John J Deltuvia, Jr.
Final Project
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Synopsis

This paper deals with a three-step analysis of networking needs for a start-up company engaged in the location of non-custodial parents who are failing to pay due amounts under a child support order, and collecting money from these persons once they are found. Although there is a public system that does this, funding levels do not allow the sort of location services required to track a person who is determined to evade payment, nor the institution of special legal processes when that person's income is not derived by salary or wages from an established company. With further cutbacks in funding at both the US Federal and State levels, this is anticipated to be a growth industry, as the number of court orders increase, the economy stagnates, and the number of State enforcement personnel declines due to funding cutbacks.

Aspect 1: The company, its basic layout and needs analysis

Organization

The company's name is CATCH-AP (Children Awaiting Cash: Team Catch Hiding Absent Parents.) Although in the public sector, parents responsible for paying support monies are now called "non-custodial parents" (NCPs), because many NCPs are not absent, pay on time, and exercise visitation rights, this company concentrates on parents who are, actually, absent. This company is technically termed a "private child support collection agency", similar to the companies found on Google at http://bit.ly/peIM2k . I have chosen this model as I work for public child support enforcement, and therefore the basic operations model is familiar to me; however, the campus requirements of the Term Project do not fit the specific operations model of a typical public child support enforcement agency. In order to simplify network design, without the need for consideration of replacements, swap-outs, etc., I am assuming a new start-up with building and network design *ab initio*.

The primary business is to locate non-payors and, once they have been found, collect child support; customers tend to be individuals ("custodial parent" even when the individual is actually a guardian) who have been unsuccessful using public means of collecting child support. Private firms in this business tend to charge a percentage of monies collected, unlike the public agencies which usually charge a flat fee up front (in NJ it is $6.00.) The means of execution of this business is intensive location efforts, which are usually unaffordable for public sector agencies. Thus, the employees in this business are primarily research personnel skilled with internet, investigatory, interview, and other information-gathering techniques.

One or more attorneys may also be employees of a firm (in my model, I will assume such), so that the firm may require the customer to retain the attorney who will issue a garnishment or other legal execution on monies to be paid through the firm so the firm can take its percentage and send the agreed-upon remainder to the customer. Other types of essential employees include fiscal processing personnel, and, of course, an Information Technology department responsible for hardware and software.

Physical Infrastructure

For this firm, I have chosen to locate a primary campus of three buildings:

- o   IT and management (including centralized servers) in a two-story building;

- o Advanced locate personnel (who handle locate functions that the local offices have not been able to effect) and centralized Legal staff in a two-story building; and
- o Financial processing personnel (who accept incoming payments, input them into the system, and, once the checks clear, ensure that the balances are correct and release checks or bank transfers to the customers, and credit the corporate account for its percentage) in a one-story building.

The basic layout of the primary campus, which is the only multi-building campus, is of three buildings:

- the Management/IT building, a two-story building, nearest the public road, and is at approximately 500 ft from the other two buildings;
- the one-story Financial building; and
- the two-story Legal/Locate building, adjacent to the Financial building, approximately 20 ft away from that building.

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Two-story Legal/Locate

One-story Financial

Two-story Mgmt / IT
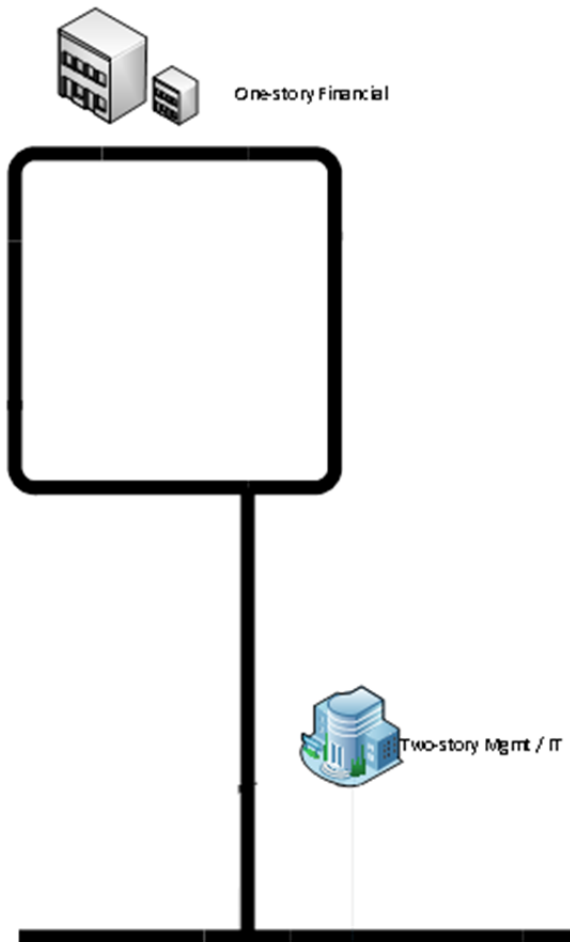
CATCH-AP will have six satellite offices for customer service, in addition to the headquarters campus. All customer service centers will be built on the same model of building and network, simplifying maintenance training; all buildings on all campuses – excepting the financial office on the headquarters campus – will be built to the same width (80 ft.) and length (110 ft.) specifications. Local offices will not have printers; all information will be kept on the computer. This will simplify matters if investigations are carried out by Government agencies as to whether or not the firm has sufficient security for private information relating to individuals, or if a lawsuit is brought by a private party touching on

such. All customer service office campuses will be located on a private road, away from the downtown area, lessening land costs. A typical satellite campus is as follows:

One-story
satellite office

P
Parking Lot

Private driveway

Public road
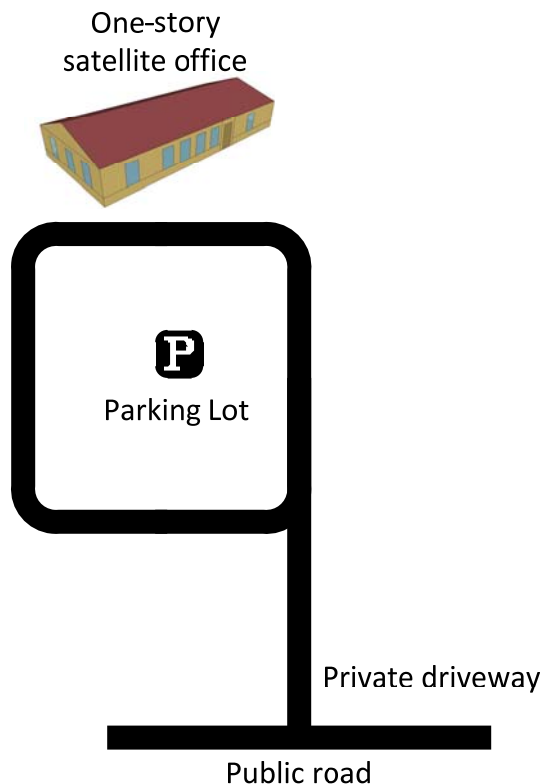
To locate the headquarters and the branch offices, I consulted the data available on the Internet for the greatest increase in child support arrears from Federal Fiscal Year (FFY) 2009 to FFY 2010 by state or state-equivalent. The top-ranking potential markets are:

State/State Equivalent	Increase
North Carolina	40.2%
Pennsylvania	10.6%
Utah	9.1%
Florida	8.3%
South Dakota	8.2%
Puerto Rico	7.3%
Mississippi	6.9%
Tennessee	6.6%
New Jersey	6.6%
Texas	5.9%
Alabama	5.7%
South Carolina	5.6%
Louisiana	4.9%
Oklahoma	4.7%
Delaware	4.5% [1]

[1] US Government. "FY 2010 Preliminary Report - State Box Scores." *Administration for Children and Families*. US Department of Health and Human Services, n.d.. Web. 8 Sep 2011.
<http://www.acf.hhs.gov/programs/cse/pubs/2011/reports/preliminary_report_fy2010/state.html>.

Based on this data, the main campus will be located in Charlotte, NC, which places it in the state where the best potential market is. The walk-in customer service center will be located about ten miles away from the main campus, keeping the processing areas safer from persons (such as people who owe child support) who might physically attack the facility. Placing the main campus and walk-in campus in Charlotte, NC, will additionally provide convenient in-person customer access for SC as well. Additional satellite customer-service campuses will be located in:

- Philadelphia, PA (which can easily provide service to New Jersey and Delaware);
- Tallahassee, FL (convenient to Alabama as well);
- Memphis, TN (also convenient to Mississippi);
- Dallas, TX (convenient to Oklahoma); and
- Houston, TX (two offices in Texas due to the size of the market, in addition to Houston's proximity to Louisiana.)

Distances among these campuses are as follows (mileage based on city-to-city mileage from http://mapquest.com):

City Names	Charlotte HQ	Philadelphia	Tallahassee	Memphis	Dallas	Houston	Charlotte Br
Charlotte HQ		583 mi.	545 mi.	619 mi.	1030 mi.	1037 mi.	10 mi.
Philadelphia	583 mi.		1018 mi.	1035 mi.	1487 mi.	1569 mi.	573 mi.
Tallahassee	545 mi.	1018 mi.		538 mi.	840 mi.	710 mi.	555 mi.
Memphis	619 mi.	1035 mi.	538 mi.		435 mi.	574 mi.	624 mi.
Dallas	1030 mi.	1487 mi.	840 mi.	435 mi.		239 mi.	1035 mi.
Houston	1037 mi.	1569 mi.	710 mi.	574 mi.	239 mi.		1035 mi.
Charlotte Br	10 mi.	573 mi.	555 mi.	624 mi.	1035 mi.	1035 mi.	

A map of relative geographic campus locations is as follows (map extracted from a US government web publication[2]):

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[2] "United States." Map. State Resource Guides. Central Intelligence Agency. Washington, DC: United States Government, 9 Aug 2011. Web. 12 Sep 2011. <http://memory.loc.gov/gmd/gmd370/g3700/g3700/ct001756.jp2>.

Qualitative rejections of statistical candidates:

- Utah was rejected due to the small size of the potential market.
- Puerto Rico was rejected due to the long-term problems of collection of PR orders[3] ; the possible complexity for a start-up in placing an office not in the contiguous United States (this is not a business which lends itself to international expansion due to the vastly differing laws by country, so PR does not offer a way to obtain US experience to expand to, say, Peru); and the additional complexity of the primary language in PR differing from the primary language of the remainder of the US.

Each customer service office shall have 20 locate specialists, 1 supervisor, 1 attorney barred[4] in the state and surrounding states as well as in the US Supreme Court, 2 IT personnel specializing in thin-client network maintenance, and one receptionist. Customer service offices are all one-story buildings.[5]

The advanced locate unit shall have 40 locate specialists and 1 supervisor. The same building will co-locate the Chief Counsel, the Assistant Chief Counsel, and 2 staff attorneys subject to the bar restrictions above. There will also be 4 paralegals.
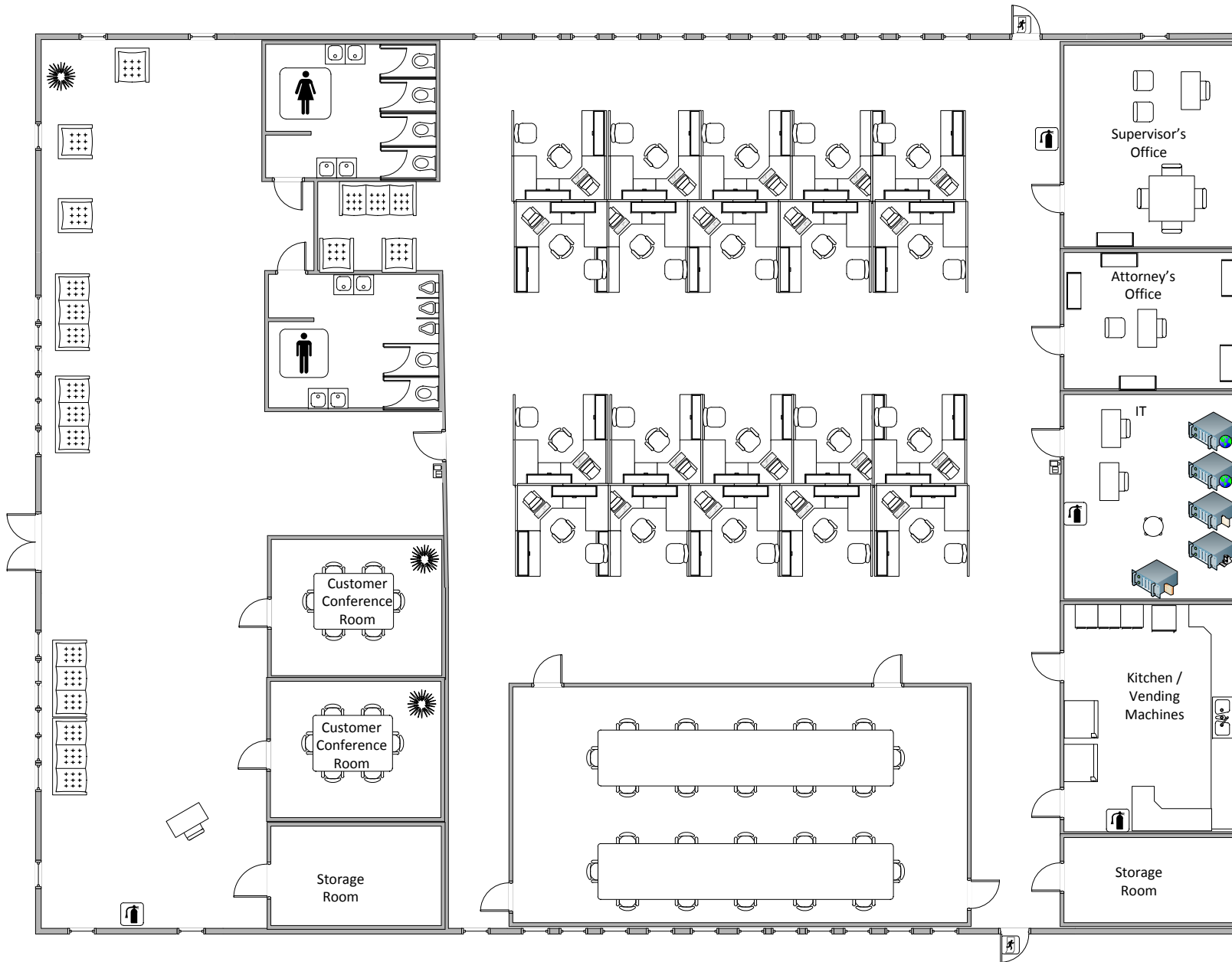
The headquarters IT staff shall have the CIO/CTO (one individual), 5 operations personnel, a DBA, and 2 programmers.

The top management team members located on the management floor include the CEO, the COO/Customer Service Coordinator, the CFO, and six general staffers. These buildings are shown on the following pages, as landscape mode is required. (Note that the IT office internal design of servers/switches changes radically from Aspect 1 to Aspect 2, as we proceeded in the course.)
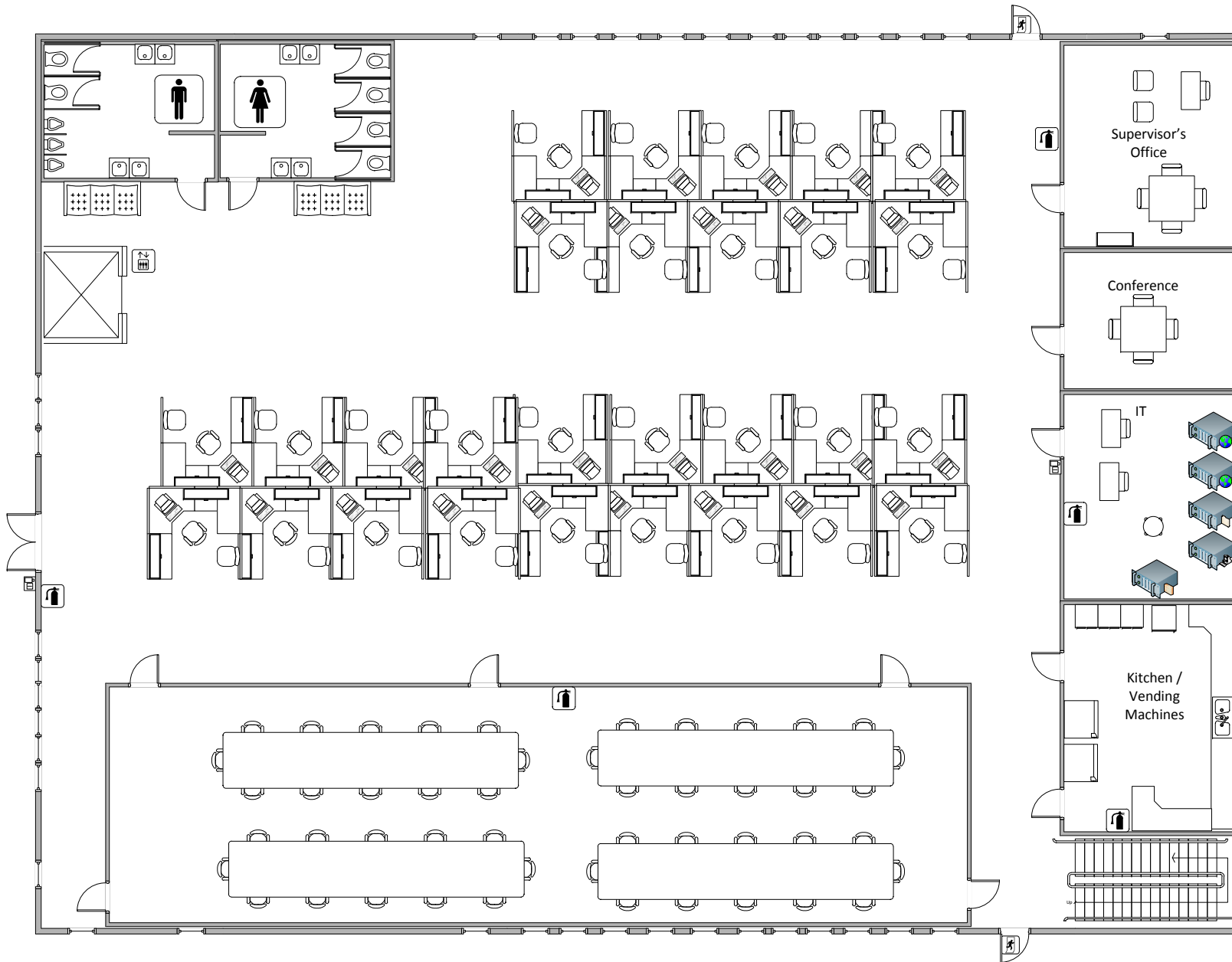
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[3] Personal knowledge from over 20 years' experience in CSE (Child Support Enforcement.)
[4] "Barred" as applied to an attorney means "admitted to practice". An attorney whose license has been revoked is "disbarred".
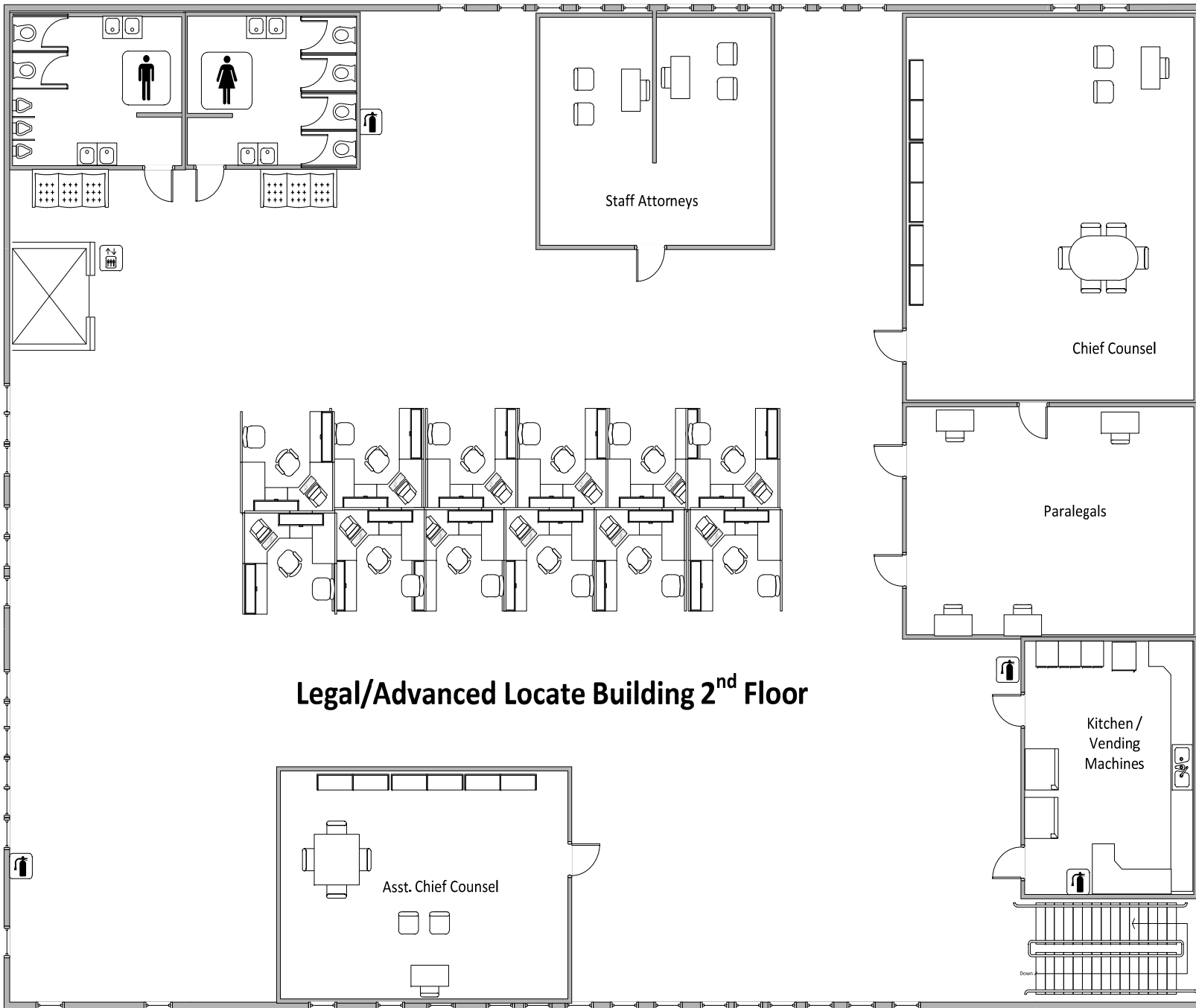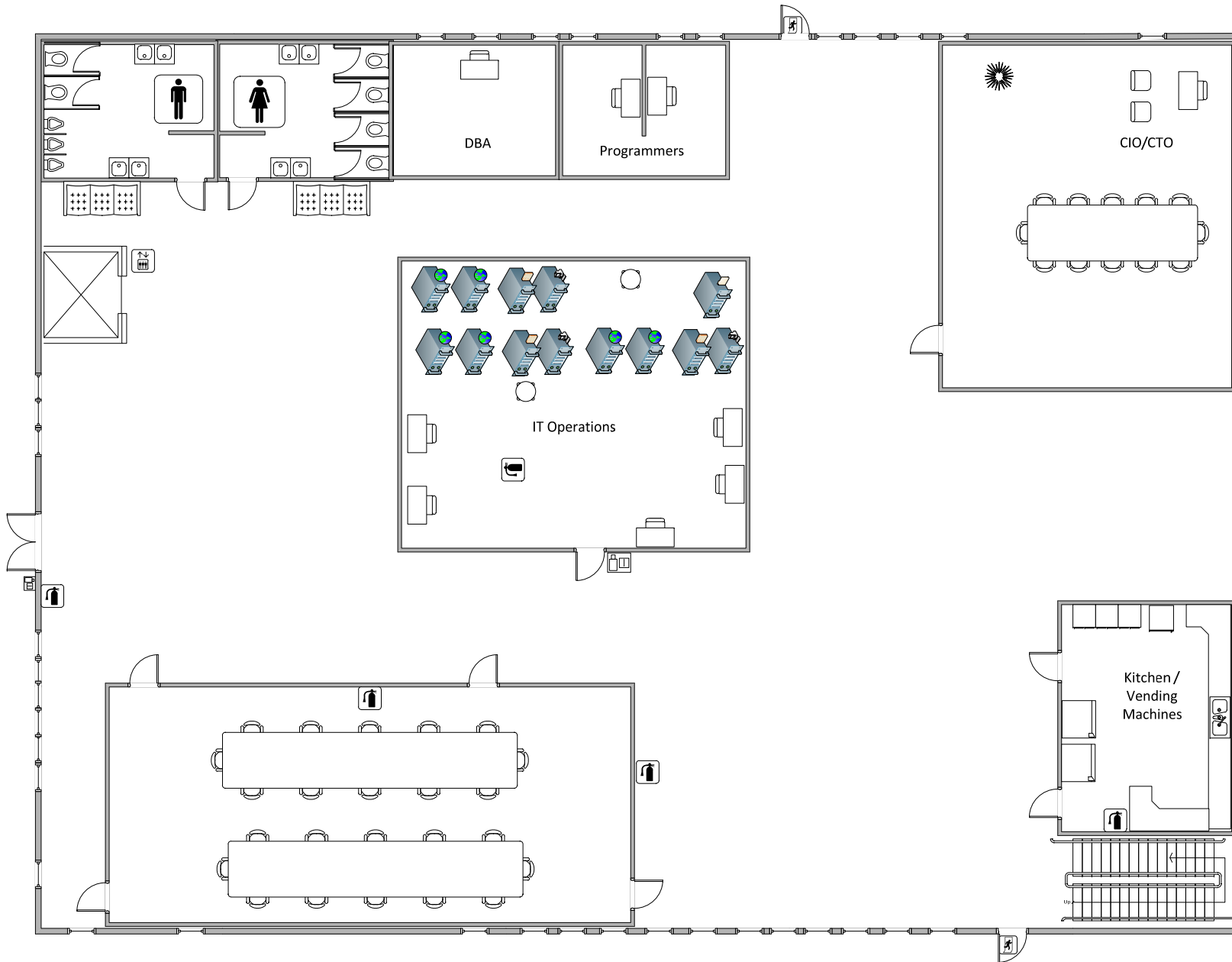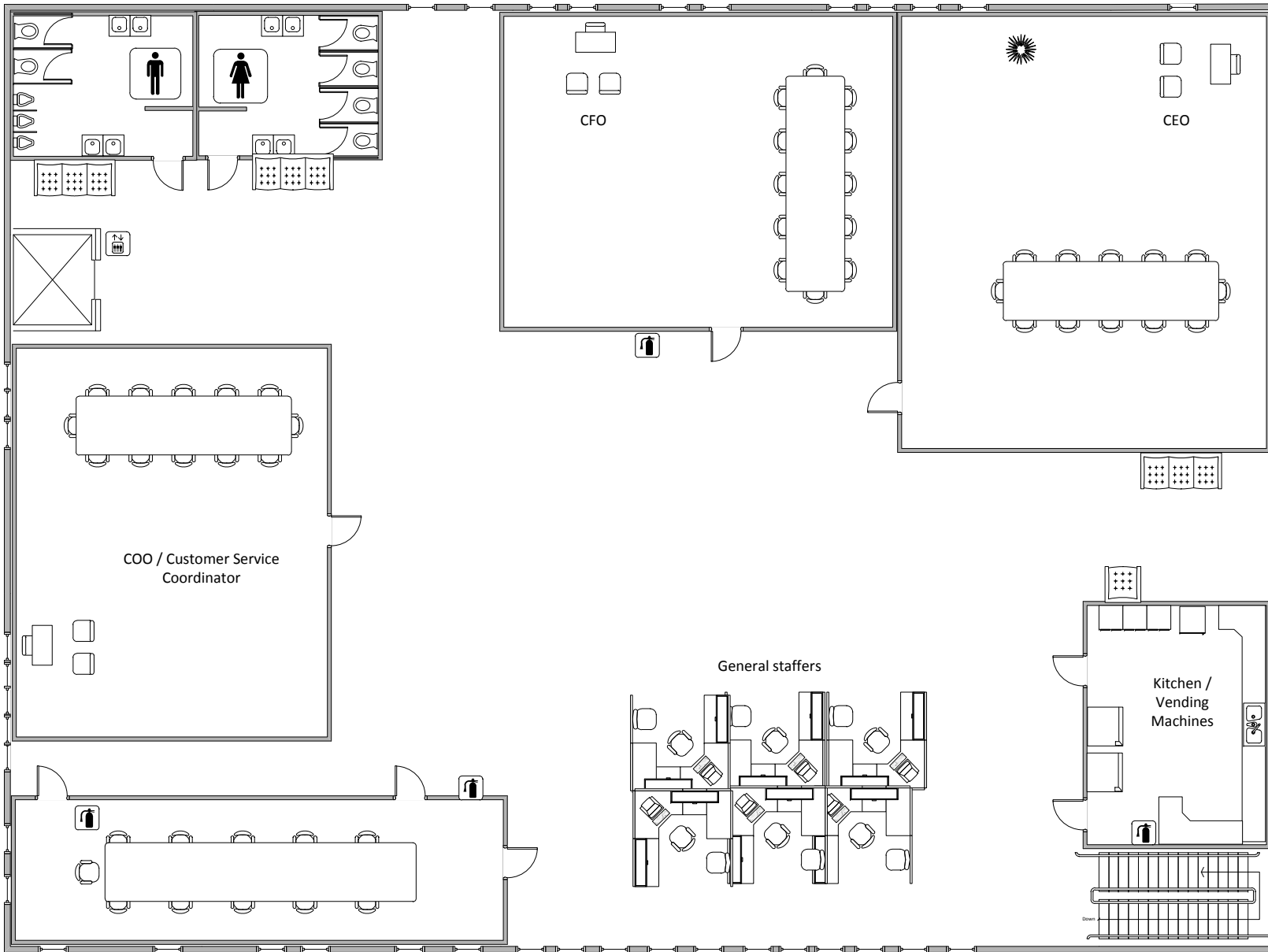[5] This diagram is part 1 of my exceeding expectations delivery.

Supervisor's Office

Attorney's Office

IT

Kitchen / Vending Machines

Customer Conference Room

Customer Conference Room

Storage Room

Storage Room

Satellite Office

Supervisor's
Office

Conference

IT

Kitchen /
Vending
Machines

Legal/Advanced Locate Building Ground Floor

Staff Attorneys

Chief Counsel

Paralegals

Legal/Advanced Locate Building 2nd Floor

Kitchen /
Vending
Machines

Asst. Chief Counsel

Down

DBA

Programmers

CIO/CTO

IT Operations

Kitchen /
Vending
Machines

IT / Management Building Ground Floor

CFO

CEO

COO / Customer Service
Coordinator

General staffers

Kitchen /
Vending
Machines

IT / Management Building 2ⁿᵈ Floor

Application Requirements

CATCH-AP has developed its own in-house application (Child support Owed with Likely Location, Enforcement, and Collection Transactions: "COLLECT") which handles all aspects of operation, including financial, locate, statistical, and legal functions. This is host-based at the primary campus with a thin-client interface. As such, it requires a service-level agreement for a secure virtual private network with a bandwidth vendor. As the clients pass their traffic through a local server to send to the central campus for processing, it is by definition at least a 3-tier, and possibly an *n*-tier application. Given that it is a startup company, I would classify it as a 3-tier but with an architectural design to move to *n*-tier once cash flow is generated to support the additional costs and to necessitate load balancing.

The average response time from the central host to the local office should be no more than 1 second; the maximum response time should be no more than 2 seconds. The application will only present items for action where secondary searches have already been made and information returned to the centralized server from locate services such as web locate services, credit queries, etc., and a human decision is required for the next course of action.

Typical System Usage by Worker

A typical locate worker primarily uses two screens:

- o Items awaiting actions
- o Actions that can be taken.
- o Initiation of internal notes (not e-mail, but a function of the system) to the supervisor, the local attorney, or to an advanced locate worker.

The worker selects a case from the Items Awaiting Action screen, which brings the worker to the Take Action screen. Examples of actions are:

- o Accept locate information and generate wage withholding from central campus electronically signed by the local attorney;
- o Request further locate information;
- o Authorize searches which are more expensive;
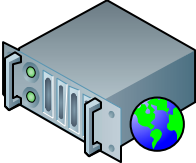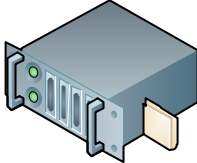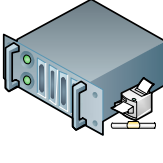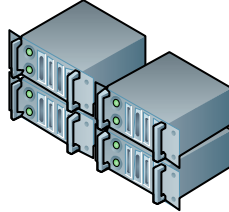- o Enter new information received via paper or fax;
- o Close case.

Use Case
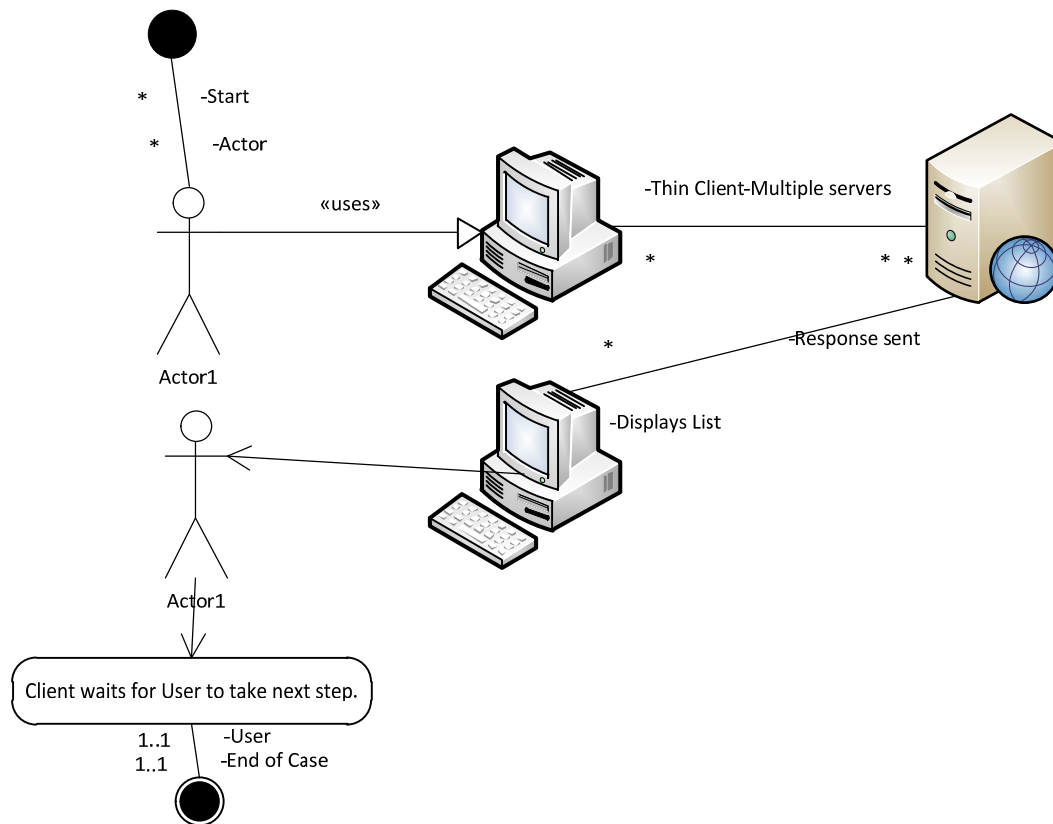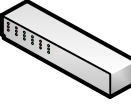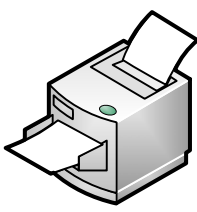
Bit-rate calculation: A typical screen in this use case may show 1 to 20 cases. Case information is comprised of the Custodial Parent Name, the Non-Custodial Parent Name, a unique case identifier of 10 characters in length, a possible action description of up to 80 characters in length, and a small graphic with an approximate size of 1 KB. An individual name is comprised of a First Name of 30 characters, a blank space, a Middle Initial, a blank space, a Surname of 30 characters, a blank space, a Suffix of 3 characters, and a trailing space, totaling 68 characters.
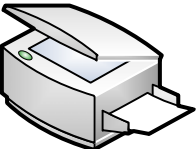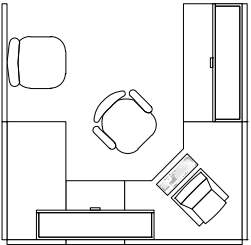
Number of bytes in CP name	68
Number of bytes in NCP name	68
Number of bytes in Case Identifier (including leading space)	11
Number of bytes in graphic	1024
Total bytes per case	1171
Potential number of cases per screen	20
Total bytes possible on screen	23420
Bits required	187360
For 2-second response time, bit-rate required	93680 bps

Allowing for 10% noise on the line, this would require a bandwidth of 103048 Hz per user assuming that no other user was sending receiving an HTTP-RESPONSE at the time.

Aspect 2: Local Area Networks in select buildings of the company

Legend for Aspects 2 and 3

Web Server	File Server	Print Server	Applications Server	10/100 Autosense Ethernet 24-port Layer-3 Switch
RJ-45 Ethernet connection jack 1.)to wire through wall to underfloor; or 2.) in IT, an exit for that wire	Cat-5 cable user device to switch (blue equal to green, used when overlap would make things unclear) / Cat-5 cable switch to switch	Printer	PC	Self-sealing print device
OC-1 cable	Cube workstation with included computer and hidden RJ-45 jack connection and cables		Connection supplied by ISP meeting or exceeding the SLA requirements	

Justifications, Organizational needs relative to network choice, and other preliminary notes

1. The building specification now calls for alarmed floor tiles above a crawlspace area, allowing wires to be run more easily away from possible sources of signal interference.
2. Because the business of this company relies strictly on data, conduits will be shielded.
3. The Visio cubicle stencil shows the computer within the cubicle. The cable from each cubicle computer plugs into a port in the cubicle rack, which in turn is aggregated with other cables in a conduit below the tiles exiting at the IT room. For this reason, these cables cannot be shown *precisely* either in the rooms or in the IT area, except where a dedicated wall jack connects to a desk computer; rather, they will be shown as coming out from the cubicles to a local switch or on a direct run to the IT area.

4. CATCH-AP uses 10/100 Ethernet[6], as switches that handle both speeds are readily available. In Aspect 1, I calculated the bit rate for each computer (allowing for 10% noise) at 93680 bps, which approximately 0.1 Mbps. Although theoretically cabling from user computers could be UTP cat 3[7], in some cases UTP cat 3 is not compatible with Ethernet; for this reason, cabling from user computers will be UTP cat 5[8].

5. Field offices, as shown in Aspect 1, *ante*, have 24 users each, at 6 offices. 6 x 24 x .1 Mbps = 14.4 Mbps, which calls for UTP cat 5[9] as a minimum connection from the cloud (the ISP may use a different connection as long as it supplies the required throughput specified in the SLA in Aspect 3.)

6. The COLLECT application does research to present choices to the users. The application will conduct its research on off-hours (evenings and weekends) so as to allow it to have the maximal Internet access possible at 100 Base-T, the maximal throughput using 10/100 Ethernet.[10]

7. All Cat 5 cables support 100Base-T Ethernet and thus can support speeds of up to 100 Mbps, although this is much more capacity than necessary.

8. Because of the privacy rules mentioned in Aspect 1,*ante*, printers in the buildings shown are restricted to IT, the Legal Department, the CEO, the CFO, and certain specialized printers in the general staffing area to print auto-mailers.

9. Some peripheral devices, such as printers, are too close to the RJ-45 jack for the cable to be explicitly shown.

10. Primary security is handled by CATCH-AP with security encapsulation. As these circuits are all conceptually within the company, symmetric cryptographic technology will be applied to all transmissions. This would utilize AES – or a successor technology not covered in the book, preferably with a 2048 bit key – over SSL .

I have prefaced the diagrams with this information, instead of placing it after the diagrams, as some items in the above are necessary to understand the diagrams. The one-story satellite building diagram constitutes my "Exceeding Expectations" submittal for Aspect 2. (There is no "Exceeding Expectations" submittal for Aspect 3, as the satellite offices are already included in the basic assignment.)

[6] FitzGerald, J. F., & Dennis, A. D. (2009). Business data communications and networking. (10th ed.). 212. Hoboken, NJ: Wiley.
[7] *Ibid*.
[8] Green, Daniel, Supervisor of LAN Technologies for the Administrative Office of the NJ Courts. Telephone Interview. Trenton, NJ. 6 Oct 2011.
[9] FitzGerald, 212.
[10] *Ibid.*

One-story satellite Customer Service Office

Supervisor's Office

Attorney's Office

IT

Connects To Cloud

Customer Conference Room

Customer Conference Room

Storage Room

Kitchen / Vending Machines

Storage Room

Legal /Locate Ground Floor

Supervisor's
Office

Conference

IT

From switches
from 2nd Fl

Connects
To
Cloud

Staff Attorneys

6

Legal /Locate 2nd Floor

Chief Counsel

Paralegals

7

Asst. Chief Counsel

DBA

Programmers

CIO/CTO

Connects
to
Cloud

From switch
from 2nd Fl

8

IT operations has three switches:
1. First floor operations
2. 2nd floor operations(on 2nd fl)
3. Building operations + servers
and router connection

IT Operations

IT /Management Ground Floor

IT /Management 2nd Floor

CFO

CEO

COO / Customer Service Coordinator

10

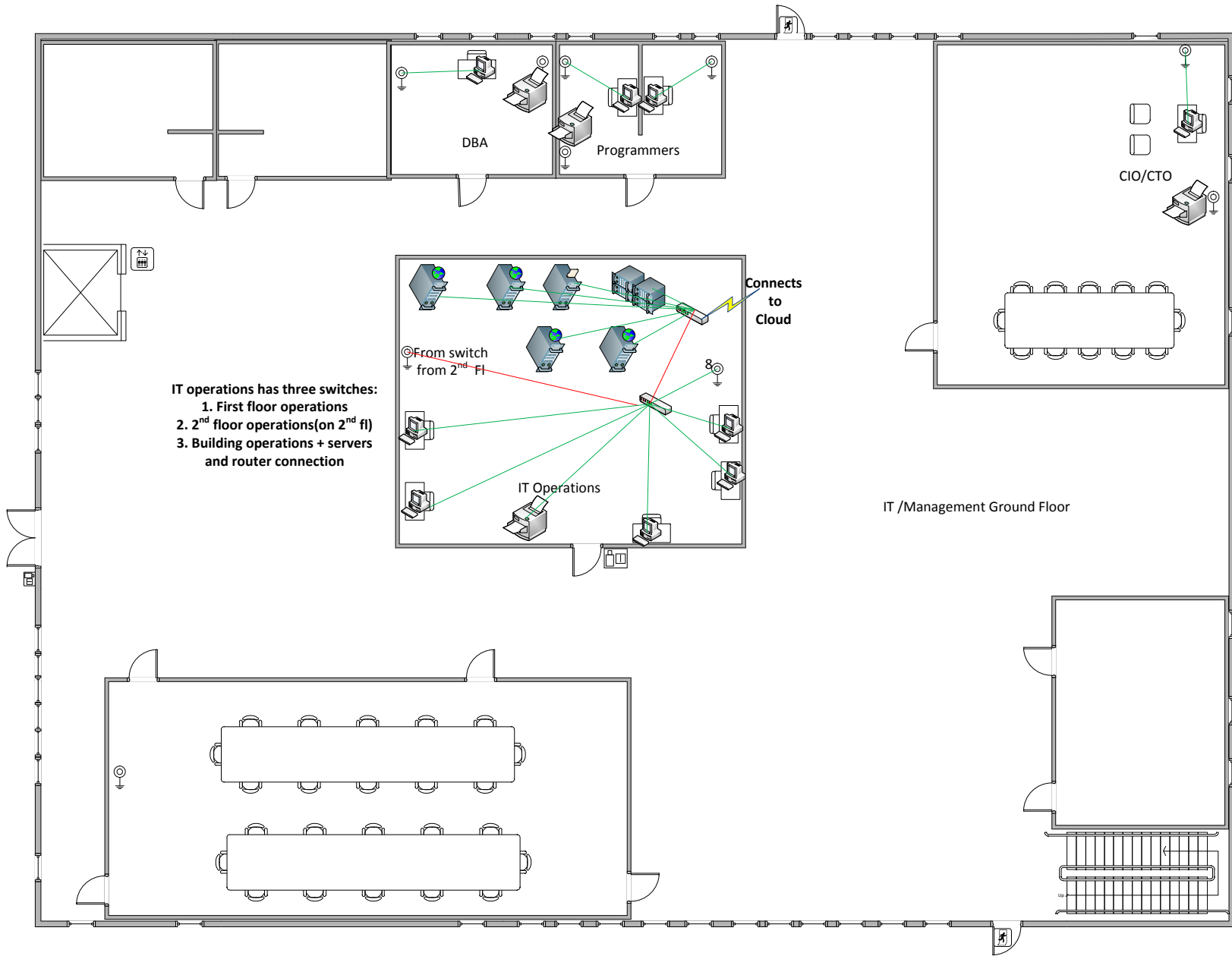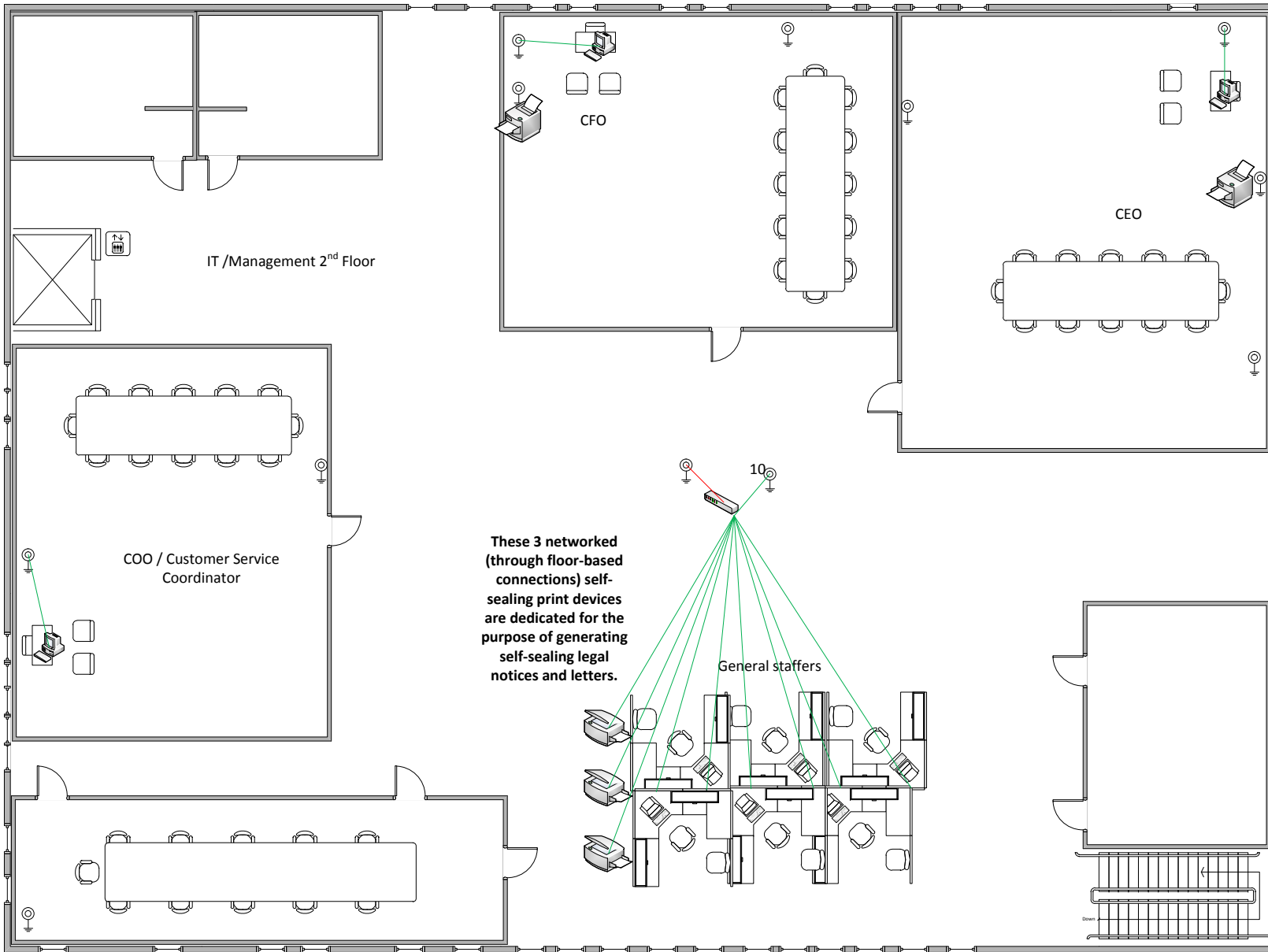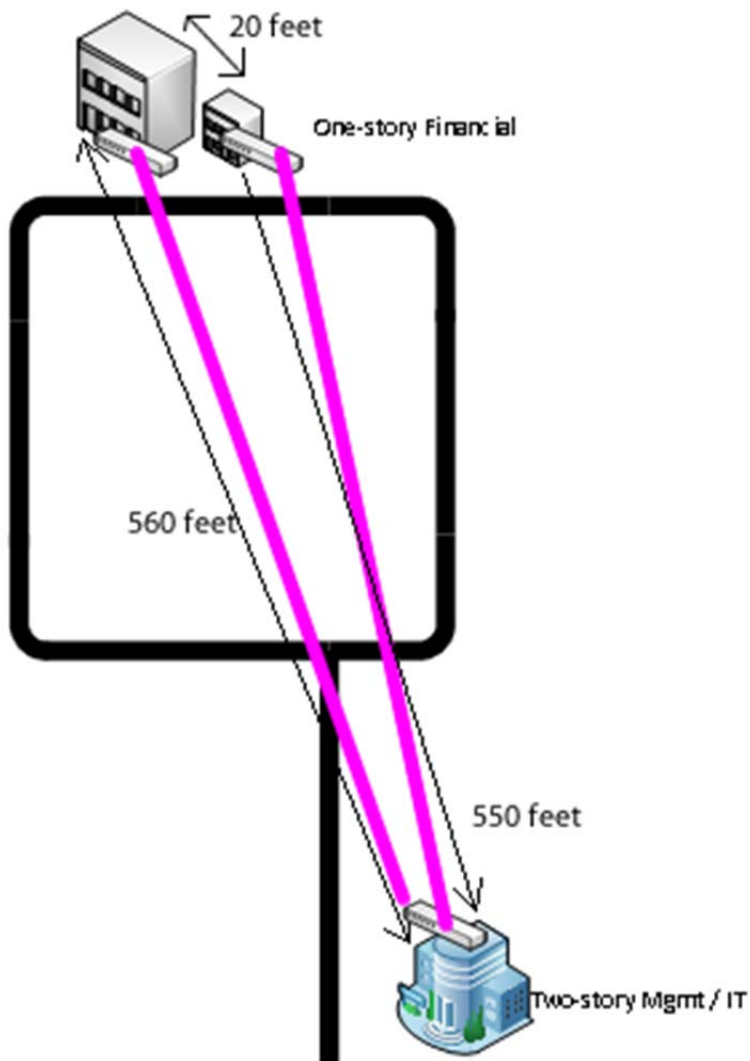**These 3 networked (through floor-based connections) self-sealing print devices are dedicated for the purpose of generating self-sealing legal notices and letters.**

General staffers

Down

Aspect 3: The Backbone Network for the company

Campus Backbone Design

The three-building campus from Aspect 1 has the following appearance:

The Management/IT building at the bottom of the diagram is **550 feet** from the closest point of the other two buildings. The Legal/locate building is located **20 feet** away from the Financial Processing center. As a Layer-3 switch provides the functionalities of both a traditional switch and an improvement on a router[11], a switched architecture is used, relying on Layer-3 switches in each building's IT department. As a switched backbone network satisfies the requirements of the COLLECT application, and as switching is used internally as well, keeping to the switched design makes maintenance of the firm's premise equipment easier, and is in line with the philosophical maxim that "A plurality should not be tolerated without necessity."[12] The backbone proper does not have any computers in it; all computers, including servers, are inside the LAN. Because all buildings connect directly to the IT building, which has the processing equipment, OC-1 cabling in a protected conduit is used to connect each of the buildings at the top of the diagram to the Management/IT building. Cat-5 would suffice, except for the length; a repeater device would be required. The standard is 100 Base-T

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[11] FitzGerald, J. F., & Dennis, A. D. (2009). Business data communications and networking. (10th ed.). 266. Hoboken, NJ: Wiley.
[12] William of Ockham, as cited in Gibbs, Phil. "What is Occam's Razor?." *USENET Physics FAQ*. Eindhoven University of Technology, 1997. Web. 16 Oct 2011. http://johanw.home.xs4all.nl/PhysFAQ/General/occam.html and translated from the Latin using http://translate.google.com ..

Ethernet, allowing connection speeds of up to 100 Mbps on both the LAN switches and the BN switch, and, as the Layer 3 switches will connect internally to wired cable, I will assume that the layer-3 switches "enable different types of cable to be connected and perform the necessary conversions."[13]

Data transport calculations

Aspect 1 showed a typical locate user, who has the most busy screen in the COLLECT application, requiring 0.103 Mbps. Number of employees and maximal internal bit rate needs for each building or building type are as follows:

Building	Number of employees	Total bit rate (Mbps)
Legal / Locate	50	5.15
Financial[14]	No more than 10	1.03
Management / IT	17	1.75
Customer Service campus building	24	2.47
Total company (including 6 local offices)	221	22.76

As OC-1 has a bitrate of 51 Mbps, it is more than sufficient to handle data transport.[15]

Wide Area Networking Concerns (sections 2 and 3 combined)

Conceptually, the Wide Area network utilizes a star topology, as Aspect 1 business needs centralize all data processing at the Charlotte headquarters campus; physically, though, it utilizes the Internet for data transport between outlying campuses and the main IT center. A service level agreement (SLA) must be entered into with a nationwide ISP providing the following characteristics:

- Each conceptual connection from a CATCH-AP premise must terminate at CATCH-AP IT premises via Ethernet;
- Each conceptual connection having originated from a CATCH-AP premise must allow return data from CATCH-AP IT premises;
- Ethernet packets self-identifying as https: or sftp: protocol may only be accepted from and returned to CATCH-AP IT premises;[16]
- A minimum throughput of 2.5 Mbps must be provided on each conceptual connection while established; this throughput must be made available after daily local office shutdown for CATCH-AP IT general Internet queries;
- End-to-end response time must not exceed one second, with the designated throughput;
- Although security encapsulation is done by CATCH-AP, the ISP must take measures to ensure no physical or routing security breaches take place on CATCH-AP data within their domain.
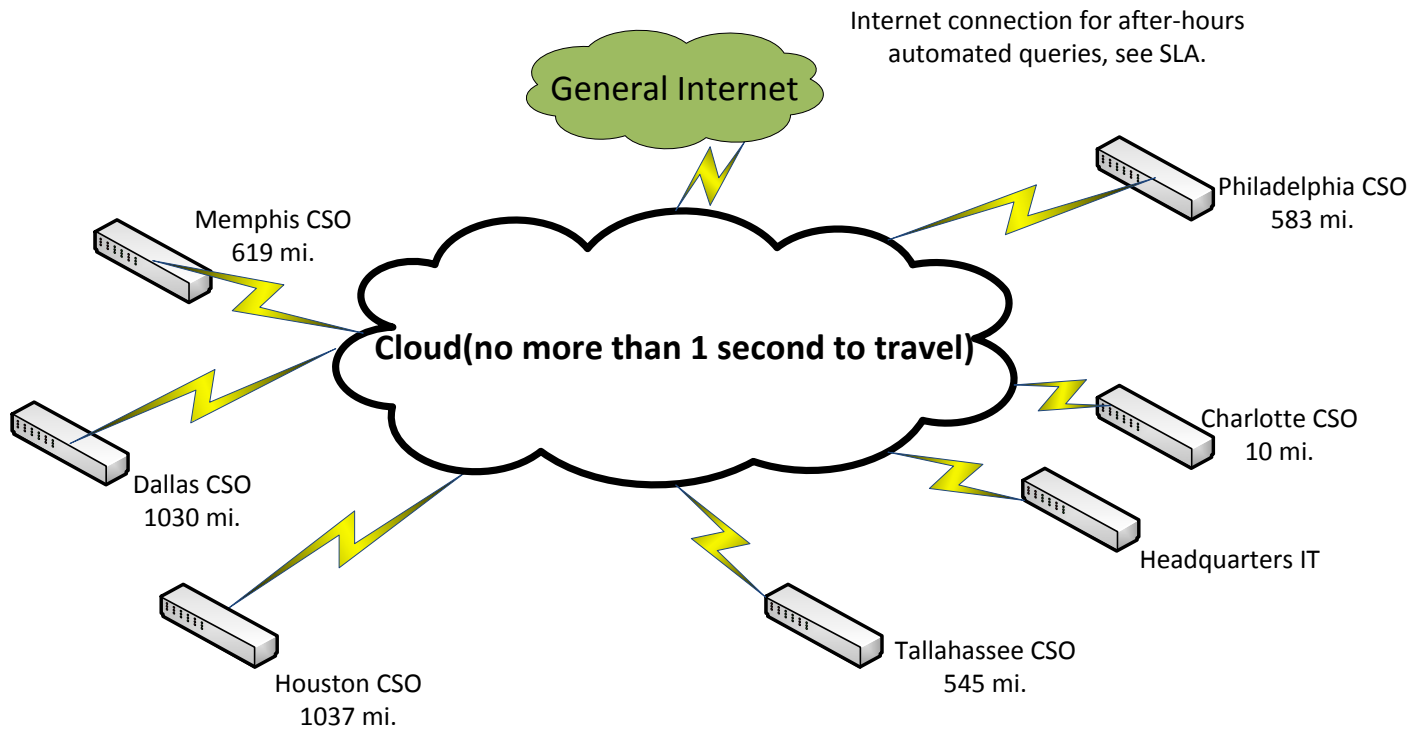
Distances in the cloud connection chart below represent the distance of the given office from the two-story Management/IT building on the headquarters campus.

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[13] FitzGerald, 205.

[14] The financial building is not addressed in detail elsewhere, but is a small building where manual, instead of electronic, payments are received and entered; and daily balancing of reports is performed before checks are released to CATCH-AP clients.

[15] FitzGerald, 324.

[16] This is for the after-hours automated locate functions of COLLECT, which interface with various location firms and sources as well as automated payment transfer from banks.

Internet connection for after-hours automated queries, see SLA.

General Internet

Cloud(no more than 1 second to travel)

Philadelphia CSO
583 mi.

Memphis CSO
619 mi.

Charlotte CSO
10 mi.

Dallas CSO
1030 mi.

Headquarters IT

Houston CSO
1037 mi.

Tallahassee CSO
545 mi.

The reasons for choosing to use the Internet for long-haul data transport are as follows:

- Many successful firms are using the "cloud" - that is, the Internet with a specific SLA for a specific tailored collection of services – to provide data transport, even for very short distances sometimes – let alone half of the country;
- This structure enables the company to easily add a customer service campus anywhere in the country (not the world, as explained in Aspect 1) without the concern of doing anything more than exactly copying the other customer service campuses, and negotiating an addendum circuit with the ISP;
- Rapid expansion if business needs require it;
- Minimization of in-house maintenance and management by placing it with experts in long-haul data transmission.

Although firms rely on data transport, long-haul data transport is becoming a commodity: as long as the speeds, reliability, and security are specified, choosing an ISP for long-haul transmission is like choosing what cable to use in-house: just as network technicians do not need to know the precise composition of a cable as long as it has the correct type on the labeling ("Cat 3", "Cat 5", "Cat 6"), so too do they not need to know the precise composition of a long-haul network as long as it is guaranteed via an SLA to meet the needed specifications.

The ISP's are experts in this matter, which in turn releases CATCH-AP from hiring personnel to keep track of the latest long-haul technology. As long as the SLA needs are satisfied, there is no reason to specify any technology preference to be used by the ISP. CATCH-AP's business is child support collection, not long-haul data transport. The ISP will be chosen based on cost, reputation, and its contractual ability to comply with the SLA.