WIRELESS COMMUNICATIONS SERVICES

PRESENTED AT CARNEGIE MELLON UNIVERSITY ATI

TELMARC GROUP, INC.

OVERVIEW

- **WHAT IS PCS?**
- **TECHNOLOGY AND CHANGE**
- **WHAT IS THE MARKET?**
- **ECONOMIC FACTORS; WHAT MAKES IT A BUSINESS?**
- **REGULATORY FACTORS; WHAT HATH THE FCC AND PUCS WROUGHT?**
- **COMPETITION**
- **THREATS; HAS BILL GATES BEEN CLONED WITH BILL MCGOWAN?**
- **OPPORTUNITIES FOR THE LECS?**

PCS DEFINITION

PCS

"TOLL GRADE QUALITY VOICE AND DATA SERVICES PROVIDED IN A SEAMLESS INTEROPERABLE NATIONAL NETWORK."

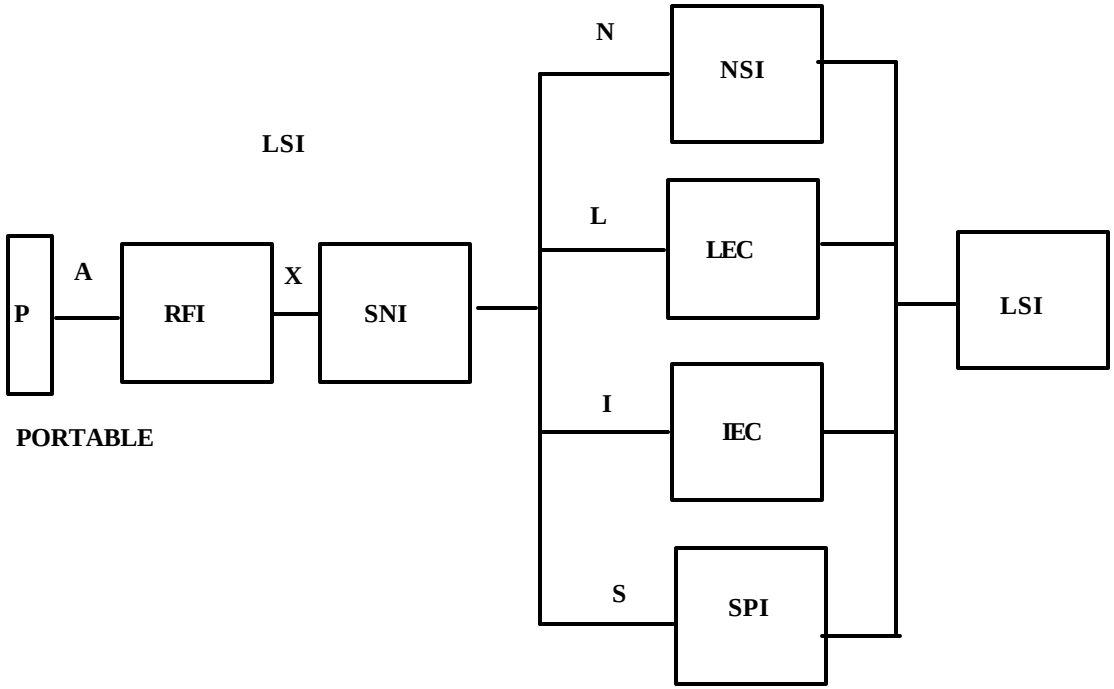
"IT'S JUST A TELEPHONE!"

TECHNOLOGY FOR WIRELESS

KEY TECHNOLOGY AREAS

- **ARCHITECTURE**
- **MULTIPLE ACCESS**
- **VOICE COMPRESSION**
- **PROPAGATION PROCESSING**
- **CELL MANAGEMENT**
- **ANTENNAE**
- **NETWORK INTERFACE**

General Architecture and Standard Interface Elements



Architecture Interfaces

o *A Interface:* This is the air interface between the portable and the LSI. It is important to note that we have not taken and further broken down the air interface and introduced a local switch interface as has Teleocator and Bellcore. The approach proposed here is more extensive than the Telelocator approach by allowing more creative technological solutions to the local interconnect problem, as has been discussed elsewhere.

o *X Interface:* This is the interface between the RF elements of the cell sites and the local switch. Generally this should be a common standard to allow the independent choice of a switch.

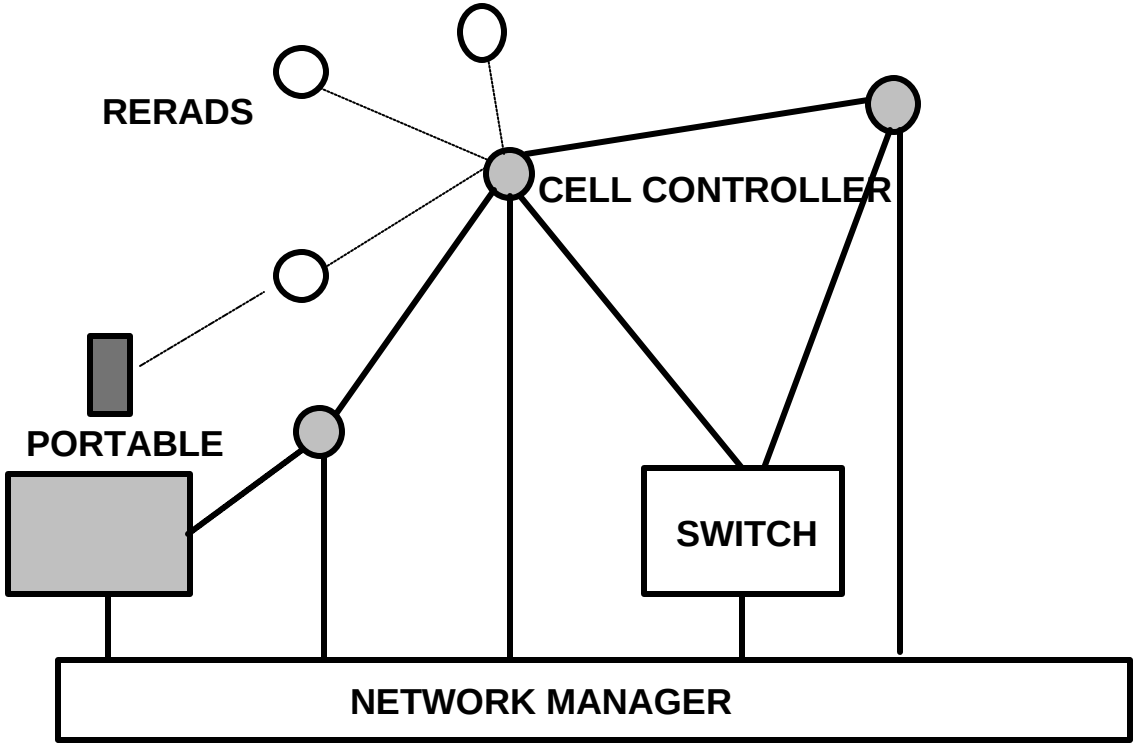
o *N Interface:* The N interface is the interface between the LSI and any and all other elements and the National Service Infrastructure. The NSI supports such functions as Network Management that means managing all of the national network.

o *L Interface:* The LEC interface is defined as a toll tandem trunk interface. It is an interface that is standard to the LEC and is viewed as either an interoffice trunk or as an IEC trunk. It typically is formatted as a DS 3 with an SS 7 overlay.

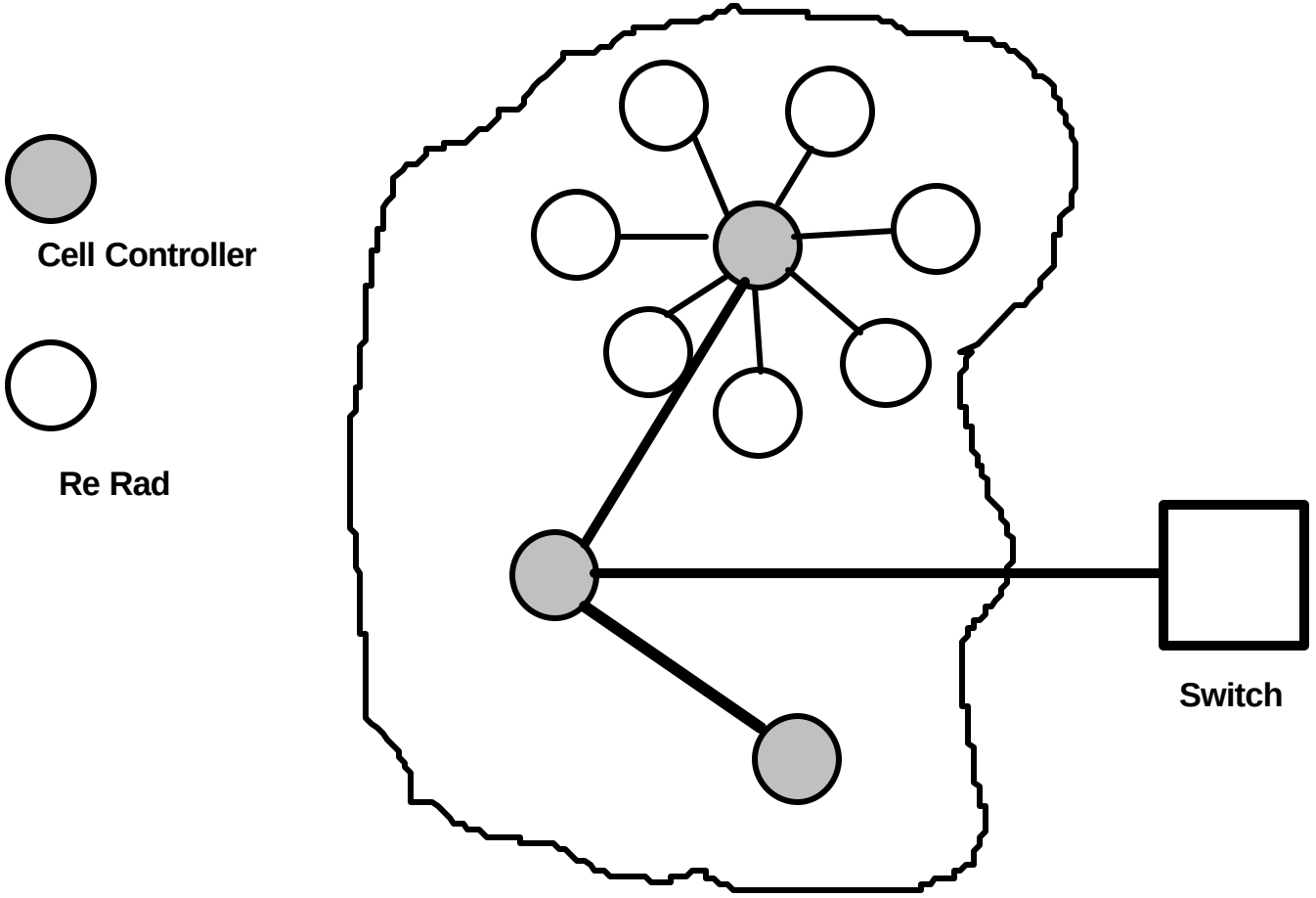
o *I Interface:* The IEC interface is also in trunk format as with the L interface.

o *S Interface:* The Service Provider interface needs further definition and development. One interface being developed is that interface at the S level for interfacing to the Internet for data purposes.

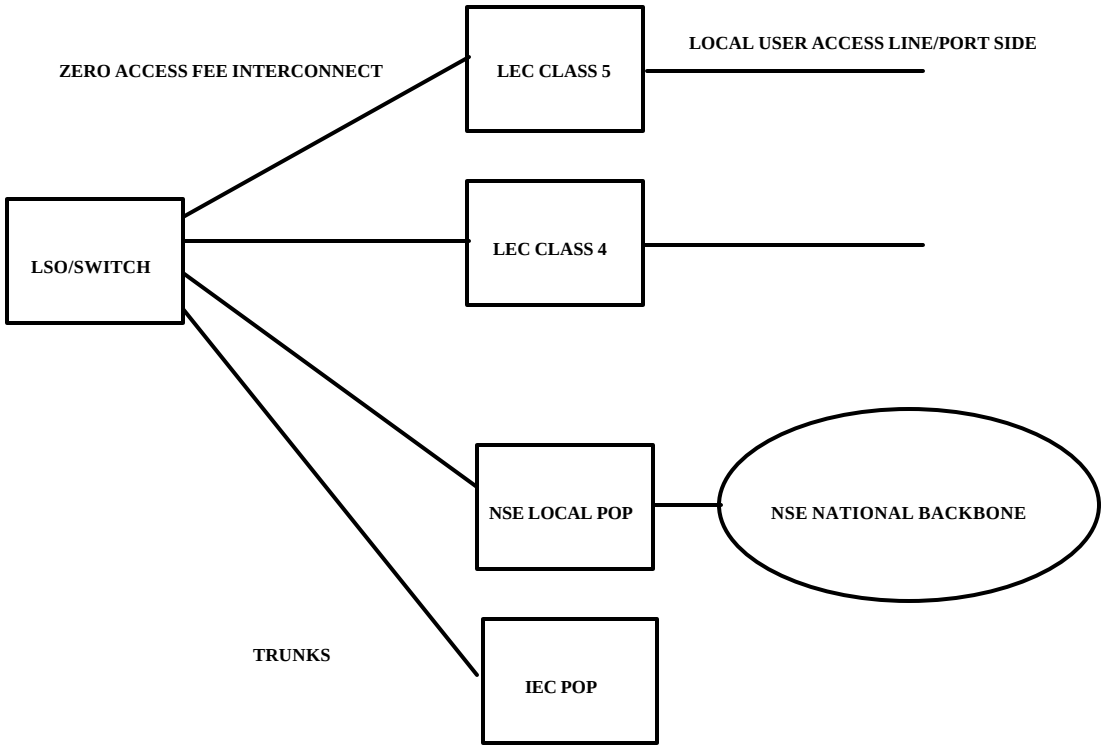
HOW DOES IT WORK?



PCS LSI DESIGN



LSO/NSE Interface and LSO/LEC Interface



Usage Assumptions

Factor	Residential	Business
Indoors:		
Average Total Minutes/Month/User	*480*	*1200*
Average Holding Timer Per Call	*2*	*3*
Average Number of Calls	*240*	*400*
Percent IEC	*20%*	*30%*
Outdoors:		
Average Total Minutes/Month/User	*120*	*150*
Average Holding Timer Per Call	*2*	*5*
Average Number of Calls	*60*	*30*
Percent IEC	*10%*	*25%*

TRAFFIC DEMAND

$$\mathrm{E}_{Average} = a\left(B(t)\frac{T}{30*24*60} \right) + b \_or;$$

$$\mathrm{E}_{Average} = a\left(B(t)\frac{T}{k} \right) + b;$$

$$\text{where}\_k = 30*24*60\_(\text{minutes}\_\text{per}\_\text{month}), \text{and}: a \geq 1, b \geq 0.$$

$\mathrm{E}_{Peak} = pd\,\mathrm{E}_{Average}$ where ;

p = Peak _ to _ Average _ Ratio;

and ; $d = \frac{k}{DHM}$; where ;

D = max days per month , H = max hours per day ,

M = max minutes per hour .

MULTIPLE ACCESS OPTIONS

- **CDMA: CODE DIVISION MULTIPLE ACCESS. ASSIGNS A UNIQUE CODE TO EACH USER THAT IS ORTHOGONAL THROUGH A CORRELATION PROCESSOR.**

- **TDMA: ASSIGNS A UNIQUE TIME SLOT TO EACH INDIVIDUAL.**

MULTIPLE ACCESS COMPARISON

SCHEME	ADVANTAGES	DISADVANTAGES
CDMA	· LOW CAPITAL PER SUBSCRIBER · ABILITY TO USE RE-RADS IN CELL IMPLEMENTATION · BALANCES COVERAGE AND CAPACITY · ALLOWS DATA AND VOICE	· LACK OF PRODUCTION EQUIPMENT · NO OPERATIONAL EXPERIENCE
TDMA	· PROVEN GSM TECHNOLOGY · AVAILABLE VENDORS OF EQUIPMENT · INTERNATIONAL "STANDARD"	· POOR CAPITAL USAGE; EACH CELL SITE IS A FULL CELL; NO RE-RAD CAPABILITY

TRAFFIC EXAMPLE

For example:

- Assume 100,000 users, each with 600 minutes of usage per month per user. The total time per month is 30 days, times 24 hours, times 60 minutes, or 43,200 minutes. If we divide 600 minutes by 43,200 we obtain, 0.0139 trunks per customer, on average. With 100,000 customers, we have 1388.9 trunks, of active circuits at any instant of time.

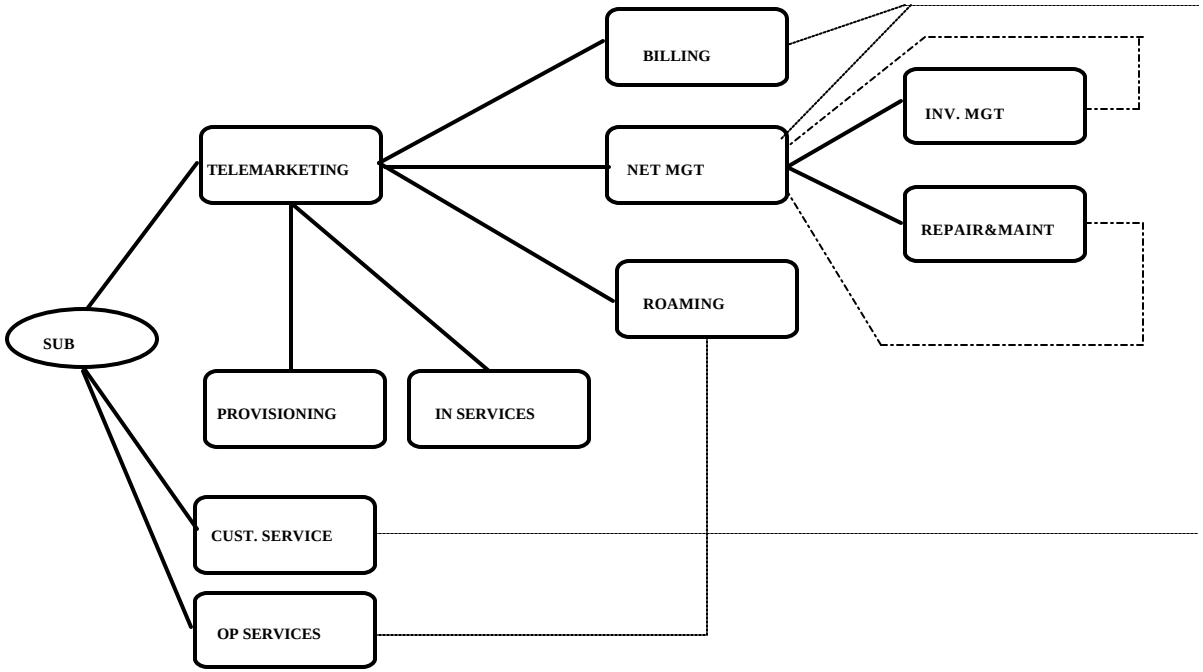
- Now assume that a customer is active only 5 days a week or twenty days a month, and only 12 hours per day, but all 60 minutes in an hour. The we have for δ, 43,200/(14,400), or 3. That is to handle this traffic we need three times the trunks, or 4166.7 trunks.

- Finally, if there is a peak too average factor that says that on any one day, we must have two times the capacity to deal with the peak loading for reasons that are related to customer call clustering, we have a need for 8,333.4 trunks for 100,000 users, using it 600 minutes per user per month.

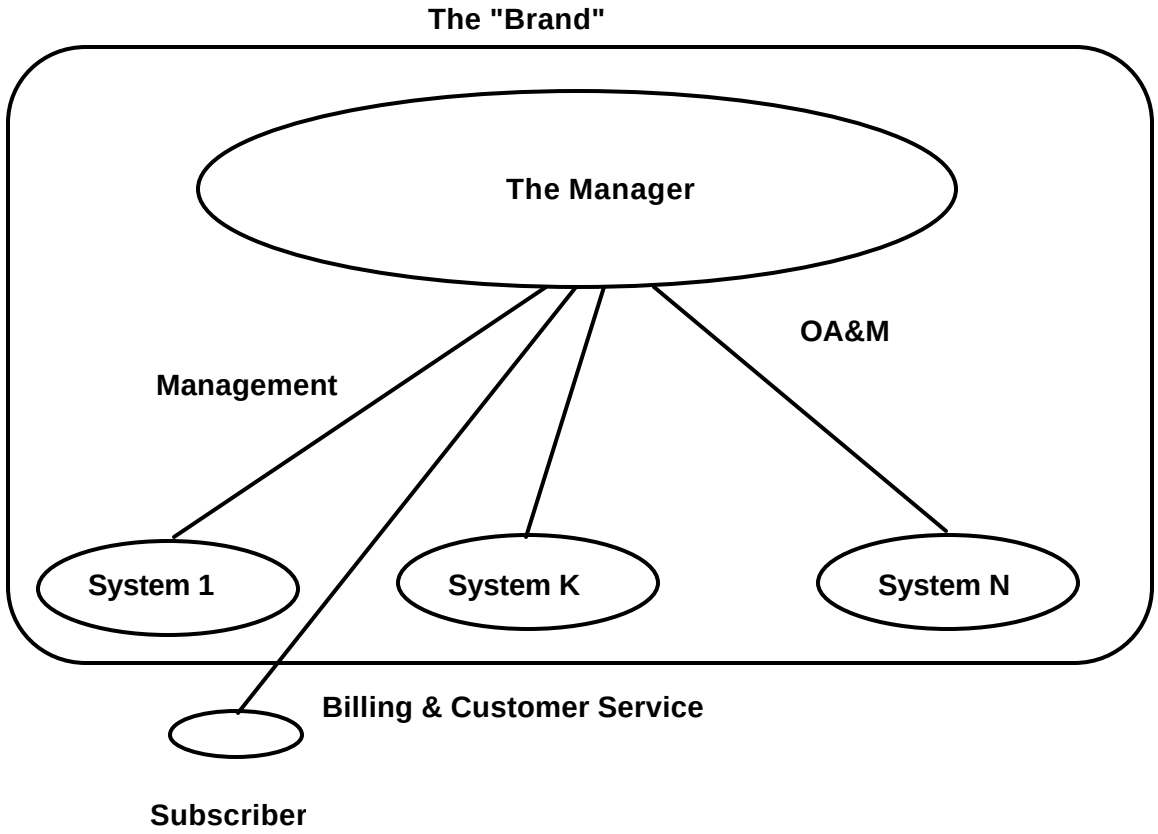
SYSTEM FUNCTIONS

- NETWORK MANAGEMENT
- ROAMING
- INTELLIGENT NETWORK SERVICES
- REPAIR MANAGEMENT
- INVENTORY MANAGEMENT
- OPERATOR AND DIRECTORY SERVICES
- CUSTOMER SERVICES
- BILLING
- TELEMARKETING
- IEC MANAGEMENT

Software Architecture

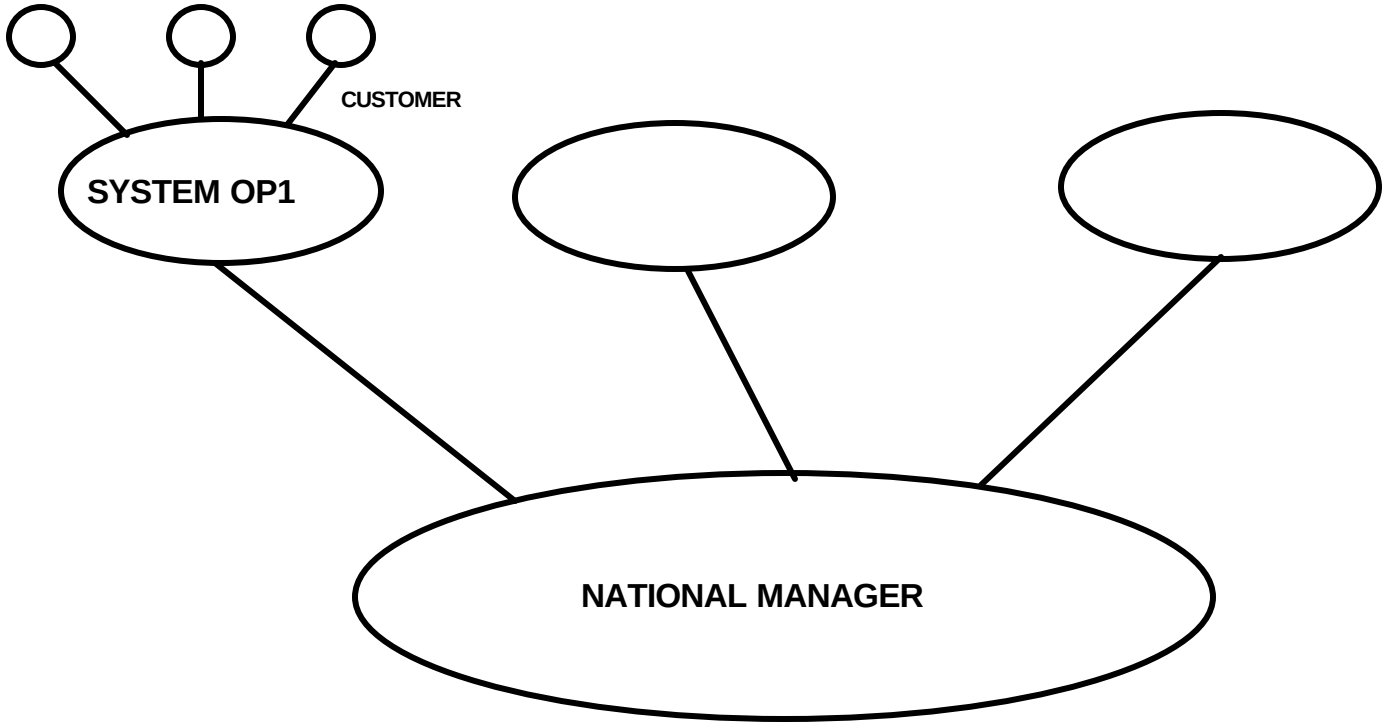


ARCHITECTURE



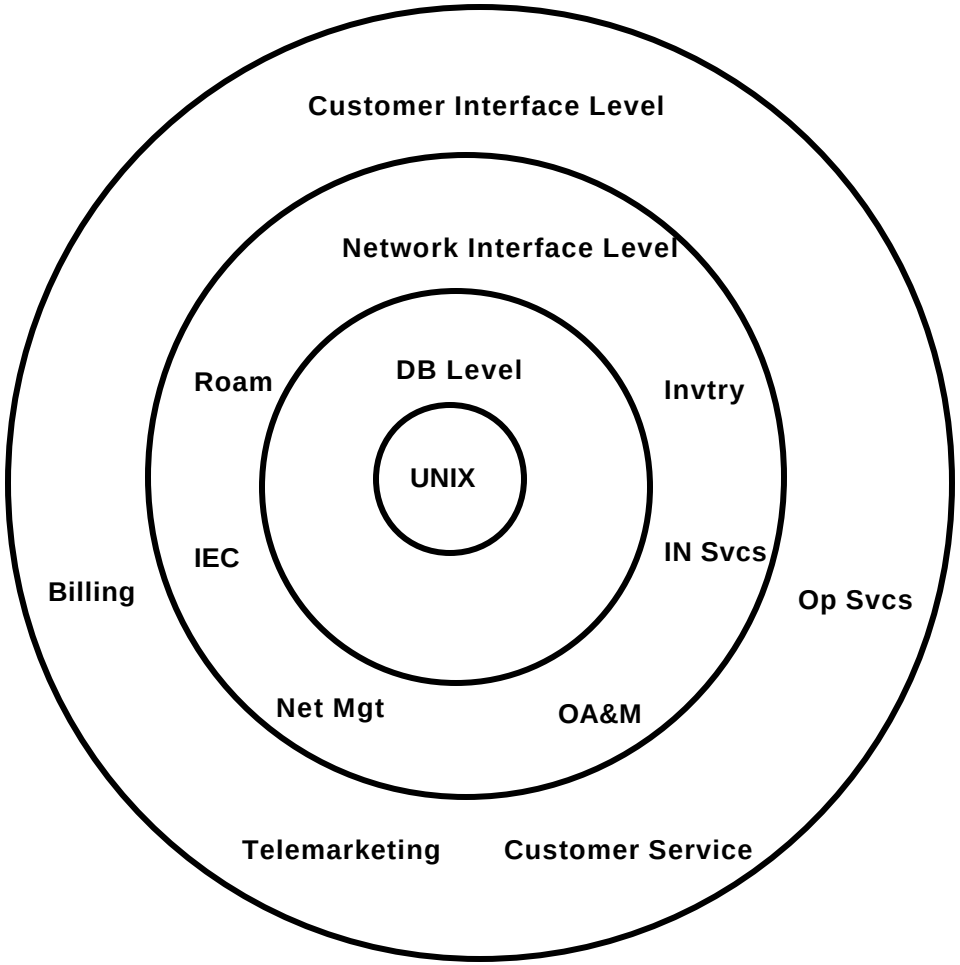
HOW DOES THE SERVICE ENTITY HELP ACHIEVE INTERFACES

"SERVICING YOUR CUSTOMER"



- o FIXED COSTS PER MONTH PER CUSTOMER
- o PREDICTABLE CAPITAL PER SUB
- o RAPID MARKET PENETRATION THROUGH "BRAND"

SERVICE SOFTWARE ARCHITECTURE



SOFTWARE DEVELOPMENT IMPLICATIONS

- CLIENT-SERVER ARCHITECTURE
- LEVERAGE FROM EXISTING SOFTWARE
- USE A RELATIONAL DATABASE FOR EASE OF UPGRADING
- LOCATE OPERATIONS AT OPTIMAL SITE
- DESIGN TO MODIFY AND UPDATE
- MODULAR DESIGN TO ARCHITECTURE

FUNCTIONS AND DELIVERABLES

FUNCTIONAL UNIT	DELIVERABLE
National Service Provision	***Network Management*** ***Roaming System*** ***IN Services Interface*** ***Repair and Maintenance*** ***Inventory Management*** ***Operator Services*** ***Customer Services*** ***Billing*** ***Telemarketing***
Research and Development	***System Design*** ***Performance Evaluation*** ***Pre-Ops Test*** ***Stress Testing*** ***Vendor Performance Evaluation*** ***Product Development***

FUNCTIONS AND DELIVERABLES (Contd)

Standards	· ***Standards Definition*** · ***Standards Representation***
Hardware Procurement	· ***RFI Preparation*** · ***RFI Review*** · ***Vendor Meetings*** · ***RFP Preparation*** · ***RFP Review*** · ***Contract Negotiations*** · ***Vendor Management*** · ***Materials Flow Management***
Regulatory and Lobbying	· ***FCC Lobbying*** · ***Hill Lobbying*** · ***Legal Representation*** · ***PUC Support*** · ***PUC Lobbying*** · ***State Lobbying***

FUNCTIONS AND DELIVERABLES (Contd)

Advertising and Promotion	· ***Ad Campaign Development*** · ***"Brand Recognition" Development*** · ***Media Buys*** · ***Media Management*** · ***Market Research and Analysis*** · ***Market Share Monitoring***
Training and Support	· ***Methods and Procedure Preparation*** · ***Staff and Ops Training*** · ***Performance Setting*** · ***Quality Development Program***
Legal	· ***Contract Management*** · ***SEC and IRS Support*** · ***Tax Filing*** · ***Antitrust Issues***

OPERATIONS STRUCTURE

OPERATIONS ELEMENTS

- **LOCAL OPERATIONS : ALL FUNCTIONS NEEDE TO BE PERFORMED LOCALLY.**

- **NATIONAL OPERATIONS: ALL FUNCTIONS BEST PERFORMED NATIONALLY.**

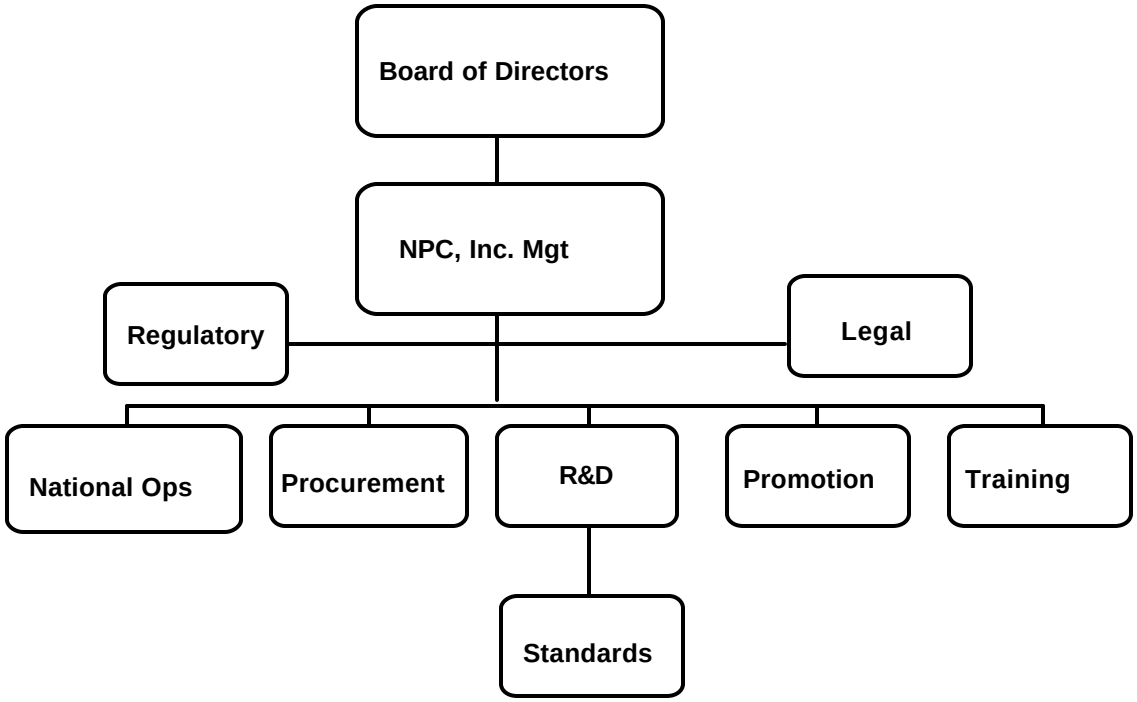
LOCAL VERSUS NATIONAL

Location	Sales Functions	Operations Functions
Local Operator	• Direct Sales • Local Advertising • Local Dealers and Resellers • Local Marketing	• Property Leasing • Installation of Cell Sites • Installation of Interconnect • PUC Interface
NSE	• National Advertising • Inbound Telemarketing • Marketing	• Billing • Customer Service • Directory Assistance • Network Management • IEC Interface • Roaming • Provisioning • Repair Dispatching • Inventory Management • FCC Interface • Vendor Negotiation

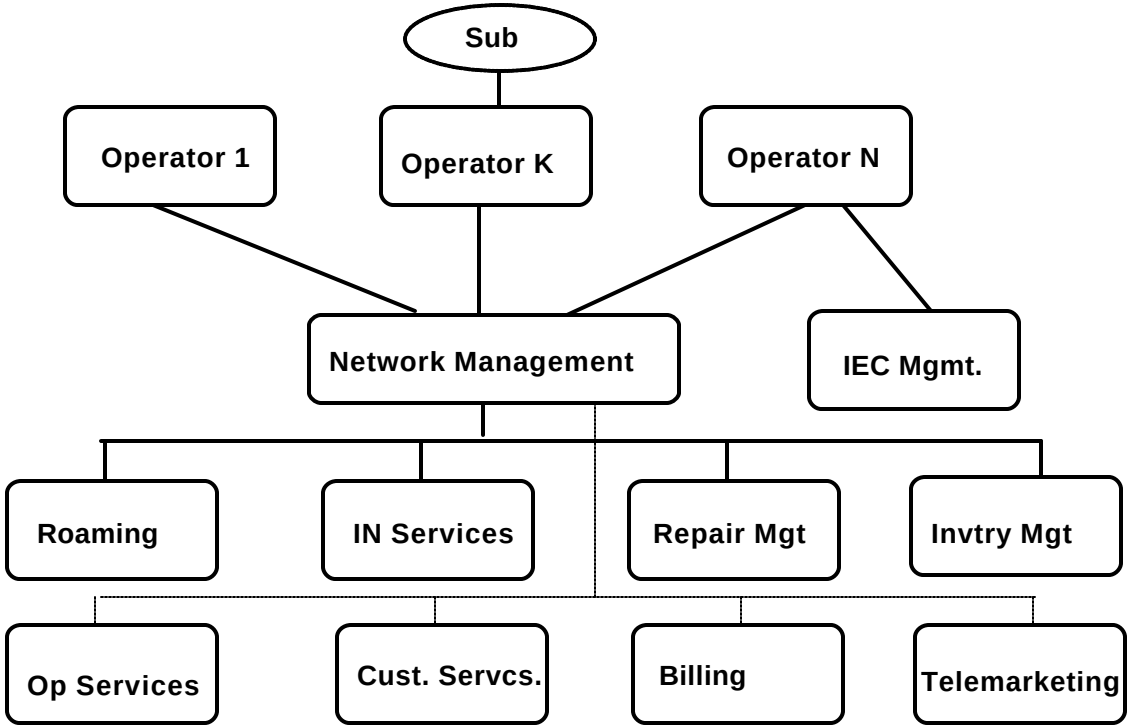
SALES CHANNELS

Strategy	Pros	Cons
National InBound	• Establishes National Brand. • Allows common message • Centrally controlled and lower cost. • More efficient use of resources. • It provided the best way to rapidly gain market share.	• Lack of local control • Lack of cost control • Failure to regionalize or localize the message. • Significant up front costs.
Local Direct/Outbound	• Best targeting of the market. • Allows direct sales to commercial as well as consumer based customers. • Better local control	• Variation of quality of customers. • May vary from market to market. • Costs may be higher than anticipated. • High up front set up costs. • Redundancy in collateral costs.
Local Dealers/Resellers	• Local stores could sell the service with the set. • It would be a good after market approach. • Stores may be a viable alternative channel amongst others.	• Local store may not control sales presentation • Higher costs of sales. • Added costs of managing the channel.

NATIONAL SERVICE ENTITY FUNCTIONS



NATIONAL OPERATIONS FUNCTIONS



ELEMENTS (1)

FUNCTION	ELEMENTS
NETWORK MANAGEMENT	CELL UNITS PORTABLES CLASS 5 INTERFACE IEC INTERFACE SERVICE PROVIDER INTERFACE SS7 DATABASE TROUBLE TICKET INITIATOR TROUBLE RESOLUTION SYSTEM
ROAMING	SS 7 DATABASE INTERFACE CELL CLUSTER HANDOFF PORTABLE HANDOFF/LOCATOR CALL SETUP/TERMINATION CALL MANAGEMENT

ELEMENTS (2)

IN SERVICES	**STANDARD INTERFACE SUPPORT** **NETWORK MANAGEMENT INTERFACE** **CUSTOMER INITIATION**
REPAIR AND MAINT	**TROUBLE TICK RECEPTION AND TRACK** **DISPATCHING** **RESOLUTION SERVICE ENTITY** **REPORTS AND REPAIR**
INVENTORY MGT	**INVENTORY TRACKING** **ORDER ENTRY** **PROVISIONING** **INVENTORY CONTROL**

ELEMENTS (3)

OP SERVICES	**CUSTOMER CALL DATABASE** **CUSTOMER FINDER SYSTEM** **OPERATOR STATION INTERFACE** **CALL INITIATOR**
CUSTOMER SERVICE	**SERVICE STATION MANAGEMENT** **BILLING INTERFACE** **SERVICE MANAGEMENT INTERFACE** **COMPLAINT REGISTER** **PERFORMANCE MONITOR** **CUSTOMER TRACKING SYSTEM**

ELEMENTS (4)

BILLING	**CALL PROCESSING RECORDS** **TOLL AND TARIFF DATA BASE** **CUSTOMER PLAN INDEX MGT** **BILL PREPARATION** **BILL ISSUANCE** **COLLECTIONS MANAGEMENT**
TELEMARKETING	**SALES REQUEST MANAGEMENT** **ORDER TAKING** **CREDIT VERIFICATION** **PROVISIONING INTERFACE** **INFORMATION MANAGEMENT** **RECORDS AND REPORTING**

NATIONAL SERVICE ENTITY POSITIONING

"THE SERVICE ENTITY WILL PROVIDES THE HIGHEST QUALITY AND LOWEST COSTS BUNDLE OF SERVICES NEEDED BY LOCAL PCS OPERATORS TO ASSIST THEM IN DELIVERING PCS TO THEIR CUSTOMERS IN A TIMELY FASHION AND ENSURING THEM OF A PREDICTABLE AND SUSTAINABLE INFRASTRUCTURE BASE."

NATIONAL SERVICE ENTITY BENEFITS

AREA	BENEFIT
MARKETING AND SALES	**o NATIONAL BRANDING OF SERVICE.** **o PREDICTABLE COSTS OF SALES PER CUSTOMER.** **o HIGHEST SERVICE QUALITY.** **o RETAINS LOCAL CONTROL**
TECHNICAL AND OPERATIONAL	**o LOWEST OPERATIONS COSTS PER CUSTOMER** **o OPEN ACCESS SYSTEM FOR LOWEST CAPITAL COSTS.** **o NATIONAL INFRASTRUCTURE FOR COMPETITIVE EDGE.**

NATIONAL SERVICE ENTITY ADVANTAGES

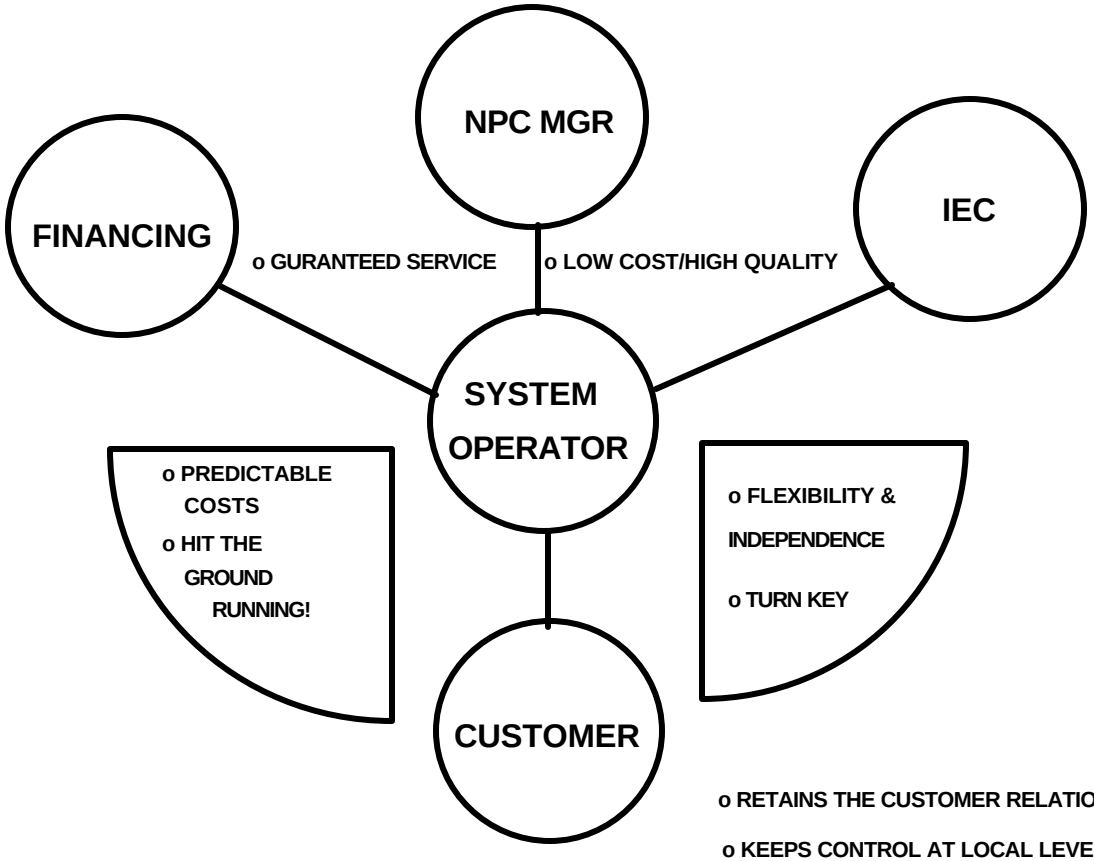
- o CUSTOMER RELATIONSHIP RETAINED
- o CONTROL LEFT IN LOCAL OPERATORS HANDS
- o NO INFRINGEMENT ON OWNERSHIP
- o COOPERATIVE PARTICIPATION
- o OPEN ACCESS SYSTEM
- o IEC INDEPENDENT
- o SUPPORT AND SERVICES FOR SMALL BUSINESSES
- o CREATE NEW INFRASTRUCTURE AT LOWEST COSTS
- o RETAINS AUTONOMY WHILE POOLING RESOURCES
- o CENTRAL PROCUREMENT ENSURING LOWEST COSTS
- o HIT THE GROUND RUNNING WITH TURNKEY SYSTEM
- o EXTENSIVE TRACK RECORD OF EXPERIENCE

WHAT DOES THE NATIONAL SERVICE ENTITY COST?

SERVICE AREA	PRICING	DELIVERABLE
NATIONAL OPERATIONS	FIXED PRICES OF $X PER MONTH PER CUSTOMER NO FIXED COSTS BASE REQUIRED AND NO UP FRONT COSTS	ALL NATIONAL INFRASTRUCTURE ELEMENTS
SALES AND DISTRIBUTION	FIXED AMOUNT PER NEW CUSTOMER THROUGH THE SERVICE ENTITY SALES CHANNEL	NEW CUSTOMERS THROUGH NATIONAL SALES AND NATIONAL "BRAND"
LOCAL INFRASTRUCTURE AND PROCUREMENT	SETS OF MOST FAVORED CAPITAL COSTS FOR LOCAL INFRASTRUCTURE	SINGLE NEGOTIATING IN BULK OF PORTABLES AND CELL SITE EQUIPMENT

HOW DOES THE SERVICE ENTITY BENEFIT ME?

"MAXIMIZES THE CHANCES TO WIN"



NATIONAL SERVICE ENTITY REVENUE POTENTIAL

- o NPC, GP: 50% OF US POPULATION (125 M) COVERED.
- o 40% PENETRATION; WITH 25% SHARE BY NPC.
- o 8% IN YEAR 10: 10M PERSONS
- o $7 PER MONTH PER CUSTOMER: $84 PER YEAR PER CUSTOMER
- o $840 m PER YEAR IN YEAR 10 FROM THIS ALONE.

PRICING OPTIONS

OPTION 1:

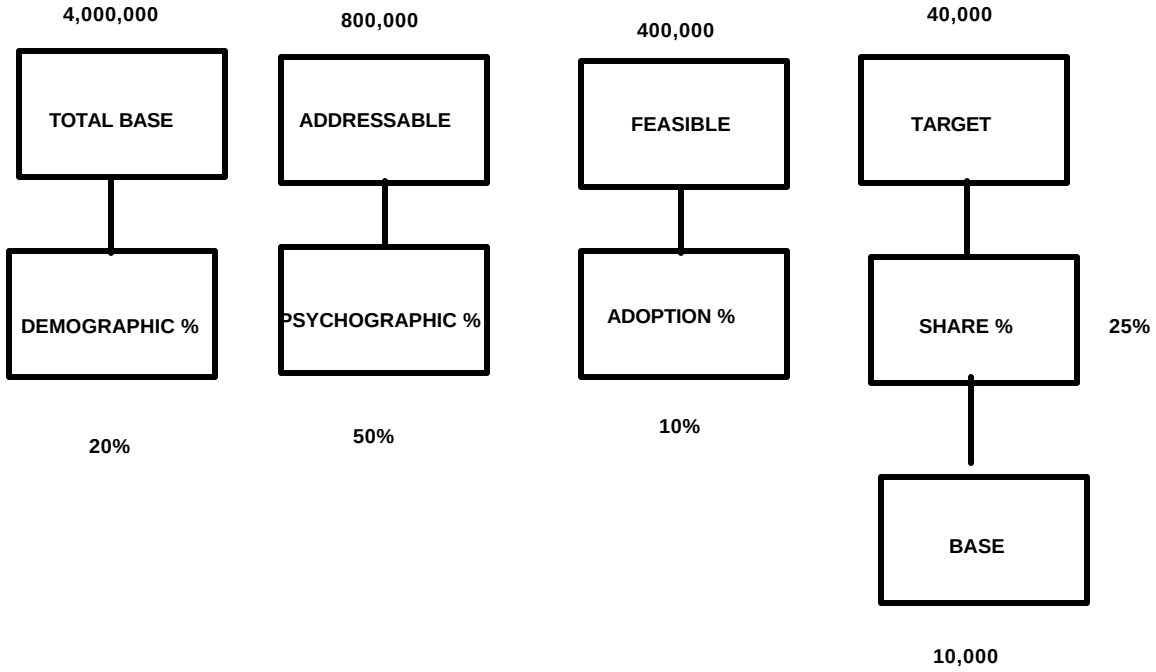
- FEE OF $7 PER MONTH PER SUB FOR OPS
- FEE OF $7 PER MONTH PER SUB FOR SALES

OPTION 2:

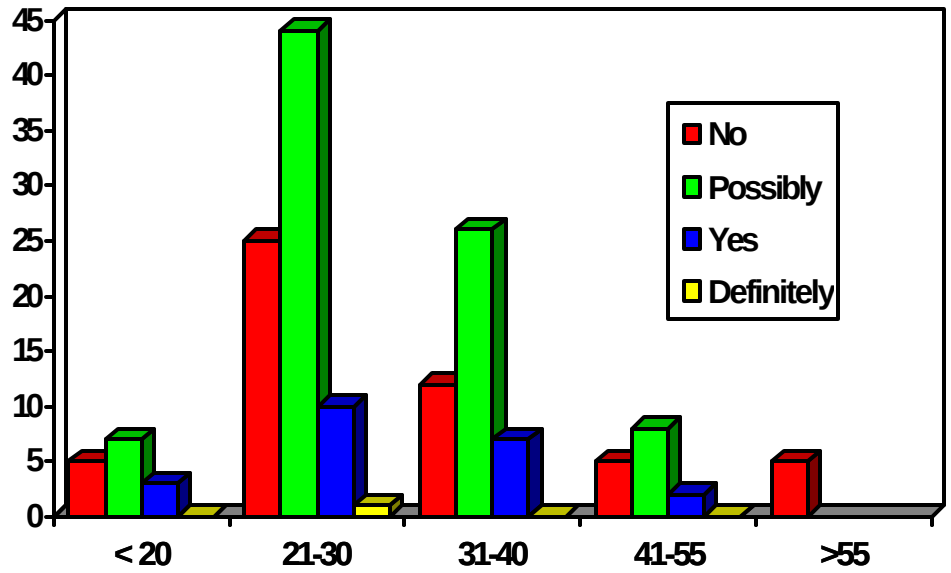
- FEE OF $7 PER MONTH FOR OPERATIONS
- UP FRONT FEE OF $300 PER NEW CUSTOMER

THE WIRELESS MARKET

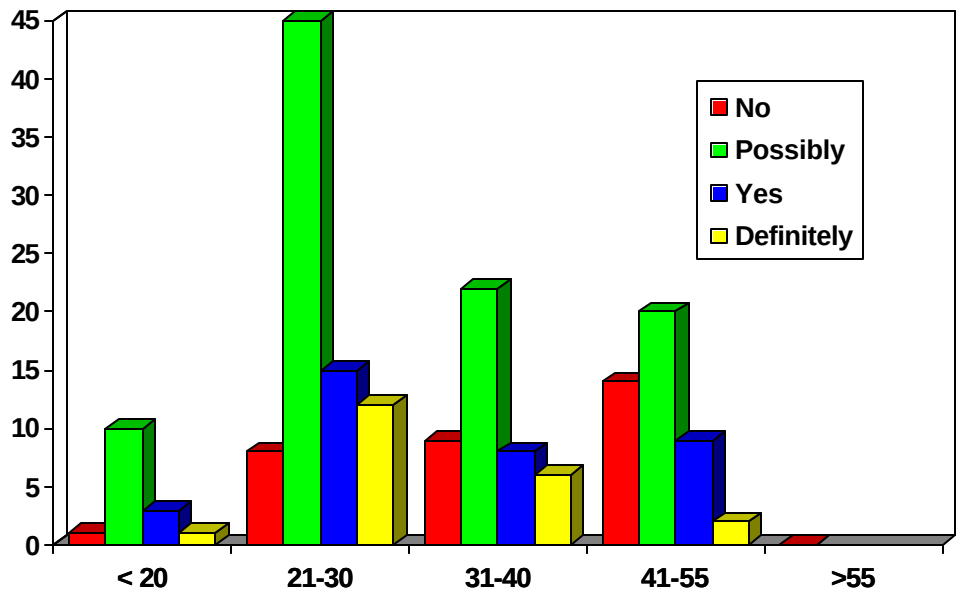
MARKET SIZING



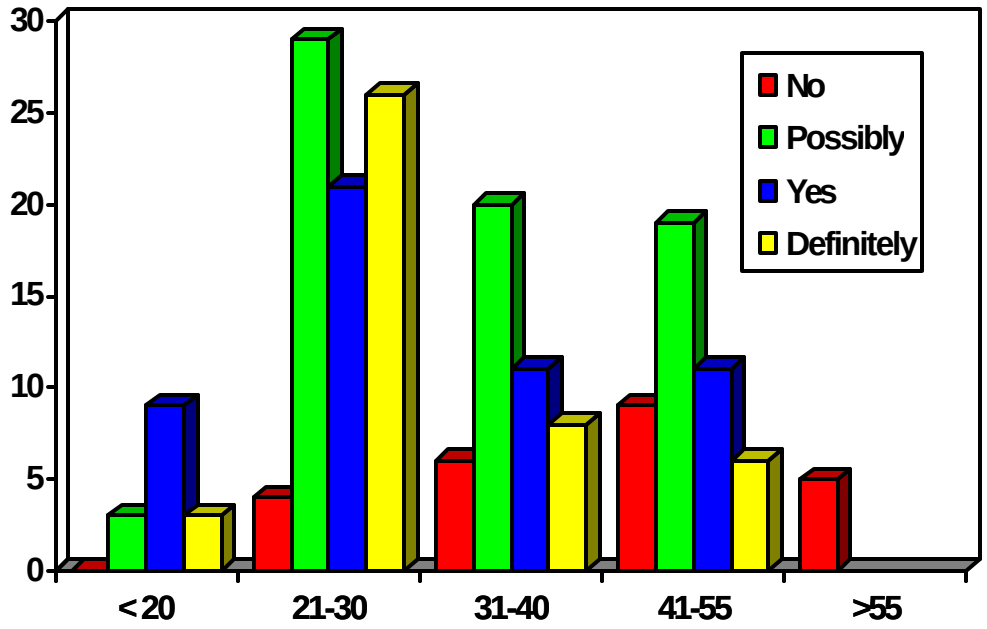
Age versus Willingness at $0.50 per minute



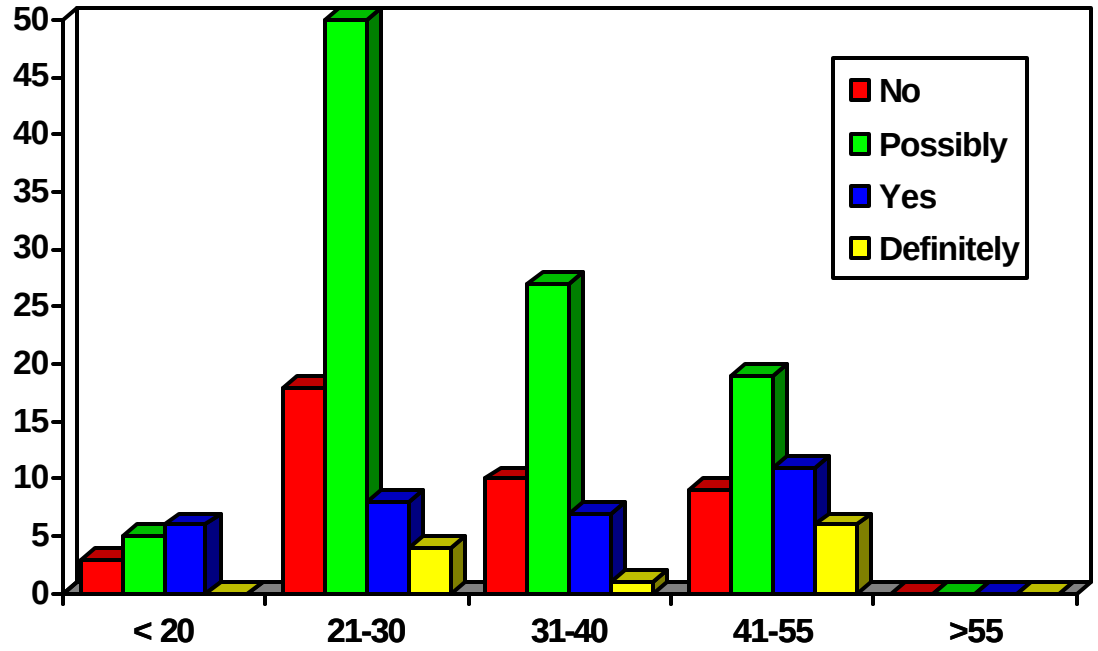
Age versus Willingness at $30 per month



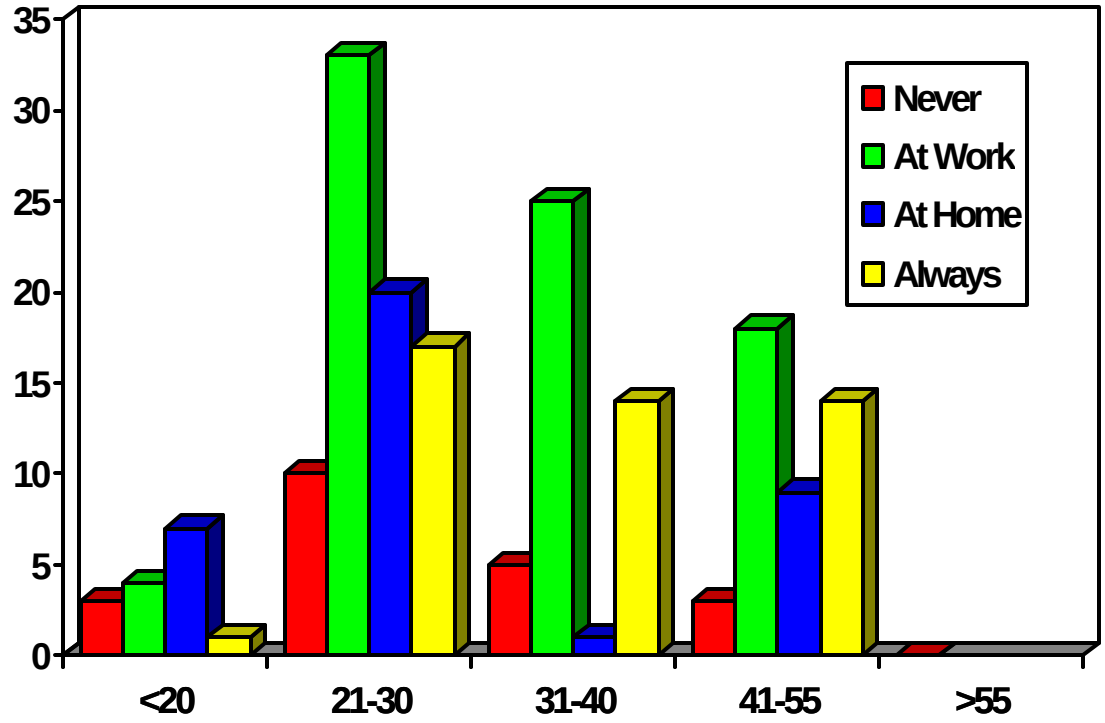
Age versus Willingness at $20 per month



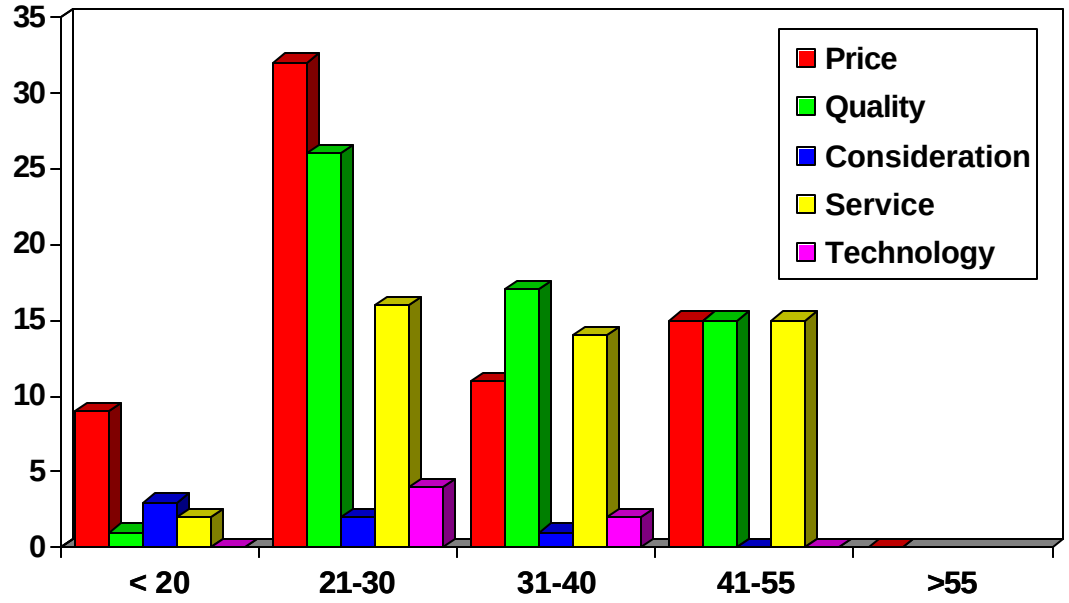
Age versus Willingness to Switch



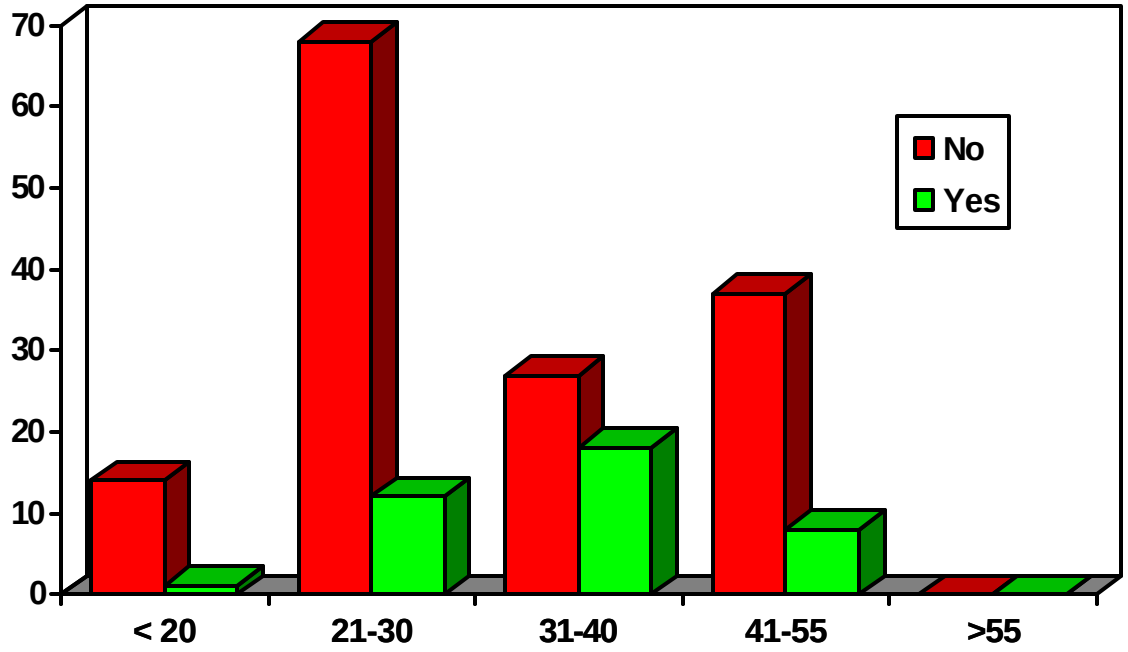
Age versus PC Usage



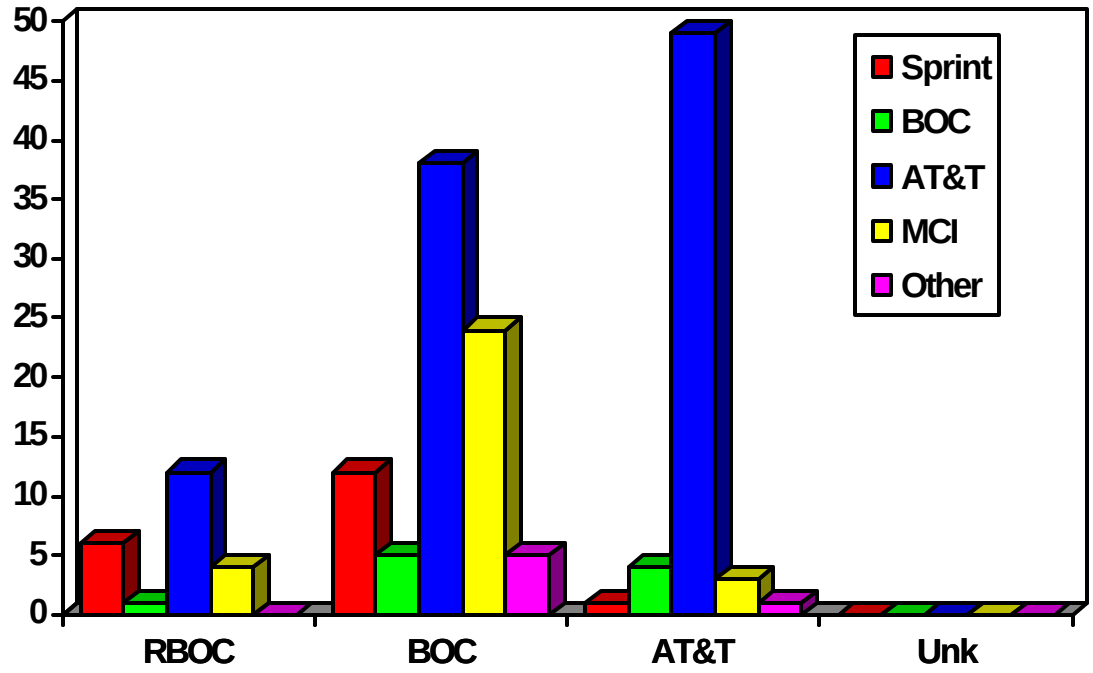
Age versus Importance



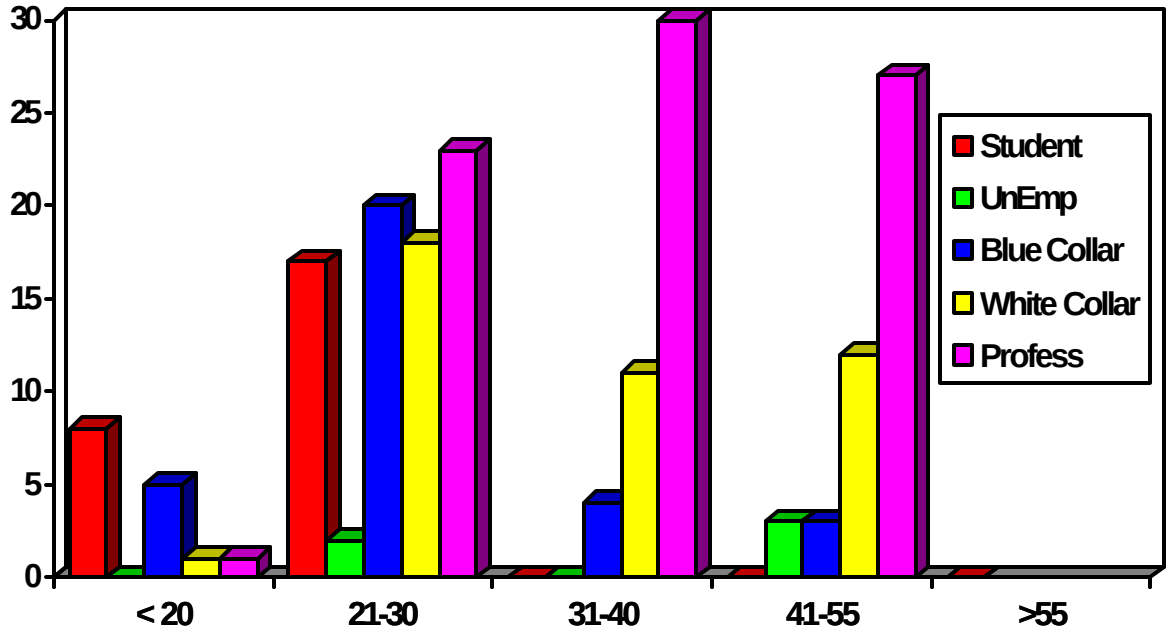
Age versus Cellular Usage



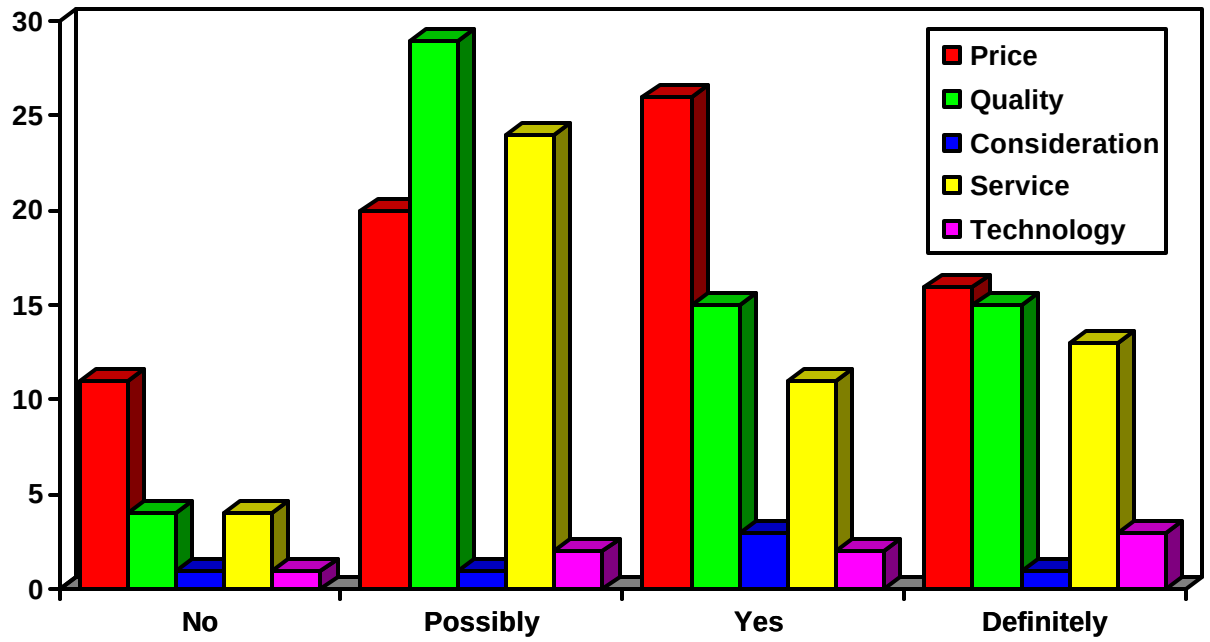
Local Carrier versus Long Distance Carrier



Age versus Occupation



Willingness at $20 versus Importance



MARKET CONCLUSIONS

- Price is the key to consumer acceptance followed by quality. The PCS provider must be able to compete on price and thus the prior arguments of the Experimenter about access fees goes to the heart of the ability to have a free and open market. The LEC has and continues to have bottleneck control.

- Brand Loyalty is still existent. It is not Brand Loyalty to the LEC, rather it is Brand Loyalty to the IEC, specifically AT&T. We argue that Brand Loyalty will make it more difficult as a newcomer to compete against the entrenched carriers, especially now that AT&T has potential control over the local access through McCaw.

- There is a broad based acceptance on all age groups. There is no small market niche for these services.

- Fixed pricing at the $20 per month range allows for rapid market acceptance and penetration. The system must therefore be capital efficient, and must have a competitive neutral environment if it is to survive, not to mention prosper.

REVENUE MODELS

- **CHOOSE A CERTAIN MARKET**
- **DETERMINE DEMO, PSYCHO, DIFFUSION %S FROM MARKET RESEARCH.**
- **CHOOSE SHARE FROM COMPETITIVE ANALYSIS.**
- **CHECK WITH DEMAND CURVE**
- **PLOT OUT NUMBERS.**

Revenue Summary

Year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Total Cities	1	1	1	1	1	1	1	1	1	1
Total Potential Base	4000	4080	4162	4245	4330	4416	4505	4595	4687	4780
Demographic %	18%	24%	28%	30%	32%	37%	42%	53%	66%	82%
Addressable Market	720	979	1165	1273	1386	1634	1892	2412	3076	3921
Psychographic %	30%	31%	35%	38%	42%	45%	50%	52%	55%	55%
Feasible Market	216	304	408	484	582	735	946	1254	1692	2157
Adoption %	18%	24%	40%	55%	70%	80%	80%	80%	80%	80%
Target Market	39	73	163	266	407	588	757	1003	1353	1725
Share %	50%	50%	45%	40%	38%	34%	30%	28%	25%	25%
Customer Base(End of Year)	19	36	73	106	155	200	227	281	338	431
No Old Customers	0	19	36	73	106	155	200	227	281	338
No New Customers	19	17	37	33	48	45	27	54	57	93
No Effective Customers	10	28	55	90	131	177	214	254	310	385
% Segment	0.5%	0.9%	1.8%	2.5%	3.6%	4.5%	5.0%	6.1%	7.2%	9.0%
No Segment	19	36	73	106	155	200	227	281	338	431
No Total Users(Eff)	10	28	55	90	131	177	214	254	310	385
% Retail	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
No Users	10	28	55	90	131	177	214	254	310	385
No Min/User/Mo	600	600	600	600	600	600	600	600	600	600
No Min/Mo	5,832	16,760	32,951	53,961	78,375	106,439	128,112	152,404	185,788	230,901
Retail Rev/Min	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Fixed Rev/Cust/Mo	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Service Revenue	$3,499	$10,056	$19,771	$32,377	$47,025	$63,863	$76,867	$91,442	$111,473	$138,541

Rev/Sub	$360	$360	$360	$360	$360	$360	$360	$360	$360	$360
Rev/Min	$0.05	$0.05	$0.05	$0.05	$0.05	$0.05	$0.05	$0.05	$0.05	$0.05
Retail Terminals										
No New Cust Seg	22	21	46	46	67	69	54	88	98	145
Rev/Terminal Seg	$300	$240	$192	$154	$123	$100	$100	$100	$100	$100
Terminal Revenue	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
TOTAL REVENUE	$3,499	$10,056	$19,771	$32,377	$47,025	$63,863	$76,867	$91,442	$111,473	$138,541
ROAM										
Retail Rev	$3,499	$10,056	$19,771	$32,377	$47,025	63863	$76,867	$91,442	$111,473	$138,541
% Roam	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
REVENUE Roam	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Local Service Revenue	$3,499	$10,056	$19,771	$32,377	$47,025	$63,863	$76,867	$91,442	$111,473	$138,541
Roaming Revenue	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Summary Revenue	$3,499	$10,056	$19,771	$32,377	$47,025	$63,863	$76,867	$91,442	$111,473	$138,541
Rev/Sub	$360	$360	$360	$360	$360	$360	$360	$360	$360	$360
GROSS REVENUE	$3,499	$10,056	$19,771	$32,377	$47,025	$63,863	$76,867	$91,442	$111,473	$138,541

WIRELESS ECONOMICS

Revenue Driver, R: The revenue drive may be as simple as the number of customers or the number of new customers. Clearly the customer service and billing functions are driven by the number of customers. The sales effort is driven by the number of new customers. The cell maintenance function is driven by the number of cell sites which in turn is driven by the number of customers.

Productivity Factor, P: The productivity factor reflects how the operations reflects revenue drivers into human resources. For example in customer service it is in terms of the calls per customer per day, the holding time per call, the hours per day per customer service representative. This results in the number of customer service representatives per unit revenue driver.

Unit Costs; U: The unit costs are the costs associated with the labor and other units of production used in the operations model. This then yields a cost for unit k as:

COST MODEL (CONTD)

$$C_k = RD_k PF_k UC_k$$

Then the total operations costs are;

$$C = \sum_{k=1}^{K} RD_k PF_k UC_k$$

Then we have for the total cost function the following, where we have parameterized it on time units, k, and have further included all cost element;

$$C(q) = C_{Capital} + C_{Cost\_of\_Goods} + C_{Service} + C_{Sales} + C_{Operations}$$

We can simplify this as:

$$C = \sum_{n=1}^{N} \sum_{k=1}^{K} RD_k^n PF_k^n UC_k^n \; ; \; where \quad ;$$

$$n = 1 = Capital \quad , \ldots , n = N = Operations \quad .$$

Unit Performance Summary

1. Customer Service	
No Prob/Cust/Year	8
No Calls/Hour	21
Holding Time/Cust	5
No Calls/New Cust/Year	10
No Calls/Hr	58
Holding Time/Call	6

2. Billing & Collections	
Cost/Bill	$0.60
Cost/New Cust	$0.00
% Bad Debt	0.00%

Unit Performance Summary

3. Network Operations & Maintenance

Local Operations & Maintenance

No Cell Sites	32
No Switches	5
No Switches	5
No Cells	32
MTBF/Switch	20000
MTBF/Cell	2000
No Failures/Switch/Area	0
No Fail/Cell/Area	6
MTTR/Switch	4
MTTR/Cell	2

Network Management

No of Cells	32
No Switches	5
No ReRads	224
Alarms/Cell/Month	300
Alarms/Switch/Month	300
Alarms/Re Rad/Month	1
Time/Alarm(min)	10

Unit Performance Summary

4. Roamer Management and Operations	
Calls/Customer/Month	200
% Calls IEC and Roaming	15%
Roaming Calls/Month (000)	467
Time/Call/Employee(min)	0.05
Total Ops Time	23

5. Repair Dispatching	
No Alarms/Month	824
Time/Alarm	10
Total Alarm Time	8240

6. Operator Services/DA	
No Requests/Customer/Month	2
Duration of Request	0.10
No Calls/Month	1555
No Requests/Call	0.05

7. IEC Operations & Management	
Number of Calls/Customer/Month	200

Unit Performance Summary

8. Inventory Management	
Network Inventory Management	
Number of Trunks	1
Number of IECs	4
Trunks/Employee	50
Employees/IEC	0.20
Portable Inventory Management	
No Customers	8
No New Customers	8
No New Portables/New Customer	1
No lost Portables/1,000 Customers	0.05
No Portables	8
No Portables/Employees	6000

SAMPLE EXPENSE MODELS

- **USES THE APPROACH SHOWN ABOVE**
- **USES DETAILS ON THE PROCESS MODEL NOT THE FUNCTION MODEL**
- **INTEGRATES PROCESSES INTO THE BUSINESS**

Year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
SALES AND SERVICE										
1.0 Sales										
Direct	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Telemarketing	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Dealers	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
No New Cust Tot	5	45	45	55	50	0	0	0	0	20
New Cust Direct	5	45	45	55	50	0	0	0	0	20
New Cust Telemktg	0	0	0	0	0	0	0	0	0	0
New Cust Dealers	0	0	0	0	0	0	0	0	0	0
1.1 Direct Sales (System Operators)										
No New Cust (Operators)	5	45	45	55	50	0	0	0	0	20
No Sales Month/New Cust	12	12	12	12	12	12	12	12	12	12
No Sales	5	45	45	55	50	0	0	0	0	20
Sal/Sales (Base)	$90	$90	$90	$90	$90	$90	$90	$90	$90	$90
Base Salary	$450	$4,050	$4,050	$4,950	$4,500	$0	$0	$0	$0	$1,800
Sales Exp	$450	$4,050	$4,050	$4,950	$4,500	$0	$0	$0	$0	$1,800
No Sales Staff	5	45	45	55	50	0	0	0	0	20
Cost/Sales (Direct)	$90	$90	$90	$90	$90	$0	$0	$0	$0	$90
Exp/Salesperson	$90	$90	$90	$90	$90	$0	$0	$0	$0	$90

1.2 Telemarketing Sales (Customers)

No New Cust (000)	22	382	1333	2623	4635	4909	5185	5491	7537	9942
No Contacts/New Cust	2	2	2	2	2	2	2	2	2	2
No Contacts (000)	43	765	2666	5246	9271	9818	10370	10981	15075	19885
Time/Contact (Hr)	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Contact Time(Hrs)	4	76	267	525	927	982	1037	1098	1507	1988
No TM Lead Gen	2	38	133	262	464	491	518	549	754	994
No New Cust/Hour	11	191	667	1311	2318	2454	2592	2745	3769	4971
Hold Time/Cust	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
No TM Sales	2	20	67	132	232	246	260	275	377	498
Sal/TM	$40	$40	$40	$40	$40	$40	$40	$40	$40	$40
Tlmktg Exp	$166	$2,329	$8,012	$15,771	$27,822	$29,476	$31,139	$32,963	$45,230	$59,690
No Staff	4	58	200	394	696	737	778	824	1131	1492
Telemktg ExpCost/New Cust	***$8***	***$6***	***$6***	***$6***	***$6***	***$6***	***$6***	***$6***	***$6***	***$6***

1.3 Dealer Sales

No New Cust	0	0	0	0	0	0	0	0	0	0
Fee/Cust	$400	$400	$400	$400	$400	$400	$400	$400	$400	$400
Dealers Exp	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total Sales Exp	$616	$6,379	$12,062	$20,721	$32,322	$29,476	$31,139	$32,963	$45,230	$61,490
Total Sales Staff	9	103	245	449	746	737	778	824	1131	1512
Exp/Sales	$90	$90	$90	$90	$90	$0	$0	$0	$0	$90
Rev/Sales	$1,109	$1,675	$1,944	$1,646	$1,752	$1,901	$1,924	$1,939	$1,919	$1,889
Exp/New Cust	***$123***	***$142***	***$268***	***$377***	***$646***	***#DIV/0!***	***#DIV/0!***	***#DIV/0!***	***#DIV/0!***	***$3,074***

2.0 Promotion

No Areas	5	50	95	150	200	200	200	200	200	220
No Centers/Area	1	1	1	1	1	1	1	1	1	1
No Centers	5	50	95	150	200	200	200	200	200	220
Prom Staff/Area	5	5	5	5	5	5	5	5	5	5
Sal/Staff	$60	$60	$60	$60	$60	$60	$60	$60	$60	$60
No Staff	25	250	475	750	1000	1000	1000	1000	1000	1100
Prom Staff Exp	$1,500	$15,000	$28,500	$45,000	$60,000	$60,000	$60,000	$60,000	$60,000	$66,000
No Areas	5	50	95	150	200	200	200	200	200	220
No Spots/Month/Area	20	20	20	20	20	20	20	20	20	20
Spot Cost	$4	$4	$4	$4	$4	$4	$4	$4	$4	$4
No Runs/Spot	20	20	20	20	20	20	20	20	20	20
Production Cost/Spot	$100	$100	$100	$100	$100	$100	$100	$100	$100	$100
No Print/Month/Area	20	20	20	20	20	20	20	20	20	20
Print Cost	$1	$1	$1	$1	$1	$1	$1	$1	$1	$1
No Runs/Print	40	40	40	40	40	40	40	40	40	40
Production Cost/Print	$10	$10	$10	$10	$10	$10	$10	$10	$10	$10
Total Spot Cost	$4,800	$48,000	$91,200	$144,000	$192,000	$192,000	$192,000	$192,000	$192,000	$211,200
Total Spot Production	$1,200	$1,200	$1,200	$1,200	$1,200	$1,200	$1,200	$1,200	$1,200	$1,200
Total Print Cost	$1,200	$12,000	$22,800	$36,000	$48,000	$48,000	$48,000	$48,000	$48,000	$52,800
Total Print Production	$60	$60	$60	$60	$60	$60	$60	$60	$60	$60
Total Cost	$7,260	$61,260	$115,260	$181,260	$241,260	$241,260	$241,260	$241,260	$241,260	$265,260
No New Cust	22	382	1,333	2,623	4,635	4,909	5,185	5,491	7,537	9,942
Cost/New Cust	$336	$160	$86	$69	$52	$49	$47	$44	$32	$27
Revenue	$10,162	$172,916	$476,824	$739,315	$1,306,016	$1,401,057	$1,497,691	$1,597,546	$2,169,719	$2,856,421
Advert %	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%
Min Advert Exp/Area	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Advert Exp	$7,260	$61,260	$115,260	$181,260	$241,260	$241,260	$241,260	$241,260	$241,260	$265,260
No New Cust	22	382	1333	2623	4635	4909	5185	5491	7537	9942
Advert Exp/New Cust	***$336***	***$160***	***$86***	***$69***	***$52***	***$49***	***$47***	***$44***	***$32***	***$27***
Advert Exp	$7,260	$61,260	$115,260	$181,260	$241,260	$241,260	$241,260	$241,260	$241,260	$265,260
Promo Exp	**$8,760**	**$76,260**	**$143,760**	**$226,260**	**$301,260**	**$301,260**	**$301,260**	**$301,260**	**$301,260**	**$331,260**
Promo Exp/New Cust	***$406***	***$199***	***$108***	***$86***	***$65***	***$61***	***$58***	***$55***	***$40***	***$33***

3.0 Customer Service

No Cust	8	153	735	1946	3964	6137	7767	9055	10771	13546
No Prob/Cust/Year	8	7	6	4	3	3	3	3	3	3
No Calls/Hour	21	358	1469	2595	3964	6137	7767	9055	10771	13546
Holding Time/Cust	5	5	5	5	5	5	5	5	5	5
No CSR	2	30	122	216	330	511	647	755	898	1129
No New Cust	17	305	1019	1887	3213	2950	2815	2787	4214	5713
No Calls/New Cust/Year	10	8	6	4	4	4	4	4	4	4
No Calls/Hr	58	814	2037	2516	4284	3933	3753	3717	5619	7618
Holding Time/Call	6	6	6	6	6	6	6	6	6	6
No CSR Employees	6	81	204	252	428	393	375	372	562	762
CSR Expense/Month/Cust	$2.00	$2.00	$2.00	$2.00	$2.00	$2.00	$2.00	$2.00	$2.00	$2.00
No Customers	8	153	735	1946	3964	6137	7767	9055	10771	13546
Total CSR Employees	8	111	326	468	759	905	1023	1126	1459	1891
Sal/CSR	$30	$30	$30	$30	$30	$30	$30	$30	$30	$30
CSR Exp	$226	$3,338	$9,785	$14,037	$22,762	$27,140	$30,679	$33,787	$43,784	$56,718
CSR Exp/Mo/Cust	$2.42	$1.81	$1.11	$0.60	$0.48	$0.37	$0.33	$0.31	$0.34	$0.35

4.0 Marketing

No New Cust(Gross)	5	50	95	150	200	200	200	200	200	220
No Staff/(000) Cust	0.50	0.50	0.50	0.30	0.30	0.20	0.20	0.10	0.10	0.10
No Mktg Staff	3	25	48	45	60	40	40	20	20	22
Sal/Marketing	$60	$60	$60	$60	$60	$60	$60	$60	$60	$60
Marketing Exp	$150	$1,500	$2,850	$2,700	$3,600	$2,400	$2,400	$1,200	$1,200	$1,320

5.0 Billing & Collectns

No Cust	8	153	735	1946	3964	6137	7767	9055	10771	13546
Cost/Bill	$0.60	$0.60	$0.60	$0.60	$0.60	$0.60	$0.60	$0.60	$0.60	$0.60
Bill Exp	$56	$1,105	$5,289	$14,013	$28,543	$44,183	$55,926	$65,194	$77,552	$97,533
No New Cust	22	382	1333	2623	4635	4909	5185	5491	7537	9942
Cost/New Cust	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
New Cust Cost	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total Rev	$10,162	$172,916	$476,824	$739,315	$1,306,016	$1,401,057	$1,497,691	$1,597,546	$2,169,719	$2,856,421
% Bad Debt	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Bad Debt Exp	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Sal/Staff	$30	$30	$30	$30	$30	$30	$30	$30	$30	$30
Billing Ratio	20	20	20	20	20	20	20	20	20	20
No Staff-Billing	0	2	9	23	48	74	93	109	129	163
Collections Ratio	10	10	10	10	10	10	10	10	10	10
No Staff Collections	0	0	0	0	0	0	0	0	0	0
No Customers	8	153	735	1946	3964	6137	7767	9055	10771	13546
BillExp/Cust/Month	$1.00	$1.00	$1.00	$1.00	$1.00	$1.00	$1.00	$1.00	$1.00	$1.00
Total Staff	0	2	9	23	48	74	93	109	129	163
Bill/Coln Exp	$56	$1,105	$5,289	$14,013	$28,543	$44,183	$55,926	$65,194	$77,552	$97,533
Bill Exp/Cust/Mo	$0.60	$0.60	$0.60	$0.60	$0.60	$0.60	$0.60	$0.60	$0.60	$0.60

6.0 Sales and Support Administrative

No Direct Staff	44	491	1103	1736	2612	2755	2934	3079	3739	4687
No Admin/Direct Staff	0.25	0.22	0.21	0.20	0.20	0.20	0.20	0.20	0.20	0.20
No Admin	11	108	232	347	522	551	587	616	748	937
Total Staff	55	599	1334	2083	3134	3306	3521	3695	4487	5625
Sal/Admin	$55	$55	$55	$55	$55	$55	$55	$55	$55	$55
Admin Exp	$609	$5,945	$12,737	$19,091	$28,730	$30,307	$32,278	$33,868	$41,134	$51,562

7.0 Sales and Support Overhead

Total Salr Exp	$2,845	$28,393	$55,132	$83,137	$116,052	$117,507	$123,017	$127,715	$144,978	$176,140
Overhead Rate	90.00%	90.00%	90.00%	90.00%	90.00%	90.00%	90.00%	90.00%	90.00%	90.00%
Overhead Exp	$2,560	$25,554	$49,619	$74,824	$104,447	$105,756	$110,715	$114,943	$130,480	$158,526
Sales and Marketing Expense	$12,978	$120,081	$236,103	$371,646	$521,665	$540,522	$564,397	$583,215	$640,640	$758,409
Headcount	55	599	1334	2083	3134	3306	3521	3695	4487	5625
Exp/Emp	$234	$200	$177	$178	$166	$163	$160	$158	$143	$135

Budgetary Cost Analysis

Function	Cost/Sub/ Month	Fixed Cost/BTA/Year	Initial Costs/PoP
Network Management	$1.00	$50,000	$0.05
IEC Interface	$0.50	$10,000	$0.05
Customer Service	$1.00	$50,000	$0.10
Billing	$1.50	$75,000	$0.15
Telemarketing	NA	NA	NA
Roaming	$0.75	$15,000	$0.05
IN Services	NA	NA	NA
Repair and Dispatching	$0.50	$5,000	$0.02
Inventory Management	$0.50	$5,000	$0.02
Operator Services	$1.25	$15,000	$0.05
Provisioning	$0.50	$5,000	$0.01

$$C_{LSI} = C_{Cells} + C_{CellInterconnect} + C_{Switch} + C_{SwitchInterconnect}$$

where;

$$C_{Cells} = N_{Type\_1} C_{Type\_1} + N_{Type\_2} C_{Type\_2}$$

with ;

C_{Type_n} = capital per cell of type n.

Now we can define;

$$N = N_{Type\_1} + N_{Type\_2};$$

where ;

$$N = \frac{A}{p R^2}$$

Capital per Subscriber

$$c_{LSI} = \frac{C_{LSI}}{B};$$

or;

$$c_{LSI} = \frac{C_{Cells} + C_{CellInterconnect} + C_{Switch} + C_{SwitchInterconnect}}{B}$$

yields;

$$c_{LSI} = \frac{\mathrm{N}_{Type1} C_{Type1} + \mathrm{N}_{Type2} C_{Type2}}{B} + \frac{C_{CellInterconnect} + C_{Switch} + C_{SwitchInterconnect}}{B}$$

CAPITAL EXAMPLES

- **DRIVEN BY THE REVENUE DRIVERS**
- **USE SYSTEM ARCHITECTURE**
- **USE CAPITAL PLANT VALUES FROM VENDOR**

Year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Initial Capital	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Net Capital	$0	$8,097	$14,494	$24,432	$47,113	$70,368	$87,808	$110,066	$123,642	$143,679
1.0 Switch Capital										
No Call Min	55987	1105063	5289273	14013261	28543331	44182851	55925999	65194092	77552162	97532629
No Areas	5	50	95	150	200	200	200	200	200	220
No Call Min/Area	11197	22101	55677	93422	142717	220914	279630	325970	387761	443330
No Call Min/Switch	500,000	500,000	500,000	500,000	500,000	500,000	500,000	500,000	500,000	500,000
No Old Switches	0	5	50	95	150	200	200	200	200	200
No Total Switch	5	50	95	150	200	200	200	200	200	220
No New Switch	5	45	45	55	50	0	0	0	0	20
Cap/Switch	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000
New Switch Capital	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total Switch Capital	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
2.0 Cell Capital										
No Customers(000, EOY)	17	321	1310	3065	5928	8164	9874	11263	13848	17622
No Cell Site/ Cust(000)	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07
No Old Cell Sites	0	32	379	840	1516	2274	2527	2527	2527	2527
Total Cells (EOY)	32	379	840	1516	2274	2527	2527	2527	2527	2779
No New Cells	32	347	461	676	758	253	0	0	0	252
Cap/Cell	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
New Cell Capital	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total Cell Capital	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
3.0 ReRad Capital										
No Repeaters	224	2653	5880	10612	15918	17689	17689	17689	17689	19453
No New Repeaters	224	2429	3227	4732	5306	1771	0	0	0	1764
Capital/Repeater	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Repeater Capital	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
New Repeater Capital	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
4.0 CPU/Computer WS Capital										
No New CPU	1	0	0	0	0	0	0	0	0	0
Cap/CPU	$500	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000
New CPU Cap	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total CPU Capital	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0

5.0 Cell Interconnect Capital

No New Cells	32	347	461	676	758	253	0	0	0	252
No Cells	32	379	840	1516	2274	2527	2527	2527	2527	2779
Miles of Interconnect/Cell	3	3	3	3	3	3	3	3	3	3
No New Miles	96	1041	1383	2028	2274	759	0	0	0	756
No Miles	96	1137	2520	4548	6822	7581	7581	7581	7581	8337
Capital/Mile	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
New Capital/Cell Inter	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total Cell Inter Capital	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0

6.0 Switch Interconnect Capital

No Cells	32	379	840	1516	2274	2527	2527	2527	2527	2779
No Switches	5	50	95	150	200	200	200	200	200	220
No Cells/Switch	6	8	9	10	11	13	13	13	13	13
No Trunks/Cell	5	5	5	5	5	5	5	5	5	5
No Trunks	160	1895	4200	7580	11370	12635	12635	12635	12635	13895
No Miles/Trunk	4	4	4	4	4	4	4	4	4	4
Capital/Mile	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total New Capital	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total Capital	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0

7.0 Operating Support Systems Capital

7.1 Network Management System

No NM Employees	46	148	366	722	1238	1570	1792	1973	2328	2880
No New NM Employees	46	102	218	356	516	332	221	181	356	552
No WS/Employee	1	1	1	1	1	1	1	1	1	1
Capital/WS	$4	$4	$4	$4	$4	$4	$4	$4	$4	$4
New WS Capital	$184	$408	$872	$1,424	$2,064	$1,330	$886	$723	$1,422	$2,206
Total WS Capital	$184	$592	$1,464	$2,888	$4,952	$6,282	$7,167	$7,891	$9,313	$11,519
New WS SW Install	$1,500	$0	$0	$1,500	$0	$0	$1,500	$0	$0	$1,500
Upgrade %	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
Upgrade Install	$0	$300	$300	$300	$300	$300	$300	$300	$300	$300
New SW Capital	$1,500	$300	$300	$1,800	$300	$300	$1,800	$300	$300	$1,800
Total SW Capital	$1,500	$1,800	$2,100	$3,900	$4,200	$4,500	$6,300	$6,600	$6,900	$8,700

7.2 Customer Service System

No CS Employees	8	111	326	468	759	905	1023	1126	1459	1891
No New CS Employees	8	104	215	142	291	146	118	104	333	431
No WS/Employee	1	1	1	1	1	1	1	1	1	1
Capital/WS	$4	$4	$4	$4	$4	$4	$4	$4	$4	$4
New WS Capital	$30	$415	$860	$567	$1,163	$584	$472	$414	$1,333	$1,725
Total WS Capital	$30	$445	$1,305	$1,872	$3,035	$3,619	$4,091	$4,505	$5,838	$7,562
New WS SW Install	$1,500	$0	$0	$1,500	$0	$0	$1,500	$0	$0	$1,500
Upgrade %	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
Upgrade Install	$0	$300	$300	$300	$300	$300	$300	$300	$300	$300
New SW Capital	$1,500	$300	$300	$1,800	$300	$300	$1,800	$300	$300	$1,800
Total SW Capital	$1,500	$1,800	$2,100	$3,900	$4,200	$4,500	$6,300	$6,600	$6,900	$8,700

7.3 Billing System

No Bill Employees	0	2	9	23	48	74	93	109	129	163
No New BillM Employees	0	2	7	15	24	26	20	15	21	33
No WS/Employee	1	1	1	1	1	1	1	1	1	1
Capital/WS	$4	$4	$4	$4	$4	$4	$4	$4	$4	$4
New WS Capital	$0	$7	$28	$58	$97	$104	$78	$62	$82	$133
Total WS Capital	$0	$7	$35	$93	$190	$295	$373	$435	$517	$650
New WS SW Install	$1,500	$0	$0	$1,500	$0	$0	$1,500	$0	$0	$1,500
Upgrade %	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
Upgrade Install	$0	$300	$300	$300	$300	$300	$300	$300	$300	$300
New SW Capital	$1,500	$300	$300	$1,800	$300	$300	$1,800	$300	$300	$1,800
Total SW Capital	$1,500	$1,800	$2,100	$3,900	$4,200	$4,500	$6,300	$6,600	$6,900	$8,700

7.4 Operator Service System

No OS Employees	2	30	138	366	744	1152	1457	1698	2021	2541
No New OS Employees	2	29	108	228	378	408	305	242	323	521
No WS/Employee	1	1	1	1	1	1	1	1	1	1
Capital/WS	$4	$4	$4	$4	$4	$4	$4	$4	$4	$4
New WS Capital	$6	$114	$432	$912	$1,512	$1,632	$1,218	$966	$1,290	$2,082
Total WS Capital	$6	$120	$552	$1,464	$2,976	$4,608	$5,826	$6,792	$8,082	$10,164
New WS SW Install	$1,000	$0	$0	$1,000	$0	$0	$1,000	$0	$0	$1,000
Upgrade %	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
Upgrade Install	$0	$200	$200	$200	$200	$200	$200	$200	$200	$200
New SW Capital	$1,000	$200	$200	$1,200	$200	$200	$1,200	$200	$200	$1,200
Total SW Capital	$1,000	$1,200	$1,400	$2,600	$2,800	$3,000	$4,200	$4,400	$4,600	$5,800

7.5 Provisioning System

No Prov Employees	82	842	1051	1491	1619	464	0	0	0	554
No New Prov Employees	82	761	209	440	127	-1155	-464	0	0	554
No WS/Employee	1	1	1	1	1	1	1	1	1	1
Capital/WS	$4	$4	$4	$4	$4	$4	$4	$4	$4	$4
New WS Capital	$326	$3,043	$836	$1,760	$510	($4,620)	($1,855)	$0	$0	$2,215
Total WS Capital	$326	$3,370	$4,206	$5,966	$6,475	$1,855	$0	$0	$0	$2,215
New WS SW Install	$800	$0	$0	$800	$0	$0	$800	$0	$0	$800
Upgrade %	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
Upgrade Install	$0	$160	$160	$160	$160	$160	$160	$160	$160	$160
New SW Capital	$800	$160	$160	$960	$160	$160	$960	$160	$160	$960
Total SW Capital	$800	$960	$1,120	$2,080	$2,240	$2,400	$3,360	$3,520	$3,680	$4,640

7.6 Inventory Management System

No Inv Mgt Employees	3	29	132	346	702	1086	1375	1602	1905	2396
No New Inv Mgt Employees	3	26	103	214	356	384	289	227	303	491
No WS/Employee	1	1	1	1	1	1	1	1	1	1
Capital/WS	$4	$4	$4	$4	$4	$4	$4	$4	$4	$4
New WS Capital	$12	$104	$412	$856	$1,424	$1,536	$1,156	$908	$1,212	$1,964
Total WS Capital	$12	$116	$528	$1,384	$2,808	$4,344	$5,500	$6,408	$7,620	$9,584
New WS SW Install	$750	$0	$0	$750	$0	$0	$750	$0	$0	$750
Upgrade %	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
Upgrade Install	$0	$150	$150	$150	$150	$150	$150	$150	$150	$150
New SW Capital	$750	$150	$150	$900	$150	$150	$900	$150	$150	$900
Total SW Capital	$750	$900	$1,050	$1,950	$2,100	$2,250	$3,150	$3,300	$3,450	$4,350
New OSS Capital	$7,597	$5,397	$4,438	$13,181	$6,756	$440	$9,258	$3,576	$5,537	$16,820
Total OSS Capital	$7,597	$12,994	$17,432	$30,613	$37,368	$37,808	$47,066	$50,642	$56,179	$73,000

8.0 Processor Capital

8.1 Net Management

Alarms/Month	824.00	3,253.00	6,480.00	11,212.00	16,518.00	18,289.00	18,289.00	18,289.00	18,289.00	20,053.00
Transactions/Alarm	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
No Transactions/Min	1.91	7.53	15.00	25.95	38.24	42.34	42.34	42.34	42.34	46.42

8.2 Customer Service

No Calls/Hour	58.06	814.20	2,037.31	2,516.32	4,283.74	3,932.88	3,753.40	3,716.57	5,618.70	7,617.63
No Transactions/Call	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00
No Transactions/Min	19.35	271.40	679.10	838.77	1,427.91	1,310.96	1,251.13	1,238.86	1,872.90	2,539.21

8.3 Billing

No Bills/Month	7.78	153.48	734.62	1,946.29	3,964.35	6,136.51	7,767.50	9,054.74	10,771.13	13,546.20
No Transactions/Bill	200.00	200.00	200.00	200.00	200.00	200.00	200.00	200.00	200.00	200.00
No Transactions/Min	36.00	710.56	3,401.02	9,010.58	18,353.48	28,409.76	35,960.65	41,920.07	49,866.36	62,713.88

8.4 Operator Services/Directory Assistance

No Calls/Month	77.76	1,534.81	7,346.21	19,462.86	39,643.51	61,365.07	77,675.00	90,547.35	107,711.34	135,461.99
No Transactions/Call	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00
No Transactions/Min	18.00	355.28	1,700.51	4,505.29	9,176.74	14,204.88	17,980.32	20,960.03	24,933.18	31,356.94

8.5 Provisioning

No New Customers	7.78	153.48	734.62	1,946.29	3,964.35	6,136.51	7,767.50	9,054.74	10,771.13	13,546.20
No Transactions/New Customer	500.00	500.00	500.00	500.00	500.00	500.00	500.00	500.00	500.00	500.00
No Transactions/Min	7.40	146.01	698.84	1,851.49	3,771.26	5,837.62	7,389.17	8,613.71	10,246.51	12,886.41

8.6 Repair/Dispatching/Inventory Management

No Failures/Year	187.34	26,260.11	128,936.71	419,842.35	944,451.37	1,166,125.54	1,166,125.54	1,166,125.54	1,166,125.54	1,410,301.78
No Transactions/Failure	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
No Transactions-Failure/Min	0.04	5.21	25.58	83.30	187.39	231.37	231.37	231.37	231.37	279.82
Alarms/Month	601.00	601.00	601.00	601.00	601.00	601.00	601.00	601.00	601.00	601.00
No Transactions/Alarm	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
No Trans-Alarm/Min	1.39	1.39	1.39	1.39	1.39	1.39	1.39	1.39	1.39	1.39
Alarm Dispatch/Month	824.00	3,253.00	6,480.00	11,212.00	16,518.00	18,289.00	18,289.00	18,289.00	18,289.00	20,053.00
Transactions/Alarm	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
No Alarm Trans/Min	1.91	7.53	15.00	25.95	38.24	42.34	42.34	42.34	42.34	46.42
No Transactions/Min	1.91	7.53	15.00	25.95	38.24	42.34	42.34	42.34	42.34	46.42
Total Transactions/Min	84.57	1,498.31	6,509.48	16,258.05	32,805.87	49,847.88	62,665.95	72,817.34	87,003.62	109,589.28
Capacity/Machine (TPM)	500	500	500	500	500	500	500	500	500	500
No Processors	1	3	14	33	66	100	126	146	175	220
No New Processors	1	2	11	19	33	34	26	20	29	45
Capital/Processor (000)	$500	$500	$500	$500	$500	$500	$500	$500	$500	$500
New Processor Capital	$500	$1,000	$5,500	$9,500	$16,500	$17,000	$13,000	$10,000	$14,500	$22,500
Total New Capital	$8,097	$6,397	$9,938	$22,681	$23,256	$17,440	$22,258	$13,576	$20,037	$39,320
Accum Capital	$8,097	$14,494	$24,432	$47,113	$70,368	$87,808	$110,066	$123,642	$143,679	$183,000
Deprecation	$810	$1,449	$2,443	$4,711	$7,037	$8,781	$11,007	$12,364	$14,368	$18,300
Accum Cap-Accum Dep	$7,287	$12,235	$19,729	$37,699	$53,918	$62,577	$73,829	$75,040	$80,709	$101,730
Capital per Sub	$521	$50	$21	$17	$13	$12	$13	$13	$12	$12

EXPENSE MODELS

$$C(q) = \min_{x_1,\ldots x_n;\, p_1,\ldots p_n;\, b_1,\ldots b_n}$$

and,

$$C = \sum_{k=1}^{n} p_k q_k + b$$

and choose x to minimize;

$$(x_1^*,\ldots x_n^*) =$$

$$\left\{ (x_1,\ldots x_n) : \_ \min\left(V = \sum_{k=1}^{n} p_k q_k + b + l\,(q - f(x_1,\ldots, x_n)) \right) \right\}$$

then, there exist an expansion path;

$$g(x_1,\ldots,x_n) = 0$$

$$C_{ShortTerm}(q) = f(q) + b$$

which is the short term cost function.

Definition: For a system of production, producing a quantity q, at unit prices, p, and at **fixed inputs**, x, define the cost function C as[1];

$$C_{ShortTerm}(q) = f(q) + b$$

Then C is called the s*hort term cost function*.[2]

Definition: The *Average Total Cost* is defined as:

$$ATC = \frac{f(q) + b}{q}$$

and average variable and fixed costs are similarly defined.

[1]We assume that there also exists an expansion path function, g(...), as developed by Samuelson and as shown in Henderson and Quandt, that implicitly shows the movement of resources, x, constrained to producing quantity q in an optimal fashion, see Henderson and Quandt, p. 83.

[2]Recall that the short term cost function is for fixed inputs and it results from the maximization of a value function, V, given by;

$$V = f(x_1,\ldots,x_n) + m(C^0 - \sum(x_k p_k + b_k))$$

The expansion to maximize this constrained function is shown by Henderson and Quandt to be the function;

$$g(x_1,\ldots,x_n) = 0$$

Definition: The *Marginal Cost* is defined as;

$$MC = \frac{dC}{dq} = \frac{\P f}{\P q}$$

Definition: The *long run cost* is defined as the costs generated by the system as follows:

$$q = f(x, \ldots, x; k)$$

$$C = \sum_{k=1}^{n} p_k x_k + j(k)$$

$$0 = g(x_1, \ldots, x_n; k)$$

where we have defined the variable long run factor k. Reduced the long run cost is:

$$C = f(q, k) + j(k)$$

Definition: The *long run cost curve* is the envelope of the short run cost curves. Specifically:

$$C_{LongRun} = \Phi(q)$$

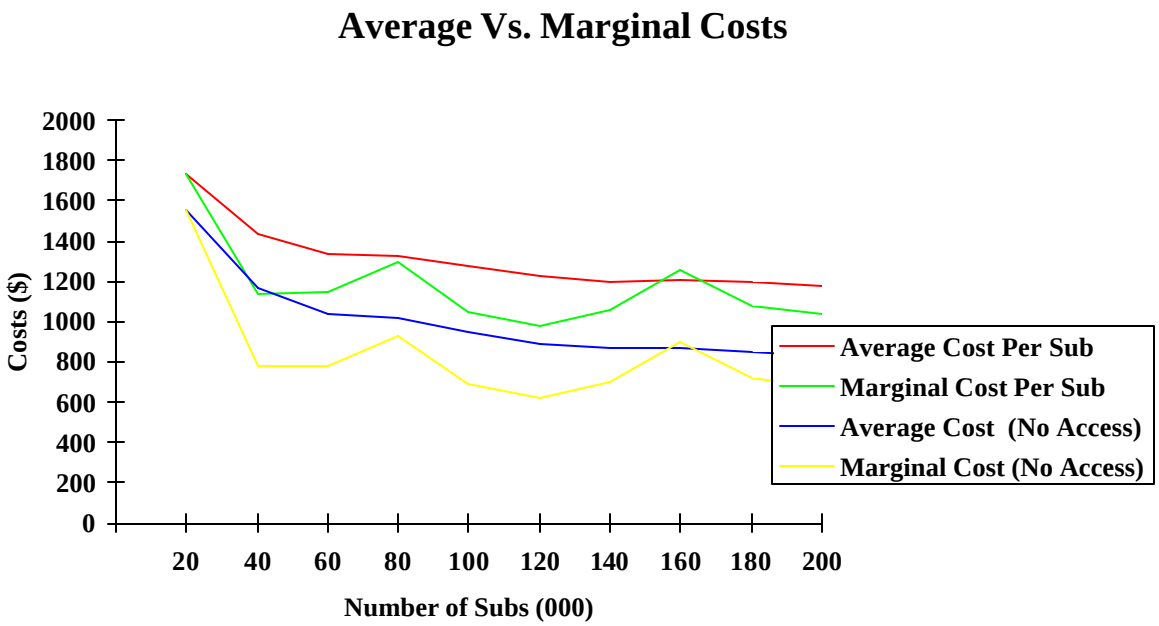
Definition: The *Long Run Average Total Cost* is:

$$AC = \frac{\Phi(q)}{q}$$

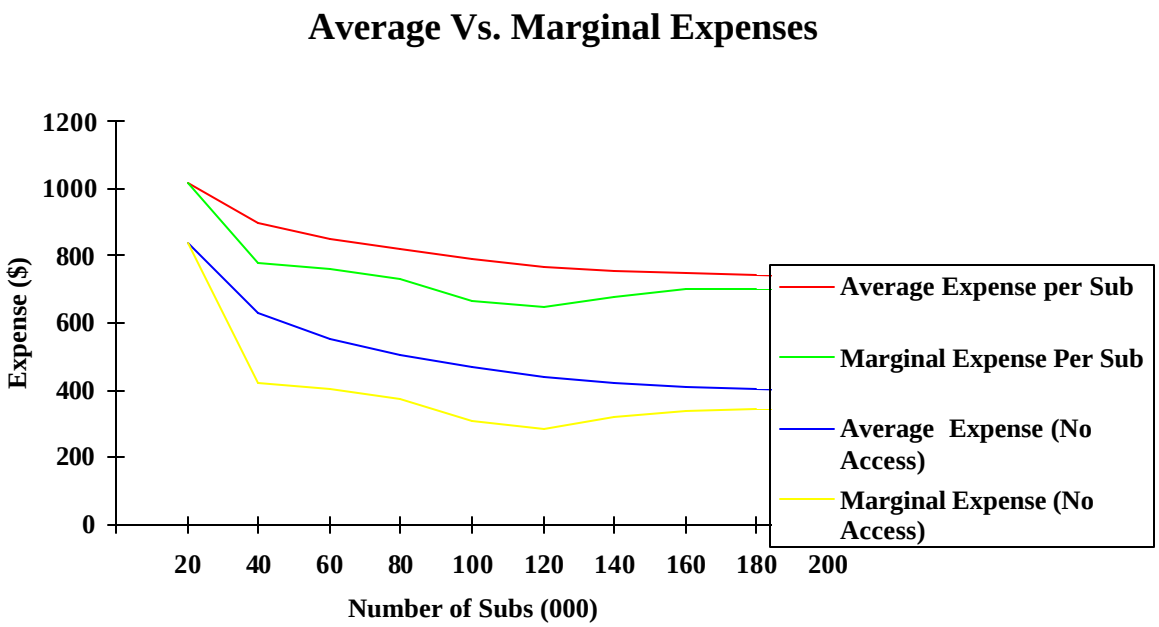
Definition: The *Long Run Marginal Cost* is:

$$MC = \frac{\P \Phi}{\P q}$$

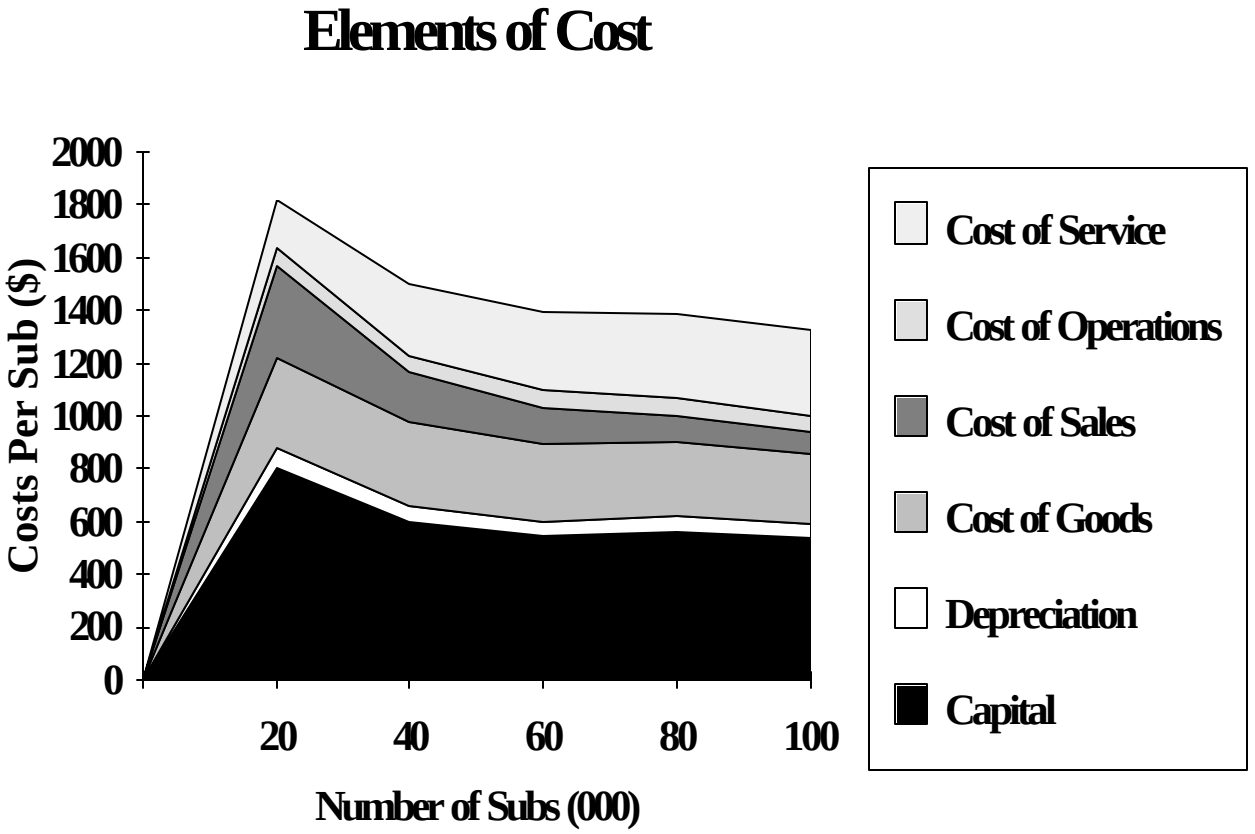
CDMA Costs Per Sub



CDMA Expenses Per Sub

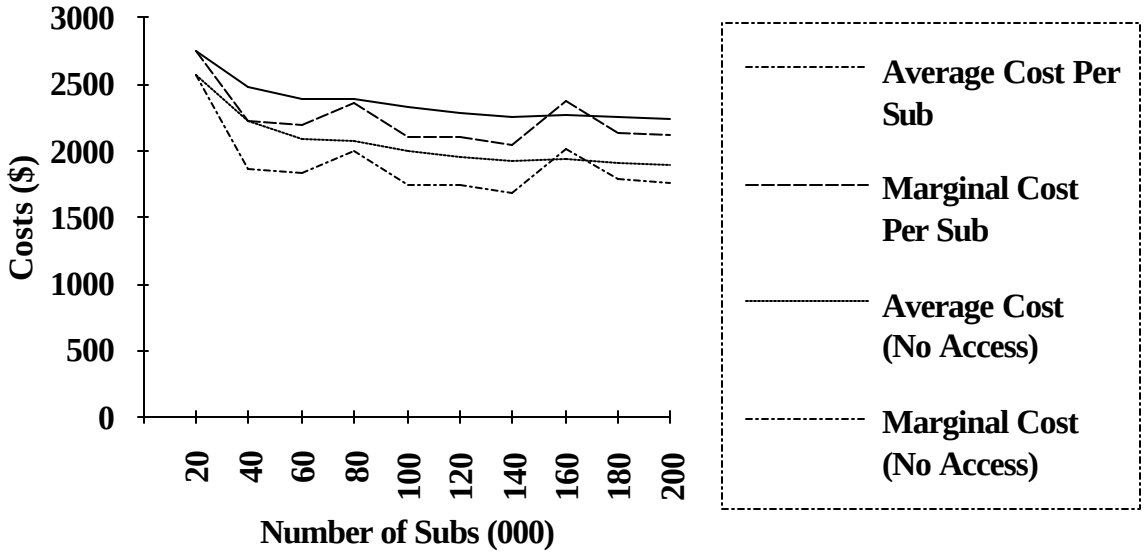


CDMA Cost Breakout

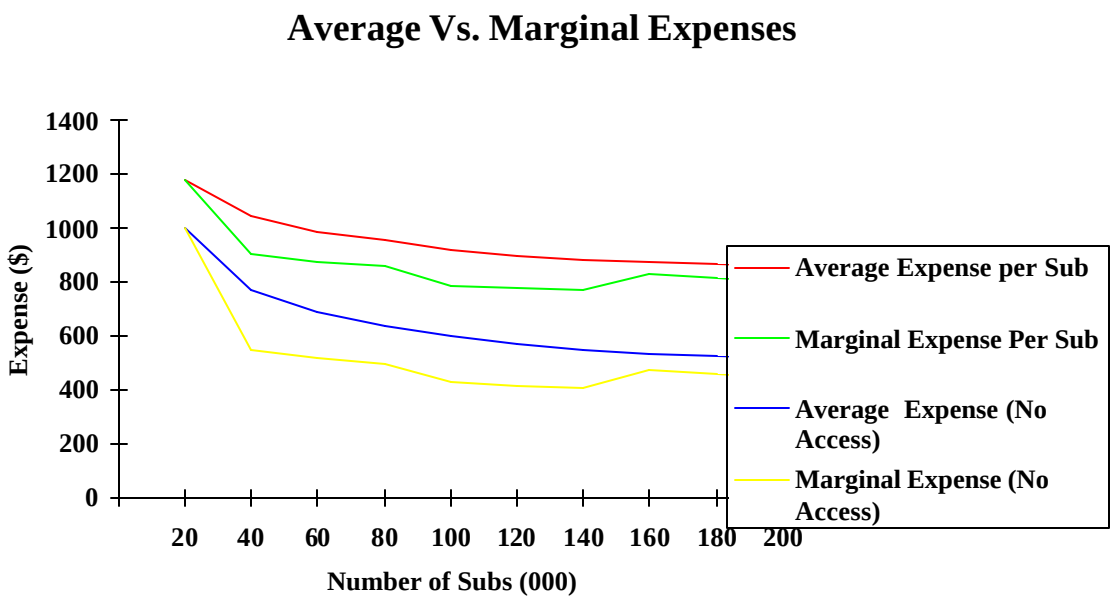


TDMA Cost Structure

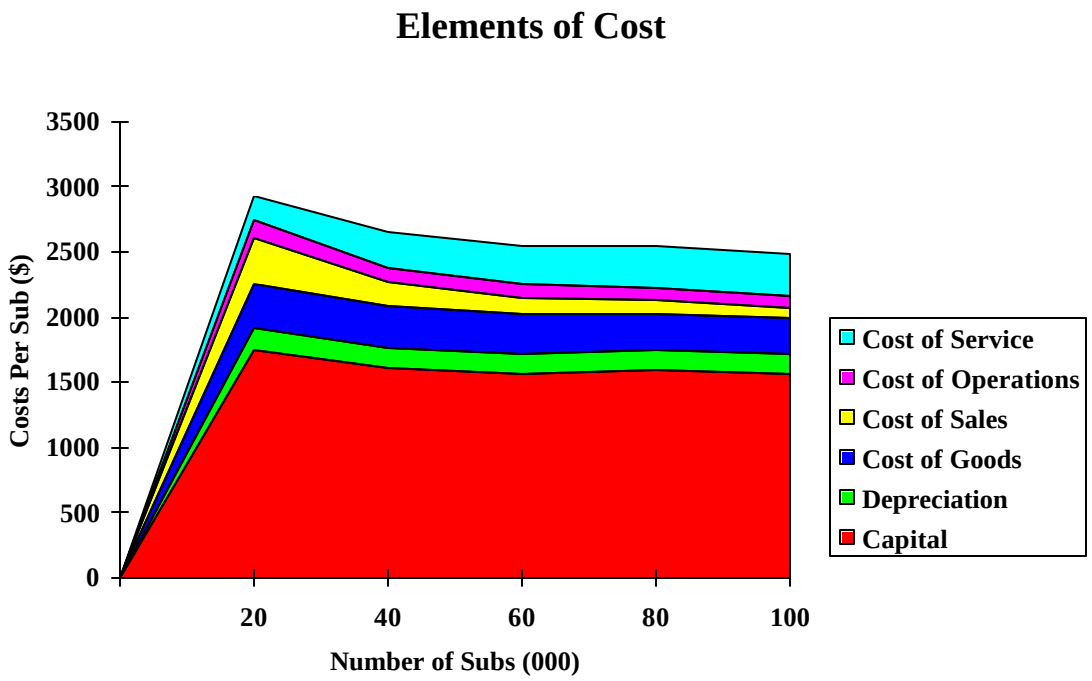
Average Vs. Marginal Costs



TDMA Expense Structure



TDMA Cost Elements



Expenses

Expense/Customer

Year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
No Customers (000)	10	28	55	90	131	177	214	254	310	385
SALES AND SERVICE										
Sales	$33.65	$11.65	$12.08	$7.38	$7.25	$5.62	$3.64	$4.84	$4.49	$5.35
Promotion	$288.07	$100.24	$50.98	$31.13	$21.44	$15.78	$13.11	$11.02	$9.04	$7.28
Customer Service (*)	$24.00	$24.00	$24.00	$24.00	$24.00	$24.00	$24.00	$24.00	$24.00	$24.00
Marketing	$67.20	$22.94	$25.02	$9.17	$9.22	$4.68	$3.05	$2.07	$1.90	$2.26
Billing & Colln (*)	$12.00	$12.00	$12.00	$12.00	$12.00	$12.00	$12.00	$12.00	$12.00	$12.00
Admin	$34.04	$10.32	$9.35	$4.32	$4.11	$2.71	$1.82	$1.93	$1.76	$2.03
OH	$317.05	$123.03	$76.89	$54.11	$45.00	$38.55	$35.29	$33.47	$31.50	$30.11
Total Sales and Service	$776.01	$304.18	$210.32	$142.11	$123.02	$103.35	$92.91	$89.34	$84.69	$83.03
OPERATIONS										
Engineering	$10.32	$7.93	$7.20	$6.96	$3.72	$3.61	$3.48	$3.50	$3.50	$3.41
Ops (*)	$24.00	$24.00	$24.00	$24.00	$24.00	$24.00	$24.00	$24.00	$24.00	$24.00
Install	$53.76	$3.94	$2.00	$2.14	$0.42	$1.40	$1.16	$0.87	$1.33	$1.36
Operator Services (*)	$18.00	$11.74	$12.03	$10.65	$10.66	$10.15	$9.57	$9.96	$9.83	$10.09
IEC Interfaces (*)	$8.40	$5.48	$5.61	$4.97	$4.98	$4.74	$4.47	$4.65	$4.59	$4.71
Inventory Management (*)	$12.00	$7.82	$8.02	$7.10	$7.11	$6.76	$6.38	$6.64	$6.56	$6.73
Admin	$2.15	$1.45	$1.26	$1.16	$0.62	$0.60	$0.58	$0.58	$0.58	$0.57
OH	$67.38	$52.58	$52.31	$49.36	$45.98	$44.87	$43.63	$44.39	$44.16	$44.55
Total Operations	$196.01	$114.95	$112.44	$106.35	$97.49	$96.12	$93.26	$94.57	$94.56	$95.41
TOTAL EXPENSES	$972.02	$419.12	$322.76	$248.46	$220.50	$199.48	$186.17	$183.91	$179.25	$178.44
Carrier	$360.00	$360.00	$360.00	$360.00	$360.00	$360.00	$360.00	$360.00	$360.00	$360.00
TOTAL UNLOADED EXPENSES	$1,332.02	$779.12	$682.76	$608.46	$580.50	$559.48	$546.17	$543.91	$539.25	$538.44
Cost of Goods	$672.00	$183.50	$160.10	$78.26	$62.94	$39.02	$25.42	$34.51	$31.63	$37.63
TOTAL EXPENSES (+COGS)	$2,004.02	$962.62	$842.86	$686.73	$643.44	$598.49	$571.59	$578.42	$570.88	$576.06
Depreciation	$157.41	$64.80	$38.06	$30.36	$21.97	$20.18	$20.09	$18.54	$18.52	$18.11
TOTAL LOADED EXPENSES	$2,161.43	$1,027.42	$880.92	$717.08	$665.41	$618.67	$591.68	$596.96	$589.40	$594.17

Employee Count With Outsourcing

EMPLOYEE SUMMARY

Year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
SALES AND SERVICE										
Sales	8	8	17	17	24	25	19	31	35	51
Promotion	5	5	5	5	5	5	5	5	5	5
Cust Service	0	0	0	0	0	0	0	0	0	0
Marketing	11	11	23	14	20	14	11	9	10	14
Bill&Collns	0	0	0	0	0	0	0	0	0	0
Admin	6	5	9	7	10	9	7	9	10	14
Total Sales&Marketing	30	29	54	42	59	53	42	53	60	85
OPERATIONS										
Engineering	2	4	7	10	8	11	12	15	18	22
O&M	0	0	0	0	0	0	0	0	0	0
Install	17	4	4	6	2	8	8	7	14	17
Operator Services	0	0	0	0	0	0	0	0	0	0
IEC Interfaces	0	0	0	0	0	0	0	0	0	0
Inventory Management	0	0	0	0	0	0	0	0	0	0
Admin	0	1	1	2	2	2	2	3	4	4
Total Operations	20	8	12	19	12	21	23	25	35	44
TOTAL EMPLOYEES	50	37	65	61	70	74	65	79	95	129

Employee Count With Full Operations

EMPLOYEE SUMMARY

Year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
SALES AND SERVICE										
Sales	8	8	17	17	24	25	19	31	35	51
Promotion	5	5	5	5	5	5	5	5	5	5
Cust Service	9	11	18	16	20	24	25	33	39	51
Marketing	11	11	23	14	20	14	11	9	10	14
Bill&Collns	1	2	4	6	9	13	15	18	22	27
Admin	9	8	14	12	16	16	15	19	22	30
Total Sales&Marketing	43	45	81	69	93	96	91	115	133	180
OPERATIONS										
Engineering	2	4	7	10	8	11	12	15	18	22
O&M	48	56	74	89	112	133	146	171	200	246
Install	17	4	4	6	2	8	8	7	14	17
Operator Services	9	15	30	42	62	80	90	111	134	170
IEC Interfaces	4	5	9	12	17	22	24	30	36	45
Inventory Management	7	16	32	50	72	96	115	138	167	208
Admin	16	18	25	31	40	49	54	65	77	96
Total Operations	103	117	180	241	312	399	450	538	645	804
TOTAL EMPLOYEES	146	162	261	310	405	495	540	652	778	984

Income Statement

Year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Revenue	$3,499	$10,056	$19,771	$32,377	$47,025	$63,863	$76,867	$91,442	$111,473	$138,541
COGS	+$6,532	$5,126	$8,792	$7,039	$8,221	$6,922	$5,427	$8,766	$9,794	$14,480
Gross Margin	($3,033)	$4,930	$10,978	$25,338	$38,804	$56,942	$71,440	$82,676	$101,679	$124,061
% Gross Margin	-87%	49%	56%	78%	83%	89%	93%	90%	91%	90%
Expense	$9,448	$11,707	$17,726	$22,346	$28,803	$35,386	$39,751	$46,713	$55,505	$68,669
Net Oper Income	($12,481)	($6,777)	($6,747)	$2,992	$10,000	$21,555	$31,689	$35,963	$46,175	$55,392
Margin %	-357%	-67%	-34%	9%	21%	34%	41%	39%	41%	40%
Depreciation	$1,530	$1,810	$2,090	$2,730	$2,870	$3,580	$4,290	$4,710	$5,735	$6,970
Profit Before Int	($14,011)	($8,587)	($8,837)	$262	$7,130	$17,975	$27,399	$31,253	$40,440	$48,422
Margin %	-400%	-85%	-45%	1%	15%	28%	36%	34%	36%	35%
Interest	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Profit Before Tax	($14,011)	($8,587)	($8,837)	$262	$7,130	$17,975	$27,399	$31,253	$40,440	$48,422
Margin %	-400%	-85%	-45%	1%	15%	28%	36%	34%	36%	35%
Taxes	$0	$0	$0	$0	$0	$0	$8,533	$12,501	$16,176	$19,369
Dividends	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Profit After Tax	($14,011)	($8,587)	($8,837)	$262	$7,130	$17,975	$18,867	$18,752	$24,264	$29,053
Margin %	-400%	-85%	-45%	1%	15%	28%	25%	21%	22%	21%

Case 1: CDMA, Buy, No Access

Cash Flow

Year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
NOI	($12,481)	($6,777)	($6,747)	$2,992	$10,000	$21,555	$31,689	$35,963	$46,175	$55,392
Interest	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Taxes	$0	$0	$0	$0	$0	$0	$8,533	$12,501	$16,176	$19,369
Dividends	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Capital	$15,300	$2,800	$2,800	$6,400	$1,400	$7,100	$7,100	$4,200	$10,250	$12,350
LTD Reduction	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Chg WC	$371	$292	$712	($395)	$518	($373)	($1,882)	$47	($673)	$302
Cash Flow(Less LTD Red)	($28,151)	($9,870)	($10,260)	($3,013)	$8,083	$14,828	$17,939	$19,215	$20,422	$23,372
Cum CF	($28,151)	($38,021)	($48,281)	($51,293)	($43,211)	($28,383)	($10,444)	$8,771	$29,192	$52,564
CF Auction	($68,151)	($9,870)	($10,260)	($3,013)	$8,083	$14,828	$17,939	$19,215	$20,422	$23,372

NPV	($5,374)	($36,392) @ COM of above	$779,052
Residual	$779,052		$779,052
NPV(18%)	($9,905)		
IRR	12%		
NPV Auction	($38,643)		
IRR Auction	2%		

Case 2: CDMA, Build, No Access

Cash Flow

Year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
NOI	($17,165)	($11,670)	($13,068)	($2,942)	$3,285	$14,549	$24,995	$27,827	$37,117	$44,102
Interest	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Taxes	$0	$0	$0	$0	$0	$0	$0	$0	$4,048	$12,683
Dividends	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Capital	$24,640	$4,613	$4,766	$17,322	$3,377	$9,113	$18,007	$6,224	$12,320	$23,565
LTD Reduction	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Chg WC	($206)	$593	$647	($747)	$853	($386)	($528)	$1,146	($787)	($1,254)
Cash Flow(Less LTD Red)	($41,599)	($16,876)	($18,481)	($19,517)	($945)	$5,823	$7,517	$20,457	$21,536	$9,109
Cum CF	($41,599)	($58,475)	($76,956)	($96,473)	($97,418)	($91,596)	($84,079)	($63,622)	($42,086)	($32,978)
CF Auction	($81,599)	($16,876)	($18,481)	($19,517)	($945)	$5,823	$7,517	$20,457	$21,536	$9,109

NPV	($52,310)	($72,714) @ COM of above	$303,626
Residual	$303,626		$303,626
NPV(18%)	($52,547)		
IRR	-7%		
NPV Auction	($87,177)		
IRR Auction	#NUM!		

Case 3: CDMA, Buy, Access $0.05

CashFlow

Year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
NOI	($15,980)	($16,833)	($26,518)	($29,384)	($37,025)	($42,308)	($45,178)	($55,479)	($65,298)	($83,149)
Interest	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Taxes	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Dividends	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Capital	$15,300	$2,800	$2,800	$6,400	$1,400	$7,100	$7,100	$4,200	$10,250	$12,350
LTD Reduction	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Chg WC	$227	$23	$313	($913)	($84)	($1,065)	($710)	$241	($761)	($172)
Cash Flow(Less LTD Red)	($31,507)	($19,656)	($29,631)	($34,871)	($38,340)	($48,344)	($51,568)	($59,921)	($74,787)	($95,326)
Cum CF	($31,507)	($51,163)	($80,794)	($115,665)	($154,006)	($202,349)	($253,917)	($313,838)	($388,625)	($483,952)
CF Auction	($71,507)	($19,656)	($29,631)	($34,871)	($38,340)	($48,344)	($51,568)	($59,921)	($74,787)	($95,326)

NPV	($205,440)	($100,743) @ COM of above	($3,177,550)
Residual	($3,177,550)		($3,177,550)
NPV(18%)	($178,709)		
IRR	#DIV/0!		
NPV Auction	($250,760)		
IRR Auction	#NUM!		

Case 4: TDMA, Buy, No Access

Cash Flow

Year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
NOI	($13,031)	($7,091)	($7,647)	$1,648	$8,007	$19,313	$30,009	$33,466	$43,412	$51,765
Interest	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Taxes	$0	$0	$0	$0	$0	$0	$0	$0	$8,537	$11,100
Dividends	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Capital	$26,500	$7,000	$13,650	$20,750	$22,050	$27,050	$17,600	$25,200	$31,250	$49,100
LTD Reduction	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Chg WC	($112)	$590	$415	($557)	$232	($354)	$236	$375	($1,656)	($255)
Cash Flow(Less LTD Red)	($39,419)	($14,680)	($21,712)	($18,545)	($14,275)	($7,383)	$12,173	$7,891	$5,282	($8,180)
Cum CF	($39,419)	($54,099)	($75,811)	($94,356)	($108,632)	($116,015)	($103,842)	($95,951)	($90,669)	($98,849)
CF Auction	($79,419)	($14,680)	($21,712)	($18,545)	($14,275)	($7,383)	$12,173	$7,891	$5,282	($8,180)

NPV	($73,911)	($77,354) @ COM of above	($272,667)
Residual	($272,667)		($272,667)
NPV(18%)	($70,155)		
IRR	#NUM!		
NPV Auction	($110,326)		
IRR Auction	#NUM!		

REGULATORY AND POLICY FACTORS

COMMODITIZATION OF PCS

- **TOLL GRADE QUALITY SERVICE ESTABLISHES A BASIC SERVICE PARADIGM.**
- **SERVICE, IF COMMODICIZED, IS THEN PROVIDED ON THE BASIS OF PRICE.**
- **PRICE IS DRIVEN BY INNOVATION AND COMPETITIVENESS.**
- **SPECTRUM IS FUNGIBLE AND COMPETITION IS GENERATED BY THE MOST NUMBER OF QUALIFIED ENTRANTS IN THE BANDWIDTH AVAILABLE.**
- **RBOCs HAVE ALMOST 70% OF THE EXISTING CELLULAR SPECTRUM, AND HAVE CONTROL OVER THE LOCAL LOOP THROUGH ACCESS FEES.**

WHY IS PCS DIFFERENT?

- **CAPITAL PER SUBSCRIBER IN WIRELINE = $1,800**
- **CAPITAL PER SUBSCRIBER IN CELLULAR = $800**
- **CAPITAL PER SUBSCRIBER IN PCS = $200**

WHAT ARE THE SUCCESS FACTORS FOR PCS?

- **OPERATIONAL IN 1994**
- **CAPITAL PER SUBSCRIBER LESS THAN $100**
- **COST PER PORTABLE LESS THAN $300**
- **COST PER NEW CUSTOMER LESS THAN $300**
- **ACCESS FEE PER MINUTE LESS THAN $0.03**

WHAT IS THE CURRENT ENVIRONMENT?

- RBOC DOMINATED SPECTRUM CONTROL
- LEC ACCESS BOTTLENECK VIA ACCESS FEES
- NEW TECHNOLOGY ALLOWING PARADIGM SHIFT
- COMMODITIZATION OF LOCAL SERVICE
- COMPETITION IN LOCAL EXCHANGE
- INTELLIGENCE IN NETWORK FOR NATIONAL BACKBONE
- AGGLOMERATION OF COMPETITORS FOR NATIONAL NETWORK (NPC, MCI)

WHAT ARE THE POLICY GOALS?

SERVICE GOAL:

SEAMLESS INTEROPERABLE NATIONAL NETWORK

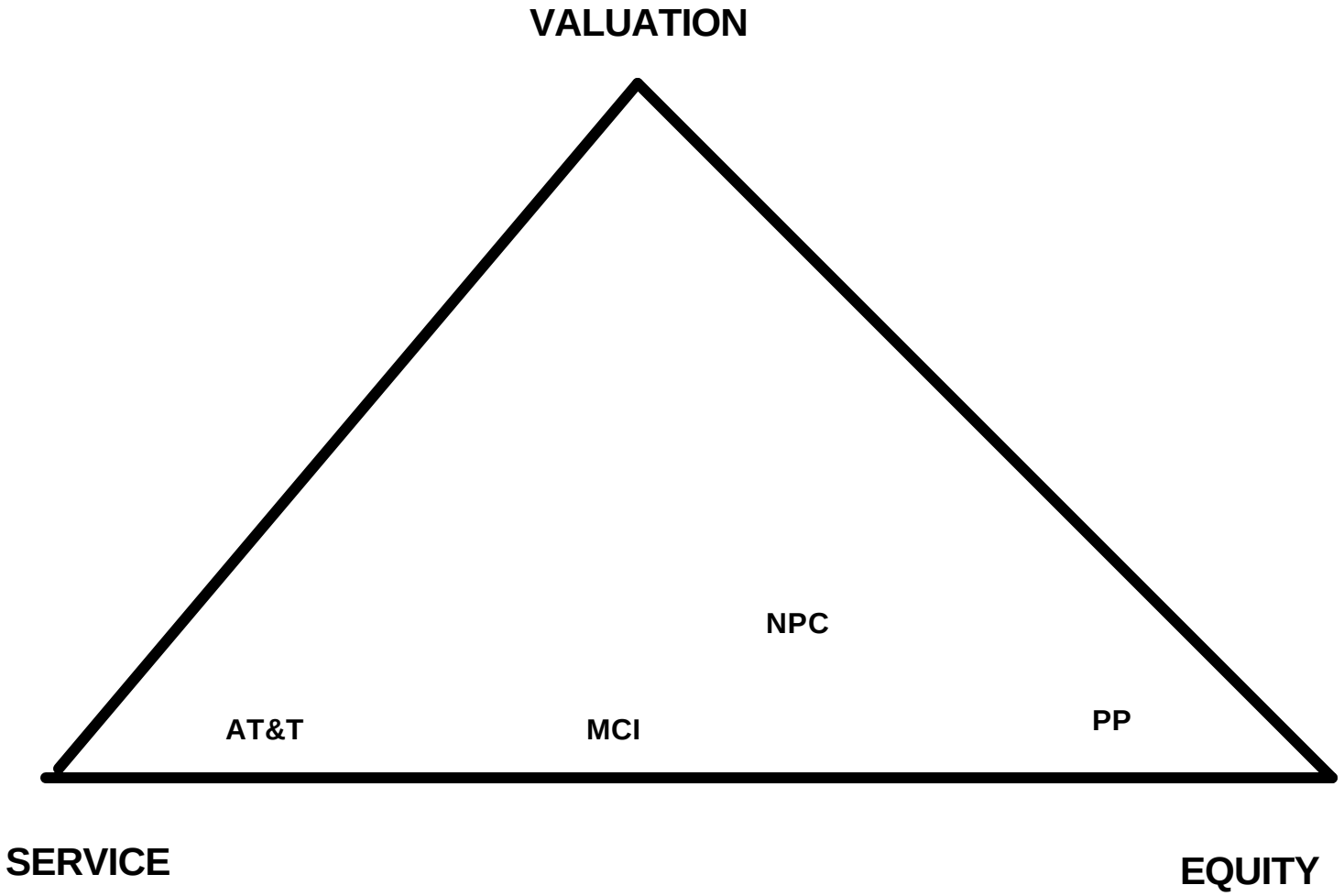
VALUATION GOAL:

COMPENSATION FOR VALUE OF SPECTRUM

EQUITY GOAL:

PREFERENCE FOR INNOVATION AND COMMITMENT

POLICY GOAL CONVERGENCES AND DIVERGENCES



VALUATION OF FREQUENCY

THE VALUE OF A PCS PROPERTY IS:

$$V_{PCS}\ (N) = \sum_{n=0}^{N} \frac{R(n) - E(n) - C(n) - T(n) - A(n)}{(1 + m)^n}$$

AND IT IS COMPARED TO AN LEC:

$$V_{LEC}(N) = \sum_{n=0}^{N} \frac{R(n) - E(n) - C(n)}{(1+m_{LEC})^n} + MR_{LEC} \quad >>$$

$$V_{PCS}(N) = \sum_{n=0}^{N} \frac{R(n) - E(n) - C(n) - T(n) - A(n)}{(1+m_{PCS})^n}$$

LEC ADVANTAGES

- **ACCESS FEES: THE LECs DO NOT HAVE A RECIPROCAL ACCESS FEE STRUCTURE.**

- **COST OF CAPITAL: THE LECs HAVE LOWER COST OF MONEY DUE TO THEIR CURRENT SIZE, PRESENCE AND BORROWING POWER.**

- **MONOPOLY RENTS: THE LECS HAVE EXISTING MONOPOLY RENTS THAT ACCRUE TO THE LEC BUSINESS.**

- **AUCTION TAX: THE LECs ALREADY HAVE B SIDE AND A SIDE CELLULAR SPECTRUM AT 800 MHz AND THUS HAVE LOWER AVERAGE COSTS OF SPECTRUM.**

SCALE AND SCOPE IN PCS

SCALE:

THERE ARE ESSENTIALLY NO SCALE ECONOMIES IN PCS IF NEW TECHNOLOGY IS DEPLOYED. CDMA DEMONSTRATES SIGNIFICANT REDUCTIONS IN SCALE AND DIRECT CLASS 5 EMULATION REDUCES CLASS 5 NEEDS.

SCOPE:

SCOPE EXISTS IF AND ONLY IF THERE ARE NON-DISAGRATEABLE ELEMENTS. OUTSOURCING AND USE OF DISTRIBUTED DATA BASES REDUCES SCOPE. SCOPE EXISTS FOR LEC AS A BOTTLENECK ONLY IN TERMS OF LOCAL SWITCH ACCESS.

POLICY IMPLICATIONS

SERVICE GOAL:

A NATIONAL NETWORK ENTITY IS NECESSARY, WHETHER THAT BE A CONSORTIUM, SUCH AS PROPOSED BY NPC OR MCI, OR A SINGLE CARRIER AWARD. COMPETITION IS REQUIRED TO ATTAIN THE CONSUMER BENEFIT OF LOWER PRICES.

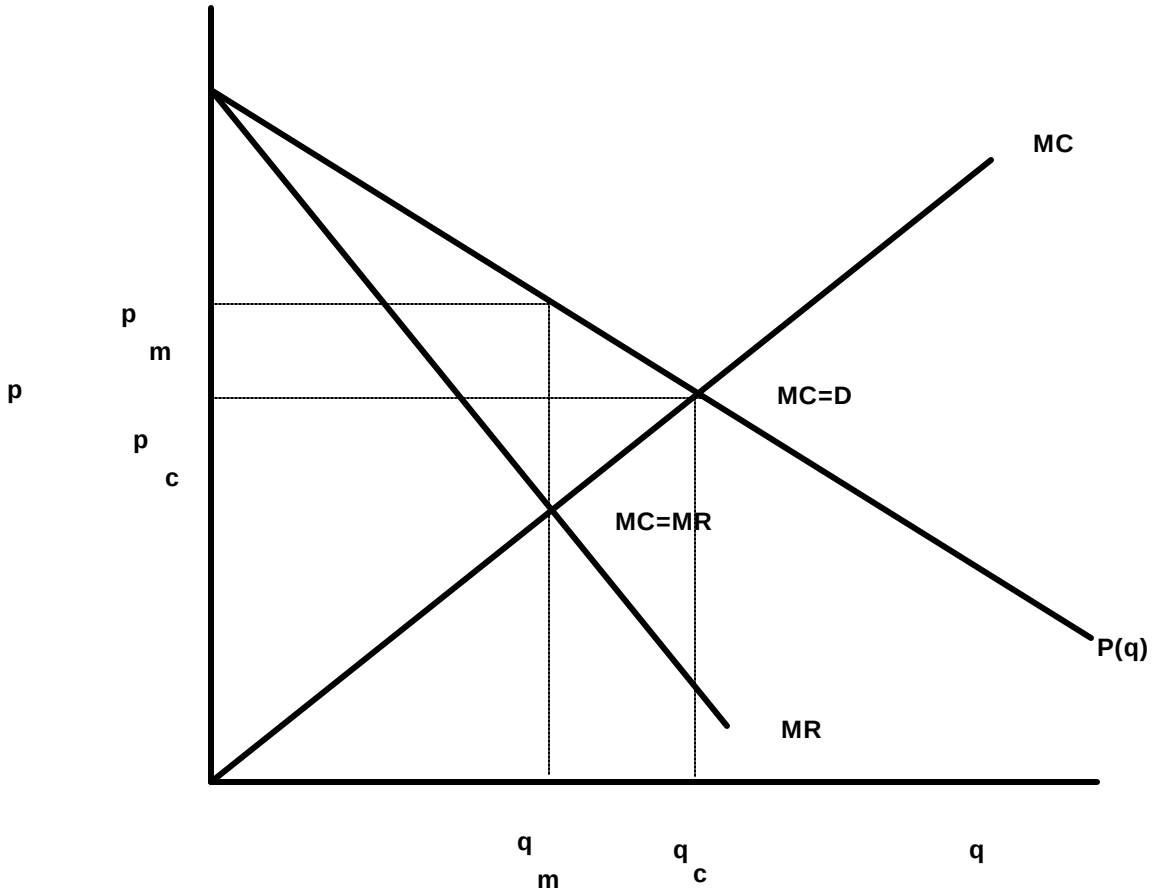
VALUATION GOAL:

PRINCIPLE IS PAYMENT FOR VALUED ASSET. OPTIONS ARE AUCTIONS, OPERATING FEES, ROYALTIES.

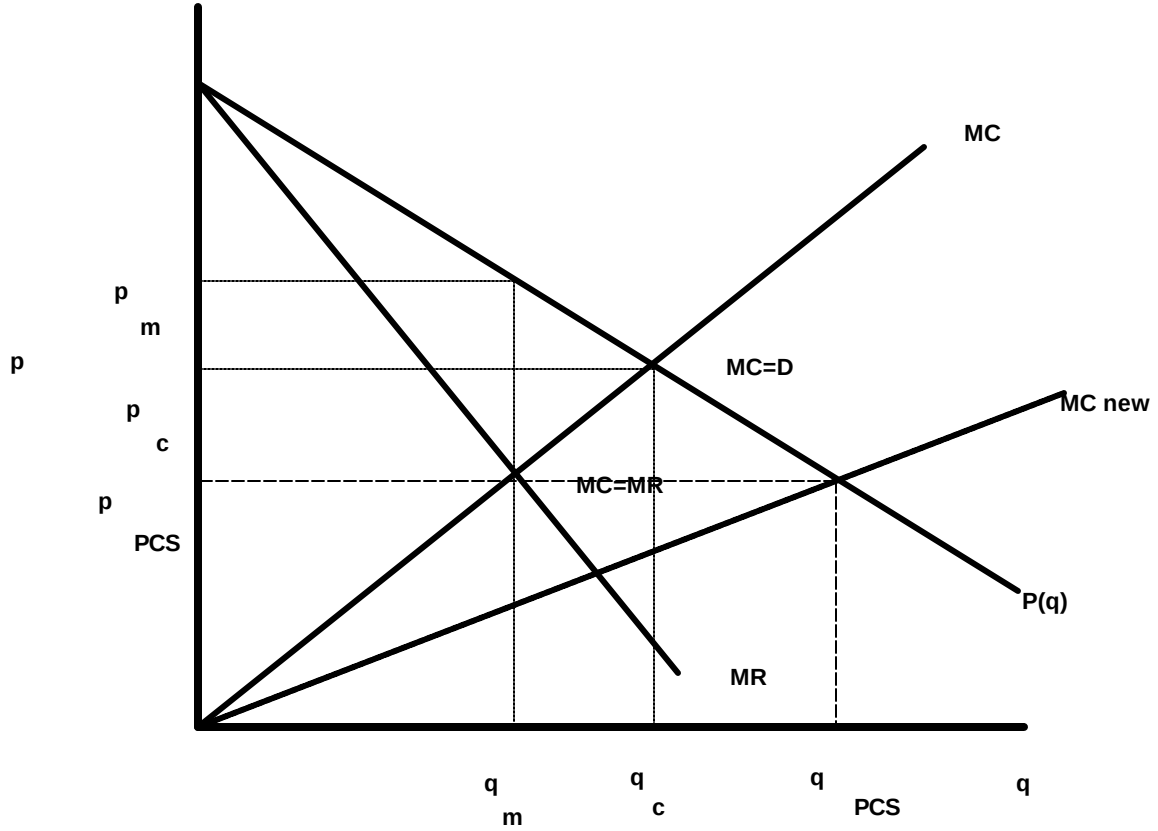
EQUITY GOAL:

INTENT IS TO AVOID SPECULATION, INTRODUCE COMPETITION AND REWARD INNOVATION AND PRIOR COMMITMENT.

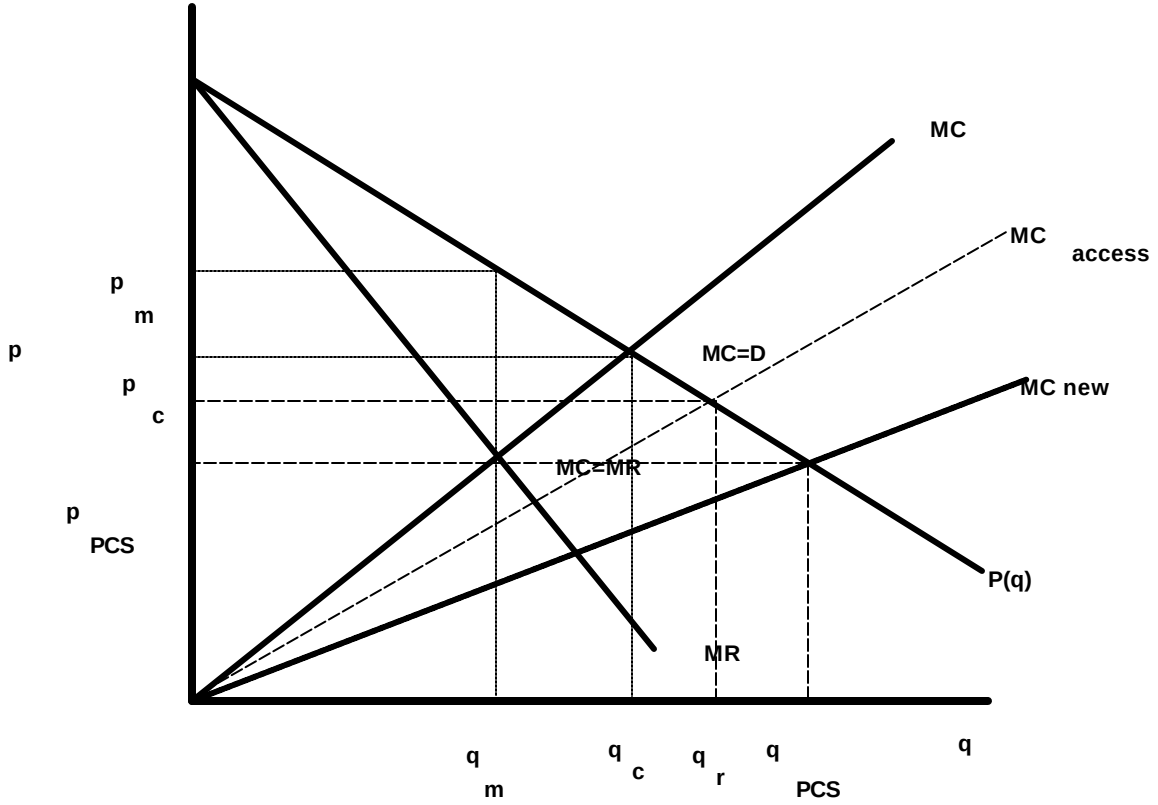
MONOPOLY VERSUS COMPETITIVE PRICING



COMPETITOR WITH NEW TECHNOLOGY



COMPETITION WITH A BOTTLENECK



POLICY OPTIONS

SERVICE: THERE IS NO ALTERNATIVE, POST THE MFJ, OTHER THAN A CONSORTIUM GROUPING TO ENSURE SEAMLESS INTEROPERABILITY IN A NATIONAL NETWORK. FAILURE WILL LEAD TO BALKANIZATION.

VALUATION: THE CURRENT RISK LEVEL WILL CAUSE, IN A FREE, EQUITABLE, AND OPEN BID, THE REDUCTION IN RETURNS TO THE GOVERNMENT IN NET PRESENT VALUE TERMS. AMORTIZED PAYOUTS BASED ON REVENUES WILL MAXIMIZE THE RETURN.

EQUITY: QUALIFICATION OF BIDDERS IS ESSENTIAL FOR THE PURPOSE OF COMMITMENT AND COMPETITION. EQUITABLE BIDDING DEMANDS COMPARABLE CLASSES. RECOGNITION FOR PRIOR CONTRIBUTION BASED UPON CLASS GROUPINGS ENSURES GROUP EQUITY.

POLICY RECOMMENDATIONS

ALL BIDDERS SHOULD BE GROUPED IN CONSORTIA COMMITTED TO A NATIONAL NETWORK THAT IS SEAMLESS AND INTEROPERABLE. NO BIDDING ON LOCAL SEGMENTS SHOULD BE ALLOWED.

VALUATION SHOULD BE SEGMENTABLE TO PoPs AND PAYMENT OF THE AUCTION PRICE SHOULD BE AMORTIZED OVER A FIXED PERIOD OF TIME.

RECOGNIZED BIDDERS SHOULD MEET CERTAIN CRITERIA WITH THOSE DEMONSTRATING PRIOR INNOVATION AND CONTRIBUTION GUARANTEED PREFERENTIAL CLASS STATUS, WITHOUT THE PRESENCE OF MARKET DOMINATORS, SUCH AS THE RBOCs

CONCLUSIONS

POLICY GOALS CAN BE ACHIEVED BY LEGISLATIVE DIRECTION.

COMPETITION WILL ENHANCE THE EXPANSION OF LOCAL TELECOMMUNICATIONS.

RISK IS STILL HIGH AND UP FRONT AUCTIONS MAY REFLECT HIGHLY DISCOUNTED VALUES.

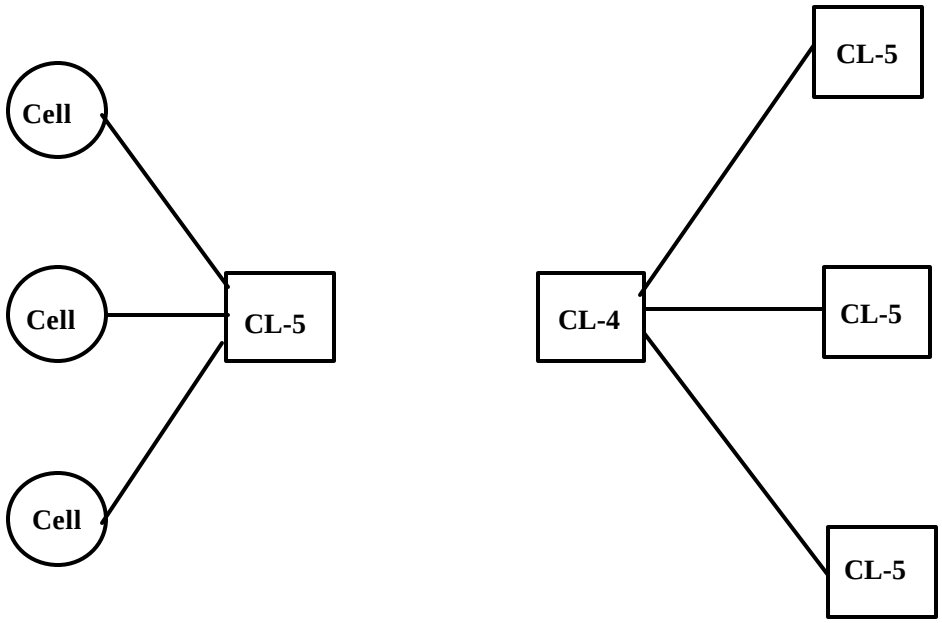
TIMING IS CRITICAL, DELAY WILL COST MONEY, JOBS, COMPETITIVE INNOVATION AND LOST U.S. TECHNOLOGY COMPETITIVENESS.

CONSORTIA ARE THE NATURAL WAY TO ENSURE GOALS.

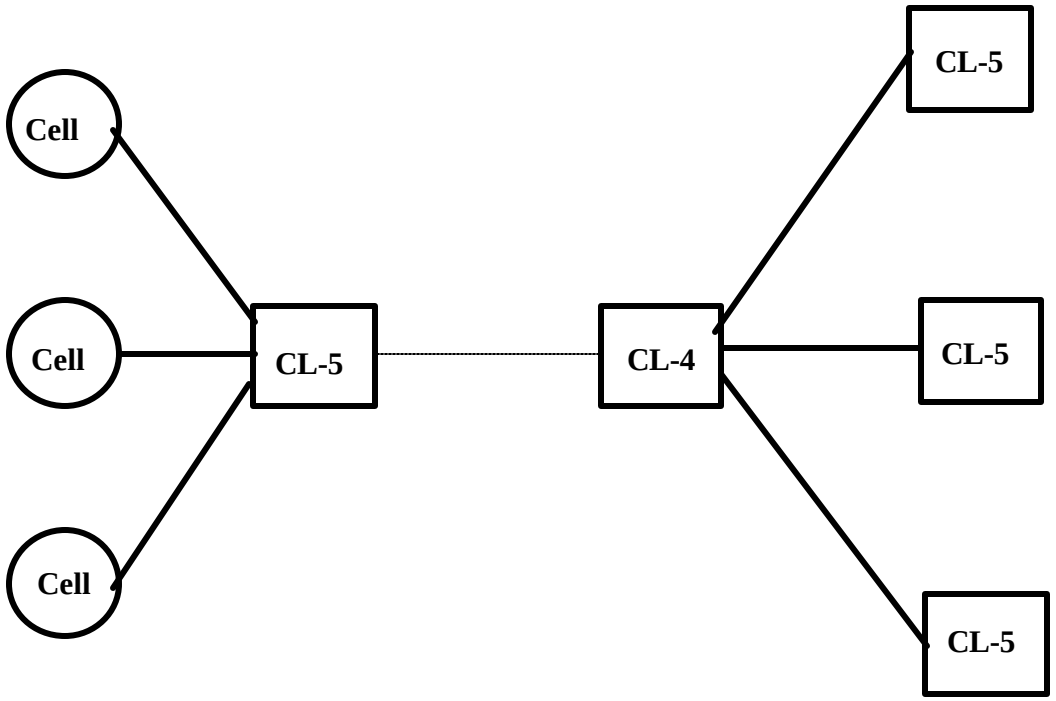
ACCESS POLICY ISSUES

- **COMPARABLY EQUIVALENT OPEN ACCESS**
- **BALANCED ACCESS FEES**
- **UNIVERSAL SERVICE**
- **OPEN COMPETITION**

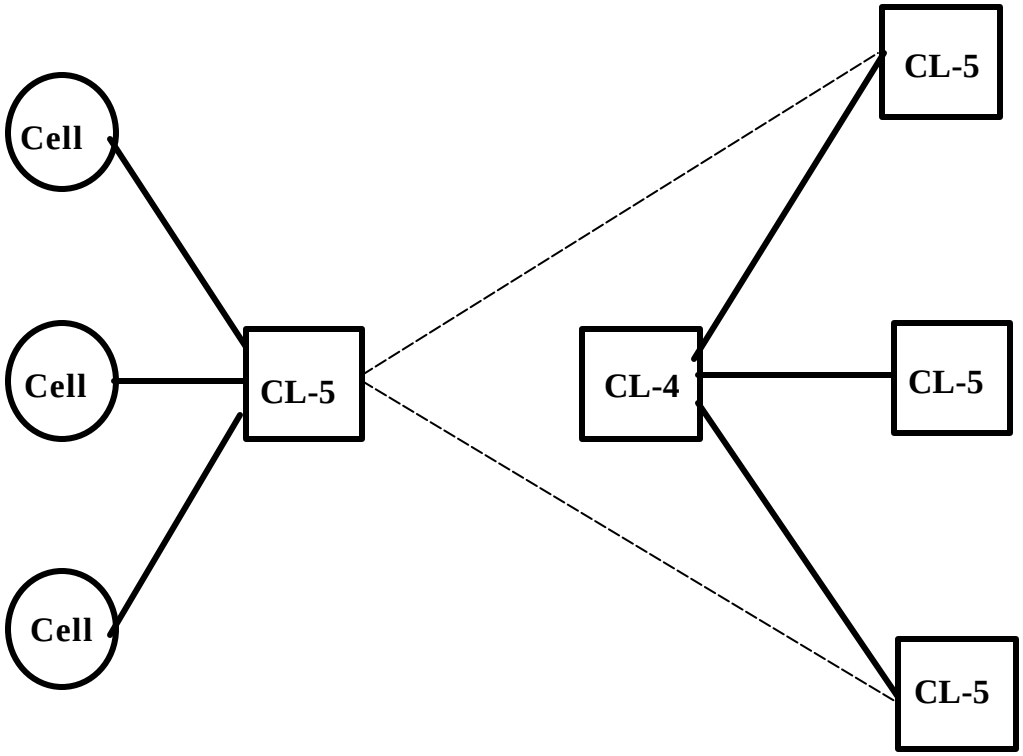
Distributed Access Modes; Toll Tandem Interface



Class 5 to Class 5 interconnect



CLASS 5 TO CLASS 4 INTERCONNECT



Local Access: Type 1 and Type 2 Connections

General	Specific	One Time	Fixed	Variable (per unit)[3]
Trunk Group		$371.95		
	Multifrequency Outpulsing		$78.82	
	Dial Pulsing		$118.33	
Trunk Interconnect		$371.95	$83.06	
Trunks		$36.24/trunk		
Overflow Option		$36.24		
IntraLATA				
	1-8 Miles			$0.0291
	16-25 Miles			$0.0322
	50-100 Miles			$0.051

[3]The variable rates are in per minute or per mile, unless otherwise specified.

TARIFFS

Type 1

Present		Proposed	
Contract	**Charges**	**Tariff**	**Charges**
Type 1 Digital Facility	$1,163[4]	Flexpath	$941

Type 2A

Present		Proposed	
Contract	**Charges**	**Tariff**	**Charges**
Land to Mobile Originating	NA	Originating Switch Access Eastern LATA Western LATA	Reference[5] $0.020947 $0.005328
Mobile to Land Terminating Per Minute ARPM	$0.07985	Terminating SW Access Eastern LATA Western LATA	Reference $0.035773 $0.033974

[4]Average Monthly Charge per Digital Facility

[5]ARPMS are weighted for time of day.

Type 3A

Present		Proposed	
Contract	**Charges**	**Tariff**	**Charges**
Eastern LATA		Originating	Reference
Per Minute	$0.020000	SW Access	
Per Message	$0.060000		
		Eastern LATA	$0.020947
Western LATA		Per Minute	
Per Minute	$0.020000		
Per Message	$0.060000	Western LATA	$0.005328
		Per Minute	

Type 3B

Present		Proposed	
Contract	**Charges**	**Tariff**	**Charges**
100 Number Group	$13.00	100 Number Group	$1.00
Per Trunk Equipped	$9.00	DID Trunk	$31.52
Trunk	$49.00	Business Exchange Line	$13.00
Total	$71.00	Total	$45.52

CO-CARRIER IMPLICATIONS

$$R = R_{IEC} + T_{IEC,LEC} R_{LEC}$$

$$R_{LEC,1} = A_{LEC,1} C_{LEC,1} + T_{LEC\,1,LEC\,2} C_{LEC,2}$$

and ;

$$R_{LEC,2} = A_{LEC,2} C_{LEC,2} + T_{LEC\,2,LEC\,1} C_{LEC,1}$$

CO-CARRIER IMPLICATIONS

$$R_{LEC,1} = AC_{LEC,1} + TC_{LEC,2}$$

and ;

$$R_{LEC,2} = AC_{LEC,2} + TC_{LEC,1}$$

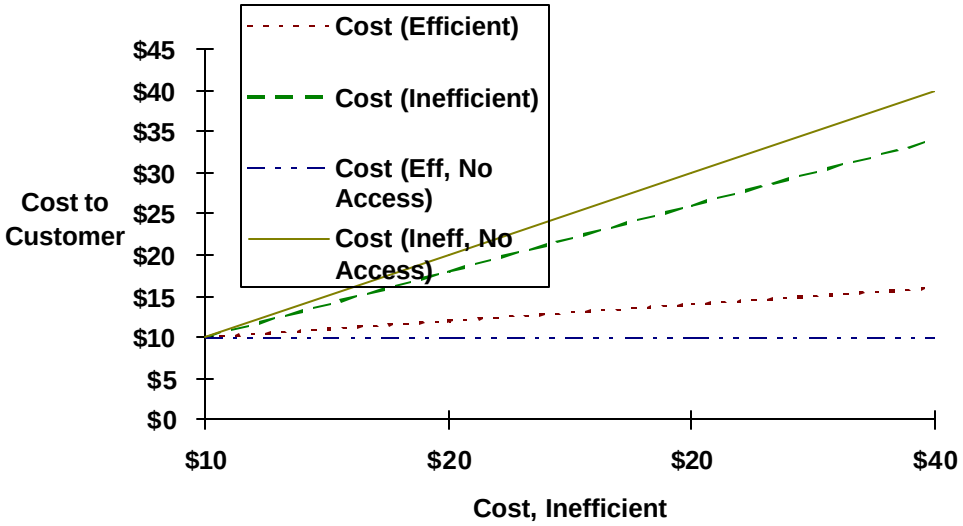
yielding ;

$$R_{LEC\ 1} = \frac{A}{T} R_{LEC\ 2} + T\left(1 - \frac{A^2}{T^2}\right) C_{LEC\ 2}$$

where ;

$$1 \leq \frac{A}{T}$$

CO-CARRIER IMPLICATIONS



COMPETITION

COMPETITORS

COMPETITOR	STRATEGY
MCI	OWN AND CONTROL NATIONAL SERVICE ENTITY. USE THE NATIONAL SERVICE ENTITY AS A MEANS TO BUY OUT LOCAL OPERATORS.
AT&T	VERTICALLY INTEGRATE THEIR OPERATIONS. SET THEM UP ON A CLOSED BASIS AND NOT RESELL.
RBOC	USE SERVICE ENTITY CAPABILITIES TO PROTECT LOCAL ACCESS BASE. SELL SERVICE IS APPROPRIATE.

WHO ARE THE COMPETITORS? (CONTD.)

COMPETITOR	STRATEGY
TELEPORT	DO NOT YET RECOGNIZE SERVICE ENTITY FUNCTIONS. SETTING UP TRANSPORT FRANCHISE ONLY.
CELLULAR ONE	NATIONAL BRAND FRANCHISE. NO INFRASTRUCTURE.
MOBILELINK	SAME AS CELLULAR ONE
MFS	NO STRATEGY EVIDENT
TIME WARNER (HYPERION)	STRATEGY TO BUILD ON US WEST BASE
EDS	POSITION TO SELL SERVICES AS UN INTERESTED THIRD PARTY. GM MAY HAVE STRATEGIC INTEREST.

STRATEGIC COMPETITIVE ADVANTAGES

AREA	ADVANTAGE
MARKETING AND SALES	CUSTOMER BELONGS TO LOCAL OPERATOR NATIONAL "BRAND" LOWEST COST ALLOWS LOWEST PRICE NATIONAL IMAGE SERVICE ORIENTATION
TECHNICAL AND OPERATIONAL	OPEN ACCESS PHILOSOPHY TURNKEY SYSTEM FOR LOWEST COST LEVERAGE ON A COMMON STANDARD PARTICIPATIVE DECISION MAKING GURANTEED TELECOM SERVICE STANDARDS

STRATEGIC POSITIONING AND ROLES

ROLE	PLAYER		ROLE	PLAYER
SOFTWARE	LOTUS, BORLAND MICROSOFT		SERVICES	MICROSOFT
OPERATING SYSTEM	MICROSOFT		NSI	NPC, INC. AT&T MCI
PC	IBM COMPAQ DELL ACER		LOCAL OPERATOR	MCI TIME WARNER ETC.
DISK DRIVES	SEAGATE ETC.		LSI	MOTOROLA QUALCOMM NORTHERN TELCOM
CPU	INTEL		PORTABLES	OKI PANASONIC MOTOROLA ETC

Competitors and Strategies

COMPETITOR	STRATEGY
MCI	OWN AND CONTROL NATIONAL SERVICE ENTITY. USE THE NATIONAL SERVICE ENTITY AS A MEANS TO BUY OUT LOCAL OPERATORS.
AT&T	VERTICALLY INTEGRATE THEIR OPERATIONS. SET THEM UP ON A CLOSED BASIS AND NOT RESELL.
RBOC	USE NATIONAL SERVICE ENTITY CAPABILITIES TO PROTECT LOCAL ACCESS BASE. SELL SERVICE IS APPROPRIATE.
TELEPORT	RECOGNIZES NATIONAL SERVICE ENTITY FUNCTIONS FOR LIMITED AREAS. SETTING UP TRANSPORT FRANCHISE ONLY.
CELLULAR ONE	NATIONAL BRAND FRANCHISE. NO INFRASTRUCTURE.
MOBILELINK	SAME AS CELLULAR ONE
MFS	NO STRATEGY EVIDENT
ADELPHIA (HYPERION)	STRATEGY TO BUILD ON CATV
EDS	POSITION TO SELL SERVICES AS UN INTERESTED THIRD PARTY. GM MAY HAVE STRATEGIC INTEREST.

PCS Entrants

Player	Strategy	Implication
MCI	National License, single dominate control via its National Service Entity, and single network infrastructure. Maximize the number of participants.	The establishment of an significant AT&T and RBOC competitor in the short term.
AT&T	Single player, no other players, dominant control and full vertical integrate	Reinstitute the Bell System.
RBOCs	Protection of existing assets, Bellcore fronting, dominate the process through fragmentation of spectrum, namely 5 license at 20 MHz of occupied spectrum. Maximize the barrier to entry to any and all competitors.	Minimize competition via market and political strength. Obfuscate the obvious by reducing the value of PCS through fragmentation. Establish a maintenance policy access.
NPC, Inc.	"States Rights" approach of having the power at the operator level. The National Service Entity serves the operators, not the other way around. Democratic structure of a National Service Entity on a contractual basis.	Maximizes opportunity to play in the market. Establishes a seamless interoperable nation network in the INTERNET paradigm.
Time Warner	Single dominant player, building from its base and extending into other markets by buyout.	Build from leading edge cable base. Establish a cable versus Telco compromise by US West buying to Time Warner.
TCI/ Bell Atlantic	Strong alliances with major competitors. Build off of key financial strengths and linkages through relationships. Be flexible without stating a specific strategy.	Co-opt the Markets with Bell Atlantic with TCI acting as a front.

Critical Success Criteria

MARKETING & SALES

(1) Provide a price competitive and complete offering.
(2) Have an established "Brand Recognition" to assure an effective entry in the consumer Segment of the market.
(3) Have cost effective and geographically complete distribution channels for the set and the service.
(4) Have a sustainable market presences in terms of local recognition, access to local services and support, as well as access to local real estate for transmission locations and local regulatory support.
(5) Have adequate financial strength to achieve adequate short term penetration.

TECHNICAL & OPERATIONS

(1) Have extensive operational experience in building and managing a national system.
(2) Have unique Intellectual Property Rights (IPR) that allows for a unique competitive advantage in reducing national infrastructure support services costs for the operational expenses as well as capital requirements.
(3) Have an open access system to assure the easy addition of new services.
(4) Have a developed and experienced Telco interface and management systems infrastructure.
(5) Provide a cost effective, integrated, and efficient billing and support systems.

Competitive Positioning

Factor	AT&T	MCI	NPC, Inc.	RBOCs	TCI/ Teleport	Time Warner
Marketing & Sales						
Complete Offering	5	4	4	3	3	3
"Brand Recognition"	5	4	3	3	2	3
Geographical Coverage	5	4	4	2	2	2
Local Market Presence	5	3	4	4	2	1
Financial Resources	5	4	3	5	3	3
TOTAL M&S	***25***	***19***	***18***	***17***	***12***	***12***
Technical and Operations						
Operational Experience (Telco)	5	4	4	5	2	1
IPR	4	2	5	2	1	1
Open Access System	4	2	4	2	1	1
Access Fee Control	4	4	5	0	0	0
Operations Support	4	3	4	2	1	1
TOTAL T&O	***21***	***15***	***22***	***11***	***5***	***4***
TOTAL	***46***	***34***	***40***	***28***	***17***	***16***

OPPORTUNITIES

THE OPPORTUNITY

- **ON SEPTEMBER 23, 1993, THE FCC ISSUED A REPORT AN ORDER INDICATING THAT IT WILL AUCTION SEVEN SPECTRUM BANDS.**

- **TWO OF THE BANDS, 30 MHz ARE DEDICATED TO SWMRS, SMALL BUSINESS, MINORITY, WOMEN AND RURAL TELEPHONE COMPANIES.**

- **A SWMR BIDDING POOL IS PERMITTED AND IS THE OPTIMAL BIDDING STRATEGY FOR THIS MARKET OPPORTUNITY.**

BANDS

BAND	BAND 1	BAND 2	BAND 3	BAND 4	BAND 5	BAND 6	BAND 7
BANDW-IDTH	30 MHz	30 MHz	20 MHz	10 MHz	10 MHz	10 MHz	10 MHz
REGION	MTA	MTA	BTA	BTA	BTA	BTA	BTA
PLAYER	ALL: AT&T, RBOC, MCI, GTE	ALL: AT&T, RBOC, MCI, GTE	SWMR	SWMR	ALL; CELL-ULAR, CATV, MID TIER PLAYER	ALL; CELL-ULAR, CATV, MID TIER PLAYER	ALL; CELL-ULAR, CATV, MID TIER PLAYER

BUSINESS POTENTIAL

A 60 BTA MARKET STRATEGY, WITH 60 MILLION PoPs YIELDS:

- TEN YEAR REVENUE POTENTIAL OF $2 BILLION
- NPV IN EXCESS OF $1.5 BILLION
- ESTIMATE PENETRATION OF TOTAL MARKET IN YEAR TEN IS 40% WITH THE C BAND OBTAINING 20% OF THE TOTAL.
- CUMULATIVE NEGATIVE CASH FLOW IS $1 BILLION
- A POSITIVE OPERATING CASH FLOW IN YEAR 4
- A TOTAL CAPITAL REQUIREMENT BY YEAR 4 OF $800 MILLION

CRITICAL SUCCESS CRITERIA

ACCESS FEES: MUST BE REDUCED TO THE ZERO LEVEL.

CAPITAL PER SUBSCRIBER: MUST BE AT $200 PER SUB AT 50,000 PENETRATION PER MARKET.

OPERATING COSTS: MUST HAVE AVERAGE CLOSE TO MARGINAL FROM THE START, AT $7 PER SUB PER MONTH.

COST PER NEW CUSTOMER: NEED A "BRAND" RECOGNITION AND NATIONAL PRESENCE.

POP VALUATION

$$V_{PCS}(N) = \sum_{n=0}^{N} \frac{R(n) - E(n) - C(n) - T(n) - A(n)}{(1 + m_{PCS})^n}$$

- **REVENUE: DEPENDS ON $30 PER MONTH PER SUB.**
- **EXPENSE: DEPENDS ON NATIONAL MANAGER**
- **CAPITAL: ASSUMES CDMA TECHNOLOGY**
- **AUCTION FEE OR TAX: ASSUMES 20% DOWN AND TEN YEAR AMORTIZATION**
- **ACCESS FEES: ASSUMES THEY ARE ELIMINATED**

VALUE PER POP

Population \ Area	33	1,000	2,000	3,000	4,000	5,000	6,000	7,000	8,000	9,000
500	($67.43)	($92.15)	($117.11)	($144.90)	($169.59)	($194.31)	($222.40)	($247.36)	($272.08)
1,000	$10.20	$0.49	($11.99)	($25.88)	($38.23)	($50.59)	($64.63)	($77.11)	($89.48)
1,500	$11.75	$18.88	$22.57	$13.31	$5.08	($3.16)	($12.52)	($20.84)	($29.08)
2,000	$22.13	$19.87	$17.11	$13.07	$16.90	$20.74	$16.46	$10.22	$4.04
2,500	$26.47	$24.83	$23.11	$19.89	$16.24	$12.58	$11.18	$14.35	$17.41
3,000	$29.51	$28.18	$26.67	$25.20	$22.19	$19.18	$15.73	$12.65	$9.60
3,500	$32.52	$31.48	$30.21	$29.04	$27.32	$24.74	$21.82	$19.21	$16.60
4,000	$34.02	$33.16	$32.08	$30.93	$30.00	$28.11	$25.55	$23.27	$21.01
4,500	$35.14	$34.41	$33.50	$32.49	$31.57	$30.69	$28.44	$26.43	$24.42
5,000	$36.70	$36.06	$35.29	$34.42	$33.51	$32.77	$31.41	$29.61	$27.82
5,500	$37.33	$36.77	$36.08	$35.33	$34.52	$33.76	$33.18	$31.54	$29.92
6,000	$37.81	$37.33	$36.73	$36.05	$35.35	$34.59	$33.96	$33.15	$31.67
6,500	$38.26	$37.83	$37.28	$36.66	$36.04	$35.35	$34.71	$34.12	$33.14

POP VALUES PER BTA

Bidding Strategy
(Assuming 2,000 Sq Mi.)

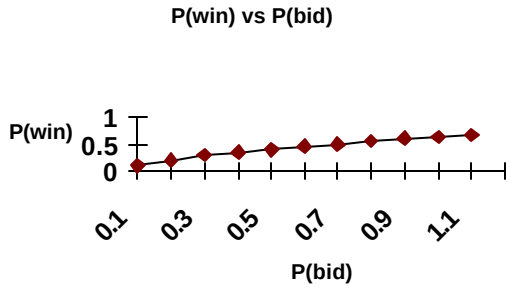
BTA No	BTA NAME	BTA STATE	NO. COUNTIES	SQ MI/CTY	SQ MILES	POPULATION	POP/SQ MILE	NPV	NPV/PoP	BID/PoP
112	Detroit	MI	9	684.45	6,160.05	4,712,700	765	$164,944,500	$35.00	$32,988,900
101	Dallas	TX	24	1,031.16	24,747.84	4,413,000	178	$150,042,000	$34.00	$30,008,400
461	Washington	DC	13	420.91	5,471.84	4,187,000	765	$141,311,250	$33.75	$28,262,250
51	Boston	MA	7	559.86	3,919.02	4,148,000	1,058	$138,335,800	$33.35	$27,667,160
196	Houston	TX	19	1,031.16	19,592.04	4,085,000	209	$134,805,000	$33.00	$26,961,000
293	Miami	FL	3	805.93	2,417.79	3,320,700	1,373	$99,621,000	$30.00	$19,924,200
24	Atlanta	GA	33	364.27	12,020.91	3,283,600	273	$95,224,400	$29.00	$19,044,880
84	Cleveland	OH	9	465.38	4,188.42	2,891,100	690	$78,059,700	$27.00	$15,611,940
298	Minneapolis	MN	23	915.14	21,048.22	2,879,700	137	$77,751,900	$27.00	$15,550,380
394	St. Louis	MO	23	604.37	13,900.51	2,757,200	198	$74,444,400	$27.00	$14,888,880
413	Seattle	WA	5	1,707.23	8,536.15	2,753,900	323	$74,355,300	$27.00	$14,871,060
402	San Diego	CA	1	2,689.19	2,689.19	2,562,900	953	$61,509,600	$24.00	$12,301,920
350	Pittsburgh	PA	9	668.96	6,020.64	2,497,300	415	$59,935,200	$24.00	$11,987,040
347	Phoenix	AZ	5	7,600.00	38,000.00	2,455,800	65	$58,939,200	$24.00	$11,787,840
29	Baltimore	MD	9	425.00	3,825.00	2,453,700	641	$56,435,100	$23.00	$11,287,020
440	Tampa	FL	5	805.93	4,029.65	2,296,500	570	$50,523,000	$22.00	$10,104,600
110	Denver	CO	32	1,646.51	52,688.32	2,086,000	40	$35,462,000	$17.00	$7,092,400
81	Cincinnati	OH	19	465.38	8,842.22	1,999,900	226	$39,998,000	$20.00	$7,999,600
226	Kansas City	MO	23	604.37	13,900.51	1,858,000	134	$35,302,000	$19.00	$7,060,400
297	Milwaukee	WI	7	754.36	5,280.52	1,757,300	333	$33,388,700	$19.00	$6,677,740

POP VALUES PER BTA (CONTD)

Bidding Strategy
(Assuming 2,000 Sq Mi.)

BTA No	BTA NAME	BTA STATE	NO. COUNTIES	SQ MI/CTY	SQ MILES	POPULATION	POP/SQ MILE	NPV	NPV/PoP	BID/PoP
358	Portland	OR	13	2,666.75	34,667.75	1,708,100	49	$32,453,900	$19.00	$6,490,780
389	Sacramento	CA	10	2,689.19	26,891.90	1,703,800	63	$32,372,200	$19.00	$6,474,440
74	Charlotte	NC	16	487.18	7,794.88	1,692,300	217	$32,153,700	$19.00	$6,430,740
324	Norfolk	VA	21	416.82	8,753.22	1,660,600	190	$31,551,400	$19.00	$6,310,280
401	San Antonio	TX	16	1,031.16	16,498.56	1,554,800	94	$29,541,200	$19.00	$5,908,240
364	Providence	RI	6	209.00	1,254.00	1,518,000	1,211	$28,842,000	$19.00	$5,768,400
95	Columbus	OH	10	465.38	4,653.80	1,490,400	320	$26,827,200	$18.00	$5,365,440
314	Nashville	TN	28	433.89	12,148.92	1,443,400	119	$24,537,800	$17.00	$4,907,560
290	Memphis	TN	18	433.89	7,810.02	1,404,000	180	$22,464,000	$16.00	$4,492,800
320	New Orleans	LA	8	680.72	5,445.76	1,364,600	251	$21,833,600	$16.00	$4,366,720
263	Louisville	KY	19	331.10	6,290.90	1,353,900	215	$20,308,500	$15.00	$4,061,700
204	Indianapolis	IN	14	389.89	5,458.46	1,330,200	244	$17,292,600	$13.00	$3,458,520
399	Salt Lake City	UT	18	2,833.34	51,000.08	1,318,500	26	$15,822,000	$12.00	$3,164,400
329	Oklahoma City	OK	28	891.94	24,974.32	1,304,900	52	$14,353,900	$11.00	$2,870,780
336	Orlando	FL	5	805.93	4,029.65	1,292,800	321	$12,928,000	$10.00	$2,585,600
174	Greensboro	NC	15	487.18	7,307.70	1,250,100	171	$11,250,900	$9.00	$2,250,180
60	Buffalo	NY	3	761.68	2,285.04	1,229,700	538	$9,837,600	$8.00	$1,967,520
106	Dayton	OH	10	465.38	4,653.80	1,211,400	260	$8,479,800	$7.00	$1,695,960
44	Birmingham	AL	13	757.46	9,846.98	1,204,100	122	$7,224,600	$6.00	$1,444,920
212	Jacksonville	FL	8	805.93	6,447.44	1,138,800	177	$4,555,200	$4.00	$911,040
184	Hartford	CT	3	605.63	1,816.89	1,130,700	622	$4,522,800	$4.00	$904,560
379	Rochester	NY	8	761.68	6,093.44	1,121,600	184	$3,364,800	$3.00	$672,960
368	Raleigh-Durham	NC	12	487.18	5,846.16	1,107,300	189	$3,321,900	$3.00	$664,380
374	Richmond	VA	28	416.82	11,670.96	1,101,200	94	$2,202,400	$2.00	$440,480
7	Albany	NY	10	761.68	7,616.80	1,034,600	136	$517,300	$0.50	$103,460
						93,069,100		$2,078,947,350	$18.15	$415,789,470

WIN VERSUS BID



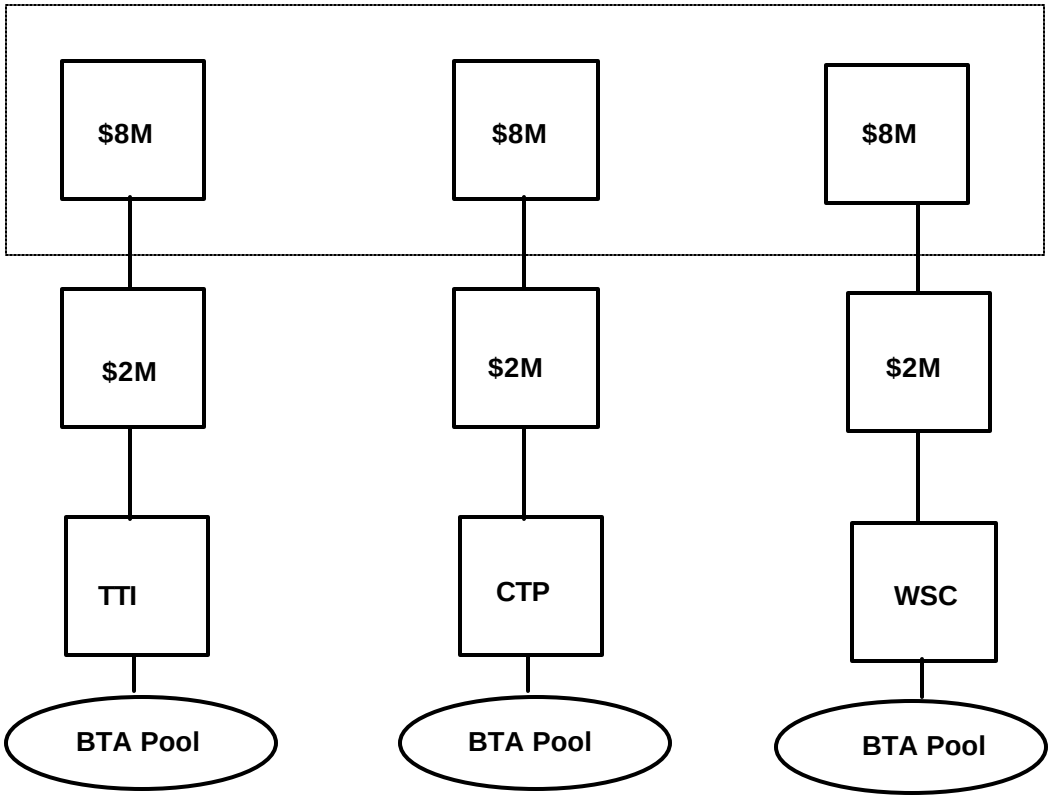
POOL STRUCTURE

240 MILLION POPS
25% ACQUISITION
$10 PER POP
$600 MILLION BID PRICE
20% DOWN AS SWMR
$120 MILLION UP FRONT PAYMENT
1 MILLION POPS PER BTA
60 BTAs
5 SWMR PLAYERS
12 BTAS PER SWMR

CASH REQUIREMENTS

PRE PAYMENT ON ALL US	**$100 MILLION**
BID POOL UP FRONT	**$120 MILLION**
CAPITAL FOR ALL SUNS	**$900 MILLION**
WORKING CAPITAL	**$400 MILLION**

Initial Fund Development



BID STRATEGY

Each participant agrees to bid on a set of BTAs that are separate and disjoint from any other bidder in the pool.

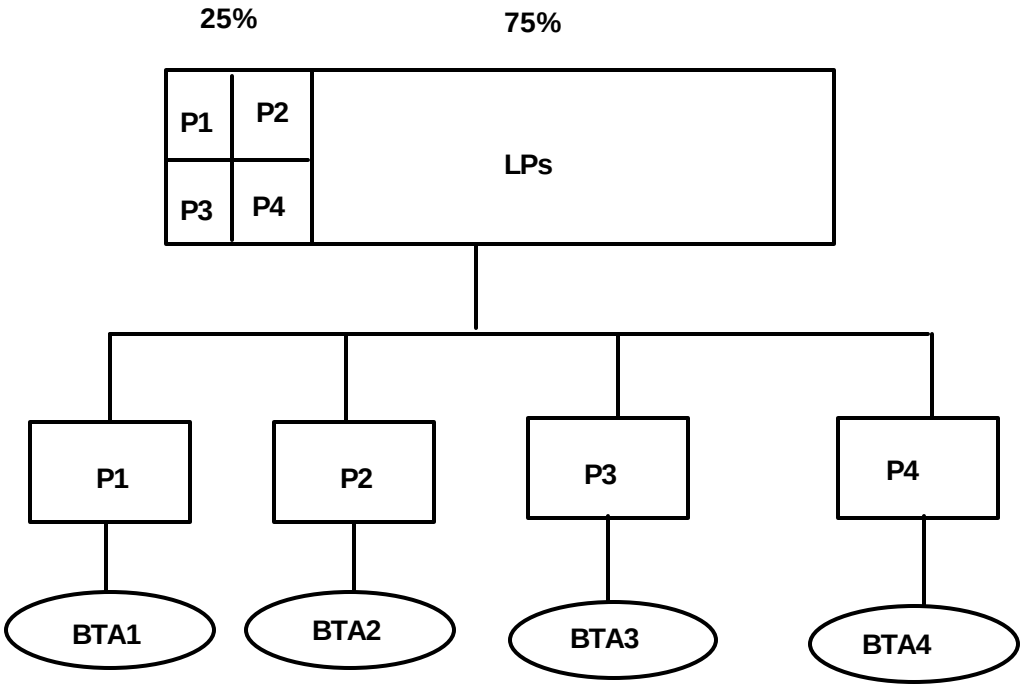
- Each Participant agrees to bring an amount of equity to the Partnership equal to 20% of the anticipated bidding price needed for the pool of BTAs chosen and based further on the win probability anticipated.

- Each Participant agrees to enter into a Partnership, as a General Partner, and to pool the capital raised, with some delimitation on selected BTA segments, with the capital raised by the LPs in the partnership.

- Each Participant further agrees to establish an equity position with the Manager Corporation, NPC, Inc., for the purpose of providing the necessary services that such an entity has been established to provide.

- Each Participant agrees to the cash out position of the Partnership and will ensure the Limited a return on their invested capital.

POOL STRUCTURE



RISKS

RISK ELEMENT	STRATEGY
ACCESS FEES	CO-CARRIER STRATEGY AND ZERO ACCESS PROPOSALS.
CAPITAL PER SUB	CDMA EQUIPMENT WITH SEPARATE OPEN ACCESS.
OPERATING COSTS	USE OF NATIONAL MANAGER WITH ISSC/IBM.
COST PER NEW SUB	BRAND RECOGNITION AND SELECTION OF NATIONAL BRANDING PROPOSAL.

BIDDING STRATEGY

- **Linking:** This is a follow the highway approach, linking all of the selected territories along certain corridors.
- **Clustering:** This approach chooses certain key BTAs and strives to achieve the greatest concentration around that BTA set.
- **Grouping:** This selects key cities and does so without regard to the linkages or clustering effect. It is a power center approach that says if one has these cities, reflected in the associated BTAs that there will be a national system because all others will follow.
- **Lowest Cost:** This approach selects a set of PoPs and attempts to bid to achieve the PoP total independent of where they are but to do so at the lowest possible cost per PoP.
- **Maximum Return**: This approach selects the set of BTAs so that they provide the maximum create of return on the investment made, based on the initial model.
- **Maximum Value**: This approach maximizes the net present value of the BTA portfolio post auction.

FINANCIAL MODELS OF BUSINESS

- **COVERAGE OF 60 BTAS WITH 60 MILLION POPS**
- **REVENUE OF $30 PER MONTH PER SUB**
- **PORTABLE BUNDLED WITH THE SERVICE PRICE**
- **NO ACCESS FEE**
- **CDMA DESIGN**
- **USE OF NATIONAL MANAGER @ $7 PER SUB/MO.**

Income Statement

Year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Revenue	$52,488	$150,839	$296,560	$485,652	$705,375	$957,949	$1,153,010	$1,371,633	$1,672,095	$2,078,110
COGS	$97,978	$76,887	$131,886	$105,581	$123,317	$103,827	$81,408	$131,491	$146,905	$217,199
Gross Margin	($45,490)	$73,952	$164,674	$380,071	$582,058	$854,123	$1,071,602	$1,240,142	$1,525,189	$1,860,911
% Gross Margin	-87%	49%	56%	78%	83%	89%	93%	90%	91%	90%
Expense	$89,159	$105,046	$196,049	$266,107	$366,251	$462,408	$522,174	$626,531	$762,400	$947,560
Net Oper Income	($134,648)	($31,093)	($31,375)	$113,964	$215,806	$391,714	$549,428	$613,611	$762,789	$913,351
Margin %	-257%	-21%	-11%	23%	31%	41%	48%	45%	46%	44%
Depreciation	$59,110	$69,750	$80,390	$91,030	$101,670	$112,170	$112,170	$112,170	$118,170	$118,170
Profit Before Int	($193,758)	($100,843)	($111,765)	$22,934	$114,136	$279,544	$437,258	$501,441	$644,619	$795,181
Margin %	-369%	-67%	-38%	5%	16%	29%	38%	37%	39%	38%
Interest	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Profit Before Tax	($193,758)	($100,843)	($111,765)	$22,934	$114,136	$279,544	$437,258	$501,441	$644,619	$795,181
Margin %	-369%	-67%	-38%	5%	16%	29%	38%	37%	39%	38%
Taxes	$0	$0	$0	$0	$0	$4,099	$174,903	$200,576	$257,848	$318,072
Dividends	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Profit After Tax	($193,758)	($100,843)	($111,765)	$22,934	$114,136	$275,445	$262,355	$300,864	$386,771	$477,108
Margin %	-369%	-67%	-38%	5%	16%	29%	23%	22%	23%	23%

Cash Flow

Year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
NOI	($134,648)	($31,093)	($31,375)	$113,964	$215,806	$391,714	$549,428	$613,611	$762,789	$913,351
Interest	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Taxes	$0	$0	$0	$0	$0	$4,099	$174,903	$200,576	$257,848	$318,072
Dividends	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Capital	$591,100	$106,400	$106,400	$106,400	$106,400	$105,000	$0	$0	$60,000	$0
LTD Reduction	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Chg WC	($7,138)	$17,338	$10,653	($3,737)	$4,549	($2,730)	($32,243)	$5,685	($9,424)	$6,325
Cash Flow(Less LTD Red)	($718,610)	($154,832)	($148,428)	$11,300	$104,858	$285,345	$406,768	$407,350	$454,365	$588,953
Cum CF	($718,610)	($873,442)	($1,021,870)	($1,010,570)	($905,712)	($620,367)	($213,599)	$193,750	$648,116	$1,237,068
CF Auction	($1,318,610)	($154,832)	($148,428)	$11,300	$104,858	$285,345	$406,768	$407,350	$454,365	$588,953

NPV	$1,954,255	($780,954) @ COM of above	$9,542,167
Residual	$9,542,167		$9,542,167
NPV(18%)	($202,131)		
IRR	32%		
NPV Auction	$2,249,979		
IRR Auction	25%		

Sources And Uses

Year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Sources	*									
Beginning Cash	$0	($718,610)	($873,442)	($1,021,870)	($1,010,570)	($905,712)	($620,367)	($213,599)	$193,750	$648,116
Net Oper Income	($134,648)	($31,093)	($31,375)	$113,964	$215,806	$391,714	$549,428	$613,611	$762,789	$913,351
Senior Debt	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Junior Debt	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Equity(Common)	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Equity(Prefrd)	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total Sources	($134,648)	($749,704)	($904,817)	($907,907)	($794,764)	($513,998)	($70,939)	$400,011	$956,539	$1,561,466
Uses										
Purchase	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Capital Req	$591,100	$106,400	$106,400	$106,400	$106,400	$105,000	$0	$0	$60,000	$0
Int Senior Debt	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Int Junior Debt	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Taxes	$0	$0	$0	$0	$0	$4,099	$174,903	$200,576	$257,848	$318,072
Dividends(Com)	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Dividends(Pref)	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Chg In JnDbt	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Chng Work Cap	($7,138)	$17,338	$10,653	($3,737)	$4,549	($2,730)	($32,243)	$5,685	($9,424)	$6,325
Chng In LTD	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total Uses	$583,962	$123,738	$117,053	$102,663	$110,949	$106,369	$142,660	$206,261	$308,424	$324,398
Net Cash	($718,610)	($873,442)	($1,021,870)	($1,010,570)	($905,712)	($620,367)	($213,599)	$193,750	$648,116	$1,237,068
Total Senior Debt	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total Junior Debt	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total Debt	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0

Balance Sheet

Year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Assets										
Current Assets										
Cash	($718,610)	($873,442)	($1,021,870)	($1,010,570)	($905,712)	($620,367)	($213,599)	$193,750	$648,116	$1,237,068
Sht Term Invest	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Accts Receivable	$6,471	$18,597	$36,562	$59,875	$86,964	$118,103	$142,152	$169,105	$206,149	$256,205
Inventory	$19,596	$15,377	$26,377	$21,116	$24,663	$20,765	$16,282	$26,298	$29,381	$43,440
Tot Cur Assets	($692,544)	($839,468)	($958,931)	($929,579)	($794,085)	($481,498)	($55,166)	$389,154	$883,645	$1,536,714
Capital Plant-Dep	$531,990	$568,640	$594,650	$610,020	$614,750	$607,580	$495,410	$383,240	$325,070	$206,900
LT Invest	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Sundry Assets	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total Assets	($160,554)	($270,828)	($364,281)	($319,559)	($179,335)	$126,082	$440,244	$772,394	$1,208,715	$1,743,614
Liabilities										
Current Liab										
Accts Payable	$27,956	$8,690	$12,429	$15,309	$19,424	$23,318	$21,459	$25,748	$33,797	$38,941
Accrued Liab	$5,249	$15,084	$29,656	$48,565	$70,537	$95,795	$115,301	$137,163	$167,209	$207,811
Taxes Payable	$0	$0	$0	$0	$0	$820	$34,981	$40,115	$51,570	$63,614
Tot Cur Liab	$33,205	$23,773	$42,085	$63,874	$89,962	$119,933	$171,741	$203,026	$252,576	$310,366
Long Term Debt	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Other Noncur liab	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total Liabilities	$33,205	$23,773	$42,085	$63,874	$89,962	$119,933	$171,741	$203,026	$252,576	$310,366
Owners Equity										
Shares @ Par	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Adtl Paid-In Cap	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Retain Earnings	($193,758)	($294,602)	($406,366)	($383,433)	($269,296)	$6,149	$268,503	$569,368	$956,139	$1,433,247
Tot Owner Equity	($193,758)	($294,602)	($406,366)	($383,433)	($269,296)	$6,149	$268,503	$569,368	$956,139	$1,433,247
Tot Liab/Own Equ	($160,554)	($270,828)	($364,281)	($319,559)	($179,335)	$126,082	$440,244	$772,394	$1,208,715	$1,743,614

INVESTOR RETURNS

Position	Shares	Purchase	Value/Share	Value	Percent	Return
Founder	60,000	$20,000	$0.33	$120,000	5%	43%
Convert	400,000	$200,000	$0.50	$800,000	33%	41%
Public	400,000	$800,000	$2.00	$800,000	33%	0%
Preferred-1	140,000	$168,000	$1.20	$280,000	11%	25%
Preferred-2	112,000	$179,200	$1.60	$224,000	9%	18%
Preferred-3	113,000	$203,400	$1.80	$226,000	9%	17%
Total	**1,225,000**	**$1,570,600**		**$2,450,000**	**100%**	

Income Statement

Year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Revenue	$52,488	$150,839	$296,560	$485,652	$705,375	$957,949	$1,153,010	$1,371,633	$1,672,095	$2,078,110
COGS	$97,978	$76,887	$131,886	$105,581	$123,317	$103,827	$81,408	$131,491	$146,905	$217,199
Gross Margin	($45,490)	$73,952	$164,674	$380,071	$582,058	$854,123	$1,071,602	$1,240,142	$1,525,189	$1,860,911
% Gross Margin	-87%	49%	56%	78%	83%	89%	93%	90%	91%	90%
Expense	$89,159	$105,046	$196,049	$266,107	$366,251	$462,408	$522,174	$626,531	$762,400	$947,560
Net Oper Income	($134,648)	($31,093)	($31,375)	$113,964	$215,806	$391,714	$549,428	$613,611	$762,789	$913,351
Margin %	-257%	-21%	-11%	23%	31%	41%	48%	45%	46%	44%
Depreciation	$59,110	$69,750	$80,390	$91,030	$101,670	$112,170	$112,170	$112,170	$118,170	$118,170
Profit Before Int	($193,758)	($100,843)	($111,765)	$22,934	$114,136	$279,544	$437,258	$501,441	$644,619	$795,181
Margin %	-369%	-67%	-38%	5%	16%	29%	38%	37%	39%	38%
Interest	$59,200	$68,791	$77,478	$86,588	$28,401	$27,114	$13,103	$0	$0	$0
Profit Before Tax	($252,958)	($169,635)	($189,243)	($63,655)	$85,735	$252,430	$424,155	$501,441	$644,619	$795,181
Margin %	-482%	-112%	-64%	-13%	12%	26%	37%	37%	39%	38%
Taxes	$0	$0	$0	$0	$0	$0	$34,732	$200,576	$257,848	$318,072
Dividends	$10,080	$20,832	$33,036	$33,036	$33,036	$33,036	$33,036	$33,036	$33,036	$33,036
Profit After Tax	($263,038)	($190,467)	($222,279)	($96,691)	$52,699	$219,394	$356,387	$267,828	$353,735	$444,072
Margin %	-501%	-126%	-75%	-20%	7%	23%	31%	20%	21%	21%

Cash Flow

Year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
NOI	($134,648)	($31,093)	($31,375)	$113,964	$215,806	$391,714	$549,428	$613,611	$762,789	$913,351
Interest	$59,200	$68,791	$77,478	$86,588	$28,401	$27,114	$13,103	$0	$0	$0
Taxes	$0	$0	$0	$0	$0	$0	$34,732	$200,576	$257,848	$318,072
Dividends	$10,080	$20,832	$33,036	$33,036	$33,036	$33,036	$33,036	$33,036	$33,036	$33,036
Capital	$591,100	$106,400	$106,400	$106,400	$106,400	$105,000	$0	$0	$60,000	$0
LTD Reduction	$110	$1,412	$1,124	$553,343	$16,087	$175,141	$163,783	$0	$0	$0
Chg WC	($7,138)	$17,338	$10,653	($3,737)	$4,549	($1,910)	($5,029)	($22,350)	($9,424)	$6,325
Cash Flow(Less LTD Red)	($787,890)	($244,455)	($258,943)	($108,324)	$43,421	$228,475	$473,586	$402,348	$421,329	$555,917
Cum CF	($787,890)	($1,032,345)	($1,291,288)	($1,399,612)	($1,356,191)	($1,127,717)	($654,131)	($251,783)	$169,546	$725,463
CF Auction	($1,387,890)	($244,455)	($258,943)	($108,324)	$43,421	$228,475	$473,586	$402,348	$421,329	$555,917

NPV	**$1,377,312**	**($1,080,571) @ COM of above**	$8,881,447
Residual	**$8,881,447**		$8,881,447
NPV(18%)	**$853,994**		
IRR	**27%**		
NPV Auction	**$1,558,019**		
IRR Auction	**21%**		

Sources And Uses

Year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Sources										
Beginning Cash	$0	$0	$0	$0	$0	$0	$0	$256,469	$605,484	$973,480
Net Oper Income	($134,648)	($31,093)	($31,375)	$113,964	$215,806	$391,714	$549,428	$613,611	$762,789	$913,351
Senior Debt	$540,000	$120,000	$110,000	$115,000	$26,000	$0	$0	$0	$0	$0
Junior Debt	$200,000	$0	$0	$0	$0	$0	$0	$0	$0	$0
Equity(Common)	$0	$0	$0	$800,000	$0	$0	$0	$0	$0	$0
Equity(Prefrd)	$168,000	$179,200	$203,400	$0	$0	$0	$0	$0	$0	$0
Total Sources	$773,352	$268,107	$282,025	$1,028,964	$241,806	$391,714	$549,428	$870,080	$1,368,273	$1,886,830
Uses										
Purchase	$120,000	$53,333	$53,333	$53,333	$53,333	$53,333	$53,333	$53,333	$53,333	$53,333
Capital Req	$591,100	$106,400	$106,400	$106,400	$106,400	$105,000	$0	$0	$60,000	$0
Int Senior Debt	$43,200	$52,791	$61,478	$70,588	$28,401	$27,114	$13,103	$0	$0	$0
Int Junior Debt	$16,000	$16,000	$16,000	$16,000	$0	$0	$0	$0	$0	$0
Taxes	$0	$0	$0	$0	$0	$0	$34,732	$200,576	$257,848	$318,072
Dividends(Com)	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Dividends(Pref)	$10,080	$20,832	$33,036	$33,036	$33,036	$33,036	$33,036	$33,036	$33,036	$33,036
Chg In JnDbt	$0	$0	$0	$200,000	$0	$0	$0	$0	$0	$0
Chng Work Cap	($7,138)	$17,338	$10,653	($3,737)	$4,549	($1,910)	($5,029)	($22,350)	($9,424)	$6,325
Chng In LTD	$110	$1,412	$1,124	$553,343	$16,087	$175,141	$163,783	$0	$0	$0
Total Uses	$773,352	$268,107	$282,025	$1,028,964	$241,806	$391,714	$292,959	$264,596	$394,793	$410,767
Net Cash	$0	$0	$0	$0	$0	$0	$256,469	$605,484	$973,480	$1,476,063
Total Senior Debt	$539,890	$658,479	$767,355	$329,012	$338,925	$163,783	$0	$0	$0	$0
Total Junior Debt	$200,000	$200,000	$200,000	$0	$0	$0	$0	$0	$0	$0
Total Debt	$739,890	$858,479	$967,355	$329,012	$338,925	$163,783	$0	$0	$0	$0

Balance Sheet

Year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Assets										
Current Assets										
Cash	$0	$0	$0	$0	$0	$0	$256,469	$605,484	$973,480	$1,476,063
Sht Term Invest	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Accts Receivable	$6,471	$18,597	$36,562	$59,875	$86,964	$118,103	$142,152	$169,105	$206,149	$256,205
Inventory	$19,596	$15,377	$26,377	$21,116	$24,663	$20,765	$16,282	$26,298	$29,381	$43,440
Tot Cur Assets	$26,067	$33,974	$62,939	$80,991	$111,627	$138,869	$414,903	$800,887	$1,209,009	$1,775,708
Capital Plant-Dep	$531,990	$568,640	$594,650	$610,020	$614,750	$607,580	$495,410	$383,240	$325,070	$206,900
LT Invest	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Sundry Assets	$120,000	$173,333	$226,667	$280,000	$333,333	$386,667	$440,000	$493,333	$546,667	$600,000
Total Assets	$678,057	$775,947	$884,256	$971,011	$1,059,711	$1,133,115	$1,350,313	$1,677,461	$2,080,746	$2,582,608
Liabilities										
Current Liab										
Accts Payable	$27,956	$8,690	$12,429	$15,309	$19,424	$23,318	$21,459	$25,748	$33,797	$38,941
Accrued Liab	$5,249	$15,084	$29,656	$48,565	$70,537	$95,795	$115,301	$137,163	$167,209	$207,811
Taxes Payable	$0	$0	$0	$0	$0	$0	$6,946	$40,115	$51,570	$63,614
Tot Cur Liab	$33,205	$23,773	$42,085	$63,874	$89,962	$119,113	$143,707	$203,026	$252,576	$310,366
Long Term Debt	$539,890	$658,479	$767,355	$329,012	$338,925	$163,783	$0	$0	$0	$0
Other Noncur liab	$200,000	$200,000	$200,000	$0	$0	$0	$0	$0	$0	$0
Total Liabilities	$773,095	$882,252	$1,009,440	$392,886	$428,886	$282,896	$143,707	$203,026	$252,576	$310,366
Owners Equity										
Shares @ Par	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Adtl Paid-In Cap	$168,000	$347,200	$550,600	$1,350,600	$1,350,600	$1,350,600	$1,350,600	$1,350,600	$1,350,600	$1,350,600
Accum Retain Earnings	($263,038)	($453,505)	($675,784)	($772,475)	($719,775)	($500,381)	($143,994)	$123,834	$477,570	$921,642
Tot Owner Equity	($95,038)	($106,305)	($125,184)	$578,125	$630,825	$850,219	$1,206,606	$1,474,434	$1,828,170	$2,272,242
Tot Liab/Own Equ	$678,057	$775,947	$884,256	$971,011	$1,059,711	$1,133,115	$1,350,313	$1,677,461	$2,080,746	$2,582,608

A LOOK TO THE FUTURE

THE NIGHTMARE AND THE REALITY

- **IS PCS A REAL THREAT OR IS IT JUST THE PLAYERS?**
- **IS THERE ANOTHER BILL MCGOWAN AND WILL THIS BE MCI VERSUS AT&T?**
- **OR, HAVE BILL MCGOWAN AND BILL GATES BEEN CLONED?**

STRATEGIC POSITIONING AND ROLES

ROLE	PLAYER		ROLE	PLAYER
SOFTWARE	LOTUS, BORLAND MICROSOFT		SERVICES	MICROSOFT
OPERATING SYSTEM	MICROSOFT		NSI	NPC, INC. AT&T MCI
PC	IBM COMPAQ DELL ACER		LOCAL OPERATOR	MCI TIME WARNER ETC.
DISK DRIVES	SEAGATE ETC.		LSI	MOTOROLA QUALCOMM NORTHERN TELCOM
CPU	INTEL		PORTABLES	OKI PANASONIC MOTOROLA ETC

POSITIONING ALTERNATIVES

PCS

BACK ROOM	· BILLING · CUSTOMER SERVICE · OPERATOR SERVICES · NETWORK MANAGEMENT
BACKGROUND NETWORK OPERATIONS	· ROAMING · IEC INTERFACE
LOCAL SERVICE INFRASTRUCTURE	· PCS CELLS · PORTABLES
SERVICES	· VOICE MAIL · MESSAGING · ORDER ENTERING

CATV

BACK ROOM	· BILLING · CUSTOMER SERVICE · OPERATOR SERVICES · NETWORK MANAGEMENT
BACKGROUND NETWORK OPERATIONS	· IEC INTERFACE · DATABASE
LOCAL SERVICE INFRASTRUCTURE	· CATV · FIBER · ALTERNATIVES
SERVICES	· MULTIMEDIA · VIDEO · INTERNET

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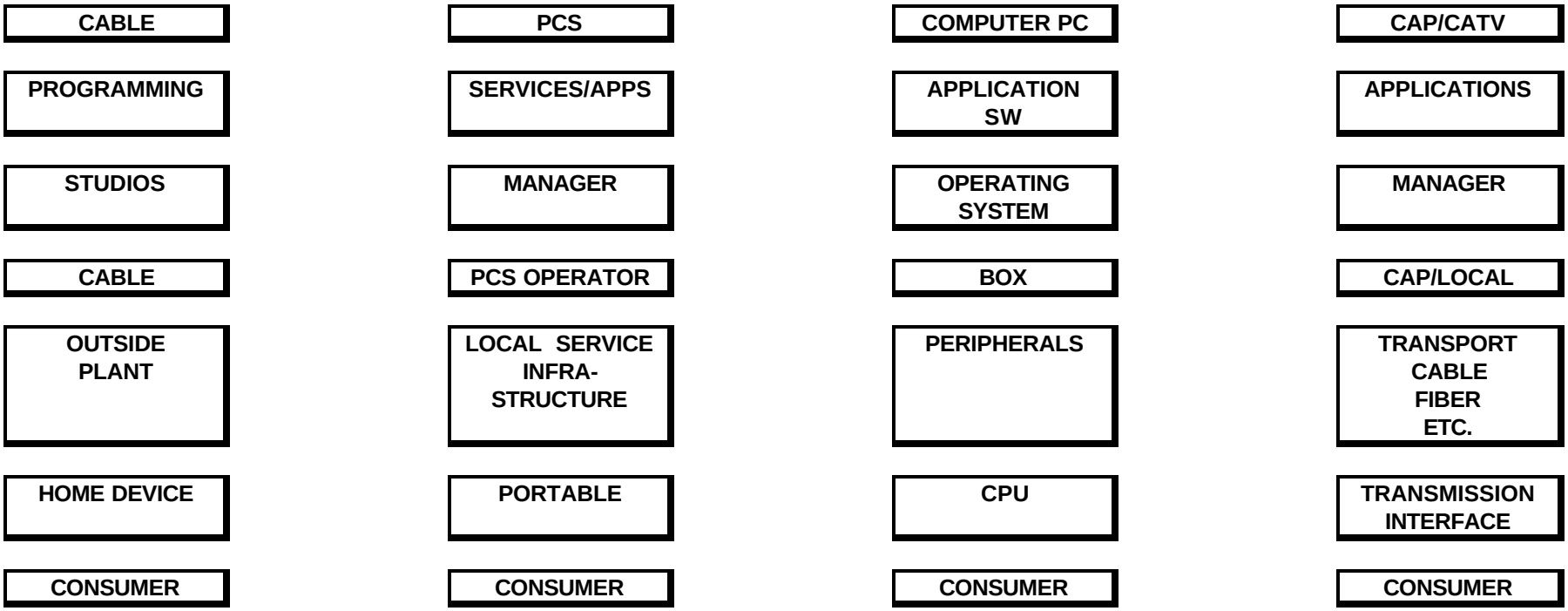

TGI PUBLICATIONS

FCC DOCUMENTS:

PIONEER PREFERENCE FILING, MAY 8, 1992
PIONEER PREFERENCE COMMENTS, JUNE 23, 1992
NPRM COMMENTS, NOVEMBER 8, 1993
NPRM REPLY COMMENTS, DECEMBER 12, 1992
NPRM JOINT COMMENTS, JANUARY 12, 1993
EX PARTE, DECEMBER 21, 1992
EX PARTE, MARCH 29, 1993
EX PARTE, FEBRUARY 17, 1993
LICENSE FILING, MAY 8, 1992
LICENSE AMENDMENT, OCTOBER 15, 1992
LICENSE FILINGS, APRIL 19, 1993
JOINT NPC FILING, JULY 29, 1993
FIRST QUARTERLY REPORT, JANUARY 1, 1993
SECOND QUARTERLY REPORT, APRIL 1, 1993
THIRD QUARTERLY REPORT, JULY 1, 1993.
FOURTH QUARTERLY REPORT, OCTOBER 1, 1993
FIFTH QUARTERLY REPORT, JANUARY 1, 1994
COMMENTS ON 93-252; ACCESS; NOVEMBER, 1993
COMMENTS ON 93-252; AUCTIONS, NOVEMBER, 1993

MASSACHUSETTS DPU FILINGS:

COMMON CARRIER PETITION, APRIL 21, 1993
COMMENTS ON SW BELL INTERVENER REQUEST, JULY 27, 1993
COMMENTS ON SW BELL COMMENTS ON COMMON CARRIER REQUEST, AUGUST 5, 1993

TGI PUBLICATIONS, CONTD.

PAPERS:

- Alternative Networking Architectures; Pricing, Policy, and Competition, Information Infrastructures for the 1990s, John F. Kennedy School of Government, Harvard University, November, 1990.
- Information Architectures and Infrastructures; Value Creation and Transfer, Nineteenth Annual Telecommunications Research Conference, Plenary Address and Paper, Solomon's Island, September, 1991.
- Communications Networks; A Morphological and Taxonomical Approach, Private Networks and Public Policy Conference, Columbia University, New York, October, 1991.
- Alternative Networking Architectures, B. Kahin Editor, McGraw-Hill (New York), October, 1991.
- Wireless Communications Economics, Advanced Telecommunications Institute Policy Paper, Carnegie Mellon University, February, 1992.
- Communications Network Morphological and Taxonomical Policy Implications, Telecommunications Policy Research Conference, Solomon's Island, MD, September, 1992.
- Architectures et Structures de L'Information, Reseaux, No 56, pp. 119-156, December, 1992, Paris.
- Economic Structural Analysis of Wireless Communications Systems, Advanced Telecommunications Institute Policy Paper, Carnegie Mellon University, February, 1993.
- Access to the Local Loop; Options, Evolution and Policy Implications, Kennedy School of Government, Harvard University, Infrastructures in Massachusetts, March, 1993.
- Wireless Access to the Local Loop, MIT Universal Personal Communications Symposium, March, 1993.
- Spectrum Allocation Alternatives; Industrial; Policy versus Fiscal Policy, MIT Universal Personal Communications Symposium, March, 1993.
- Access Policy and the Changing Telecommunications Infrastructures, Telecommunications Policy Research Conference, Solomon's Island, MD, September, 1993.
- Internet Architectural and Policy Implications, Kennedy School of Government, Harvard University, Public Access to the Internet, May 26, 1993.
- Healthcare Policy Optionas and Alternatives: TGI Policy Paper, November 1993.
- Multimedia Communications: A Philospohical and Technological Analysis, TGI Policy Paper, December, 1993.