3. Carriers nominating CBGs for auction would be required to establish their qualifications to be carriers of last resort or winners of the auction.
4. Other parties may nominate additional, adjacent areas to be included in that auction.
5. Carriers submit sealed bids in a single round for each market indicating the amount of support they require in each CBG.
6. If no bids are submitted at or below the maximum support rate, the incumbent LEC would continue to be the COLR supported on the basis of the actual cost, and the auction would be considered to have not taken place.
7. Winners are those who bid within a specified percentage of the lowest bid. Support will be provided to each winner in an amount equal to the highest of the winning bids. Winners in the initial auction for an area will bear COLR obligations for a minimum of three years, subject to performance standards. After the initial period has expired, any qualified carrier can put that market up for bid for a five-year period. If no carrier does, support will continue at the same level for the incumbents with no additional period of protection.
8. Bidders are permitted to withdraw from one or more market areas after results of the auction are disclosed, subject to the payment of a reasonable withdrawal penalty.
9. At least two bidders are required to hold an auction. If all bidders withdraw, the auction will be canceled and support will be provided to the incumbent at Day 1 levels.

Policy Rationale

Auctions have a number of advantages over the use of cost models. (See Statement of Paul Milgrom, CC Docket 96-45.) As pointed out above, support levels are set using a market mechanism. No cost estimation model will ever be as accurate for a carrier as a carrier's own bid in an auction. Auctions also can be set up to determine how many carriers should operate in a given market and which carriers they should be. Especially if they are conducted at regular intervals, auctions would provide important information about the costs of providing universal service. This information would be useful both to would-be competitors evaluating other markets and to regulators. When conducted over time, as carriers complete their obligation terms, auctions will automatically adjust support payments to take account of changes in technologies, service definitions, population shifts, and other factors.

Legal Authority

The Commission has the authority to adopt a universal service support mechanism as long as it is "specific, predictable and sufficient." Section 254(b)(5). As demonstrated above, auctions for universal service support adhere to these statutory criteria.

FUNDS TO SCHOOLS

Implementing the Snowe-Rockefeller-Exxon-Kerry Amendment

▸ *Requirement*

Section 254(h) of the Telecommunications Act of 1996 requires the provision of telecommunications services at rates that are deemed affordable to schools, libraries and health care providers. The Act also calls for a specific, predictable and sufficient fund to reimburse carriers. The Act does not specify a mechanism for implementation.

▸ *Recommended Plan*

To meet the requirements of sufficient and predictable, the industry initially recommended a "funds to schools" approach that would provide vouchers to schools that could be used to obtain free services from any telecommunications service provider. Recommended establishing fund of about $1 billion a year from which vouchers are distributed, and would place constraint on amount of free services that schools may obtain at about $10,000-12,000 per year (125,000 schools at $10K equals $1.25 billion annual fund). Schools in rural and low income areas would receive additional funding above $10K limit to ensure equity and prevent situation of "haves and have nots." Concern is that without some constraints (i.e., if schools could obtain free services and there are no limits on the services they can obtain), cost to be borne by consumers could far exceed $1 billion per year, and industry could not accurately predict a fund level that would be sufficient and predictable.

Because of concerns expressed by education community with voucher plan, the industry has proposed an alternative plan based on a sliding discount. Under that plan, services would be offered at 30-70% discounts with a ceiling on benefits of $12,000 per school per year, and discounts halved to 15-35% on additional services up to $25,000. Discounts would not apply for services beyond $25,000 except in extreme cases. To ensure rates are affordable for schools in rural and high cost areas where tariff rates may be very high, discounts would apply to benchmark prices in lieu of actual rates, and LECs could receive reimbursement based on the difference between tariff rates and the benchmark price. To ensure that benefits accrue to those schools not yet connected to the information infrastructure, rather than to schools that can afford and have already been connected, the sliding discount would be phased in over five years for *existing* services (the full discount, with a ceiling on the benefits to be received, would apply to all new services).

▸ *Eligible Services*

Flexibility is important. Rules should not mandate deployment of specific technology or services. Specifying a particular technology or services might conflict with what schools already have, or with existing state plans. Schools are at different stages of technology deployment and have different needs, and therefor should be able to choose from any commercially available regulated services.

▸ *Inside Wiring*

Question of whether FCC has jurisdictional authority to require LECs to wire classrooms, since inside wire is not a regulated telecommunications service. As a practical matter, few LECs are any longer involved in the inside wire business. Cost of providing connections to every classroom would greatly escalate size of Universal Service Fund (about 125,000 eligible schools times industry estimate of $50,000-100,000 per school equals $6-12 billion just to wire classrooms).

▸ *Use of TELRIC in Determining USF Reimbursement*

Inappropriate and probably unlawful to use imputed costs (i.e., benchmark cost model) to determine basis for reimbursement from Universal Service Fund. Difference between tariff rate and rate for schools should be basis for reimbursement. Any shortfall in recovery (i.e., if fund is not "sufficient and predictable") might fall upon states. Also, use of TELRIC as basis for reimbusement would create administrative nightmare, with all providers having to perform cost studies and file tariffs for services in every jurisdiction in order to be competitively neutral.

▸ *Libraries and Rural Health Care Providers*

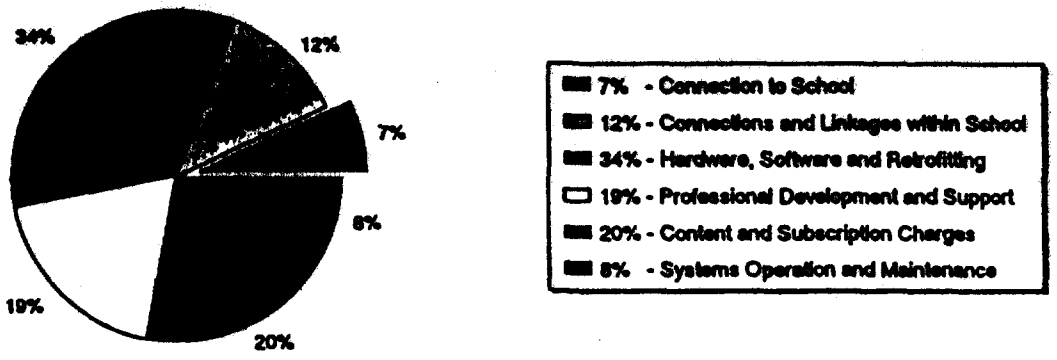
Have similar needs and require similar plans to schools. Approximately 15,000 libraries in nation; estimate they would increase necessary fund size about 10% over what is required for schools. No estimates available for health care providers.

▸ *KickStart Initiative*

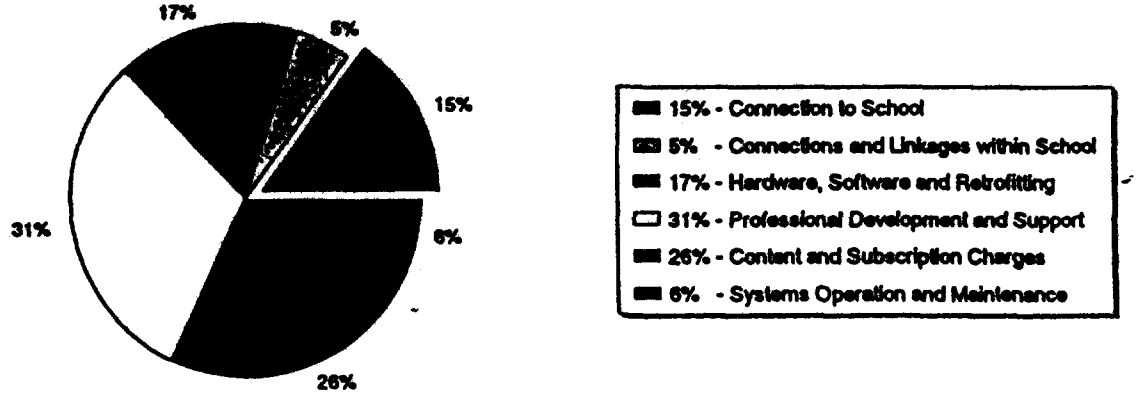
The attached pages show the estimated cost of deploying and operating a computer infrastructure in the nation's public schools under two different scenarios. A study performed in 1995 by the United States Advisory Council on the National Information Infrastructure shows that connecting schools to the public switched network is but one of many costs of equipping schools with computer technology. Depending on the "model" chosen for technology deployment, the cost of connecting schools would be between $770 million and $1.88 billion for initial deployment, and $600-980 million a year for annual operating costs, *not* including connections and linkages (i.e., inside wiring) within the school.

Cost of Deploying and Operating Computer Infrastructure
K-12 Public Schools - "Laboratory Model"

Initial Deployment Costs - $11 Billion



Annual Operating Costs - $4 Billion

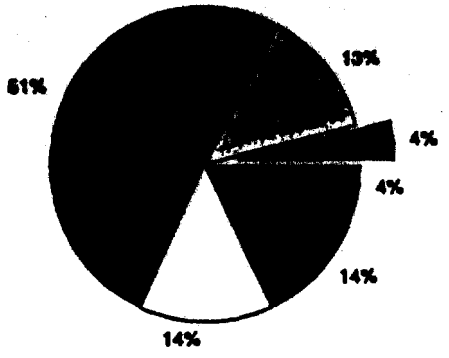


Single laboratory room in each school with 25 computers; ethernet LAN in laboratory; 10 telephone lines. Deployment accomplished over 5 years.

Source: KickStart Initiative; Connecting America's Communities to the Information Superhighway. United States Advisory Council on the National Information Infrastructure; 1995.

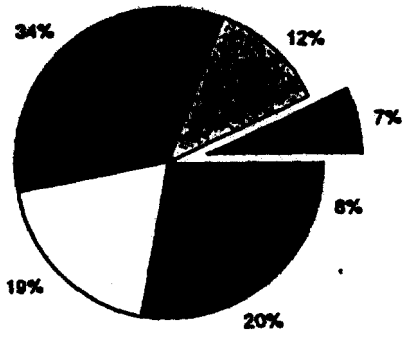
Cost of Deploying and Operating Computer Infrastructure
K-12 Public Schools - "Classroom Model"

Initial Deployment Costs - $47 Billion



- 4% - Connection to School
- 13% - Connections and Linkages within School
- 51% - Hardware, Software and Retrofitting
- 14% - Professional Development and Support
- 14% - Content and Subscription Charges
- 4% - Systems Operation and Maintenance

Annual Operating Costs - $14 Billion



- 7% - Connection to School
- 12% - Connections and Linkages within School
- 34% - Hardware, Software and Retrofitting
- 19% - Professional Development and Support
- 20% - Content and Subscription Charges
- 8% - Systems Operation and Maintenance

All classrooms have 1 computer per 5 students; ethernet LAN connecting all classrooms; T-1 connection. Deployment accomplished over 10 years.

Source: KickStart Initiative; Connecting America's Communities to the Information Superhighway. United States Advisory Council on the National Information Infrastructure; 1995.

Statement of Paul R. Milgrom

Attached to GTE's Comments in Response to Questions
CC Docket 96-45

I. Introduction

This statement presents a proposal to conduct a series of auctions to identify which firms should assume universal service obligations in each geographic area of the country and at what support level. A properly designed auction mechanism is a relatively quick, objective and straightforward market process that replaces more elaborate, subjective and opaque regulatory processes to determine the "who" and "at what price" of universal service support. What I suggest below is a flexible plan to implement auctions over time in those areas where circumstances permit their use.

As will be apparent from the discussion below, the Commission confronts a number of trade-offs in designing an auction. The comment period in the Commission's Notice is not sufficient for me to recommend to the Commission the optimal way of making those tradeoffs. For that reason, this statement should be considered an outline describing some of the main features that should be included in a COLR auction, rather than as a final, fixed proposal.

When there are two or more potential carriers of last resort (COLRs), auctions have several important advantages over industry cost models as a means of determining the support payments for meeting universal service obligations. First, an auction uses an actual market process to set support levels. That is desirable not only to avoid the controversies that inevitably accompany cost modeling and estimation but also because even the best cost models are both biased and incomplete as a basis for

setting support levels. Support payments based on cost models overestimate the actual level of support needed to attract a COLR when the LEC technology and facilities locations on which the models are based are not the least cost way to meet the COLR obligation. Also, when the LEC technology *is* the cheapest way to meet COLR obligations but competition in the provision of services is desired, support payments based on LEC costs may be too low to attract and sustain the desired competition, or perhaps any competition at all. Further, it is reasonable to assume that the firms' actual bids will be based on even more detailed cost estimates than could be reflected in an industry cost model and will be reduced to reflect the profit opportunities on any incidental or complementary services that the firm expects to sell along with basic services. No model that the Commission could plausibly implement would include so many factors or be based on such detailed cost analysis as the bids in an auction.

A second advantage is that auctions can determine how many COLRs should be supported and who they should be. Competition among potential COLRs can be of two kinds: "competition in the market" – in which several carriers accept COLR obligations and compete to acquire subscribers and the associated support payments – or "competition for the market" – in which companies bid for the right to serve as the exclusive COLR (or as one of a limited number of COLRs). "Competition in the market" is likely to lead to more innovative and responsive service to consumers and to reduce the severity of "hold up" problems that come from reliance on a single supplier. However, competition in the market can also result in duplicated facilities costs and burdensome support payments that necessitate imposing surcharges on other communications services. Competition "for the market" in a traditional auction can lead

to lower support payments as the bidders vie aggressively for the exclusive (or at least limited) right to serve as a COLR, reducing the burden on other services. Auctioning a fixed number of COLR designations would require the FCC to determine the fixed numbers: it must decide how many COLRs to authorize in each area. That determination would be a difficult and costly one for any regulator to make well because it would require extensive and reliable cost information and, possibly, market and technology forecasts.[1] By contrast, my proposal permits the number of COLRs to be an outcome of the auction itself, as auction participants place bids based on what will be inherently better cost information and on what they believe is the best information on future market and technological developments.

Third, by establishing actual market prices for universal service in the various service areas, the auction provides useful information to potential entrants. Market prices are useful for determining which markets may be ripe for entry and what cost targets need to be reached to make entry profitable in these markets. COLR auctions would also be likely to generate statistical information about service costs that the FCC might find useful in other proceedings and at other dates. For example, the FCC might use the auction results in markets with substantial competition to assess standards for LECs in regions where there is no competition.

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[1] I note that the recent Telecommunications Act appears to be largely premised on the presumption that the benefits of promoting entry will usually outweigh the costs, but the extent of entry will still vary among service areas and the auction design needs to be cognizant of that.

Another important advantage arises when service areas are re-auctioned over time, as I propose. A series of auctions allows the support payments to respond to changing technologies, population densities, and other factors. Probably, there will initially be some geographic areas in which only a single COLR operates but for which changing circumstances will eventually make competition among multiple COLRs feasible and desirable or in which reduced costs call for reduced support payments. The auction system can respond flexibly to changing circumstances, allowing entry to occur when the time is ripe and encouraging support payments to fall in tandem with the falling costs of service.

The auction proposal developed here calls for sealed tender auctions that would allow multiple COLRs to be selected if the several lowest bids are close enough together. The support levels would be the same for each COLR serving an area and would be set equal to the highest accepted bid.

This is a novel auction design, constructed to meet the novel challenges posed by the universal service context. While the FCC's simultaneous multiple round auctions have proved themselves to be effective for the spectrum sales with fixed numbers of licenses, I shall argue that such a design is less well suited to determine the extent of competition that should prevail among COLRs in each market area.

Section II of this statement examines theoretical considerations that apply in designing an auction to determine the amount of support and the level of competition simultaneously. Section III contains a specific proposal and a discussion of both the basic auction design and related practical details.

It is important to set realistic expectations about what a good auction design can and cannot achieve. Most importantly, auctions cannot resolve all the problems that may arise when there is a single facilities based universal service provider. If a single COLR with large sunk costs is the inevitable practical outcome in any particular geographic region, no auction, however cleverly it may be designed, can substitute for effective continuing regulation of the monopoly COLR.[2]

Second, an auction system cannot be effective unless the bidders have something to win. If one allows providers other than auction winners to provide basic service with support from the universal service fund, then that eliminates the bidders' incentives to bid for a low support levels,[3] leading to undesirable increases in the surcharge needed to fund universal service.

II. Principles of Auction Design for COLR Obligations

The COLR auction design problem is characterized by a number of special features that distinguish it from other government auction design problems. First, in contrast to the spectrum auctions, the market structure in a universal service auction

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[2] If an exclusive franchise is efficient but large sunk costs are not required, then there can be effective "competition for the market" each time the franchise is available for auction.

[3] An auction could conceivably be designed in which the winner receives a cash bonus but no advantage in the subsequent market competition. However, our analysis in section II implies that such a scheme is never optimal.

would vary from area to area, as determined by the auction results.[4] Consequently, the number of COLRs and the amount of support must be considered together in evaluating the performance of the auction. Second, to promote efficient competition among COLRs, it is desirable that the level of support in any area be the same for all COLRs. A "discriminatory" auction in which different bidders receive different levels of support, though useful in other settings, is to be avoided because such discrimination would distort subsequent market competition among COLRs.[5] Third, if the proposals to use very small, homogeneous service areas are adopted, then the number of universal service areas is likely to be very large, making the administration of a complicated auction potentially quite costly for both the FCC and the bidders. Fourth, there is enormous uncertainty about the initial level of interest in the various COLR service areas, making it important to design an auction that discourages collusion in case the number of interested bidders in many areas is just two. Finally, because the bidders are undertaking an obligation in exchange for a payment (in contrast to making payments to acquire licenses in the FCC's spectrum auctions), more attention must be paid to ensuring that bidders are qualified and motivated to perform as promised in the auction.

The mathematical analysis of this section accounts explicitly only for the first of these differences, but the way the mathematical results are applied takes some account

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[4] In the PCS auctions, the market structure was determined primarily by restrictions on the amount of spectrum that individual licensees are permitted to control. These restrictions were the same for all areas of the country.

[5] The US Treasury uses a discriminatory auction to sell T-bills, but the individualized prices in that auction do not distort subsequent competition because the bids become sunk costs before the buyers engage in resale.

of the second, third and fourth differences as well.[6] That is, we seek an auction design that is simple for the bidders and the administrators, that generates uniform levels of support for all COLRs in a market area, and that is resistant to collusion while still taking proper account of the benefits arising from competition after the auction among COLRs in the market.

To derive principles to guide the design of an auction for carrier of last resort obligations, I first consider a scenario in which there is just one region in which universal service needs support. The main problem in this scenario is to use the bids to determine how many COLRs there should be and what level of support to pay. The principal qualitative finding of the analysis is that the auction outcome should specify that the COLR obligation is shared only when the bidders' service costs are sufficiently close. This may be reflected by sufficiently close bids in a sealed bid auction. Of course, the detailed quantitative conclusions of the analysis, including how many COLRs to authorize for any particular cost or bid levels, depend on the detailed assumptions of the model, but the general conclusion reported here is sufficient to help us distinguish some poor auction designs from more desirable ones. For example, I find that multiple round auctions such as those used for the PCS auctions, even in the trivial case where there is just one COLR service area for sale, cannot generally implement the optimal

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[6] The last difference is a matter to be solved primarily by pre-qualification of the bidders and by specifying that the support payments are made on a per subscriber basis rather than by lump sums (at least when there is competition in the market). It is not a matter to be resolved directly through the auction design.

auction outcomes, but that certain sealed bid auctions can implement the optimal outcomes.

The theoretical analysis cannot specify how many COLRs should be assigned in any particular situation, but it can identify the relevant considerations. Generally, the number of COLRs should depend on the gains to increased competition in the ensuing market, the magnitude of the duplicated fixed costs (greater duplication favors fewer COLRs), the differences between the COLRs in the levels of their variable costs (smaller differences favor more COLRs), and the social loss associated with paying unnecessarily high support payments (larger losses favor fewer COLRs).

An Optimal Auction

I begin by assuming that there is just one region for which universal service must be provided (or where there are multiple regions but each is independent so that a commitment to serve one does not affect the cost of service in any other). The main problem is to use the bids to determine how many COLRs there should be and what support levels should be paid. Alternative auction designs are compared in this exercise in terms of a social objective which balances the desires (i) to encourage competition "in the market" in order to promote better and more innovative service to consumers, (ii) to have service provided by the providers for whom the actual cost of service is lowest, and (iii) to hold down the support levels that must be paid, since financing those supports distorts other economic decisions. The constraints in the problem are that the bidders are assumed to behave rationally, entering the auction only if they expect to

profit by doing so (the "*participation constraint*") and bidding to maximize their individual expected earnings given the strategies of the other bidders (the "*incentive constraint*").[7]

I make the simplifying assumption that the fixed costs of service are the same across bidders.[8] Also, at this stage, I assume that at least one COLR must be selected for each area.[9] The solution to this problem can be characterized using the methods of optimal auction theory.[10]

The optimal auction problem is to choose the rules and the behavior of the bidders, subject to the constraints described above, to maximize the following three-term objective:

Expected Benefits to Consumers

– Expected Costs Incurred by the COLRs

– α×Expected Support Payments to COLRs

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[7] That is, the strategies are assumed to form a Nash equilibrium of the auction game.

[8] This is not an assumption I make happily. I make it because it makes the analysis tractable and leads to intuitively sensible results. Also, the auction obtained from the analysis has at least some robustness: identical recommendations are obtained when the ratio of fixed to variable costs are the same across bidders.

[9] This assumption sets aside the question of reserves, i.e., maximum opening bids. As we shall see later, the franchises offered for auction are determined by a nomination process with a workable reserve determined as part of that process.

[10] Myerson, Roger, "Optimal Auction Design," *Mathematics of Operations Research* 6 (1981): 58-73.

where α is a parameter indicating the costs of distortions created by the support payments to the COLRs.[11] The benefit to consumers is assumed to be B_1 if there is just one COLR; B_1+B_2 if there are two COLRs, and so on, with B_n denoting the incremental benefit of introducing an n^{th} COLR to compete in providing universal service.

The analysis characterizes the optimal auction in terms of the outcomes that ensue. To avoid technical problems, we limit our analysis here to what the modern economic auction theory literature calls the "regular case."

Then, an auction design that always selects at least one winner is optimal if and only if its outcomes have these two characteristics: (1) bidders with sufficiently high costs cannot expect to profit from participating in the auction and (2) for any profile of actual costs, the set of bidders selected to be COLRs maximizes the expected benefits to consumers minus the expected costs incurred, minus α times a "*virtual cost*" (which is a theoretical construct consisting of the actual cost adjusted upwards to account for bidding incentives). If the bidders are otherwise symmetric, multiple COLRs are most likely when the low cost bidders' cost levels are close together.

One immediate implication of this characterization is that multiple round auctions, which the FCC has used successfully in other contexts, are not well adapted to this context. To see why, consider the simplest case with just two bidders. An efficient multiple round auction would then need to specify that a support payment near the

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[11] More exactly, the distortion is created by the surcharge or tax used to finance the subsidy.

reserve is paid to both bidders if the auction ends immediately after opening bids near the reserve. With such rules, it is often consistent with rational behavior by both bidders for neither to lower the bid below the reserve even if the two bidders' costs are very different and much lower than the reserve.[12] In plain English, a multiple round auction that tries to implement the efficient outcome rule is exceptionally vulnerable to both explicit and implicit collusion. Such collusion is undesirable because it would be likely to result in unnecessarily high support payments and the inclusion of inefficient COLRs among the winning bidders.

An auction design that does encourage efficient outcomes in case there are just two bidders is the sealed tender auction in which two COLRs are assigned if the second lowest bid is close enough to the lowest bid. The support payment may be set equal to the highest accepted bid (although, as we shall see later, other payment rules are also permitted by the theory). An important advantage of the proposed sealed tender auction compared to the multiple round design is that it creates a powerful incentive for each bidder to defect from any pre-auction collusive agreement by undercutting its rival's bid in order to acquire the exclusive right to receive support payments for COLR services.

This analysis implies that an auction can be used to encourage competition both *for the market* and *in the market* even when there are only two bidders. Of course, the idea can also be extended to apply when there are more than two bidders. For a simple

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[12] That is, strategies incorporating this behavior may comprise a Nash equilibrium.

(though unrealistic) example, suppose $B_2=B_3=...$ (meaning that the incremental benefit of additional competitors is the same for each extra competitor). Let us assume for the cost calculation that the COLRs would share the market equally. Then, in the optimal auction, the n^{th} lowest bidder should be included as a COLR only if the *n–1* lower bidders are included and the cost of the n^{th} lowest bidder does not exceed the average of the costs of the *n–1* lower bidders by more than a specified amount *c*.[13] In the interests of simplicity, one might use an "approximation" of this outcome rule by specifying that all bidders whose bids are within some amount *c'* of the lowest bid are included.

Generally, with more than two bidders, the form of the optimal auction depends on several things, including prominently the relative magnitudes of B_2, B_3, etc. On the basis of economic theory, it is reasonable to suppose that the benefits of additional competition decline as the number of competitors increase, that is, $B_2>B_3>B_4>....$ The theoretically optimal rule in this case depends on the likely market shares of the bidders as determined by their various costs. If one assumes that the COLRs will eventually have roughly equal market shares, the optimal rule would be to include the n^{th} bidder as a COLR if its cost is not too much higher than the average of the cost of the *n-1* lower cost bidders. As a practical approximation of the actual optimal outcome rule, one might set the outcome rule in an actual auction as follows.

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[13] If the shares are not equal, the relevant comparison is between the cost of the n^{th} bidder and the weighted average cost of the *n-1* lower cost bidders, weighted according to the number of customers taken from each bidder by the n^{th} bidder.

Case	*Condition*	*Outcome*
1	At least one competing bid is within 15% of the lowest bid.	All who bid within 15% of the lowest bid become COLRs.
2	No competing bid is within 15% of the lowest bid but one is within 25%.	The two lowest bidders become COLRs.
3	[illegible] bid is within 25% of the lowest bid.	The lowest bidder becomes the exclusive COLR for the area.

The parameters in this auction design – including the use of just three cases and the 15% and 25% cut-offs – are merely illustrative and not based on any detailed analysis. The illustrative rule shows how the auction is constructed to facilitate the presence of at least two actual COLRs in the market when the inefficiency from doing so, in terms of supporting a relatively inefficient competitor, are not too high. A more restrictive standard is set for including competitors beyond the second, because they are expected to contribute less to consumer welfare.

According to theory, the outcome rule described here could be used with any of several different payment rules without affecting the optimality of the auction. The payment rule, however, should be set to respect the other considerations not included in the optimal auctions model. For example, as described earlier, it is desirable to have the same level of support payments for each COLR, for that avoids creating distortions in the subsequent competition among them. One such rule would set each bidder's support payment at the level of the highest accepted bid. Yet another variation would

specify that, in case 3 only, the support payment would be set at the level of the second lowest bid.[14]

Each of these variations would change the bidders' strategic problem and lead to different levels of bids being submitted, making cost comparisons among the various rules appear difficult. One of the surprising conclusions of optimal auction theory, however, is that *contrary to simple intuition, the expected size of the support payments to the winners is unaffected by the form of the payment rules (among the set of payment rules that always produce the same set of winners).* A rough explanation for this conclusion is as follows: If one payment rule leads to systematically higher support payments corresponding to any particular bids than another rule, the bidders will offset that difference by submitting systematically higher bids for the rule that calls for the lower support payments.

In practice, the proposed auction would consist of a large number of simultaneous sealed bids for the job of being the COLR. The main difficulty with this proposal is that it fails to allow bidders to account fully for "*cost synergies*," that is, for the possibility that it is cheaper to provide COLR services in one market when they are already providing COLR services in related markets. Such synergies might arise because the related markets used shared switching, transmission or other facilities.

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[14] Another rule would specify that the support payment is the level of the highest accepted bid multiplied by 1.15 in case there are two winners and by 1.3 in case there are three or more winners. Again, the percentages are arbitrary and intended for illustrative purposes only. What is illustrated is that the payments can be made to depend on the number of COLRs selected.

However, permitting combination bids would add significantly to the complexity of the auction design, which is quite important given the possibly large number of small auctions to be conducted. To evaluate the potential benefits of combination bids, one needs to assess the importance of cost synergies.

The need for COLRs arises only in markets where it costs more to serve some potential subscribers than the established maximum basic service rate. If these high cost customers are subscribers who are distant from a town center, then the main cost complementarity may be between serving customers close to town and those at a greater distance from the town center. In that case, if service for the core town will be established anyway, then there are no important cost complementarities in serving two outlying areas bordering the town. If the core town will be served by the COLR in any event, then the model used to study the optimal auction adequately characterizes the basic auction design problem.

However, it may be the case that the bidder, possibly not the LEC, fails to win the COLR designation for the core town and rates for basic service are so low that support payments are required for service to all the potential subscribers in a particular town or other geographic area. In this alternative scenario, a firm's decision to provide any service to the area may depend on its ability to acquire business in the town core, or even throughout the related areas. If the relevant areas are the same for all bidders, one might try to avoid the problem by specifying larger areas for the universal service obligation. However, different customers within any large area may have very different costs of establishing service. That creates a problem as the COLRs avoid offering

service to the highest cost customers. This "cherry picking" problem is discussed in more detail in the next section. Even without cherry picking, if the areas with synergies vary among bidders, then the way the areas are carved up is another tricky problem that needs to be resolved in the auction. These cases, which may be called the cases of "*complex cost synergies*," are the most difficult ones for simple auction designs to treat successfully.[15]

My central proposal is based on the presumption that complex cost synergies are of secondary importance, especially in areas where there are to be multiple COLRs, and that it is not worthwhile to adopt the more complex auctions necessary to account fully for cost synergies. In my judgment, the complexity of the combinatorial auction in this context are even greater than was found to be the case in the PCS spectrum auction. Partly, this additional complexity arises from the need to provide uniform pricing in each separate market after the auction, and partly it derives from the very large number of small areas that need to be combined. This complexity suggests that such combinatorial bidding schemes should only be considered where the strength of the synergies means the likelihood of very inefficient outcomes from any non-combinatorial scheme is very high. Even in that case, one might first consider the use of a simultaneous multiple round auction, weighing the risk of collusion against the desire to allow bidders to assess the values of combining service areas.

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[15] In the paging, PCS, and SMR auctions, besides any cost synergies, there were important additional synergies from demand side effects. Buyers of PCS services, for example, find the service more valuable when the phone works over a wider

In the next section, to account in a highly imperfect way for cost synergies, I will propose a rule allowing winning COLRs to withdraw bids. The ability to withdraw bids allows the potential COLRs to avoid being forced to provide service in a patchwork quilt of geographic areas. These proposed withdrawals will be subject to penalties, as in the spectrum auctions, to discourage frivolous bidding.

III. The Proposed Auction Mechanism

In this section, I outline the major components of an auction for the COLR designation, motivated by the previous discussion of optimal auctions. The kind of auction I propose is in some important respects similar to the kind of auction that GTE has recently proposed to the FCC and other state PUCs.

In summary form, the auction would be conducted as follows. Auctions would be conducted twice annually on specified dates. For each *Census Block Group* (CBG), the FCC or state PUCs would first establish a maximum support rate (the "*reserve*") based on a multiple of the predicted cost under an adopted cost model.[16] A notice process in

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geographic area. In contrast, there appear to be no important demand side synergies in meeting universal service obligations.

[16] A multiple greater than 100% of the estimated cost should be used, with the extent of the mark-up dependent on the amount of error in the cost estimates. The mark-up is needed to compensate for "*selection bias*": auctions will be most likely to be conducted for those areas where the model overestimates the costs and will be least likely where the model underestimates the costs. Consequently, a simple 100% rule would leave the LEC receiving the model cost estimate most often when the model most underestimates the actual cost. A reasonable allowance for upward movement also needs to be made when an area is reauctioned to allow for changes that may increase costs over time, such as a change in the definition of the "core" service.

which potential bidders nominate areas in which they are interested in providing service would fix the CBGs for which COLR obligations are to be auctioned. Those making nominations would be required to establish their qualifications to satisfy the COLR obligation. If a party indicates an intention to bid on one particular area for an auction, other parties may nominate additional adjacent areas to auction with that particular area. On the auction date, sealed bids would be submitted indicating the support levels that the bidders require.

In the initial auction for each area, if there are no bids submitted at or below the reserve, the LEC is designated the COLR at an "official" support level determined by the FCC or state PUCs and based upon a cost model (such as the BCM or CPM).[17] This would be treated as if no auction had transpired and the area would remain eligible to be noticed for auction.

Once a new COLR (instead of or in addition to the LEC) has been established in any CBG, the obligations would be fixed for a period of three years, subject to performance standards. After the initial three year term, any qualified entity could notice the area for an auction. If no one notices these areas, then the incumbents would continue to receive the same level of support payments but without extending the period of protection.

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[17] If the LEC believes that the official rate is too low, it may seek a higher rate from the FCC or state PUC. Of course, the higher rate may encourage other potential COLRs to petition for an auction of some or all of the LEC's COLR service areas.

In order to mitigate the complex cost synergies problem described earlier, I suggest that any bidder be permitted to withdraw its bid from one or more areas. If a bid is withdrawn, the outcome of the auction will be determined as if the withdrawn bidder had never participated in the auction for that area. To discourage frivolous bidding and withdrawals, the FCC and/or state PUCs should establish withdrawal penalties similar to those adopted for the PCS auctions. The penalty might be equal to the larger of any increase in (e.g.) the twelve-month support obligation of the government as a result of the withdrawn bid or, say, $20 per subscriber in the CBG.

In what follows, I describe how these components will serve to ensure that the objective of providing universal service is efficiently attained.

a. The size of the service area.

It is very difficult, if not practically impossible, to define service areas that are homogeneous in terms of the costs of serving subscribers. Heterogeneous costs in a single service area lead to several costly effects. First, the COLRs may have an incentive to avoid serving the higher cost subscribers and to focus their marketing efforts solely on the relatively low-cost subscribers.[18] This problem is compounded when there is competition among COLRs, each of whom may hope to force its

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[18] In general, if an area is sufficiently homogeneous, the COLR will find this kind of discrimination unprofitable because (1) even a subscriber that is more expensive to serve than the average subscriber may make a positive contribution to covering the system's fixed costs and (2) when the heterogeneity is not too great, the cost of discriminating between relatively high- and low-cost subscribers may exceed the profit from successful discrimination.

competitors to serve the subscribers for whom costs are highest. Second, support payments distort competition between COLRs and non-COLRs to serve subscribers for whom service can be provided at relatively low cost. The more heterogeneous the costs of service in an area, the worse these problems are likely to be. Smaller service areas therefore tend to reduce these costs.

An additional advantage of small service areas is that different service providers can assemble groups of areas that fit their technological capabilities. Larger service areas that include geographic areas outside the reach of a potential entrant may dissuade the entrant from bidding.

In economic terms, the choice between small and large service areas is governed by a comparison of the costs of cherry picking plus the costs of the monitoring and regulation needed to mitigate it, the costs of conducting auctions for a multitude of small areas, and the tendency of large service areas to block entry by some service providers. GTE has proposed the use of CBGs (which are quite small service areas) to control the costs of cherry picking and its regulation. If adopted in combination with my proposal for relatively simple, inexpensive sealed bid auctions, the package would constitute a coherent and workable plan for developing market competition.

Question 58 in the Commission's Public Notice asks whether wire centers rather than CBGs should be used as the basis for cost projections. The considerations already discussed above suggest that wire centers have two disadvantages. First, they are relatively large, encouraging cherry picking. Second, they are a natural area only for the

incumbent LECs. A new entrant might be able to serve many CBGs but unable to serve the entire wire center, giving the LEC an artificial cost advantage in serving as the COLR. The use of CBGs would be technologically neutral because the definition of a CBG is unrelated to the provision of telephony. Thus, the use of CBGs would tend to avoid the possibility of biasing the auction outcomes towards one technology (or one incumbent).

b. One-shot sealed bids.

The simultaneous multiple-round auction format used in the FCC's spectrum auctions has a number of advantages. Foremost among them is that it permits bidders to take into account the possibilities of substitutability and complementarity among the licenses for which they bid and to adopt back-up strategies (for example, to acquire substitute licenses) in case their primary strategies fail.

In theory, the simultaneous multiple round format should be particularly good at accounting for substitutes, and the FCC experience has borne that out. In the paging auctions, for example, some bidders switched between bidding on the high capacity 50/50 licenses and the lower capacity 50/12.5 licenses during the auction to account for the changing levels of bidding activity. Similarly, in the PCS A and B block auctions, bidders frequently switched between the very similar A and B blocks, substituting between them. The simultaneous design also has important advantages over the sealed bid design in dealing with complementarities when those are important.