



**Communications Division**

# **Market Share Analysis of Retail Communications in California 2001 through 2009**

***Expanding Markets, Market Concentration,  
and the Impact of Merger Activity***

**March 10<sup>th</sup>, 2011**



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# MARKET SHARE ANALYSIS OF CONSUMER COMMUNICATIONS IN CALIFORNIA 2001 through 2009

## California Public Utilities Commission Communications Division

*“Market structure decisions require facts, not faith; intellect, not ideology; flexibility, not fixed notions.” The “central, continuing responsibility of legislatures and regulatory commissions” is “finding the best possible mix of inevitably imperfect regulation and inevitably imperfect competition.”* (Alfred E. Kahn, *The Economics of Regulation*, Vol. I at p. xxxvii; Vol. II at p. 114, 1970-71).

### Summary

In this White Paper we examine the market share of service providers by technology and report the level of concentration in California’s retail communications markets. We examine individual communications market segments by technology. The five individual modes are wireless voice, wireline voice, interconnected VoIP, fixed broadband and mobile broadband. We also examine service provider concentration by voice service and a total market inclusive of broadband. In this analysis we treat California as a single statewide market with consideration of parent company ownership and limitations of service provider availability. A state-wide perspective reveals aspects of *market concentration* different from an analysis of individual geographical pockets – an exercise currently under way as part of our agencies study of California’s market.

Assessing California’s retail communications market by technology type and on a state-wide basis offers several advantages. It allows us to:

- determine to which technologies California consumers subscribe;
- evaluate the extent to which wireless, wireline, cable and VoIP service providers compete for the same customers; and
- examine the degree to which corporate parents own and operate services across different technology platforms.

### Statewide trends become visible:

- **Intermodal competition reduces total market concentration.** The California communications market is most competitive when considering competition between and among technology modes. The shrinking traditional wireline telephone market has corresponded with growth in wireless voice subscribership and VoIP from providers other than the traditional wireline telephone companies. Consideration of substitution between services results in market concentration lower than when considering each technology mode individually.
- **Wireline telephone is the most concentrated of the individual technology modes.** Market concentration varies considerably among the technology modes, however they are all at or above levels considered moderately concentrated.

- **Market concentration remains evident.** The overall market is led by only two parent provider companies across all technologies. AT&T's and Verizon's combined market shares of all wireline telephone, wireless voice, broadband and VoIP subscribership totals 66% of all communications subscribership in California. Although there is possibly competition between a parent company's wireless and its wireline offerings, such cross-ownership is reasonably a cause of concern if it serves to limit consumer choice of services or service providers.
- **Mergers have increased the level of market concentration.**<sup>1</sup> Consolidation among wireline and wireless service providers has led to fewer providers, with the merged entities having increased their market shares. In years 2004/2005, four of California's top five providers were involved in mergers.

## Background

The CPUC's Uniform Regulatory Framework (URF) decision of 2006 found that wireless, cable and VoIP<sup>2</sup> voice services are close and/or direct substitutes for local wireline telephone service.<sup>3</sup> Further, the URF decision concluded that the potential entry<sup>4</sup> of competitors offering these services, combined with unbundling requirements developed by the FCC and the CPUC, represent sufficient competitive options to check the market power of the four largest incumbent local exchange telephone companies (ILECs), AT&T, Verizon, SureWest and Frontier. The decision determined, however, that "[t]here is an ample need for the Commission to remain vigilant in monitoring the voice communications marketplace in order to ensure that the market continues to serve California consumers well."<sup>5</sup> Accordingly, this White Paper updates the previously-issued Market Share Report of December 2008, and joins other monitoring reports on conditions in California's communications marketplace.<sup>6</sup>

'Market concentration' is the extent to which the largest company or companies in a market may dominate that market. Of regulatory concern is whether market concentration lead to an exercise of market power, with an excessive transfer of wealth from buyers to sellers and/or a misallocation of resources. Practically, this could mean consumers have fewer choices and/or pay too much relative to a fully competitive market.

While we evaluate market concentration in California, we do not identify whether market concentration has resulted in the exercise of market power and market abuse. We later discuss implications of market concentration and factors that may influence a service provider's ability to exercise market power.

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<sup>1</sup> This report is limited to an analysis of subscribership data and does not address other merger effects.

<sup>2</sup> VoIP (Voice over Internet Protocol) enables broadband users to send voice calls via Internet Protocol. More familiar examples include Vonage and Skype which allow users to send calls over the Internet. Digital voice service provisioned by cable service providers is also classified and reported to the FCC as VoIP.

<sup>3</sup> D.06-08-030, Findings of Fact 19, 20, 39, 44, 62 and 63.

<sup>4</sup> Ibid., Finding of Fact 61. The consideration of the threat of entry as a sufficient indication of competition is based on contestable markets theory, which states that such markets' "fundamental feature is low barriers to entry and exit; a perfectly contestable market would have no barriers to entry or exit." William J. Baumol, John C. Panzar, & Robert D. Willig (1982). *Contestable Markets and the Theory of Industry Structure*.

<sup>5</sup> D.06-08-030, Finding of Fact 73.

<sup>6</sup> Staff first published an HHI analysis in December 2009. In 2002 and 2003, in response to a legislative mandate to report on the status of competition and deregulation in the telecommunications industry, CD produced three reports documenting then-current trends and recommendations to the State Legislature: An update describing market share trends was prepared in December 2008. <http://www.cpuc.ca.gov/PUC/Telco/Reports/030326TelecommunicationsCompetition.htm>.

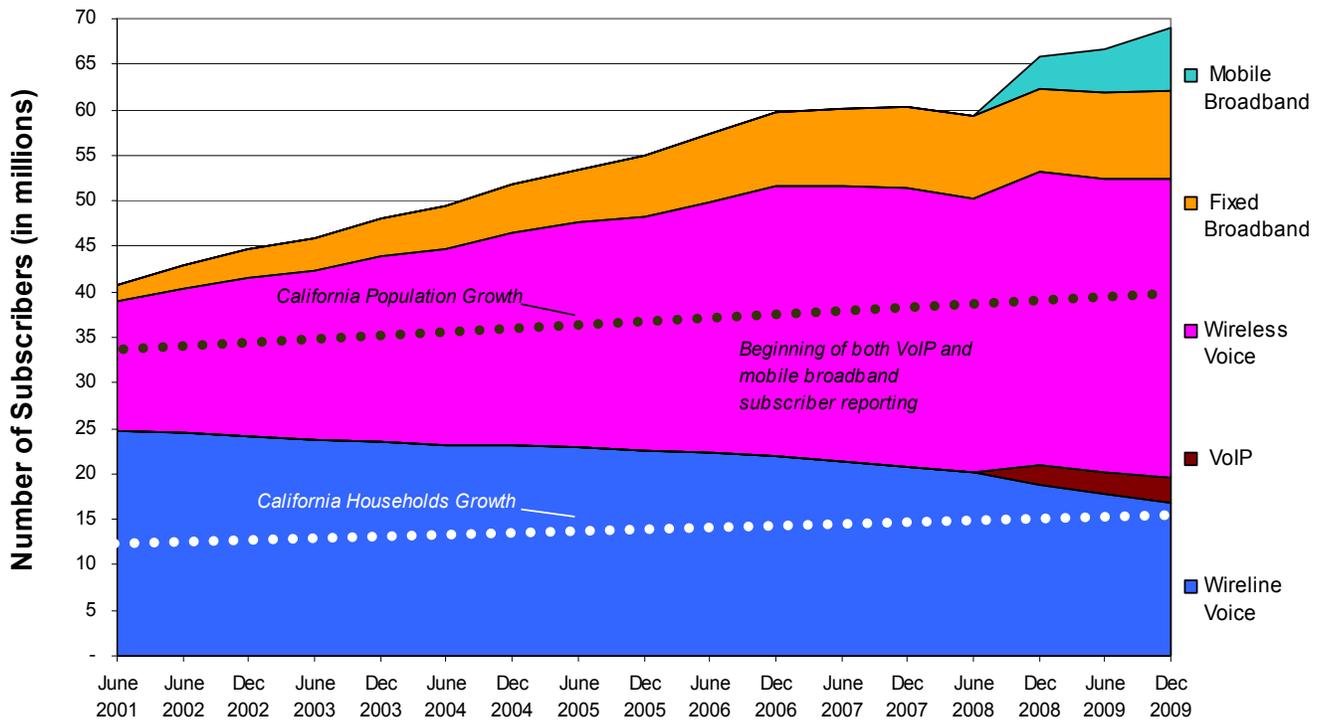
For purposes of our market share analysis here, we use retail service provider subscribership data reported on FCC Form 477, through December 2009, consisting of: (1) *wireline* telephone lines, (2) *wireless* voice subscriptions billed directly, (3) *VoIP* subscriptions interconnected to the public switched telephone network, (4) *fixed broadband* internet connections such as cable modem and DSL, and (5) *mobile broadband* subscriptions for wireless data plans associated with smart-phones and wireless cards. Appendix A contains a description of data used herein.

### California’s Growing Communications Market

Since adoption of URF, California’s retail communications market has continued to shift as customers embrace new technologies from new providers. Besides new services and devices, many households which had previously subscribed to multiple communications services from unaffiliated individual providers now purchase service bundles from a single provider or replace them with a single smart-phone device. For purposes of our analysis, we consider the total number of retail consumer subscriptions to be the total market. Chart 1 below shows the trends in the number of retail consumer subscriptions by technology.

Chart 1

#### Subscribership Trend of All Communications Services In California by Technology (in Millions of Subscribers)



In June 2001, traditional wireline telephone service represented the largest portion (about 61 percent) of the total communications market, whereas by December 2009 it represented the second largest share (about 24 percent). Over that interval the absolute number of wireline telephone subscriptions declined about 32 percent.

The subscribership trends are clear. Traditional wireline telephone service is shrinking in absolute terms and relative to the total market. Further, subscribership in all technologies but traditional wireline telephone service is increasing. It is important to note that while wireline subscribership is declining, overall household voice telephone subscribership has not declined. This fact is due to substitution to wireless and VoIP services from wireline.

As of November 2009, 96.7 % of households in California had some type of telephone service; this exceeds the Commission's universal service goal of 95 % telephone service subscription and is an increase over previous years.<sup>7</sup> The shift in household subscriptions from reliance solely on wireline subscriptions toward inclusion of wireless and VoIP services has not harmed universal phone service. However, staff found that 24% of California's households still rely solely upon traditional landline telephone service, and it remains an important service.<sup>8</sup>

## **Communications Market Findings:**

**California's communications market growth outpaced population growth.** Total market subscribership grew 72% between June 2001 and December 2009, whereas the state's population grew by 9.7% over approximately the same period.<sup>9</sup>

**Fixed and Mobile broadband connections have the highest growth rates.** These grew at an average annual growth of 55% since June 2001. In 2009, mobile broadband subscribership doubled in size with almost 7 million subscribers reported, and by December 42% of all broadband was mobile.

**Wireless voice is the largest portion of the market.** Wireless billed accounts grew at an average annual growth rate of about 16% since June 2001.

**Wireline is declining and is no-longer the largest subscribed technology.** Despite its decline, wireline represents the second largest subscribed technology.

Historically, the Commission's regulatory policies generally have focused on Incumbent Local Exchange Carriers and in particular the two largest carriers, AT&T of California (formerly Pacific Bell) and Verizon of California (formerly General Telephone of California). Chart 1 reflects extreme changes in the communications market. Such changes have caused policy makers to revise regulatory policies created for vastly different market conditions than exist today. Important policy revisions by the Commission and the Legislature, and the Federal Communications Commission and Congress include open entry policies for competitive service providers, removal of inter and intra-LATA regulatory barriers, removal of rate and economic regulation for competing services and providers, permitting Bell Operating Companies into the long-distance market, removal of most regulatory tariffs, removal of the cross-ownership ban between video and voice communications, creation of the state-wide video franchises, and efforts to make technologically neutral low-income access to subsidized phone

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<sup>7</sup> CPUC Residential Telephone Subscribership and Universal Service Report to the Legislature, December 2010. <http://www.cpuc.ca.gov/PUC/Telco/generalInfo/Universal+Telephone+Service+Reports+to+the+Legislature.htm>

<sup>8</sup> Staff Report to the California Legislature, Affordability of Basic Telephone Service, September 2010. [www.cpuc.ca.gov/PUC/Telco/generalInfo/2010AffordabilitySurveys.htm](http://www.cpuc.ca.gov/PUC/Telco/generalInfo/2010AffordabilitySurveys.htm)

<sup>9</sup> <http://quickfacts.census.gov/qfd/states/06000.html>

service. Further, policy changes are under consideration at the FCC that would treat broadband as a universal service and reform current universal service programs.<sup>10</sup> Regardless of the regulatory changes in the past two decades, two service providers, AT&T and Verizon continue to be the largest providers of retail communications services across the wireline, wireless, and mobile data technology platforms, though not across fixed broadband and VoIP.

#### Combined Market Share of Two Largest Service Providers by Technology Mode as of December 2009

- 87% of *traditional wireline* voice market was AT&T and Verizon.
- 64% of *wireless* voice market was AT&T and Verizon.
- 74% of *mobile broadband* was AT&T and Verizon.
- 54% of *fixed broadband* was AT&T and Comcast.
- 50% of *interconnected VoIP* market was Comcast and Time Warner Cable.

#### Combined Total Market Share of Two Largest Service Providers as of December 2009

- 68% of the total *voice* market (wireline, wireless and VoIP) was AT&T and Verizon.
- 66% of *all connections* in the market were AT&T and Verizon.

These market share data alone are not determinative of whether the market is unreasonably concentrated or results in the exercise of market power. Below, we explain methods used to assess market concentration and later discuss implications and factors affecting market power.

### Market Concentration by HHI Indicator

We use the Herfindahl-Hirschman Index (HHI) to assess the level of market concentration in California. The HHI measures a range of scores between 0 and 10,000 based on the sum of squares of the individual market shares. The higher the HHI, the more concentrated the market and vice-versa. A concentrated market is generally characterized by a score greater than 1800 and a moderately concentrated market is characterized by a score between 1000 and 1800 points.<sup>11</sup> (For methodology, see Appendix B)

Our analysis of HHI concentration by technology mode assumes choice is limited within the technology mode, and in the case of an intermodal HHI analysis assumes choice of services among technology modes.<sup>12</sup> For both of these analyses there are two mutually exclusive adjustments applied. First, to address concerns regarding cross-ownership, we analyze HHI market share considering parent company totals so that the data are inclusive of affiliated subsidiaries also operating in the state. We call this the *Parent Company Adjustment*.<sup>13</sup>

Second wireline, broadband and cable service provider territories are generally limited in size and do not overlap; often reflecting their embedded geographical segmentation from legacy franchise service territories. Today's AT&T retail wireline phone services generally do not compete with the Verizon

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<sup>10</sup> The CPUC is participating in these FCC proceedings.

<sup>11</sup> [http://www.justice.gov/public/guidelines/horiz\\_book/15.html](http://www.justice.gov/public/guidelines/horiz_book/15.html); <http://www.economicexpert.com/a/Herfindahl:index.htm>; <http://www.justice.gov/atr/public/testimony/hhi.htm>

<sup>12</sup> Arguably, for some small percentage of the population, there may be only one choice of communications technology available. However, for the vast majority of Californians, there exists more than one technology choice. The suitability of technology mode substitution is not addressed here.

<sup>13</sup> ILEC affiliates have provided services within a mode in addition to intermodal services.

retail wireline phone services.<sup>14</sup> Similarly, the TimeWarner cable retail fixed VoIP phone services generally do not compete in the territories served by the Comcast cable network where it offers fixed VoIP phone services.<sup>15</sup> Thus, we combine data; and treat ILECs as a single entity and cable companies as another single entity. We call this the *Territory Adjustment*.

Both adjustments are mutually exclusive and each has limitations. The parent adjustment is particularly useful for assessing overall market share owned by a parent company across technologies. However, due to the parent company analysis consideration of all provider services as being an equal competitive option regardless of actual serving territory the method overstates competitive choices and thereby results in biased-low HHI values. The territory adjustment corrects for this by summing the different wireline territory subscriptions and summing the different broadband service territories subscriptions. However, in doing so it is no longer possible to assess parent company ownership across technologies.<sup>16</sup> Thus, the territory adjustment understates parent company ownership when assessing the total market because each technology mode is considered a competitive option.<sup>17</sup> No such correction is necessary for wireless and non-affiliated VoIP providers as generally they offer service statewide.<sup>18</sup>

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<sup>14</sup> To underscore this point, the author attempted to subscribe to Verizon Home Phone and received the following response: “We are having trouble locating your address...” “... If the zip code listed below is correct, Verizon does not provide service in your area.”

<sup>15</sup> Author’s inquiry into Time Warner Cable service availability resulted in a website redirect to the local cable operator, Comcast. In both cases, author was unable to get service offered from the non-territorial serving entity.

<sup>16</sup> Not entirely true as some weighting criteria could be established to assign relative HHI share to parent companies, however such additional methodological step would add a questionable variable to outcomes.

<sup>17</sup> Consider whether current General Motors products Chevy, Buick, GMC and Cadillac compete with each other.

<sup>18</sup> Among wireless providers, geographical distinctions, if they exist, reflect a regional focus unrelated to wireline franchise territories. Wireless companies are usually national (or international) in scope (e.g., AT&T Mobility, Verizon Wireless (with Vodaphone of Germany), Sprint, T-Mobile-Deutsche Telekom), and other wireless companies, while they may have a regional reach, provide roaming services to their customers that extend beyond these geographical focuses.

## HHI by Technology Mode

Chart 2 below shows HHI concentration by technology; wireline, wireless, fixed broadband, mobile broadband and interconnected VoIP. Some companies have or had affiliates offering similar services within a mode and the HHI parent company ownership calculation adjusts for such. Note that the VoIP category corresponds with an increase in wireline HHI in December 2008. Previously, Comcast and Time Warner Cable offered a service categorized as wireline. The VoIP category was created nearly coincident with the Comcast and Time Warner Cable migration from offering a wireline service to VoIP service.

Most importantly, Chart 2 shows the wireline mode having the highest concentration trend, which is over two times higher than fixed broadband and wireless. Further, the largest increase in HHI concentration in wireline is coincident with the AT&T/SBC merger in 2005, and in wireless is nearly coincident with the AT&T Mobility-Cingular Wireless merger and the Sprint-Nextel merger. The HHI for wireless voice accounts decreased after 2001 but then rose in December 2004 and December 2005 due to the respective mergers.

Chart 2

### HHI Market Concentration by Technology Adjusted for Parent Companies

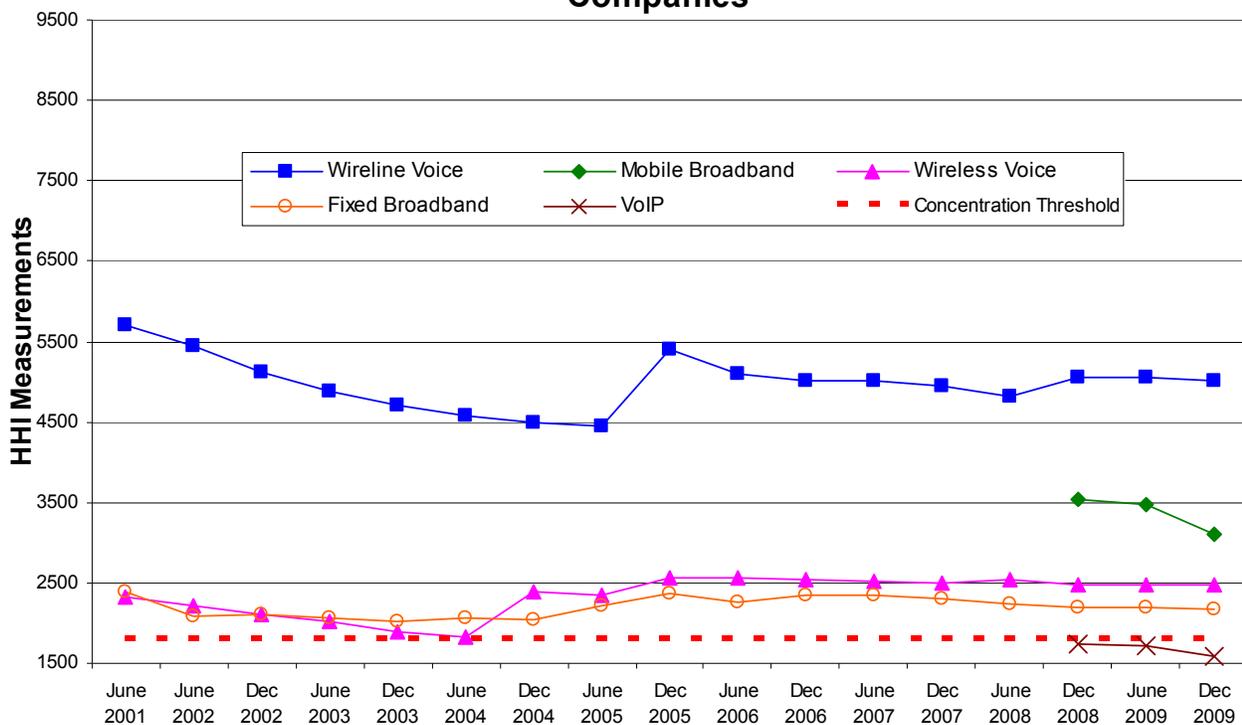
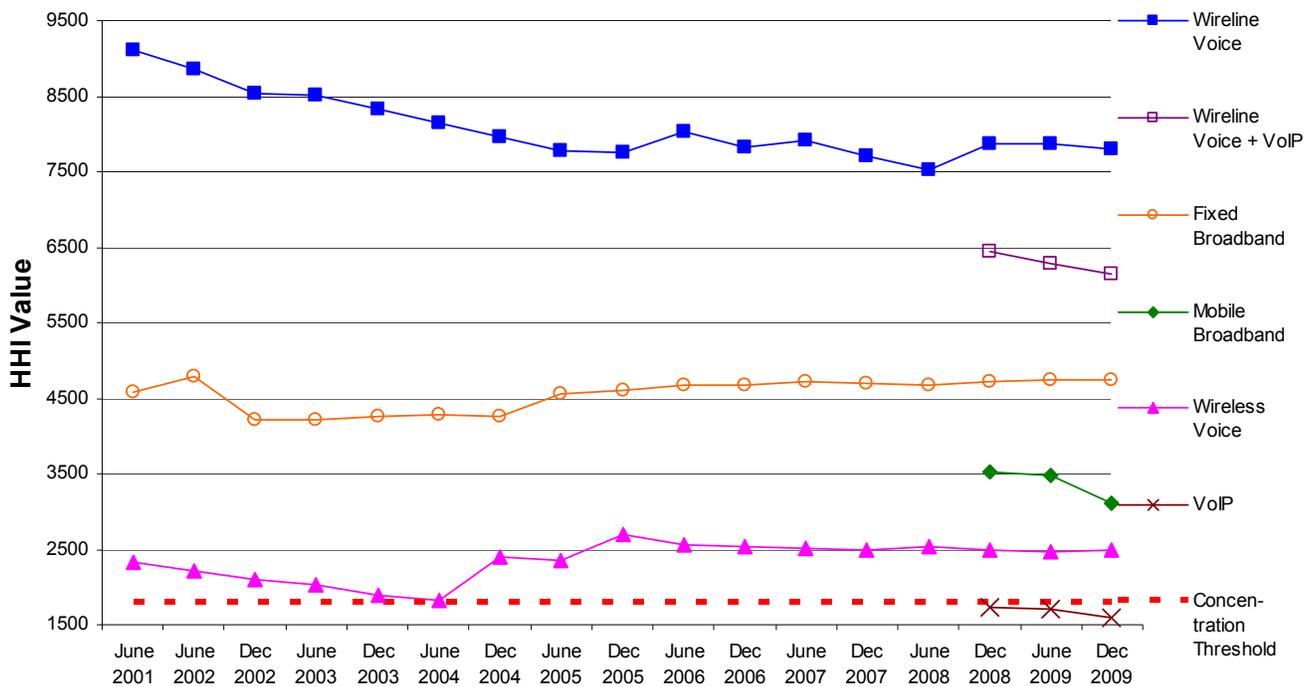


Chart 3 below represents HHI concentration using the Territory Adjustment. Because ILEC data are combined, the wireline HHI increased about 60 percent over the prior Parent Analysis. Similarly, the fixed broadband market concentration increases over 100 percent above the Parent Analysis, with the HHI hovering above the 4,500 level. In this case, concentration reflects primarily the market shares between the combined cable entities versus the combined ILECs entity. Regardless, the fixed broadband mode concentration remains less than the wireline mode but is now more concentrated than wireless. We believe this analysis superior to the parent company adjusted analysis because it better reflects statewide concentration within each market segment.

Chart 3

**HHI Market Concentration by Technology  
Adjusted for ILEC and Cable Service Territories**



## Technology Mode Findings:

**Most individual communications technology modes are HHI concentrated.** Except for interconnected VoIP, each technology mode exceeds the 1800 point concentration threshold.

**Wireline is the most HHI concentrated, having a *declining* trend partially offset due to mergers.** The HHI for wireline voice was declining after 2001, but then increased after the 2005 SBC merger with AT&T, and the 2006 Verizon merger with Worldcom. In December 2009, there were **76** providers reporting.

**Wireless has low HHI concentration but mergers increased concentration.** There has been very little volatility in HHI concentration following the mergers. In December 2009, there were **15** providers reporting.

**VoIP is not HHI concentrated.** VoIP's HHI is the only individual communications technology in California to score below the 1800 HHI threshold for a 'concentrated market'. In December 2009, there were **106** providers reporting of which 38 reported fewer than 100 subscribers.

**Fixed Broadband, territory adjusted is HHI concentrated and exceeds wireless.** The HHI for fixed broadband shows little volatility since 2005. In December 2009, there were **102** providers of which **57** of these report residential subscriptions.

**Mobile Broadband HHI concentration is declining.** Mobile wireless capable devices were first reported in June 2005 and for several years had only two service providers in the state. In December 2009 there were **7** providers reporting.

## HHI by Intermodal Voice and Total Market

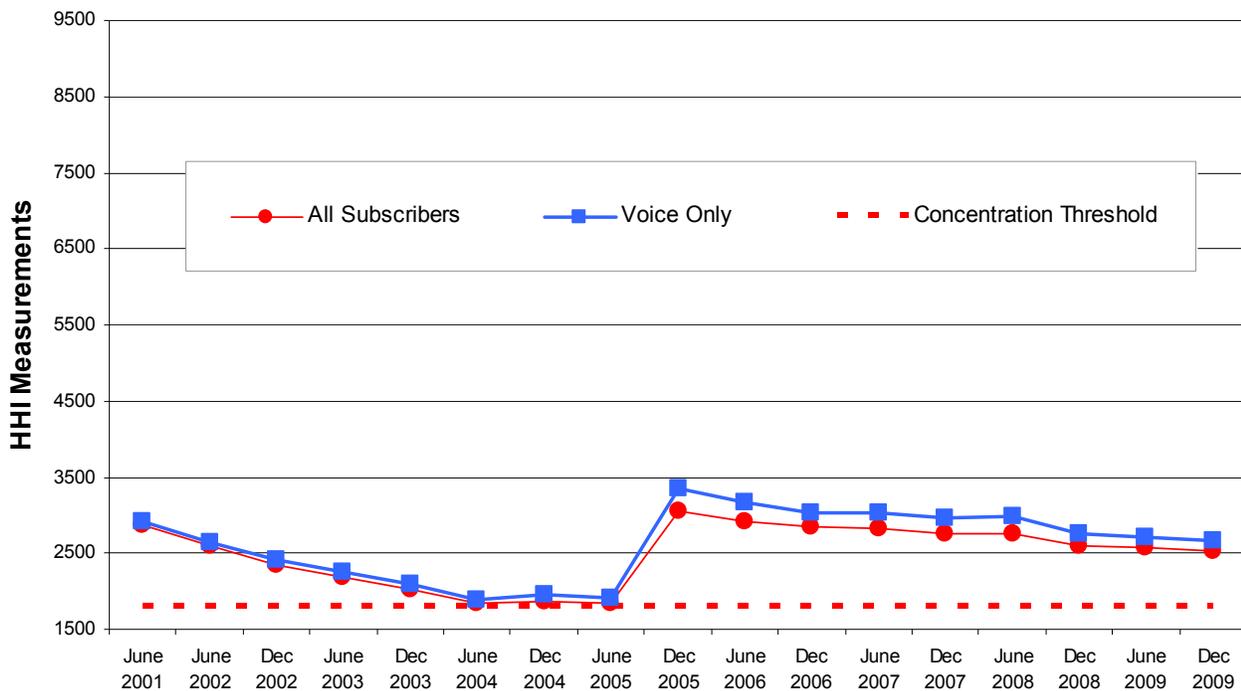
For our statewide total market analysis by parent company the retail data of the parent and its affiliated companies are summed. Thus, for the Parent Company Adjustment AT&T's affiliated wireline, wireless and broadband services are treated as an offering of one entity.

The chart below shows HHI scores for voice service related subscribers and the total market adjusted for parent company ownership. The voice category includes landline, wireless and interconnected VoIP subscribers, whereas the all-subscribers (total market) category also includes mobile and fixed broadband subscribers. (See Appendix A for data) We provide the HHI for voice services which exclude fixed and mobile broadband to address concerns about broadband not being a direct substitute for voice services, though arguably for some it is.

Of note is (1) the general decline in total and voice market trends offset by merger activity, (2) the closeness in the two lines and (3) the two lines relatively lower HHI values compared to the wireline or broadband markets shown in previous charts. Because the parent adjusted method combines ownership among technologies, the mergers occurring in the mid 2005 weigh heavily in the result and competition between wireless and wireline services offered by the affiliated companies is not considered.

Chart 4

### HHI Market Concentration for Intermodal Voice and Total Market Adjusted for Parent Companies

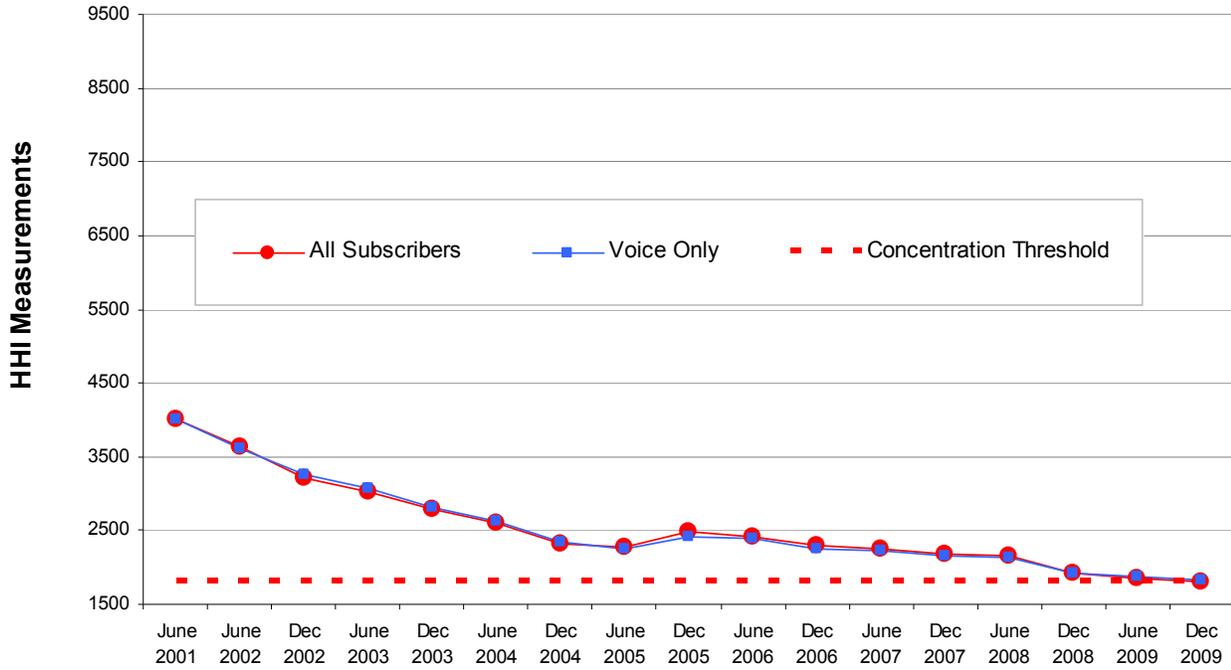


As previously described for the Territory Adjustment, retail data was adjusted to reflect the limited territorial offering of certain wireline and broadband service providers. In the territory adjusted total market analysis, all technologies are treated as direct substitutes regardless of ownership.

Chart 5, below shows that the HHI concentration for both the intermodal voice market and total market are nearly identical. (See Appendix A for data) Of interest is (1) that the total market concentration is much lower than in any of the prior analysis, (2) that merger activity had a small overall market impact and (3) that the market is showing a nearly continuous decline in market concentration approaching the 1,800 concentrated market thresholds.

Chart 5

**HHI Market Concentration for Intermodal Voice and Total Market  
Adjusted for ILEC and Cable Service Territories**



We believe the territory analysis is superior to the parent company analysis for purposes of measuring intermodal competition. However, we again caution that the analysis assumes full substitutability of the technology modes.

## **Intermodal Market Findings:**

**Intermodal analysis indicates less HHI concentration due to substitution.** The HHI scores for the voice and total market are less than the individual wireline mode. Intermodal substitution results in a leveling of the market; as wireless, VoIP and broadband grow, there is less concentration and increasing shares among individual service providers. Wireless growth appears to be the largest factor affecting a intermodal HHI concentration.

**Defining the market affects outcomes. When considering parent company ownership, there is a declining trend in market concentration; however merger activity has erased most of that decline.**

**When adjusting for territory the intermodal analysis shows a consistent decline in HHI toward the concentration threshold.** Merger activity impact is greatest when considering parent company ownership. Between periods June 2001 and June 2004 there is a decline in market concentration. The decline in concentration is erased by the merger activity occurring in 2005. However, post merger there continues a declining trend in concentration, with December 2009 concentration slightly less than in June 2001. When using the territory adjustment, the concentration values decline because merger activity has a relatively smaller intermodal impact.

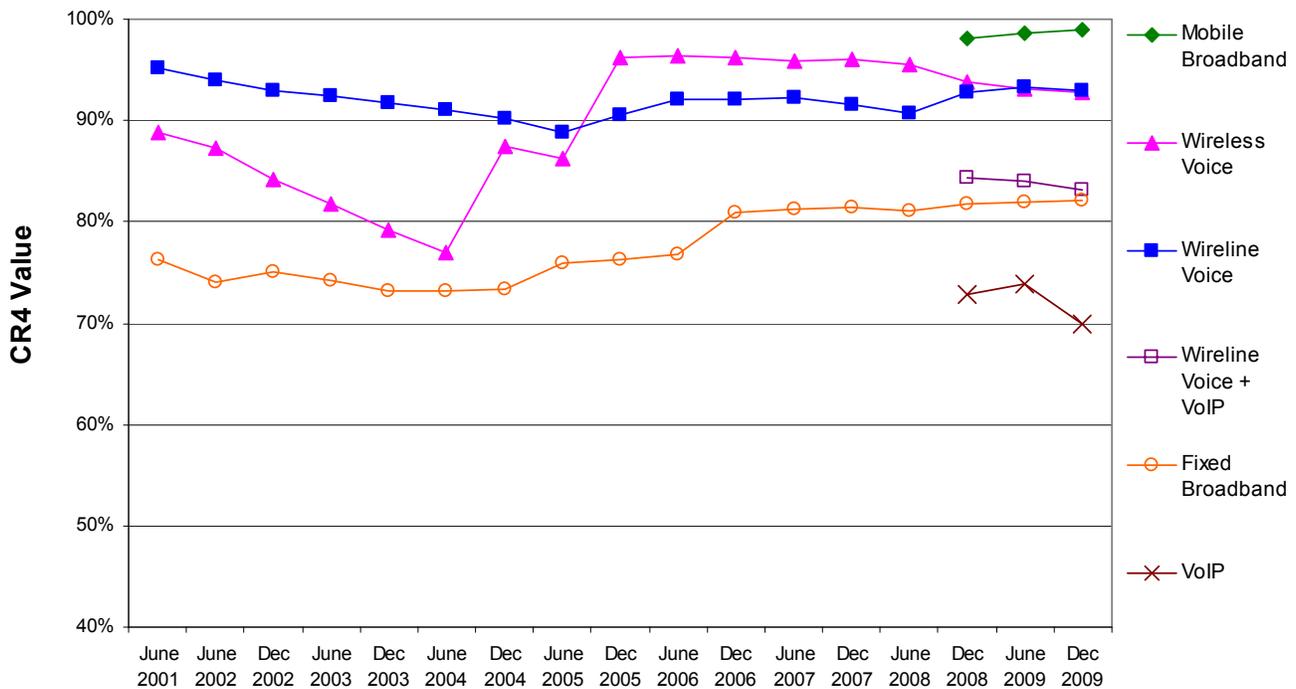
**Voice and Total Market trend closely.** For both the parent and territory adjustment, the voice market and total market concentrations are very similar. As of the December 2009 data, there were **204** separate providers reporting in the total market. In December 2009, there were **163** providers reporting retail voice subscriptions; 88 of these report residential subscriptions and 44 reported fewer than 100 total subscribers.

## Market Concentration by Four-Firm Concentration Ratio

The Four-Firm Concentration Ratio method provides another method to assess concentration.<sup>19</sup> A market CR4 ratio is calculated by simply adding the percentage market shares of the four largest firms in a given market. The combined ratio does not consider the remaining market providers, regardless of how many there are in that particular market. The higher the CR4 measure, the more concentrated the market, with four firms serving a larger share of the customers. A concentrated market is generally characterized by CR4 ratios greater than 40% and a highly concentrated market is characterized above 70-80%.<sup>20</sup> The chart below displays CR4 data in graph form by technology. (See Appendix A for data).

Chart 6

### Four-Firm (CR4) Market Concentration by Technology Adjusted for Parent Companies



<sup>19</sup> The CR4, Four-Firm Concentration ratio is described in Appendix B. In Mark Hirschey's words, "When concentration ratios are low, industries tend to be made up of many firms, and competition tends to be vigorous. When concentration ratios are high, leading firms dominate and sometimes have the potential for pricing flexibility and economic profits. The Herfindahl-Hirschmann Index (HHI) is a measure of competitor size inequality that reflects size differences among both large and small firms." Hirschey adds, "From the public policy perspective, competitive forces must be understood if the rules governing the competitive process are to maximize social benefits." *Managerial Economics*, 12<sup>th</sup> Edition. Cengage Learning, 2009, p. 536.

<sup>20</sup> The various CR measures of 2 or more firms are somewhat arbitrary. For a discussion of concentration ratios, see; <http://info.umuc.edu/mba/public/AMBA607/IndustryStructure.html>; and <http://www.economicexpert.com/a/Concentration:ratio.htm>

## CR4 by Technology Mode Findings:

**All technology modes are concentrated.** For each technology mode in California over the entire period from June 2001 through December 2009, the CR4 ratios exceeded 70% – that is, well above the 40% “oligopoly”<sup>21</sup> threshold. In fact, the average CR4 measurement for all technology modes during this period is 86.4%. Interconnected VoIP is the least concentrated mode.

**Wireless concentration rose dramatically post mergers.** The wireless CR4 values decreased through June 2004 and rose sharply from 77% to 99% following the merging of Nextel and Sprint, and AT&T’s acquisition of Cingular Wireless. The CR4 results show that wireless concentration exceeds that of wireline and peaks near 100% following merger activity. The wireless CR4 has since moved slightly downward to 93%. Nevertheless, four providers dominate this service mode.

**The fixed and mobile broadband modes each show increasing concentration since 2004.** The fixed broadband mode could have increasing concentration partly due to the offering of service bundles. This hypothesis would benefit from further exploration utilizing other data sources.

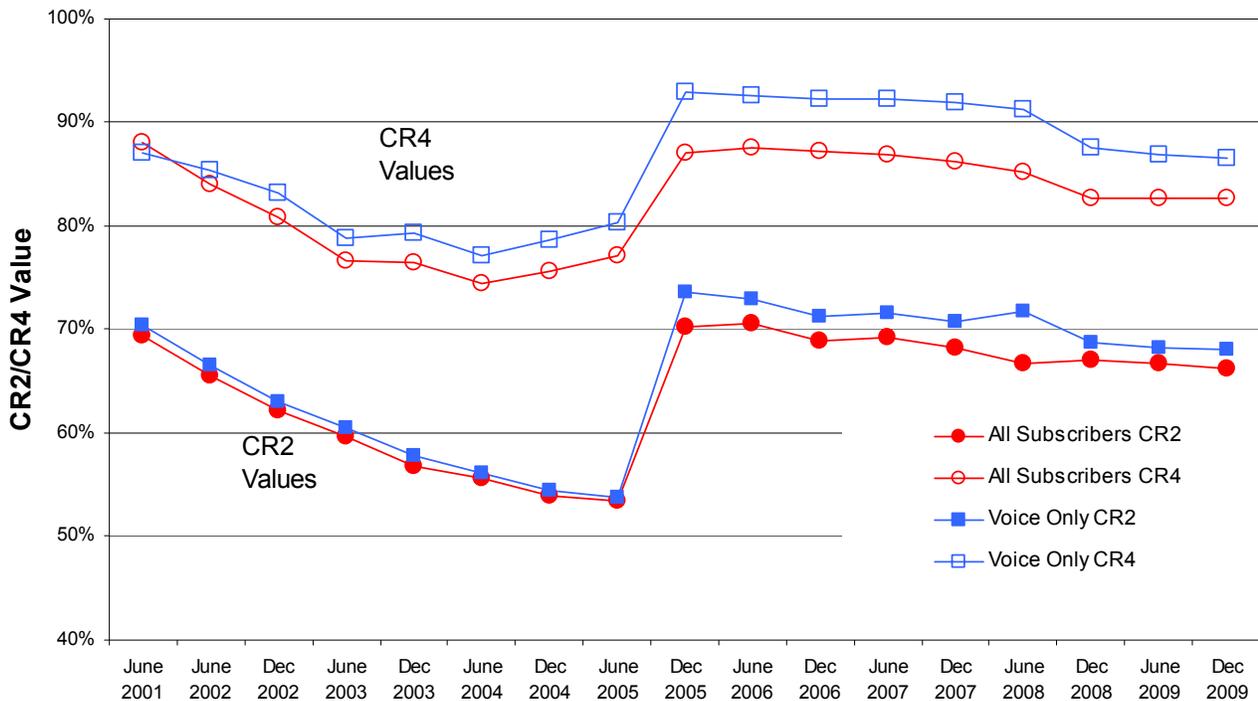
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<sup>21</sup> An oligopolistic market or industry is one in which a few firms account for a large share of the industry’s output and where action of one provider can influence other providers in the market. <http://en.wikipedia.org/wiki/Oligopoly>

Chart 7, below, shows the CR2 and CR4 values for both voice services and the total market. The CR2 values are calculated using the combined market share of the largest two service providers, adjusted for parent company ownership across the technology modes. Similar to the parent adjusted analysis used for the preceding HHI analysis, parent company ownership of wireline, VoIP, wireless and broadband services are combined into a single parent entity market share.

Chart 7

**CR2 and CR4 Market Concentration for Intermodal Voice and Total Market Adjusted for Parent Companies**



**CR2 and CR4 by Voice and Total Market Findings:**

**The Market is dominated by two providers.** For December 2009, 68% of the combined voice market and 66% of the total market is served by two service providers. The next two largest service providers serve only an additional 7% and 6% of the market respectively.

**The CR2 values are consistently below the CR4 values.** It appears that the difference between the two CR values do not substantially change over time, which suggests that market share “positioning” between the top two and top four market service providers is fairly constant. For example, the variance between the lines is not substantially different pre-merger from post merger. The average variance is 20.9 pre-merger, and 19.9 post-merger.

**The voice market and total market track closely together.** Although, beginning December 2005 the variance between voice and total market diverges slightly more, there is slightly less concentration when broadband is included. For December 2009, 68% of the intermodal voice market subscribers are served by the two largest service providers and 87% are served by the four largest providers. The respective

values for the total market are 66% and 83%. Thus, the total market concentration is similar to the voice market.

## Implications of Market Concentration

Our analysis indicates that concentration exists in all but the interconnected VoIP communications technology modes. Further, concentration is greatest in the wireline mode, and concentration exists but at a much lower level in the voice and total market. The imperfect market condition may be best summarized as oligopolistic, where a small number of firms compete.<sup>22</sup> However, these findings do not provide evidence of market power.

In this paper, the HHI and CR are used solely to evaluate relative market concentration over time. This is reasonable because;

*“...Market power is a dynamic issue, which cannot be entirely represented by such static measure as HHI. Consequently, it is not possible to establish a clear value below or above which market power exists for any concentration index. The greatest usefulness of this index is as a relative market power indicator.”*<sup>23</sup>

Market power is the ability of a firm to alter the market price of a good or service to the detriment of consumers. In an oligopolistic market having a few dominant providers, market power can take the form of tacit collusion to sustain high prices. However, this is not always the case as ripe circumstances for collusion do not always result in its practice. As one study illustrates:

*“...tacit collusion relies to a large extent on firms’ conjectures about the future reactions of their competitors to their pricing or production decisions. For this reason there is not one but many potential forms that collusion may take for a given market structure, defined in terms of firms, products, costs and demand. Whether a particular form of coordination occurs or not depends on managers’ perception of the industry, which can be to some extent subjective or manipulated by specific participants. Thus, even in situations where collusion is indeed sustainable, firms may still end-up “competing” in each and every period if they expect their rivals to do so: the fact that firms could sustain collusion does not mean that they actually succeed in doing it; firms may well compete in each period as if it were the last one, even if there exists another equilibrium in which they could maintain monopoly pricing forever.”*<sup>24</sup>

Further, although markets may be concentrated, market participants may compete for market share resulting in lower prices. Such was the finding in an evaluation of concentrated markets by Vaughan Dickson.

*Increasing concentration industries are more likely the ones where leading firms have lowered prices to gain share, while decreasing concentration industries are more likely the ones where smaller firms have lowered concentration by lowering prices. An additional conclusion is that the cost-reducing effects of changes in concentration are greater for increasing concentration*

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<sup>22</sup> The market outcome in an oligopolistic market is explained via game theory and is contrasted with other imperfect market scenarios. See <http://www.unf.edu/~traynham/ch14%20edited%20lecture.pdf>

<sup>23</sup> See: A History of Mergers: Theory and Regulations, Jura Liaukonyte, Spring 2007, page 6.

<sup>24</sup> Collective Dominance and the telecommunications industry, Patrick Rey, University of Toulouse, September 7, 2002, page 20.

*industries, meaning that increasing concentration industries have lower price increases compared to decreasing concentration industries.*<sup>25</sup>

Our previous analysis indicates that when considering intermodal competition, the communications industry is declining in concentration. Dickson's study found that in decreasing concentration markets, the dominant provider is not the one to decrease prices. If there is market share loss in a concentrated industry such as wireline telecommunications, it is likely due to competition via substitution product providers. Extrapolation of these findings to the communications market suggests that price decreases in the incumbent's traditional wireline phone service offerings are not likely.

The issue of incumbency is important, and is complicated by regulatory policies themselves that promote avenues for potential collusion. Thus, the cause of market power may be difficult to determine when;

*“...the need for mutual interconnection among competitors and the required cooperation that these interconnection agreements involve also creates some danger for the effectiveness of competition between mature operators. First, they provide one more way in which competitors interact, thereby creating more scope for retaliation and thus for collusion. Second, incumbents may collude in the terms they propose to new entrants, in order to protect their incumbency advantages. In addition, incumbents that collude – or take advantage of their own bilateral agreements to maintain soft competition, as stressed below – have actually higher incentives to keep entrants out, since their arrival could endanger collusion and restore more effective competition. Third, and perhaps more importantly, interconnection agreements have a direct impact on the operators' perceived costs, and thus exert a direct influence on their pricing decisions, as well as on their decisions concerning new capacity investments, technological choices, and so forth. But then, operators can design the agreements so as to soften competition.”*<sup>26</sup>

There other factors that may simultaneously constrain or encourage market concentration. We describe below some of these factors.

### **Factors increasing market concentration:**

**The bundling of services increases market shares.** Parent company ownership of multiple types of service provides bundling opportunities to increase market share in the total market. The bundled offering of broadband with voice services is not discernable in the 477 data. Thus, it is not possible to assess cross-elasticity of demand between voice and broadband modes and to test whether, through bundling, to what extent a dominant provider may increase market share in another communications mode.

**Regulatory barriers can constrain competitors.** Regulatory processes that limit competitive access to rights-of-way can be a significant entry barrier, e.g., environmental regulations, and local permit

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<sup>25</sup> Vaughan Dickson, “Concentration history and market power in US manufacturing industries”. *Applied Economics*, Vol. 39, No. 16 (September 2007), pp. 2049-2055.

<sup>26</sup> Ibid, page 28.

processes that limit entry or outright deny placement of a competitor's network facilities. Further, scarce right-of-way resources that are hoarded or that are prohibitively expensive can be significant network barriers, e.g., spectrum allocation auctions where the winner takes all.

**High capital costs and economies of scale can impede competition.** In the case of California's communications retail market, one can hypothesize increasing returns to scale<sup>27</sup> and economic barriers to entry as potentially being the most significant reason for market concentration *and* market power within an individual market segment. Communications networks can have high capital costs, and smaller firms may find it difficult to replicate and compete in the network side of the business. It is understandable that over time individual markets relying on these networks become dominated by a few large firms.<sup>28</sup> This hypothesis is strongest when applied to individual market modes such as in the wireline and broadband markets. However, when considering a total market where underlying networks are provisioned by multiple providers, and where there is service convergence, intermodal competition and substitution, then the barrier to entry hypothesis is somewhat weakened. Further, regulatory telecommunications resale requirements and collocation have somewhat muted the cost of network development, thereby reducing network barriers. Regardless, replicating existing networks remains costly.

### **Factors decreasing market concentration:**

**Innovation challenges incumbent technology.** Theoretically, market power can be sufficiently kept in check via a contestable market when entry barriers are low.<sup>29</sup> Because the market is dynamic, market power may be short lived for the leading technology provider as it may lose market share to an innovative rival product or provider offering a disruptive technology. Disruptive technologies might include VoIP, Skype, Twitter and other social media related communications applications available via the Internet. Unique products tend to exist only in short run as they are eventually subject to close substitute products, e.g., the "iPhone" was tied for a few years to AT&T Mobility, and now is available on the competing Verizon network. And Android is available on competing networks and competing devices.

**Intermodal competition challenges incumbent services.** Wireless can replace the wireline function, especially for those consumers who perceive wireless mobility as superior to wireline's better call quality. Cable modem competes directly with DSL and T-1s, and fixed broadband can compete with mobile broadband. There are fairly homogeneous products with some differentiation, e.g., smart phones differ by operating systems, size, yet offer similar service. Similarly, fixed broadband technologies offer similar service, though speed may differ. The removal of regulatory barriers, in the form of regulated franchises that prevented entry has had a positive effect, but for residential and small business wireline competition has been short lived and small.

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<sup>27</sup> Returns to scale means revenue per customer, generally enabled by lower costs per customer. For communications access service providers, cost per customer goes down when there are more customers served in a particular geographic area. For example, a cable running the length of a city block has the same cost regardless of how many subscribers that provider serves. Since the cable is already there serving existing customers, additional customers on that block means more revenue but not higher costs, thus increasing the return to scale.

<sup>28</sup> Krugman & Wells, *Microeconomics* 2d ed. (Worth 2009), accessed at wikipedia.org April 29, 2010

<sup>29</sup> See Baumol, Panzar and Willig, 1982. A contestable market can attract competitors because the costs of entry and exit are low and variable costs are comparable.

## Conclusion and Recommendation

Given the parent and territory adjusted HHI, and the CR calculations that we have reviewed, we conclude that a significant degree of concentration characterizes individual technology modes, primarily wireline and to a lesser degree the fixed broadband communications market. However, when considering the intermodal voice and total market, over time the level of concentration declines nearly enough to pass below the concentrated-market threshold.

Mergers of the last decade were a major occurrence that caused concentration levels to increase in the wireline and wireless technology modes. Any future mergers would likely have a comparable impact and should remain a concern. Regardless of the past mergers, the intermodal analyses adjusted for parent company ownership or when adjusted for territory still yield much lower levels of market concentration than consideration of the wireline market alone.

While evident that the communications market is experiencing technological and temporal changes in market share, the dynamics of competition vary depending on the technology mode of interest. Wireline is highly concentrated whereas wireless is much less so. The Commission's regulatory policy relies upon intermodal competition as the foundation of its consumer choice policy. This is appropriate because competition among all technology modes via intermodal substitution and new innovative applications benefit consumers in the form of reduced market concentration, potentially reducing the opportunity for dominant providers to exercise market power. However, when considering parent corporation cross ownership, the benefits of intermodal competition may be reduced if the declining share of one technology (wireline) is simply replaced by the offerings of the affiliated substitute (wireless) technology. As Mark Hirschey in *Managerial Economics* has observed, "In oligopoly markets, a large percentage of *the overall market* is taken up by a few leading firms."<sup>30</sup> Such conditions may lead to oligopolistic behavior and the exercise of market power.

We conclude that the HHI and CR analysis presented here is not determinative of the existence of exercised market power. Because market concentration does exist, the Commission's pledge to monitor the state's communications market is appropriate. The Communications Division on December 16, 2010, committed in a Commission meeting to monitor market price and to report quarterly to the Commission. Should circumstances warrant, staff will propose appropriate regulatory action to the Commission.

In addition to measures of changing concentration, future analyses should consider how price and service quality fare in this marketplace. In particular, the Commission staff will report to the Commission by end-of-year 2011 on how competition and concentration manifest themselves in geographical dimensions where customers choose services based on availability in their particular location. Concentration and market power cease to be abstract issues for the consumer when a decision as to service at a particular price in a particular location under particular terms and conditions presents itself. From the policy-maker's perspective, the accurate characterization of competitive forces and their concentration are key ingredients in the assessment of the marketplace.<sup>31</sup>

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<sup>30</sup> Mark Hirschey, *Managerial Economics*, 12<sup>th</sup> Edition. Cengage Learning, 2009, p. 511 (emphasis added).

<sup>31</sup> See Hirschey, *Managerial Economics*, p. 536.

## Appendix A - Description of Data and Data Tables

### Data Source Analysis:<sup>32</sup>

The FCC, under a nondisclosure agreement, provides California-specific data for wireline, wireless, and VoIP<sup>33</sup> telephone, and broadband subscribership data to the CPUC approximately every six months.<sup>34</sup> For our analysis here, CD staff primarily utilized data sets from the FCC's Form 477.

### FCC Form 477

We used Form 477 data to calculate consumer communications access subscribership statistics at the state and, to a limited extent, ZIP code levels.

Form 477 data includes company-specific data on:

- the total number of voice grade (wireline) telephone subscribers and the percentage that are residential;
- the total number of interconnected VoIP subscribers and the percentage who are billed directly by the reporting company;
- the total number of wireless subscribers and the percentage who are billed directly by the reporting company;
- and the total number of broadband access subscribers and the percentage who are residential.

### Wireless Broadband/Mobile Data Connections

Included in the totals of broadband connections reported on Form 477 is a relatively new and rapidly expanding consumer communications broadband access service, wireless broadband (also called mobile data). Some 42% (nearly 7 million) of the 16.5 million California broadband connections reported in Form 477 data from December 2009 were mobile broadband connections, provided by wireless carriers to laptop computers, notebooks, and "smart phone" devices such as iPhones, Android smartphones, and Blackberries.<sup>35</sup>

One consequence of this trend is that the number of "residential broadband connections" reported in Form 477 does not identify the number of households with broadband service. Certainly there are a substantial number of mobile wireless subscribers who also subscribe to a separate fixed-location broadband connection within their homes. Some of these are within service bundles from one carrier, while other consumers could be customers of several communications companies.

Until December 2008, mobile broadband service providers reported the number of capable *devices* on FCC Form 477. Beginning with the December 2008 cycle, mobile broadband providers began reporting only those handsets where *subscribers* actually purchased a mobile broadband plan. We have elected to

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<sup>32</sup> While CD staff uses FCC Form 477 data in this report, traditional market analysis may employ revenue data. However such data is available through the FCC's Automated Reporting Management Information System (ARMIS) and only the largest local telephone companies are required to submit ARMIS data.

<sup>33</sup> The FCC defines "voice telephone service" as local exchange or exchange access services that allow end users to originate and/or terminate local calls on the public switched telephone network, whether used by the end user for voice telephone calls or for other types of calls carried over such network. <<http://www.fcc.gov/Forms/Form477/477inst.pdf>>

<sup>34</sup> The FCC requires Form 477 reporting of all facilities-based providers of broadband connections to end-user locations; local exchange carriers, including resellers as well as facilities-based carriers (including cable and VoIP); and commercial mobile radio service providers that serve mobile telephone service subscribers using licensed spectrum. <<http://www.fcc.gov/form477/>>

<sup>35</sup> FCC Form 477 classifies these connections as "terrestrial mobile wireless."

omit the pre-2008 data from the overall market analysis; prior to 2008, this metric did not provide usable data on actual customers utilizing the service.

The FCC uses Form 477 data to calculate summary statistics of subscribership in consumer communications services, which it publishes in its *Local Telephone Competition*, *High-Speed Services for Internet Access*, and annual *Commercial Mobile Radio Services* reports.<sup>36</sup> CD staff analysts utilize Form 477 data to calculate consumer communications access subscribership statistics at the state level.

Companies with wireline telephone and/or broadband customers also provide lists of the ZIP codes in which they have at least one customer. Although the Form 477 data allows us to determine the total number of wireline telephone subscribers, VoIP subscribers, broadband connections, and wireless accounts billed directly, certain limitations in the data prevent a more thorough analysis that could include service type, customers of service bundles, or measures of market concentration at a city or county level.

- Limited detail is provided as to type of service a company's customers subscribe to over its lines/connections (i.e. basic vs. premium, or flat vs. measured, whether a voice service supplements another rather than replacing it);
- Form 477 data does not specify whether a company's voice customers also subscribe to broadband connections as part of a bundle, as opposed to stand-alone subscriptions.
- Lack of geographic granularity precludes analysis of smaller geographic "markets" by region or population center. Many companies concentrate their business in one or several specific areas, thus each company's share of subscribers may vary from region to region, even neighborhood to neighborhood.
- Prior to December 2008, figures were inflated by counts of devices rather than subscribers. Thus we show data as of that date, other wise the data would be skewed.

### **Form 477 Customer Type Reporting and Threshold Changes**

The reporting requirements for Form 477 changed between December 2004 and June 2005. First, the reporting threshold of 10,000 voice grade equivalent lines for wireline telephone and wireless subscriber, and 250 connections for broadband, were eliminated so that all carriers report Form 477 data, regardless of the size of their subscribership. This increased the total number of reporting entities and the total numbers of connections and subscribers. Additionally, the FCC amended the requirement to indicate what percentage of total subscribers were residential or small business customers.<sup>37</sup> This has added quite a large number of new participants to 477 data. In 2009, some 30% of entities had fewer than 10,000 voice grade lines or fewer than 250 broadband connections. However, because the number of subscriber lines is small the impact of the reporting change for purposes of calculating the HHI should be negligible.

### **Form 477 Addition of Interconnected VoIP Reporting**

December 2008 was the first reporting cycle of FCC Form 477 data to include a category for VoIP services. The FCC defines Interconnected VoIP as a "service that enables real-time, two-way voice communications; requires a broadband connection from the user's location; requires Internet-protocol compatible customer premises equipment; and permits users generally to receive calls that originate on

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<sup>36</sup> Federal Communications Commission Local Telephone Competition and Broadband Deployment webpage <<http://www.fcc.gov/wcb/iatd/comp.html>>

<sup>37</sup> *Report and Order In the Matter of Local Telephone Competition and Broadband Reporting*, rel. November 12, 2004 (FCC 04-266) <[http://hraunfoss.fcc.gov/edocs\\_public/attachmatch/FCC-04-266A1.pdf](http://hraunfoss.fcc.gov/edocs_public/attachmatch/FCC-04-266A1.pdf)>

the public switched telephone network and to terminate calls to the public switched telephone network.” As of December 2008, VoIP services provisioned by cable service providers over coaxial cable are classified and reported to the FCC as VoIP lines.<sup>38</sup> Following that date, the wireline market concentration increased because of the migration of cable-provider’s digital voice service subscribers to VoIP service. Time Warner Cable and Comcast transitioned their product to VoIP service and coincidentally, the FCC required VoIP reporting. Thus for the traditional wireline voice market, the largest ILECs, AT&T and Verizon gained market share in the wireline sector even though their subscribership declined.

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<sup>38</sup> <http://www.fcc.gov/form477/inst.htm#hotlink3>>

## Data Tables:

The graphs depicted in the text are based on the following data tables.

### California Communications Subscribers By Technology in Millions of Subscribers

	Total	Wireline	Voice	VoIP	Broadband	Fixed
	All Services		Wireless		Mobile	
June 2001	40.7	24.8	14.2			1.7
June 2002	42.9	24.5	15.9			2.6
Dec 2002	44.6	24.2	17.4			3.0
June 2003	45.8	23.7	18.7			3.5
Dec 2003	48.1	23.5	20.4			4.2
June 2004	49.5	23.2	21.6			4.7
Dec 2004	51.9	23.0	23.5			5.4
June 2005	53.5	23.0	24.6			5.9
Dec 2005	54.9	22.6	25.6			6.7
June 2006	57.3	22.4	27.5			7.4
Dec 2006	59.7	22.0	29.7			8.0
June 2007	60.1	21.4	30.2			8.5
Dec 2007	60.3	20.8	30.6			8.8
June 2008	59.4	20.2	30.0			9.1
Dec 2008	65.8	18.7	32.2	2.2	3.5	9.2
June 2009	66.6	17.7	32.2	2.5	4.8	9.4
Dec 2009	69.9	16.8	32.9	2.7	7.0	9.6

Required subscriber reporting for VoIP and mobile broadband began December 2008; Prior to this VoIP was not reported while mobile broadband reported capable handsets rather than subscribers. sources: FCC Form 477 filings, June 2001 - December 2009

### HHI Market Concentration by Technology Adjusted for Parent Companies

	Wireline Voice	VoIP	Fixed Broadband	Mobile Broadband	Wireless Voice
June 2001	5,711		2,396		2,318
June 2002	5,438		2,091		2,212
Dec 2002	5,110		2,108		2,107
June 2003	4,885		2,058		2,019
Dec 2003	4,699		2,029		1,899
June 2004	4,577		2,069		1,826
Dec 2004	4,503		2,034		2,391
June 2005	4,453		2,218		2,354
Dec 2005	5,399		2,369		2,569
June 2006	5,097		2,259		2,558
Dec 2006	5,009		2,340		2,532
June 2007	5,018		2,340		2,509
Dec 2007	4,939		2,295		2,495
June 2008	4,816		2,236		2,535
Dec 2008	5,061	1,732	2,188	3,528	2,483
June 2009	5,066	1,715	2,187	3,476	2,470
Dec 2009	5,013	1,595	2,171	3,114	2,477

sources: FCC Form 477 filings, June 2001 - December 2009

### HHI Market Concentration by Technology Adjusted for ILEC and Cable Service Territories

	Wireline Voice	VoIP	Wireline Voice + VoIP	Wireless Voice	Fixed Broadband	Mobile Broadband
June 2001	9,119			2,318	4,587	
June 2002	8,862			2,212	4,796	
Dec 2002	8,546			2,107	4,216	
June 2003	8,509			2,019	4,220	
Dec 2003	8,319			1,899	4,251	
June 2004	8,139			1,826	4,272	
Dec 2004	7,964			2,391	4,269	
June 2005	7,771			2,354	4,553	
Dec 2005	7,757			2,704	4,593	
June 2006	8,022			2,558	4,666	
Dec 2006	7,832			2,532	4,676	
June 2007	7,902			2,509	4,714	
Dec 2007	7,715			2,495	4,694	
June 2008	7,524			2,535	4,664	
Dec 2008	7,866	1,732	6,446	2,483	4,710	3,528
June 2009	7,868	1,715	6,291	2,470	4,737	3,476
Dec 2009	7,794	1,595	6,137	2,477	4,733	3,114

sources: FCC Form 477 filings, June 2001 - December 2009

### HHI Market Concentration for Intermodal Voice and Total Market Adjusted for Parent Companies

	All Subscribers	Voice Only	Wireline + VoIP
June 2001	2,878	2,926	
June 2002	2,591	2,651	
Dec 2002	2,339	2,407	
June 2003	2,175	2,246	
Dec 2003	2,015	2,085	
June 2004	1,847	1,900	
Dec 2004	1,873	1,955	
June 2005	1,837	1,906	
Dec 2005	3,066	3,347	
June 2006	2,916	3,164	
Dec 2006	2,852	3,038	
June 2007	2,832	3,028	
Dec 2007	2,754	2,956	
June 2008	2,758	2,982	
Dec 2008	2,592	2,747	4,094
June 2009	2,579	2,713	3,994
Dec 2009	2,537	2,675	3,881

sources: FCC Form 477 filings, June 2001 - December 2009

## HHI Market Concentration for Intermodal Voice and Total Market Adjusted for ILEC and Cable Service Territories

	All Subscribers	Voice Only	Wireline & VoIP
June 2001	4,008	4,002	
June 2002	3,631	3,617	
Dec 2002	3,222	3,268	
June 2003	3,026	3,068	
Dec 2003	2,786	2,813	
June 2004	2,608	2,622	
Dec 2004	2,328	2,338	
June 2005	2,267	2,249	
Dec 2005	2,481	2,418	
June 2006	2,418	2,402	
Dec 2006	2,287	2,260	
June 2007	2,255	2,225	
Dec 2007	2,181	2,150	
June 2008	2,155	2,132	
Dec 2008	1,911	1,914	6,446
June 2009	1,862	1,868	6,291
Dec 2009	1,801	1,830	6,137

*sources: FCC Form 477 filings, June 2001 - December 2009*

## Four-Firm (CR4) Market Concentration Measurements By Technology (Adjusted for Parent Companies)

	Wireline Voice	Wireless	VoIP	Fixed Broadband	Mobile Broadband
June 2001	95%	89%		76%	
June 2002	94%	87%		74%	
Dec 2002	93%	84%		75%	
June 2003	92%	82%		74%	
Dec 2003	92%	79%		73%	
June 2004	91%	77%		73%	
Dec 2004	90%	87%		73%	
June 2005	89%	86%		76%	
Dec 2005	91%	99%		76%	
June 2006	92%	96%		77%	
Dec 2006	92%	96%		81%	
June 2007	92%	96%		81%	
Dec 2007	92%	96%		81%	
June 2008	91%	95%		81%	
Dec 2008	93%	94%	73%	82%	98%
June 2009	93%	93%	74%	82%	99%
Dec 2009	93%	93%	70%	82%	99%

*sources: FCC Form 477 filings, June 2001 - December 2009*

**Two-Firm(CR2) and Four-Firm (CR4) Market Concentration for Intermodal Voice and Total Market Adjusted for Parent Companies**

	All Subscribers		Voice Only	
	<u>CR2</u>	<u>CR4</u>	<u>CR2</u>	<u>CR4</u>
June 2001	69%	88%	70%	87%
June 2002	66%	84%	67%	85%
Dec 2002	62%	81%	63%	83%
June 2003	60%	77%	60%	79%
Dec 2003	57%	76%	58%	79%
June 2004	56%	75%	56%	77%
Dec 2004	54%	76%	54%	79%
June 2005	54%	77%	54%	80%
Dec 2005	70%	87%	74%	93%
June 2006	71%	88%	73%	93%
Dec 2006	69%	87%	71%	92%
June 2007	69%	87%	72%	92%
Dec 2007	68%	86%	71%	92%
June 2008	67%	85%	72%	91%
Dec 2008	67%	83%	69%	88%
June 2009	67%	83%	68%	87%
Dec 2009	66%	83%	68%	86%

*sources: FCC Form 477 filings, June 2001 - December 2009*

## Appendix B - Measuring Market Concentration Explained

The Herfindahl-Hirschman Index (HHI) and Two-firm and Four-firm Concentration Ratios (CR2 and CR4) are three methods for measuring market concentration. Both methods rely on determining the market share of each individual firm within a given market. The HHI and CR both have been used by the Department of Justice and the Federal Trade Commission for evaluating the legality of a proposed merger. Their current Horizontal Merger Guidelines describe the HHI and other standards for determining the likely potential competitive effect of a merger.<sup>39</sup> Horizontal Merger Guideline criteria have evolved to consider information, such as merger efficiencies, cross-elasticity and anti-competitive effects that the HHI methodology alone does not consider.

### HHI

The HHI is calculated by taking the square of each firm's market share, and then adding all of these squared shares together. Where  $n$  is an individual company's total customers and  $t$  is the total number of customers in the market: Market share =  $n / t$

$$\text{HHI} = \sum ((n/t)^2 = \text{the sum of squares of the individual market shares for every company participating in the market} = (n_1 / t)^2 + (n_2 / t)^2 + (n_3 / t)^2 + \dots$$

Often the HHI is expressed as that sum multiplied by 10,000 for a score of 1-10000 points.

For a perfectly competitive market with  $n$  firms and  $t$  total customers, each firm would have an equal share of the market ( $n/t$ ). If  $n = 10$  and  $t = 100$  (10 firms competing for 100 customers), HHI would be then be  $10 * (10/100)^2 = 1$

The HHI for a three-firm market where one firm has 80% of the market while the other two have 10% each would be  $(4/5)^2 + 2*(1/10)^2 = .66$  or 6,660. The HHI for a three-firm market where one firm has 50% of the market while the other two have 25% each would be  $(1/2)^2 + 2*(1/4)^2 = .375$  or 3,750. As the number of competitive firms increases infinite, the HHI approaches zero. This means that a higher HHI indicates a more concentrated, or oligopolistic, market.

Markets in which the HHI is between 1,000 and 1,800 points (0.1000 to 0.1800) are considered moderately concentrated and those in which the HHI is greater than 1,800 points (0.1800) are considered to be concentrated.<sup>40</sup>

### CR2 and CR4

The CR4 is calculated by adding the market shares of the four largest firms in a given market. In a one-firm market, the CR4 would simply be 100 %. In a perfectly competitive market with, for example, 100 firms, the CR4 would be  $4 * (1/100) = 4 \%$ . A similar method is used for CR2, except only two firms are combined. An oligopoly is generally characterized by a CR4 ratio greater than 40%.<sup>41</sup>

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<sup>39</sup> Horizontal Merger Guidelines, U.S. Department of Justice and the Federal Trade Commission, Revised April 8, 1997.

<sup>40</sup> [http://www.justice.gov/atr/public/guidelines/horiz\\_book/15.html](http://www.justice.gov/atr/public/guidelines/horiz_book/15.html); <http://www.economicexpert.com/a/Herfindahl:index.htm>;  
<http://www.justice.gov/atr/public/testimony/hhi.htm>

<sup>41</sup> <http://info.umuc.edu/mba/public/AMBA607/IndustryStructure.html>;  
<http://www.economicexpert.com/a/Concentration:ratio.htm>; <http://www.unf.edu/~traynham/ch14%20edited%20lecture.pdf>

After determining the market shares of individual companies, we calculated the HHI and CR4 for each separate service; for traditional wireline, VoIP and wireless accounts billed directly (wireline + VoIP + wireless); and for all services combined into one “market” (wireline + VoIP + wireless + broadband).

HHI and CR4 measurements provide snapshot views of a market at a single point in time; thus, they are static metrics and do not capture information regarding the nature of competition in the specific market. An historical approach to HHI and CR4, which we have used in this analysis, allows us to observe how market concentration has changed in the time period for which CD has available data.<sup>42</sup>

Several factors justify calculating HHI and CR4 for wireline, wireless and broadband combined: a parent company may own, for example, both a wireline and a wireless service. Many ILECs own both a wireline telephone and a broadband service. Such a situation may reflect intermodal competition, but it does not reflect, and may in fact diminish, the possibility of entry into the market by an unaffiliated competitor in a given area or market segment that can not offer bundled services.

Again, the HHI and CR2 & CR4 measurements are based on numbers reported for the entire state. We recognize that in certain that areas *within* the state smaller companies have larger shares than reflected in a statewide framework (see *Telephone Penetration and Assumptions Regarding Availability of Service*). It is also certain that, although these measurements indicate significant market concentrations on a statewide level, some markets are likely to be even more concentrated *locally* than is reflected in the statewide data. Smaller population centers and rural areas are likely to have fewer choices in service providers. By the same token, in large population centers, the local market may be less concentrated than statewide data would show.

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<sup>42</sup> The URF decision refrained from examining HHI or other market concentration measurements, stating that “market share tests are inherently backward looking and not a good predictor of future developments.” Since CD is concerned with identifying trends in market share since 2006 and before, it is appropriate here to examine these measurements.