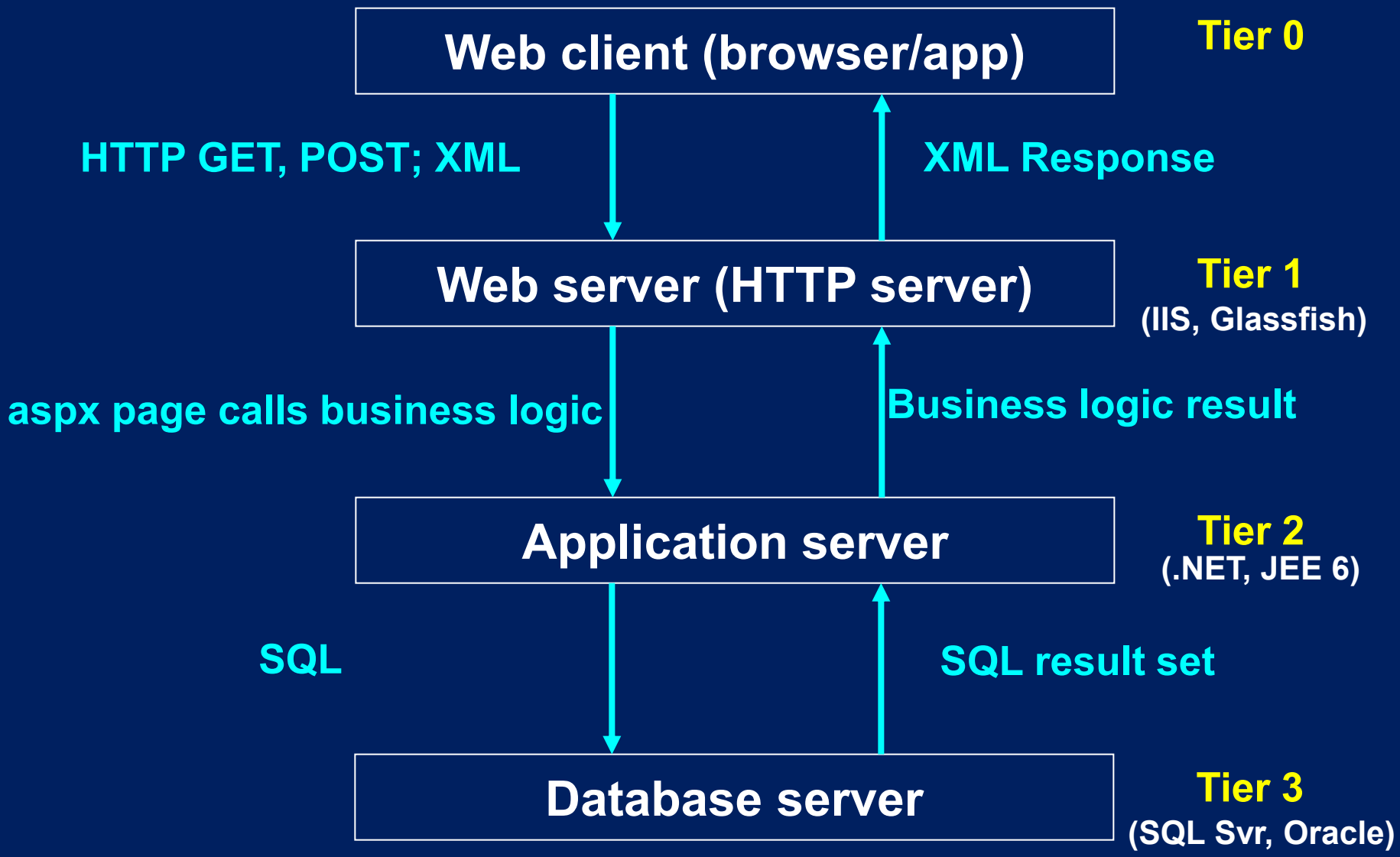
1.264 Lecture 30

System architecture

Next class: Exercise due after class
Please start Visual Paradigm-we'll use it in class today
No zip file to download-it's online

Three tier architecture



In HW7, your aspx pages include the business logic that is usually in the application server

Case study: Travel industry

- Open Travel Alliance (www.opentravel.org)
  - 150+ airlines, hotels, car rental, GDS, others
    - GDS: global distribution system (Sabre, Apollo, etc.)
  - Collaboration to implement industry-wide open e-business specifications
  - Electronic distribution supply chain
    - Developed common XML formats, trading partner to trading partner
  - Goals are to lower supply chain costs and improve consumer travel costs and experience
- Current conditions
  - Two protocols in current use
    - ResTeletype: 64 character sentence
    - UN/EDIFACT (EDI): fixed messages, difficult to change
  - Same systems, messages have been used for 30 years

"T" travel agency

- US travel agency "T" in Midwest:
  - Lines of business:
    - Airline, hotel reservations for residents
    - Local attraction reservations for international visitors
  - Systems used:
    - Telephone, fax, teletext message service
    - Internally developed computer apps: customers, local attractions, etc.
  - Web changed travel business
    - "T" became GDS partner for international travel in Midwest
    - New suite of services offered: air, hotel, rail, car rental
    - New suite of international services for US customers
    - Opened branch offices around the world

Based on Kumar, Narayan, Ng, "Implementing SOA Using Java EE"

"T" travel agency, cont.

- "T" changed its information systems to work with GDS and its consumer customers
  - Application software, middleware, desktops, servers
- "T" unable to penetrate international travel market
  - To remedy this, it bought UK and Asian travel agencies
  - All three companies had different legacy applications, and networks, which created problems
- Systems architecture needed for new company
  - Meet evolving customer and GDS requirements
  - Minimize legacy systems
  - Retain existing Web services, if possible
  - Create new Web services to replace legacy apps

Activity diagram: current system

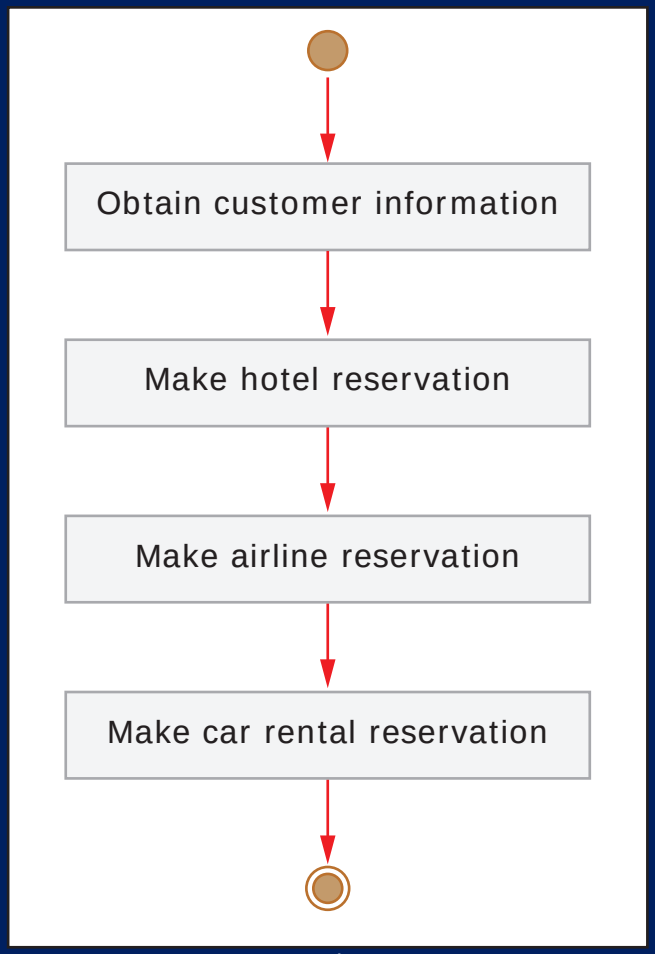


Image by MIT OpenCourseWare.

- **Problems:**
  - **Choices are complex:**
    - **Air: carrier, price, time, hops,…**
    - **Hotel: chain, room type, rate, location, …**
    - **Car, sightseeing package similar**
  - **Airline reservation may bundle hotel, car reservations at discount**
  - **Reservation confirmation may be delayed (especially international)**
  - **Partial itinerary not acceptable to customers today**
    - **Customers change their mind partway through the itinerary process**
  - **Travel packages must be flexible, attractively priced, easily booked**
    - **Customers have own discounts: AAA, …**
  - **Sequential process too slow for online users**

Exercise: Activity diagram

- Draw a UML activity diagram:
  - Do as many steps from previous diagram in parallel as possible
  - Check that parallel results fit together
  - If results fit together: present the outcome to customer
    - Otherwise, re-do required step(s) until a fit is found,
    - Or tell/ask customer to search again

Solution

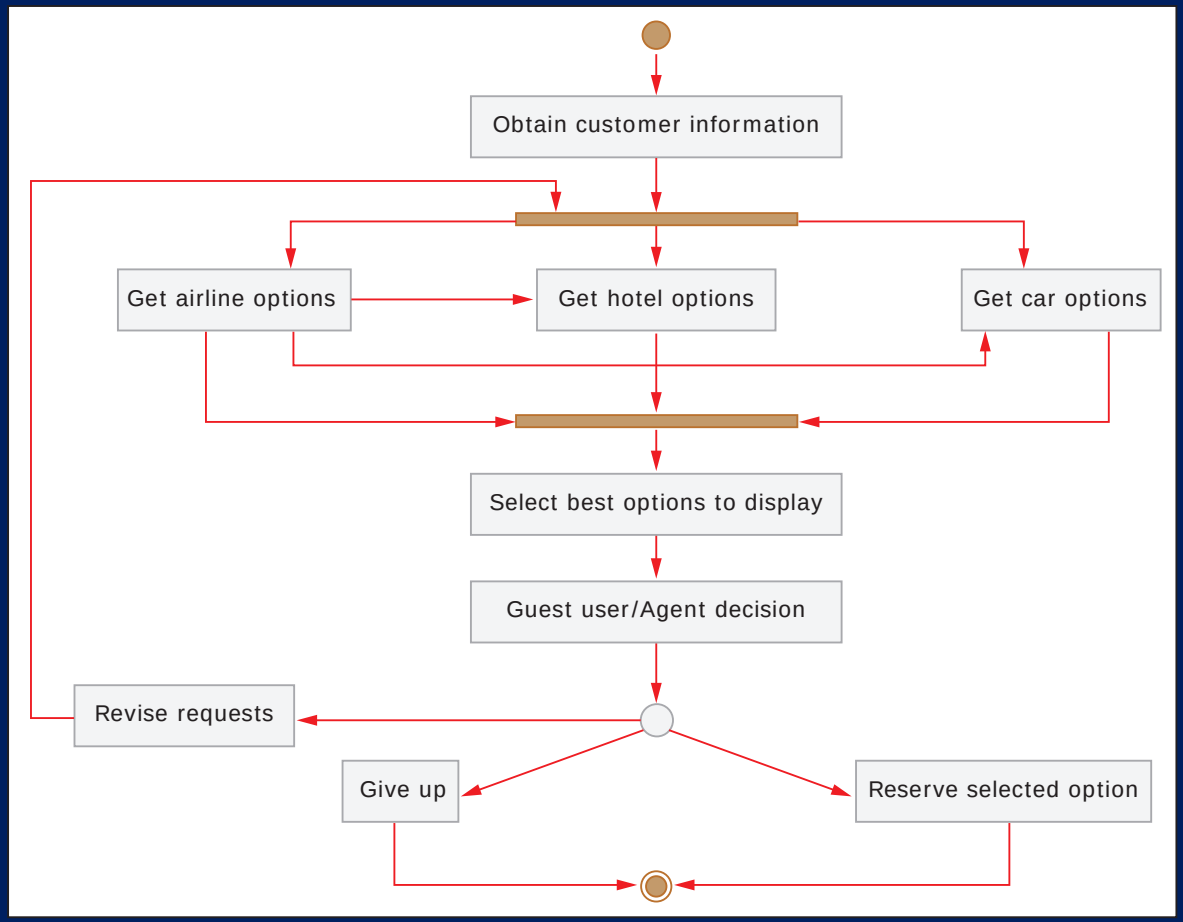


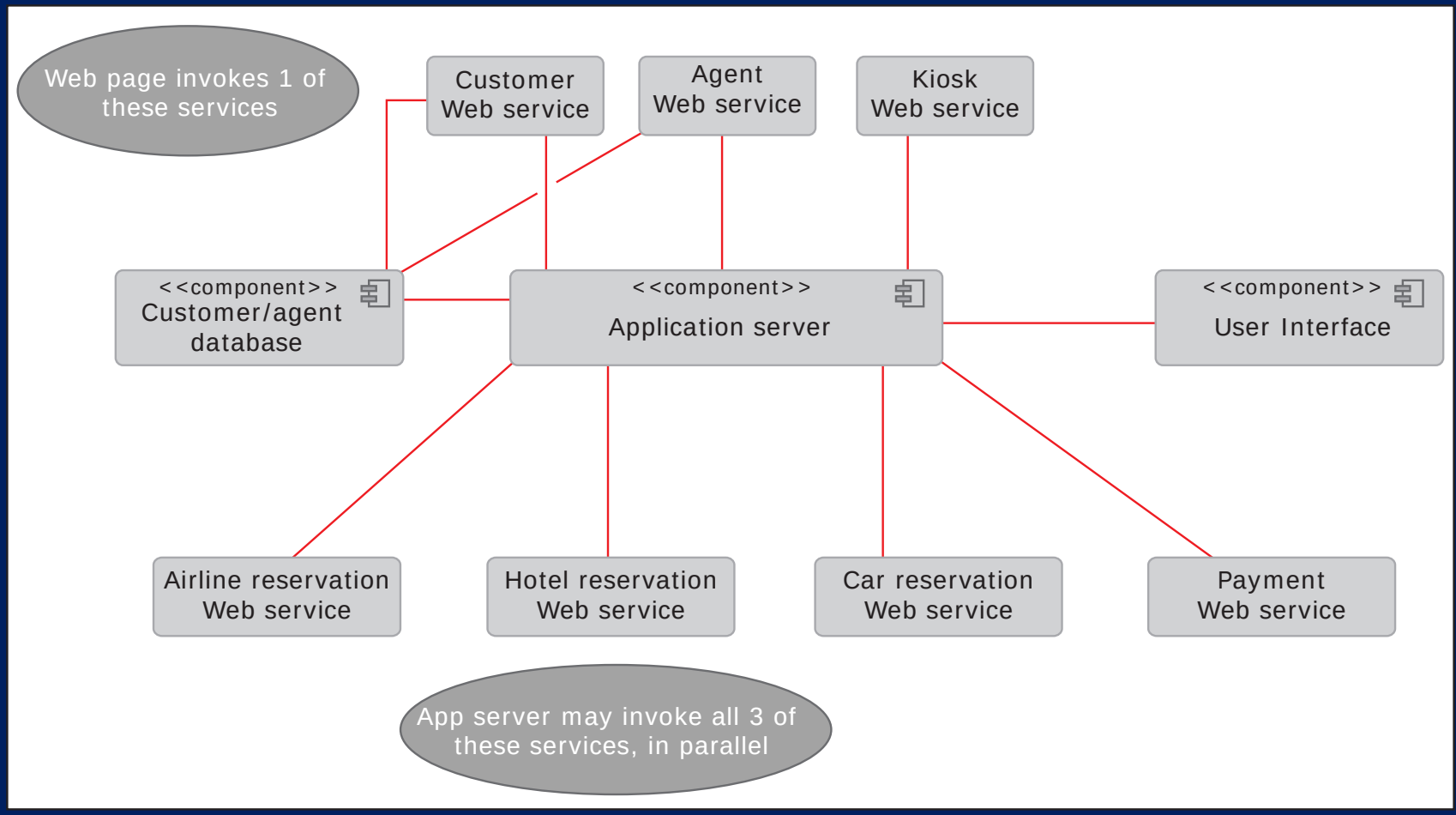
Image by MIT OpenCourseWare.

- This models a set of Web services, providing reservations for multiple customers connecting to multiple reservation systems.
- Reservation itinerary gets filed with “T”
- “T” checks if air res made; if not it uses air Web service.
- “T” then checks hotel, car in same way

Solution, cont

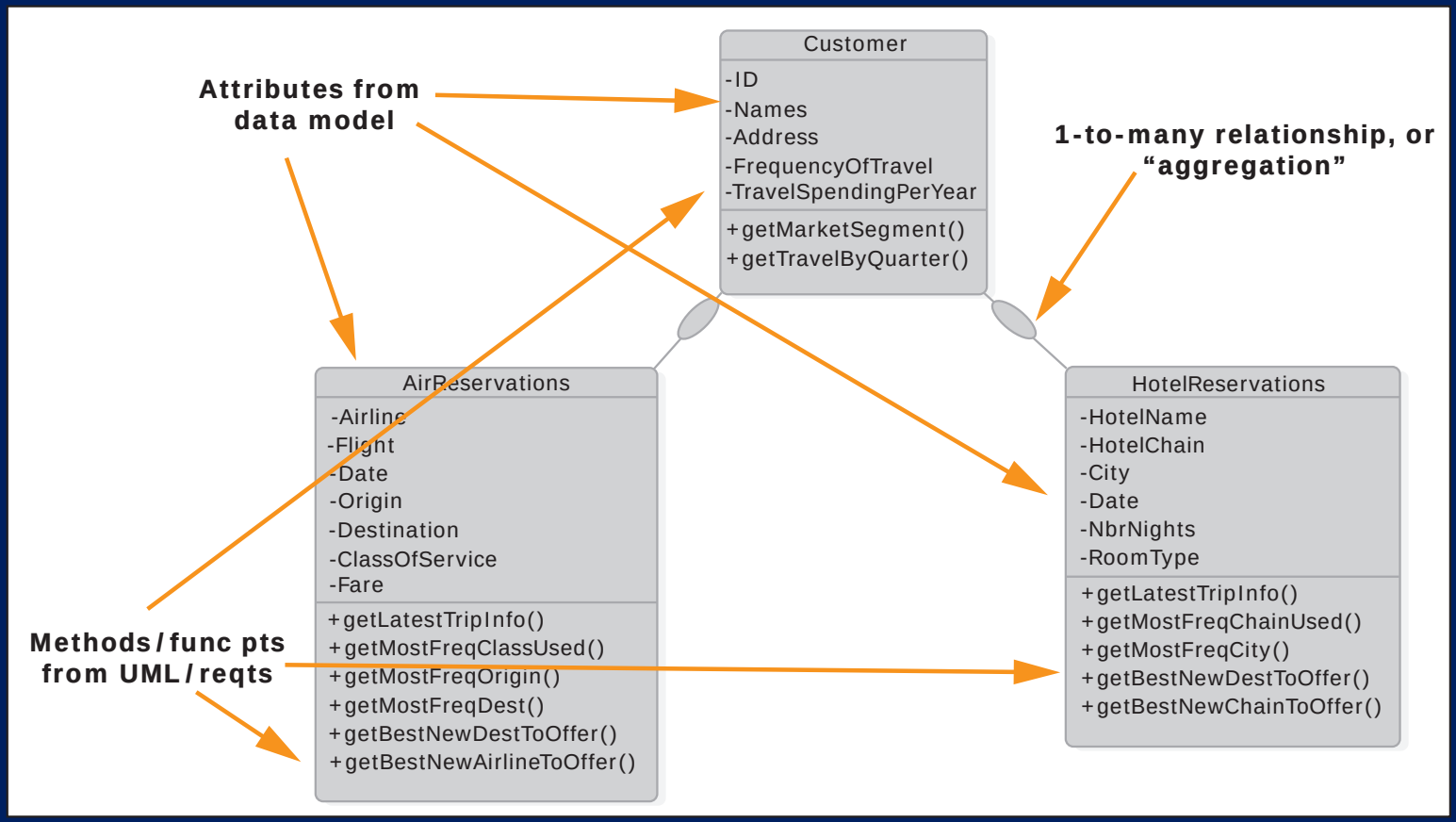
- This architecture will generate many (often thousands) of queries in parallel
- Most of the results won't be used directly
  - They are sorted and assembled by the application
  - Only the best ones are shown to the user
- This requires much more (often thousands of times more) bandwidth than older approaches
  - Fiber optic bandwidth is large and can support this
- Supply chain and other business applications are moving to this model
  - Query many carriers, vendors, etc. for availability, price, …

System architecture based on activity diagram



"Wrapper" legacy code: almost all allow Web services to be added. Only a few Web services needed per legacy app to interface to it.

Class diagram for application server



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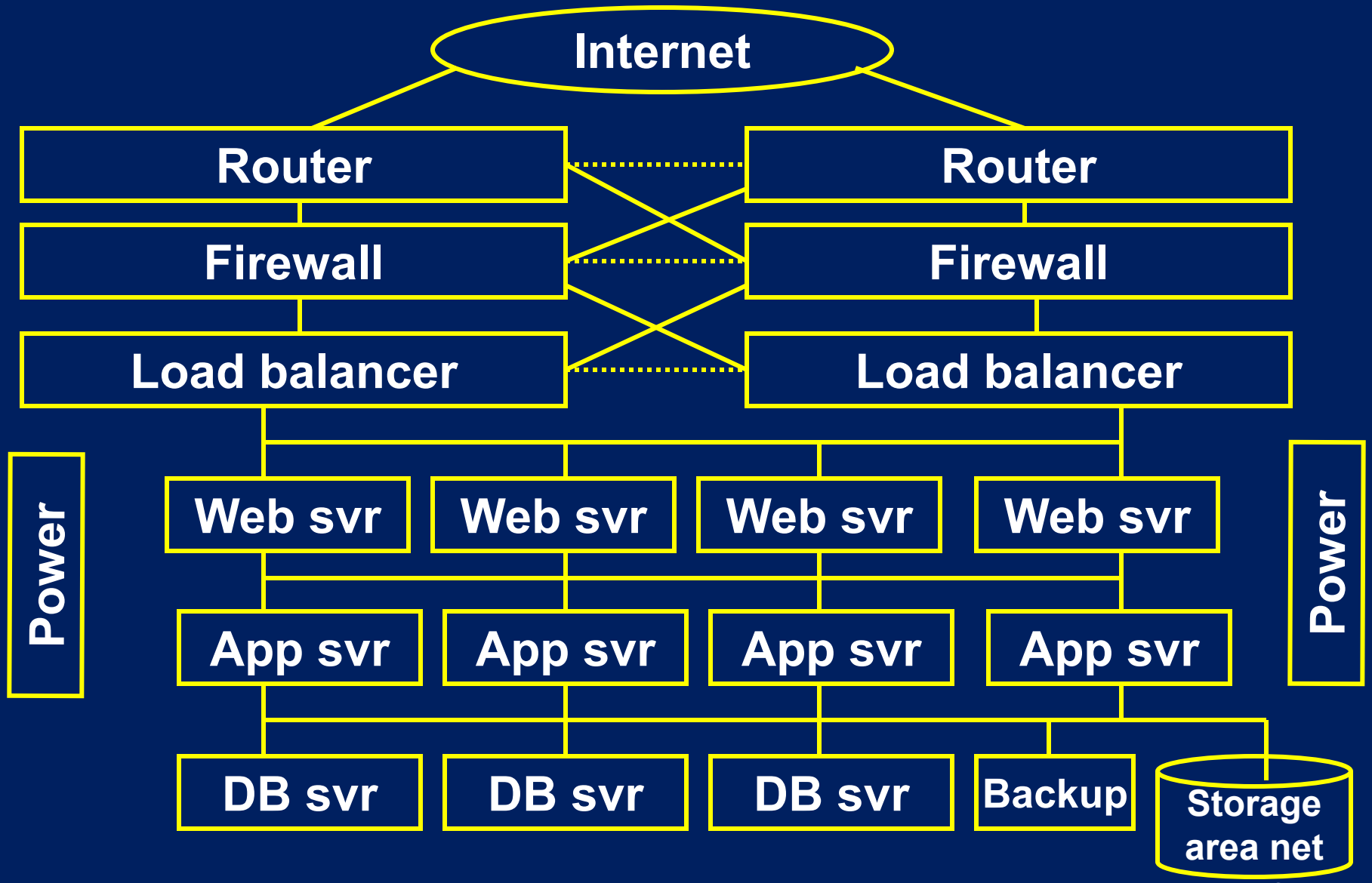
Similar classes for car rental, itinerary check, etc.
Write these methods in C#, similar to those on .aspx pages
App server and its tools handle db, xhtml, xml input/output

System architecture components

- Application components
  - Web server
  - Application server
  - Database server
- Network interface architecture components
  - Router
  - Firewall
  - Load balancer
- All include the hardware and the software that runs on it

Architecture components at server end



Simple example of system hardware architecture

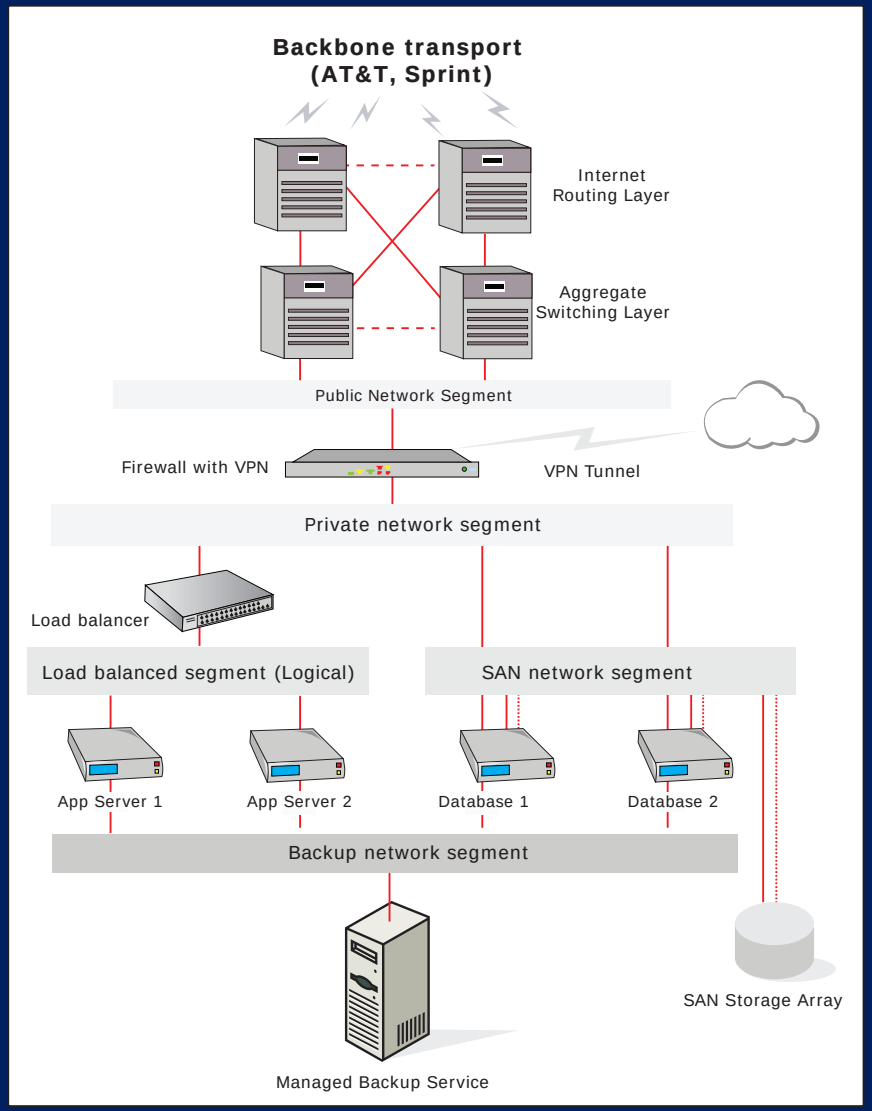


Image by MIT OpenCourseWare.

Router, firewall, load balancer

- Router routes IP (TCP/IP and UDP/IP) packets
  - Routing table: send packet to local machine or to another router
- Firewall examines all packets
  - Checks IP address, port
  - Extracts contents from all Internet protocols if suspicious
- Load balancer sends HTTP packets to Web servers
  - Balances based on HTTP header: client IP, cookie, …
  - Many inexpensive servers function as single server
  - Add new servers, sites without interruption to service

Web server, app server, database server

- Web (HTTP) server:
  - Handles HTTP requests and responses
  - Reads and writes XML and XHTML documents
- Application server:
  - Think of it as a pre-written main program with many pre-written components for common tasks
    - Can generate Web pages/XML, read/write from db easily
  - Designed from UML use cases, sequence diagrams: e.g.,
    - Order entry, receiving, shipping, payment, engineering, …
- Database server:
  - Persistent storage of data
  - Sharing of data across applications and organizations
  - Repository of business rules, within database and to guide XML document exchange

System architecture and configuration

- Organization of all system components (hardware, software, network) is the system architecture
- Done early in system development or configuration project
  - Assess users, applications, system software, networks, hardware
  - Configure Web/app/db servers, networks, backup, etc.
  - Configurations are complex and changing
  - Information is usually wrong on which estimates are based
  - Step is needed because you need a budget for a project
- Remember the estimate convergence curve
  - There is much uncertainty in the final system hardware and software. We are only in spiral 1 still.
  - If you make a baseline (point) estimate, you have a lot of error and about a 50% chance of being too low
  - If you've done everything else right but your system is slow because of inadequate hardware or telecom, it will be very frustrating
  - Your customer can't tell why your system is slow. It may be bad database, bad/inefficient software implementation, etc.
  - This is one of the few problems that you can throw money at to solve!

System architecture and configuration, p.2

- Successful configurations are usually overbuilt
  - Most components will be oversized, but you have a better chance of having enough capacity at the (unanticipated) bottleneck
  - Spend your entire budget, always, or use cloud computing
- Each server (often virtualized) does just one thing:
  - HTTP server (Web server)
  - Business logic (app server)
  - SQL (database server)
  - We can understand and characterize its task this way. If a box handles many functions, sizing and managing it is hard

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