OFF-PREMISES ADDRESSABILITY
SYSTEM DESIGN AND OPERATIONAL CONSIDERATIONS

Joseph P. Preschutti

AM Cable TV Industries, Inc.
E-Com Products Division

INTRODUCTION

Off-premises jammer systems (including the Tier Guard System) have been receiving higher interest due to intangible benefits associated with improved customer satisfaction: the use of VCRs, multi-channel sound, additional outlets for extra TVs and FM radio, etc.

This paper describes system design concepts required to deploy the off-premises Tier Guard System in a variety of CATV systems. Differences from traditional tapped feeder concepts are highlighted.

In addition, financial models for initial installation costs and operational benefits are provided, showing the Tier Guard System to be a cost-effective design concept in a variety of systems including urban, suburban, rural, new build, rebuild and upgrade situations.

SYSTEM DESIGN

A cost-effective system design which takes full advantage of the characteristics of off-premises addressable equipment must take into consideration design rules and concepts which are different from the standard tapped-feeder concepts used in a traditional broadband system. Several categories of inherent differences are indicated, namely the clustering or grouping of outlets to take advantage of shared electronics, the resultant longer drops which are produced by this type of cluster design, powering methods and costs, and most importantly, limited deployment of active electronics.

Tapping

The purpose of a traditional broadband system design approach utilizing low-cost directional taps is to, at minimum, provide an outlet for every potential subscriber. The use of standard directional tapping devices in configurations having two, four and eight outlets results in deployment of 115-125% of outlets as a percentage of homes passed. This is a naturally cost-effective system design since the cost per port for a standard directional tap is very low.

The cost per port of an off-premises addressable system such as the Tier Guard System is quite low compared to an addressable converter or an off-premises addressable tuner. Consider, however, a hypothetical system design that treats the Tier Guard tap as a standard tap in a system that, for example, has 60% penetration and 120% deployment of outlets. This would result in deployment of two outlets for each subscriber and would double the cost of the Tier Guard implementation. This is clearly an undesirable situation.

A system design technique that achieves 70% to 80% utilization of deployed ports was devised to overcome this situation. An explanation of the concepts underlying this system design technique along with the advantages and disadvantages follows.

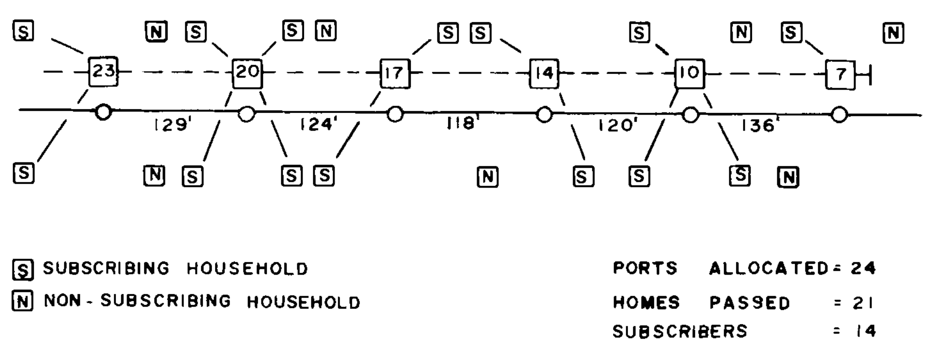


FIGURE I
TRADITIONAL TAPPED FEEDER

Tapping Example

Figure 1 shows a sample design area with 21 homes passed, 14 subscribers, and six four-port taps allocated.

Figure 2 shows the same area with the Tier Guard off-premises system deployed with the following results:

1. End of feeder is reduced by one span.
2. Two active locations are utilized instead of six.
3. Sixteen ports are allocated to serve fourteen subscribers.
4. Two blank plate (TGT-0) locations are available for further expansion.

Advantages of the System Design

Several advantages are presented by this system design concept.

1. Efficient Port Usage

Deployment of active electronics and efficiency of active port usage is optimized, reducing installation costs.

2. Increased System Reliability

The shared electronics have reduced the number of active components in the system and reduced the number of serially-connected devices in the feeder.

3. Lower Tap Losses

This particular example shows a loss of 1.2 dB per TGT or 4.8 dB passive loss. The traditional passive losses in figure one totals 8.6 dB without the terminating 7 tap! This increases the efficiency of line extender use in the system.

4. Lower Cable-Bearing Strand Footage

The result of reducing each and every end of feeder in the system by one span has a dramatic effect on reducing cable-bearing strand footage, reducing installation costs.

5. Lower Passive Installation Costs, Fewer Connectors

As demonstrated by the examples presented in Figures 1 and 2, the traditional design required installation of six passives, one at each pole, while Tier Guard off-premises design required installation of four passives for the same feeder. This results in lower installation costs for the passives themselves and use of fewer connectors.

Limitations of the System Design

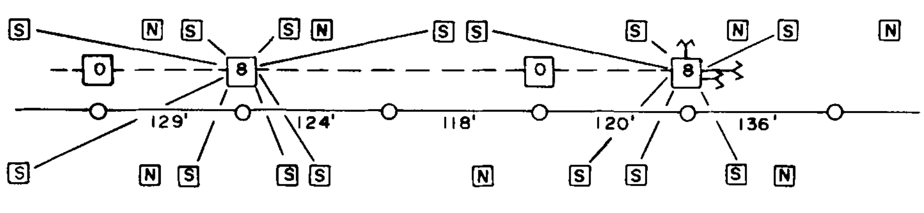
There are several limitations to this system design technique which should be identified by the system designer.

1. Longer Drops Required

In order to take advantage of the shared electronics of the Tier Guard System, the subscribers must be served from more concentrated tap points. As can be seen in the example, instead of providing services for two, three or four subscribers from each of six poles, active TGTs are deployed on a limited basis at only two locations. Service that would traditionally be provided from the poles adjacent to the Tier Guard tap must be handled by running an extended drop. The installation and materials cost for the longer drops must be added to the initial system installation cost for the Tier Guard system.

2. Added Power Supply Costs

The Tier Guard System is capable of being powered from the feeder system or, optionally, by the drops. Since the Tier Guard tap power consumption is quite low (14 watts for a TGT-8), powering from the feeder system is preferred. In this case, the initial



S SUBSCRIBING HOUSEHOLD
N NON-SUBSCRIBING HOUSEHOLD

ACTIVE PORTS ALLOCATED	= 16
POSSIBLE PORT ALLOCATIONS	= 32
HOMES PASSED	= 21
SUBSCRIBERS	= 14

FIGURE 2
TIER GUARD TAP FEEDER DESIGN

installation costs will be increased by the added costs of power supply locations. A rough estimate for the number of additional power supplies required when using the Tier Guard System can be calculated based on the following assumptions for a moderately dense system of about 100 subscribers per mile:

A. 70% efficiency of power supply use.
B. 900 watts available from the power supply location (60 volts at 15 amperes).
C. 42 poles per mile.
D. 14 Tier Guard taps per mile (one every third pole).

With the above conditions, and further assuming that the powering system will be current-limited, not voltage-limited, 640 watts of power is available to power the Tier Guard system. At 14 watts per Tier Guard tap, 45 taps may be powered from a single power supply location. Assuming 14 active taps per mile, an additional power supply will be required every 3.2 miles of cable-bearing strand plant.

For those systems employing standby power, the cost of added power supplies might be reduced by using standby power on the trunk with traditional supplies in the feeder area.

Summary of Tier Guard System Design Rules

1. Deploy TGT-0s throughout the system, assuming each tap will be capable of providing an outlet for eight subscribers. This will typically result in 50-65% of the poles in the system having the capability to provide active TGT outlets. This will result in potential outlets for 100% of homes passed.

2. Populate only those TGTs required to service the projected penetration. Typically this will require active TGTs at only 50% of the locations indicated in Item 1 above, or, in other words, an active Tier Guard tap at every third pole in the system.

3. An objective for the system designer should be to achieve a minimum of 70% efficiency in active TGT port deployment. That is, seven out of every ten active TGT ports deployed should be used.

Implementations in Sparse Areas

The specified output level of the TGT is +15 dBmV at the highest frequency. This limits long drop lengths using RG-6 to approximately 300 feet. If the designer places TGT-8s optimally so that full reach is achieved in both directions along the feeder line, the minimum number of TGTs that can be deployed is about 10 units per mile. In systems which have only 30 or so subs per mile, efficient deployment of the system will rely on implementing system design techniques that minimize the number of TGTs required by extending the length of the drop. Two methods have been investigated. These are:

1. Use of a "Booster Amplifier" of a low cost variety which will allow drop levels to be increased to +23 dBmV in long-drop situations.
2. Use of 0.412" backfeed cable to lower the insertion loss of the drops.

Both of these alternatives have been selected by designers of off-premises systems using TGT.

Implementation in Upgrade Situations

The replacement, on a one-for-one basis, of existing taps with either a TGT-0 or an active TGT is a straightforward matter. The option to relocate line extenders remains with the system designer. In a system that is already over-extended (three extenders or more in series), it is possible to take advantage of TGT to reduce the number of extenders, increase reliability, and reduce maintenance costs. On the other hand, the designer may choose to leave intact existing line extender locations.

Upgrading with TGT theoretically requires extending the drop length of approximately 2/3 of existing drops to cluster existing subs for more cost-effective deployment.

CALCULATING THE INSTALLATION COSTS OF AN OFF-PREMISES TGT SYSTEM

In projecting the cost to deploy the Tier Guard System, the designer must consider several parameters. New systems, rebuilds and upgrades each have requirements which will affect system design, installation and deployment tactics. This section attempts to model the new-build situation and presents the variables that change the model for rebuild and upgrade scenarios.

New Build TGT Installation Cost Parameters

In order to accurately predict the installation cost of the Tier Guard System in a new build, it is necessary to quantify the following parameters:

1) Homes passed per mile
2) Projected penetration
3) Number of TGT-0s deployed
4) Number and value of active TGTs deployed (TGT-4, TGT-6, TGT-8)
5) TGT-0 installation costs
6) Active TGT installation and activation costs
7) Added costs of longer drops
8) Added power supply costs
9) Number of "plain vanilla" converters used taking into account cable ready sets

New Build Addressable Set-Top Installation Cost Parameters

In order to compare the installation costs of the Tier Guard System to a set-top addressable system, the following additional factors need to be quantified:

1) Lower distribution system costs with TGT due to lower cable-bearing strand footage, fewer taps, fewer extenders, fewer connectors, etc.

2) Number of addressable set-top converters used, taking into account how basic subs are provided service, additional outlet requirements and inventories, etc.

3) Use of "plain vanilla" converters

4) Added Drop Costs - Although a significant number (about 1/3) of the total drops in the system are

standard length, about 2/3 of the total will be longer than normal. Some of these longer drops will require a complete span to the adjacent pole location (about 50%) while the remainder can be handled by a half-span extension in drop length. Both material costs and added labor costs must be considered.

5) Combined distribution plant costs - The effect of the savings produced by fewer taps, lower strand footage, lower passive installation costs plus cost adders on the distribution plant including additional power supply costs are detailed for a specific design example at the end of this paper.

OPERATIONAL BENEFITS

Off-premises equipment should be deployed in many systems for reasons which vary in importance, depending on the unique characteristics of the individual system. The primary operational cost benefits which may be calculated directly from data available from operations are:

1) Reduction in theft of service losses
2) Reduction in hardware losses
3) Reduction in churn losses
4) Reduction in equipment repair costs.

In some systems the payback associated with only one of these benefits will justify the off-premises approach. In most systems a combination of these items will produce significant operational improvements which should be analyzed when a new build or rebuild of a system is being planned. A payback model for each of these benefits is presented in the following sections.

Theft-of-Service

One of the valuable benefits of an off-premises system is the increased revenues which can be generated by eliminating theft-of-service and converting non-paying subscribers to paying subscribers.

The following model calculates theft-of-service benefits on a per-subscriber basis using the initial subscriber count before service theft is eliminated as a basis. The following parameters are used as required data for the calculation:

Parameter	Equation Variable
Homes Passed per mile	HP
Penetration, %	PEN
Illegal Connections, % of HP	ILL
Illegals caught, % of ILL	CAUGHT
Illegals converted, % of ILL	CONV
Average takeout/sub/month, $	TAKEOUT

The number of converted subscribers per mile is calculated as follows:

(NEW) = (HP)x(ILL/100)x(CAUGHT/100)x(CONV/100) (1)
= new subs/mile

The additional revenue per mile per year generated (NEW $) is calculated as follows:

(NEW $) = (NEW) x (TAKEOUT) x 12 (2)
= $Mile/year

This additional revenue (based on original subscriber count) is as follows:

$/sub = (NEW $)/(HP)x(PEN/100) (3)

Theft of Service Example #1 (High Theft)

The following example presents an actual system which has a high theft-of-service problem, with the following parameters,

PEN	= 17% existing subscriber penetration
ILL	= 30% illegal connections
CAUGHT	= 100%
CONV	= 50%
TAKEOUT	= $20 average per subscriber per month

Justification for an off-premises TGT system installation is almost completely based on projected cash from improving penetration from 17% to 32% as follows:

(NEW) = (220)x(30/100)x(100/100)x(50/100)
= 33 subs per mile

(NEW) = 33 x (20) x 12 = $7920/mile
$/sub = $211.76 per existing sub per year!

Theft-of-Service Example #2 (Average Theft)

The previous example was an extreme (but real) situation in a problem system. An "average" urban system is presented below with the following numbers:

HP	= 220 homes/mile
PEN	= 50% of HP
ILL	= 10% OF HP
CAUGHT	= 100% Of illegals
CONV	= 25% of those caught
TAKEOUT	= $25/month

In this case,

(NEW)	= 5.5 new subs/mile
(NEW $)	= $1,650.00 per mile
$/Sub	= $12.50 per existing sub per year

In this "average" case, the improvement in revenue due to an off-premises system is still substantial, but one must also look at other areas for additional operational savings in order to justify deployment.

Reduction in Hardware Losses

The reduction in hardware losses when comparing an off-premises system to a set-top addressable system is a function of two elements:

1) The cost of in-home electronics is substantially reduced by the difference in cost between a "plain vanilla" converter and an addressable

converter ($40 versus $100).

2) Converter deposits represent a much larger proportion of total exposed cost. For example, with a $25 deposit, the exposure to a converter theft would be as follows:

Plain vanilla = $40 - $25 = $15
Addressable = $90 - $25 = $65

In other words, with a reasonable deposit on in-home electronics, the exposure to theft of equipment with off-premises equipment can be a fraction of the exposure with an addressable converter system.

Assuming a 15% hardware loss for theft-of-services, the following calculations can be made for the "average" urban system, taking into account an additional converter needed for additional outlets and no converter needed for a TGT system with a cable-ready set.

HP	= 220 homes/mile
PEN	= 60% of HP
LOSSES	= 15% of equipment annually
DEP	= $25 deposit on converters
% ADD	= 20% additional outlets
% Cable-ready	= 30% cable-ready sets

Hardware Loss, Set-top Addressable

Converters lost per mile = (HP) x (PEN/100) x (LOSSES/100) x (1 + ADD/100)

= (220) x (.6) x (.15) x (1.2)

= 23.76 lost converters/mile/year

$ lost/mile = $23.76 x ($90 - $25)

= $1,544.40 per mile per year

or, on a subscriber basis

$ lost/sub/year = $11.70/sub/year

Hardware Loss, TGT

$Converters lost/mile = (HP)x(PEN/100) x (Losses/100) x (1+ADD/100) x (1-cable loss/100)

= 16.63 lost plain converters/mile/year

$ Lost/mile/year = 16.63 x ($40 - $25)
= $249.48

$lost/sub = $1.89/sub/year.

Hardware Loss Savings

This represents an operational savings of $11.70 - $1.89 = $9.81 per sub per year!

CHURN ANALYSIS

Many systems have unusually high churn due to the nature of the community. Classic examples include resort communities, university communities, and the like. The off-premises Tier Guard approach has been, so far, universally advantageous in each of these types of communities analyzed to date.

Several transactions need to be identified in analyzing what this paper defines as churn. These are:

1) Disconnects
2) New Connects
3) Reconnects
4) Upconverts - to add a pay channel
5) Downconverts - to delete a pay channel

When comparing the TGT system to addressable set-top systems, the primary benefits of the TGT system are obtained by eliminating truck rolls for disconnects. When considering the TGT system instead of a trapped system in high churn environments, the reduction in up- and down- converts along with disconnects must be determined.

TGT vs Set-top Addressable Churn Cost Comparison

One of the key system operational strategies that should be employed in reducing the costs of churn with the TGT system is elimination of the need to make a service call to collect the converter. Since homes with cable-ready sets require no converter (the penetration of cable-ready sets will increase continuously in the future), this type of subscriber naturally does not require a truck roll. Since a "plain vanilla" converter is used in homes without cable-ready sets, it is assumed that a modest deposit will provide adequate incentive for an effective converter return policy.

Neither Up or Down converts of pay channels require truck rolls with either a TGT or an addressable set-top system. Also, quite naturally, a New Connect requires a truck roll with both systems. The key to a comparison in the operational costs of these two types of systems relies on comparing disconnect and reconnect losses.

The data required to calculate the operational benefits in this case are:

Parameter	Equation Variable
Homes passed per mile	HP
Penetration, %	PEN
Disconnects, % of subs	DISC
Truck Roll Cost, $	ROLL

Disconnect Costs

Since the disconnected subscriber is generally not a cooperative one, it is assumed that an average of 1.9 truck rolls/disconnect is required to retrieve the set-top addressable box, while no truck roll is assumed for the TGT system.

Example

The following example of a typical urban system s presented:

HP	=	220 homes/mile
PEN	=	60% of H. P.
DISC	=	20% of subscribers
ROLL	=	$25

TGT Churn Benefit (Moderate Churn)

The calculation for the churn benefit on a per-subscriber basis of the TGT system is as follows:

Churn Benefit = ((HP x PEN/100) x (DISC/100 x 1.9) x (ROLL))/(HP x PEN/100)

= (DISC/100) x 1.9 x (ROLL)

The first conclusion is that this churn benefit on a per-subscriber basis is independent of houses passed and penetration. The value of this benefit in this example (20% disconnect rate) is:

Churn Benefit = (.2) x 1.9 x $25 = $9.50/sub/year

High Churn Example

Systems that experience a high churn rate (100%) with the above truck roll cost will experience the following operational benefit with TGT versus an addressable set-top system:

Churn Benefit = (1.0) x 1.9 x 25
= $47.50/sub/year

REDUCTION IN EQUIPMENT REPAIR AND MAINTENANCE COSTS

The effect of the ideal TGT system on repair and maintenance costs is dramatic. The number of active electronics in a TGT system with no subscriber equipment is less than 20% of the electronics needed to deploy a set-top addressable system. Assuming that the cost to repair and maintain TGT hardware is 50% more than that for set-top addressable converters, the net result is still 30% of a set-top system or a 70% savings in maintenance and repair costs. An example of this scenario follows.

Ideal Repair & Maintenance Cost Savings

The following data is required in addition to previous data:

Parameter	Equation Variable
Addressable set-top failure rate, %	ADDFAIL
Addressable set-top repair cost, $	ADD$REP
Truck Roll Cost, $	ROLL
TGT failure rate, %	TGTFAIL
TGT repair cost, $	TGT$REP
Additional Outlets,%	ADD

Repair Benefit Value Calculation

Addressable set-top repair $ =

(HPxPEN/100)(1+ADD/100)(ADDFAIL/100)

(ADD$REP+ROLL)/(HP x PEN/100)

Again, the penetration drops out on a per-subscriber calculation, leaving :

Addressable set-top repair $ =

(1 + ADD/100)(ADDFAIL/100)(ADD$REP+ROLL)

Example: The following example is presented:

ADD	=	20% of subscribers with additional outlets
ADDFAIL	=	10% failure per year
ADD$REP	=	$20
ROLL	=	$25

Addressable set-top repair $ = $5.40/sub/year

The TGT system repair costs are as follows: assuming 80% efficiency of TGT outlets and average use of TGT-6s in the system design:

TGT FAIL = 10%
TGT $REP = $30

$$\text{TGT Repair \$} = \frac{(\text{TGTFAIL}/100)(\text{TGT\$REP}+\text{ROLL})}{(.8 \times 6)}$$

= $1.15/sub/year

This represents a substantial operational savings per subscriber each year. However, this also represents a boundary value condition in the future when most sets are cable-ready. At this point in time, assuming 20% or so existing penetration of cable-ready sets, the repair costs tend to be equal in both systems, because of the need to maintain and repair the "plain vanilla" convertors used in the TGT system. Depending upon specific system parameters, the TGT advantage is approximately $1.00/sub/year with a projected increase towards $4.05/sub/year as cable-ready sets increase in numbers.

EXAMPLE SUMMARY ANALYSIS

The following example is a computer program printout of a Tier Guard versus addressable set-top cost comparison for an urban system. The first "page" of the printout lists the various assumptions. The second page indicates initial system design considerations. In this section, the total effect on the distribution plant is added as one line. This includes reduction in strand footage, line extenders, taps, connectors, and increased power supply costs. Cost of longer drops is included as a separate item.

This particular situation indicates a slightly higher installation cost with a very quick payback favoring the off- premises approach.

TIER GUARD COST COMPARISON
versus ADDRESSABLE SET-TOP
URBAN SYSTEM

SYSTEM INFORMATION

Homes Passed	225.00
Penetration,%	45.00
Subscribers	101.25
Additional Outlets,%	20.00
Cable Ready Sets,%	20.00
Poles per Mile	42.00
Truck Roll Cost,$	25.00
Avg. Sub Bill/Month,$	25.00
Hardware Theft,%	15.00
Service Theft, % of H.P.	10.00
% Illegals Converted	25.00
Disconnects,%Subs/year	10.00
New Connects,%Subs/year	2.50
Reconnects,%Subs/year	7.50
Upconvert Pay,%Subs/year	10.00
Downconvert Pay,%Subs/year	10.00

ADDRESSABLE SET TOP INFORMATION

Addressable Price,$	100.00
Inventory,%	10.00
Failure Rate,%/yr.	15.00
Repair Cost,$	20.00
Customer Deposit,$	30.00

PLAIN CONVERTER INFORMATION.

Converter Price,$	40.00
Inventory,%	10.00
Failure Rate,%/yr.	15.00
Repair Cost,$	11.00
Customer Deposit,$	30.00

TIER GUARD INFORMATION

TGT Price,$	
TGT-8	590.00
TGT-6	550.00
TGT-4	510.00
TGT-0	40.00
TGT Inventory,%	5.00
Failure Rate,%/year	3.00
Repair Cost,$	30.00

INITIAL SYSTEM INSTALLATION CONSIDERATIONS

TGT SYSTEM COSTS

Poles per TGT (design spec)	3.00	These figures were derived from TGT tap utilization programs. Avg. subs/pole assumes min design goal of 50% H.P.
Avg. Subs per TGT Pole	7.23	
Total Active TGTs used	18.20	
TGT Tap Utilization		
TGT-8	9.80	TGT-0....Amount used to allow potential TGT outlets to achieve 100% H.P.
TGT-6	4.20	
TGT-4	4.20	
TGT-0	9.93	
TGT Cost per Mile	10631.00	
Cost per Sub	105.00	
Number, Plain Converters	106.92	Adl. Outlets, Cabl Rdy, Invtr
Total Converter Cost, $	4276.80	
Cost per Sub	42.24	
Total Cost, $ TGT +Conv.	14907.80	
Cost per Sub	147.24	
Plus Added Drop Cost, $	7.00	
Minus Distribution Plant, $	13.95	
		140.29 GRAND TOTAL TGT SYSTEM

ADDRESSABLE CONVERTER SYSTEM COSTS

% Subscribers Addressable	100.00	
% Subs with Plain Basic	0.00	
Number of Addressable Units	133.65	Addl.Outl, Inventory
Plain Units	0.00	=above with cable ready
ADDR. Cost	13365.00	
Plain Cost	0.00	
Total	13365.00	
Per Sub		132.00.....GRAND TOTAL ADDRESSABLE

INITIAL SYSTEM COST DIFFERENTIAL 8.29

TIER GUARD OPERATIONAL BENEFITS

HARDWARE THEFT

% Converters Lost,Stolen	15.00		
	ADDR	TGT	
Addressable Converters,$	1403.33	0.00	
Plain Converters,$	0.00	160.38	
Total	1403.33	160.38	
PER SUB	13.86	1.58	
TGT ADVANTAGE			12.28

SERVICE THEFT

% Illegal Connections	10.00		
% Caught	100.00		
% Converted to Paying Subs	25.00		
Annual Revenue Increase,$	1687.50		
PER SUB			16.67

CHURN ANALYSIS, TRUCK ROLLS ONLY

Transactions				
Reconnects,%	7.50			Annual Percent of Homes Passed
Disconnects,%	10.00			
New Connects,%	2.50			
Upconvert,%	10.00			
Downconvert,%	10.00			
Truck Rolls	ADDR	TGT		
Reconnect	16.88	13.50		.........Addr.=1, TGT=0.8
Disconnect	42.75	0.00		.........No roll for plain con.
New Connect	5.63	5.63		Deposit covers loss
Upconvert	0.00	0.00		
Downconvert	0.00	0.00		
Total Truck Rolls	65.25	19.13		
Cost of Rolls,$	1631.25	478.13		
TGT ADVANTAGE		1153.13		
PER SUB			11.39	

REPAIR ANALYSIS

	ADDR	TGT	
Cost of Repair			
Plain	0.00	577.37	
Addressable	902.14	0.00	
TGTs	0.00	30.03	
Total	902.14	607.40	
PER SUB	8.91	6.00	
TGT ADVANTAGE			2.91
ADDED POWER COST/SUB			2.26
TIER GUARD OPERATIONAL BENEFITS/YEAR TOTAL $			38.07

FINANCIAL SUMMARY

TIER GUARD vs ADDRESSABLE SET-TOP

Costs per Subscriber

	ADDR	TGT		
Initial Costs,$	132.00	140.29		
Cost Difference			8.29	
Annual Savings,$	0.00	38.07		
PAYBACK, TGT vs ADDRESSABLE SET-TOP, Months				2.61
TGT COST ADVANTAGE	FIRST YEAR			29.78
	after FIVE YEARS			182.07

SUMMARY AND CONCLUSIONS

Off-premises systems such as the Tier Guard Tap can be effectively deployed in a variety of systems. Installation costs will vary depending upon projected penetration and subscriber count. Design techniques somewhat different from traditional tapped-feeder concepts need to be employed for cost-effective deployment of the shared electronics.

Installation costs are comparable to addressable set-top systems. Operational benefits result in very short paybacks on investment compared to addressable set-top systems. Benefits vary from system to system and a thorough analysis is justified on any system design opportunity, whether urban, suburban or rural, new build, rebuild or upgrade.

References

1. Dickinson, Robert V. C., "Jamming Techniques for Off-Premises Addressability," NCTA Technical Papers, June 1983.

2. Dickinson, Robert V. C., "Protection of Premium Television Services by Off-Premises Interfering Signal Techniques," CATCOM Conference Technical Papers, November 1984.