from analyzed images, medical diagnosis, patient demographics, study description, and various patient conditions
  - Standardization and data sharing between diverse medical database systems such as HIS, RIS, and PACS are critical

Common Guidelines for Interfacing PACS/HIS/RIS

- Each system (HIS, RIS, PACS) remains unchanged in its configuration, data, and functions
- Each system is extended in both hardware and software for allowing communications with other systems
- Only data are shared while functions remain local
  - For example, RIS functions cannot be performed at PACS or at HIS workstations
  - Keeping each system specific and autonomous will simplify interface process

- Interfacing Requirements based on guidelines
  - Identify the subset data that will be shared by other systems and set up access rights and authorization
  - Convert the subset data to HL7 standard form (designing high-level presentation, solving data inconsistencies, and naming conventions) using common data model and data language and defining rules of correspondence between various data definitions
  - Define the protocol of data transfer (e.g., TCP/IP or DICOM)

Common Data in HIS, RIS, and PACS

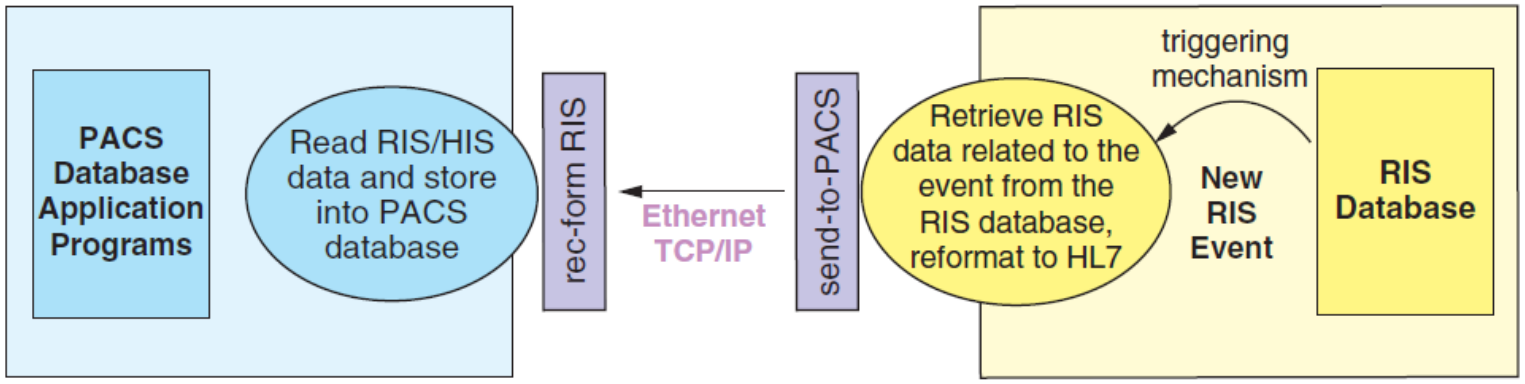


Events	Message	From	To	Action	Location
(1) Admission	Previous images/reports	HIS/RIS	PACS server	Preselect images and reports, transfer from permanent archive to workstations	WS at FL, RR
(2) Order entry	Previous images/reports	RIS	PACS server, scanner	Check event (1) for completion	WS at FL, RR
(3) Arrival	PT arrival	RIS	PACS server, scanner	Check events (1) and (2) for completion	WS at FL, RR
(4) Examination complete	New images	Scanner	RIS, PACS server	New images to Folder Manager, WS	Temporary archive; WS at Fl, RR
(5) Dictation	"Wet" reading	RR	Digital dictaph-one	Dictation recorded on DD or VR, digital report to Folder Manager and to WS	DD or VR; WS at FL, RR
(6) Transcript	Preliminary report	RR	RIS, PACS Server	Preliminary report to RIS, temporary archive and to WS, dictation erased from DD	RIS; temporary archive: WS at FL, RR
(7) Signature	Final report	RR	RIS, PACS server	Final report to RIS, to WS, and to temporary archive. Prelim report erased.	RIS: temporary archive; WS at FL, RR
(8) Transfer	Patient transfer	HIS/RIS	PACS server	Transfer image files	WS at new location
(9) Discharge	Images, report	HIS/RIS	PACS server	Patient folder copied from temporary to permanent storage, patient folder erased from WS	WS at FL, RR; temporary and permanent storage

Key: DD: digital dictaphone; VR: voice recognition; FL: floors in the ward; RR: reading rooms in the radiology department; WS: workstations.

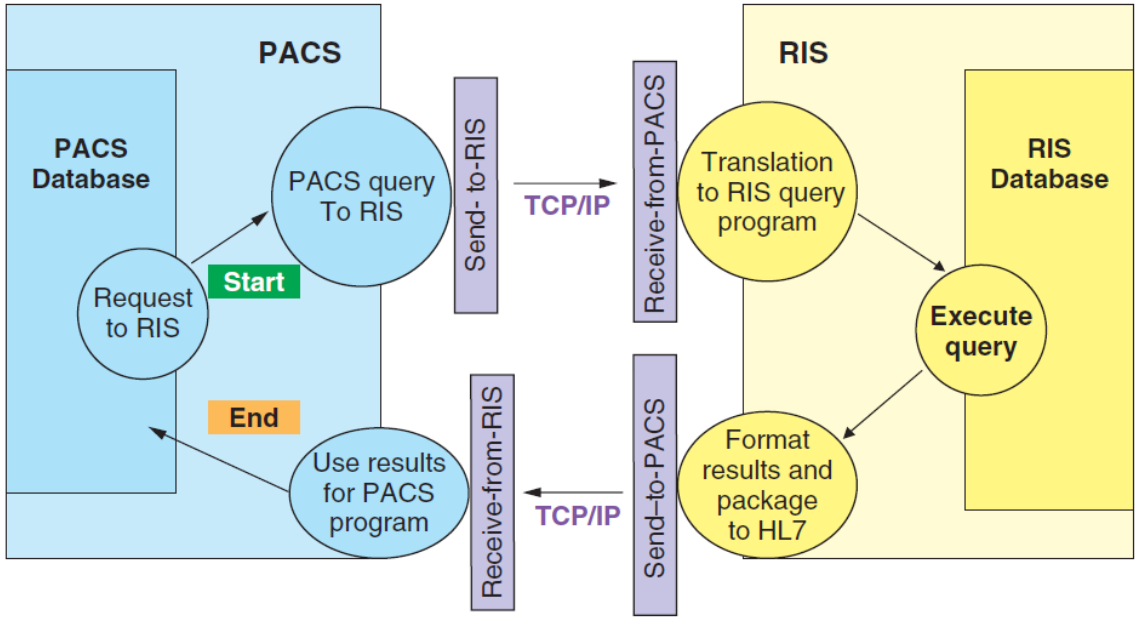
Implementation of RIS–PACS Interface

- Trigger Mechanism between Two Databases
  - PACS is notified of following events in HL7 format when they occur in RIS: ADT, order received, patient arrived, examination canceled, procedure completed, report approved
  - Application level of interface software waits for occurrence of one of these events and triggers corresponding data to be sent
  - Communication level transfers HL7 file to PACS server with processes send (to PACS) and *ris_recv*
  - PACS server receives this file and archives it in database tables for subsequent use
  - Trigger mechanism is used in systematic and timely fashion when small amount of predefined information from RIS is needed from PACS
  - Requires additional storage allocation in both databases, which is tedious for information updating and not suitable for user queries



Implementation of RIS–PACS Interface

- Query Protocol
  - Allows access to information from HIS, RIS, and PACS databases by using an application-layer software on top of these heterogeneous database systems
  - From PACS workstation, users can retrieve information uniformly from any of these systems and automatically integrate them to the PACS database
  - Application-layer software utilizes specific standards
    - SQL as global query language
    - Relational data model as global data model
    - TCP/IP communication protocols
    - HL7 data format



Reference Material

- H. K. Huang, *PACS and imaging informatics : basic principles and applications*, John Wiley Blackwell, 2010.
  - Chapter 13