Achieving Win-Win in a Regulatory Dispute: Managing 3G Competition

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Abstract

Hutchison Telecom Hong Kong had a problem. The telecoms Regulator, OFTA, wanted to take away some of its spectrum and use it to add yet another competitor into this already highly-competed market. Hutchison perceived that the proposed action would not only be unfavourable for Hutchison, but also for the consumer. But this view hadn't been accepted by the Regulator, when expressed in the form of traditional regulatory arguments. This case study describes how Hutchison commissioned and used a System Dynamics simulator of the Hong Kong wireless markets (2G and 3G, voice and data) to rigorously and transparently quantify the situation. The simulator used 1) interviews with many experts and stakeholders, including the regulator, 2) confidential company data, appropriately protected, 3) judicious calibration against 2G history and 3G plans, 4) optimization of 3G competitor's pricing and investment strategies to "game out" future market evolution, under different regulatory decisions. Sensitivity testing showed that the remaining uncertainties did not alter the fundamental results: The regulator's proposed action would not benefit the public. After due consideration, OFTA dropped its plans and will not bring in more 3G carriers. Both Hutchison and OFTA have done well for their respective stakeholders.

Key words: Regulation, licensing, wireless, competition, spectrum, optimization, calibration, validation, win-win, dynamic simulation

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Introduction: A dissatisfied regulator

In 2003, Hong Kong's regulator, the Office of the Telecommunications Authority (OFTA) was dissatisfied with the pace of development of wireless data services and applications. Hong Kong, 8 million people with a thriving capitalist economy, had, like many Asian countries, achieved 100% wireless penetration through vigorous competition in 2G (second-generation technology voice) wireless. But Japan and South Korea already had thriving data services markets, with 2.5G and 3G technologies that added such services as audio, picture, data and video services to simple voice transmission. They already had numerous and imaginative applications and significant earnings from non-voice services, whereas Hong Kong had significantly less. The Japanese and South Korean services were delivered by the CDMA branch of wireless technology, in contrast to the GSM branch that is used in Europe, somewhat in the US, and for all four 3G licensees in Hong Kong.* Even though OFTA had granted four 3G licenses, only one carrier had launched a 3G service and thus begun to offer advanced services.

And so OFTA proposed in a consultation paper in August 2003 proposing to increase competition, investment and innovation by licensing a 5th 3G competitor to use CDMA technology. Spectrum for the new competitor would come from terminating two licenses for 2G spectrum that were sparsely utilized, since they used technologies that in Hong Kong had been displaced by GSM.

This case study describes the participation of one stakeholder, Hutchison Telecom, in this regulatory process, and their efforts to protect their business interests by analyzing the public interest. This paper is intended to be of interest to government and corporate readers as well as academics. The focus is on the practical organizational and process aspects of the case. References to the full public report, relationships to economic theory and methodological issues are given in the Readings section at the end. As is usual in telecoms, the full story has more complications than are given here. Nothing in this paper should be taken to supersede or modify official submissions on this consultation.

Hutchison Telecom's starting position: Likely true but hard to prove

Hutchison Telecom HK had an especially large stake in OFTA's proposal, being the only carrier that had launched a 3G service, and as well, owning half of the 2G spectrum that suddenly was to be taken back, by unexpectedly not renewing one of one of Hutchison's 2G licenses (their lightly-used CDMA offering. Hutchison's GSM offering, quite successful and in a separate spectrum, was not at issue). Hutchison objected to OFTA's proposal on two main grounds: That it would not benefit the public (as it was OFTA's responsibility to do), and that the rapid termination of 2G licenses violated worldwide precedent in the handling of such matters. Intuitively, extreme competition in a market not yet formed could reduce incentives to invest, and introduction of a

* Terminology has been simplified for clarity to non-experts. The 3G technologies in question are more precisely called CDMA2000 for the proposed licensee, and WCDMA for the existing licensees, who use GSM as their 2G technology.

second wireless technology would further divide the impact of investments. But such arguments, even though based on sound economic principles and business judgment, are very difficult to prove. An interlocking and complex set of markets lies between regulatory action and the downstream consequences for the public (Figure 1), and it is easy for different stakeholders to draw different conclusions.

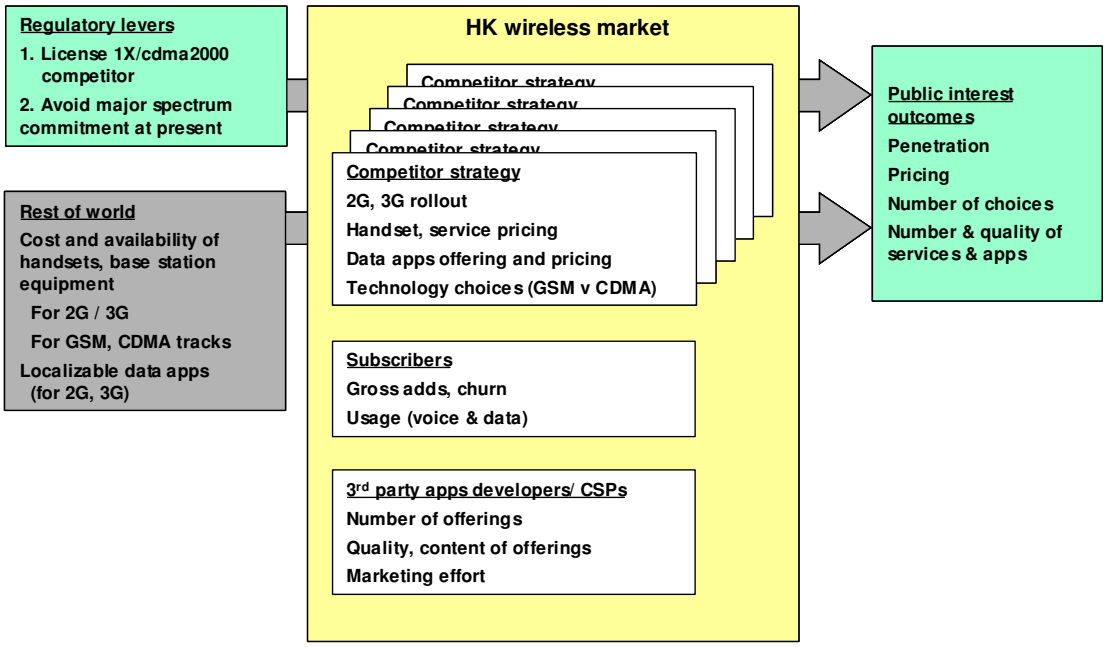

Figure 1. Why proving regulatory positions is so challenging: Complex market dynamics lie between a regulatory action and the impact on public interest.

Regulatory economics disputes, be they over licensing, merger or antitrust, often to have a "blind men and the elephant" character, with each side presenting a partial theory supporting their views, and pieces of evidence in support. Although standards for economic proof exist, they acknowledge that they are only guidelines, and application to specific cases requires considerable judgment. Unfortunately for Hutchison, judgments in the 21st century tend toward "more competition is always better". "Economies of scale" rationales for monopolies or oligopolies are seldom even quantified, let alone incorporated into a complete analysis. (Ironically, the customary level of supporting regulatory arguments would not pass minimum standards of evidence in some courts, as US expert witness testimony, for example). So in practice, the burden of proof was very much upon Hutchison to demonstrate its case. Indeed, Hutchison had made such arguments qualitatively in the first round of regulatory consultations, without changing the OFTA's position. A different approach was needed.

A dynamic model to make the case

Hutchison's outside counsel, Peter Waters at Arculli and Associates was aware that PA Consulting Group had successfully used a dynamic simulation model in a previous case in Hong Kong for PCCW Ltd., the incumbent landline telephone provider. The issue there was unbundling—requiring owners of fibre-to-the-premises to unbundle and rent out such lines to competitors. Analysis showed that unbundling reduced investment incentives, sufficient to impair the rollout of new high-speed (and inexpensive) broadband, and thus harm the public good. With that precedent (and other cases involving standardization) it appeared to Arculli

lawyers and Hutchison executives that a parallel analysis using a dynamic model would prove their case.

So Hutchison and Arculli tasked PA Consulting Group to develop a model of the Hong Kong wireless markets. As is prudent, Hutchison and Arculli created a portfolio of experts and arguments. They engaged well-respected regulatory economists to offer argument in a classic economic framework. And PA was also tasked to investigate the critical success factors behind the early successes of Japan and South Korea in wireless data, and provide positive guidance on what the regulator and others *should* be doing to accelerate the growth of wireless data services in Hong Kong. (It was other factors, not CDMA technology as such. The submission to OFTA discusses them in depth.) Hutchison went to considerable lengths to not only argue its case, but to give to OFTA a constructive assessment of where to take action to benefit the people of Hong Kong.

Constructively engaging the regulator

In a System Dynamics study, after agreeing purpose, scope and method, the actual model building usually starts with qualitative modelling, with the construction of an influence diagram (also known as a causal diagram). The purpose is to validate (with those in a position to know) that the modelling is considering all the relevant variables and the cause and effect relationships among them. In a regulatory discussion, it is important that the views and theories of all the stakeholders be represented in the model so that their importance can be impartially tested.

PA discussed and reviewed theories on how the proposed licensing would impact the 2G and 3G competitors, third party applications developers and Hong Kong consumers. Figure 2 illustrates the same causal diagram overlaid with three different sets of callout balloons, describing three different theories of impact. There was explicit examination of theories with opposing implications: For example, on one hand, more competition should kick-start the transition to 3G and enhanced offerings of data services. On the other hand, a new entrant would not only make applications development more difficult (and interoperability a greater challenge), but also they would need to offer 2G handsets, which would lower 2G prices and slow the move to 3G.

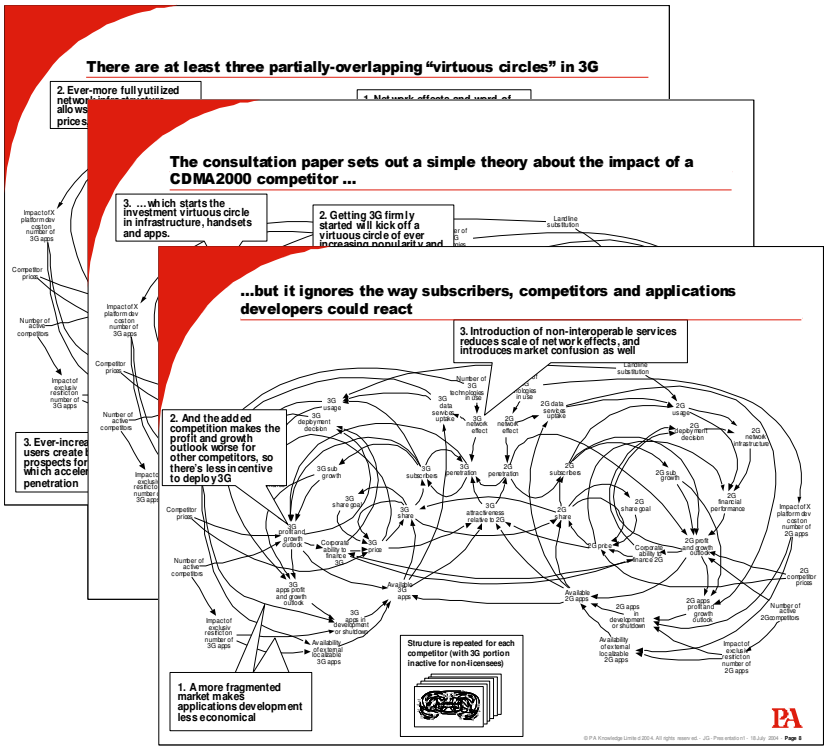

Figure 2. Influence diagrams used to discuss competing theories with stakeholders, including the regulator

PA reviewed the same diagrams and theories with experts from every stakeholder group: Hutchison executives, competitor executives, 3rd party developers, local professors specializing in

mobile markets, and respected regulatory economists. In many cases, interviews gave not only insights on the diagram, but rough estimates for some parameters. OFTA in particular was gracious enough not only to discuss and clarify the thinking of the consultation paper, but also to allow PA to meet with the consultants they'd hired, to exchange views.

It is difficult to overestimate the importance of such discussions. In one meeting with OFTA, we learned that the thinking behind the phrase "compete on innovation" to them meant that they expected that introduction of a new competitor would increase operators' seeding investments in data applications. With that clarification, PA later refined the model to allow explicit applications development by operators (instead of treating it implicitly, as equivalent to reducing price), and included seeding investment decisions in the optimization. (The testing validated the original, simpler approach: The results were fundamentally unchanged.)

Quantifying a new market

When people hear a proposal to model issues involving a highly uncertain future, the nearly universal reaction is "you don't have enough data to predict the future". Assuming that "predict *accurately*" is what they mean, they are quite right. But accurately predicting the future is too ambitious. The purpose of the modelling is to guide action—"People will be better off doing A than doing B". "Hong Kong is better off not licensing a CDMA competitor than licensing one." It is possible to validate such assertions, in several steps of progressive refinement. Quantification phase is only the next step of the many steps of progressive refinement.

As is typical, the quantification step started from an earlier wireless model, whose gross and fine structure was modified to reflect the findings from the interviews, the causal diagrams and the gross characteristics of the Hong Kong market, e.g. market size, number of competitors, approximate market shares and so on. Some sectors were simplified, as the detail was irrelevant to the Hong Kong marketplace issues. We added subscripts to repeat many parts of the structure to represent all of the competitors explicitly (competing in voice and data, over 2G and 3G technologies), more feedback factors around pricing decisions, and a sector representing carrier and third-party development of data services applications and their impact on uptake and usage. A fully simulation-capable model was thus being built from prior information alone, very much in contrast with most modelling methods. This tested the logical completeness of the translation to equations: when simulated, did the decisions collectively lead to market behaviour that is at least sensible?

After quantification, the next step was checking simulated behaviour during the historical period to historical data, as illustrated in Figure 3 (next page). Because the model structure already existed, data for every variable is not needed. Because in a feedback system, variables drive and are driven by many other variables, it is difficult for errors that matter to the overall behaviour, even in an unmeasured variable, to remain undetected, since they will impact measured variables. Validation can be effective using only the normal operating data that corporations and other organizations routinely collect anyway. Accordingly, the interviewing and data collection, for such a major issue, created a relatively small burden for Hutchison executives and staff.

The next step examines future behaviour. Decision-making for 3G markets is based on validated decision-making in 2G markets, with appropriate *a priori* adjustments to reflect the differences in services and technologies. For data, Hutchison had provided well-researched cost projections in a number of different scenarios for their business growth. The simulated behaviour was checked closely against this cost data, and checked for obvious implausibility against views from a number of experts about likely uptake, and for parallels to other markets (for software applications, for example).

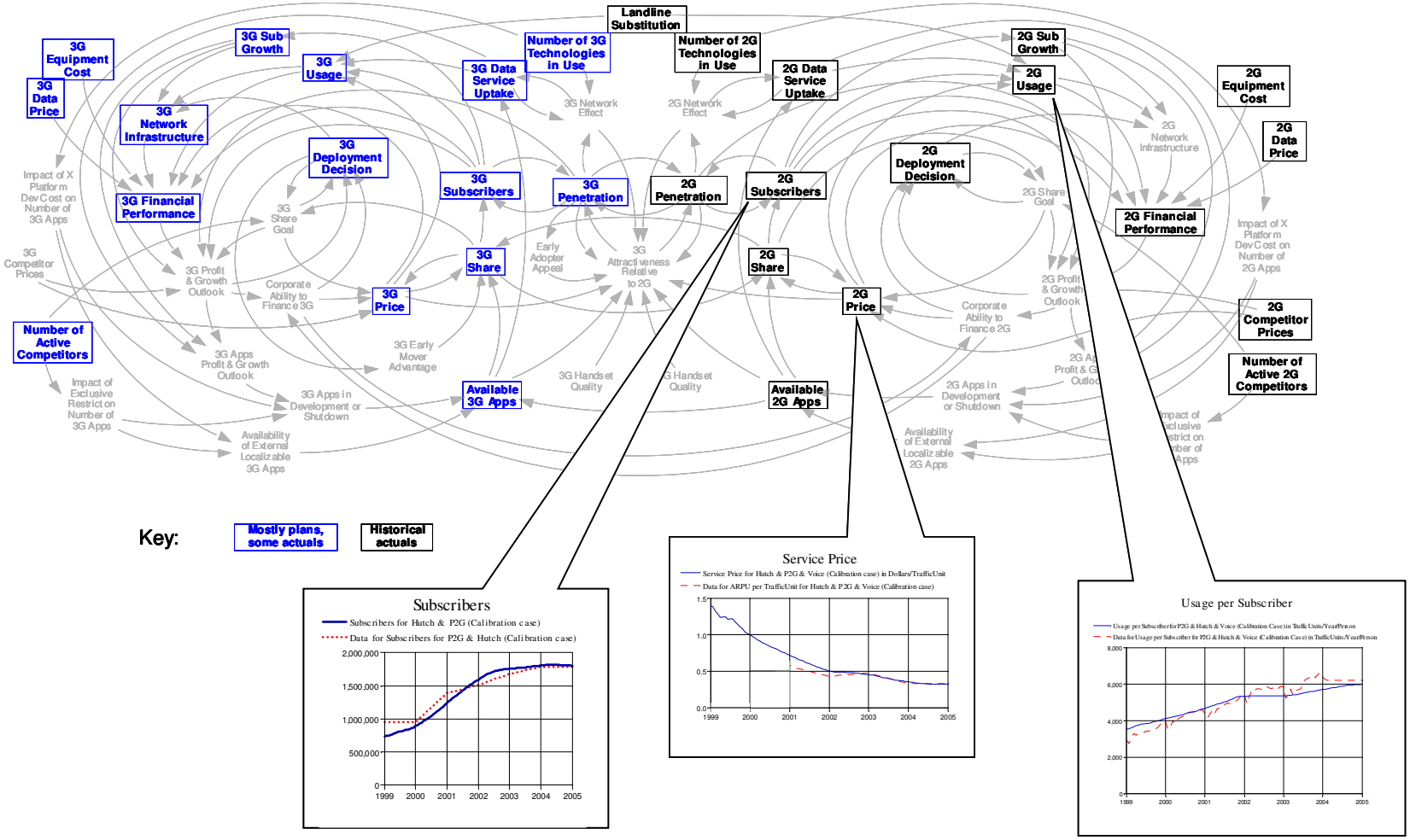

Figure 3. Calibration data (boxes) relative to all principle variables on the causal diagram. Representative plots compare simulation to (here, publicly available) data series.

To refine and validate the representation of future decision-making, pricing and investment decisions of each competitor were optimized, to represent the forward-looking strategic planning going on in each operator's management, gaming out likely scenarios and best responses. Optimization functioned as an additional layer of validation testing. Similar to experience in other cases, optimization identified missing assumptions about extreme cases—because the mechanical search doesn't care if it's unrealistic to push an assumption to an implausible extreme. Optimization also confirmed that the original model formulations constituted reasonable approximations to stakeholders trying to do the best for their company. This use of optimization is precedented but not common in the System Dynamics methodology. When so much about the unfolding of 3G markets had yet to happen, optimization seemed appropriate here, to add another layer of validation.

To optimize simulated decision-making, a software tool (MatLab®) simulated and re-simulated the model to iteratively improve each operator's 3G strategy (maximizing Net Present Value)—how it invested in applications development, and how its 3G pricing should respond to profitability, share behaviour and competitor's pricing during different phases of market development. Each competitor strategy was in turn optimized in a "round robin" iteration until all competitors had their best strategies for responding to the others' best strategies. This is the baseline scenario for analysis.

Even with these successive layers of validation testing, uncertainties remained. These were dealt with through sensitivity analysis, described below.

Controlling Confidential Data

Corporations often hesitate to put forward an analysis-heavy argument, because such analyses are expected to involve commercially sensitive data. The results of a study, after all, will enter the public record, and potentially the Regulator could request to inspect the modelling that lead to the conclusions. Inappropriate disclosure of confidential information could potentially be harmful to the company. Hutchison executives, with PA, evolved a plan to protect confidential company data.

Figure 4 illustrates the plan to protect (and control the revelation of) confidential data through multiple layers of protection, and yet allow the modelling full utilization of the data.

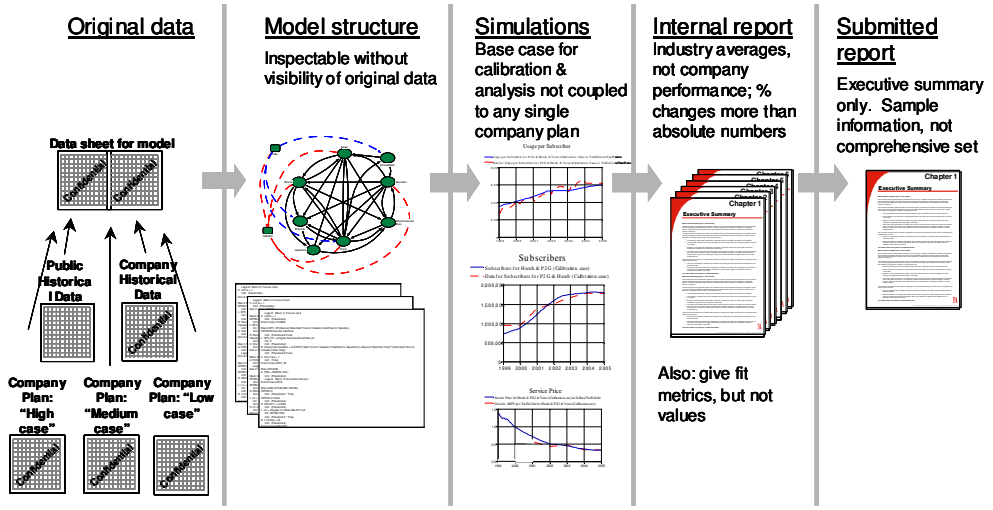

Figure 4. Company confidential data were protected within multiple layers of disclosure

Hutchison and PA could progressively reveal a great deal about the analysis, without revealing the company's actual plans, and at each successive layer, stricter and stricter nondisclosure protections could be used.

Hutchison offered OFTA the opportunity to inspect the whole modelling effort, under appropriate controls, but OFTA declined. Perhaps the offer itself established some credibility.

Assessing regulatory impact

Assessing the impact of a regulatory change calls for a controlled experiment with the model, comparing two scenarios. A base case is one scenario. The second scenario starts from all assumptions being exactly the same, except for the entrance of a 5th licensee with CDMA technology. Then the same simulation and optimization process gives a new scenario. Comparing the two gives the impact of the regulatory actions on the entire system, including public interest-related outcomes like prices, penetration of 3G phones, applications / services (investment, number available and usage by subscribers), and usage of voice and data services.

Rather than choosing just one base case, four "base cases" were used—the four combinations of the major uncertainties for the licensing issue: First, how competitive would the hypothetical new licensee be (strong or weak), and second, whether any existing licensee would change plans and not launch a 3G service (all four 3G GSM licensees launch their services, or one stays out). (A third major uncertainty was how optimistic to be about consumer uptake of 3G phones and data services, optimistic or pessimistic. But OFTA's fundamental assumption was pessimistic—there is no need for action if the market will develop nicely.) For each case, the corresponding new licensee scenario was run, whose results are summarized in Figure 5: Contrary to the theory articulated by OFTA, no outcome was strongly beneficial to Hong Kong consumers in terms of prices, usage and variety of data services, and for many measures in many scenarios the public was arguably worse off. A long list of additional uncertain assumptions were changed one at a time, with the same overall result: No set of reasonable assumptions would produce a significant improvement for consumers.

	Weak CDMA 2000 competitor	Strong CDMA 2000 competitor
All W-CDMA licensees stay in the market	**What happens:** The new operator is a failure, achieving around 5% market share. It puts downward pressure on prices and causes fragmentation of the applications industry, which leads to slower development of applications and slower growth in data service usage **Impact on key metrics:** • 3G penetration – unchanged • Data usage – unchanged • Data pricing – unchanged • Applications development – unchanged • Impact on market development * – unchanged	**What happens:** The market is still underdeveloped when the new entrant arrives. The new entrant takes share of over 50%, using its ability to import new applications. Others respond with increased price cuts. Fragmentation becomes a serious problem slowing down applications development. **Impact on key metrics:** • 3G penetration – unchanged • Data usage – **down 10%** • Data pricing – **down 5%** • Applications development – **down 20%** • Impact on market development * – **delayed approx 1½**
One W-CDMA licensee drops out of the market	**What happens:** The new operator is a failure, achieving around 5% market share. It puts downward pressure on prices and causes fragmentation of the applications industry, which leads to slower development of applications and slower growth in data service usage **Impact on key metrics:** • 3G penetration – unchanged • Data usage – **down 5%** • Data pricing – unchanged • Applications development – unchanged • Impact on market development * – **delayed 1 year**	**What happens:** The market is still underdeveloped when the new entrant arrives. The new entrant takes share of over 50%, using its ability to import new applications. Others respond with increased price cuts. Fragmentation becomes a serious problem slowing down applications development **Impact on key metrics:** • 3G penetration – **down 5%** • Data usage – **down 10%** • Data pricing – **down 5%** • Applications development – **down 20%** • Impact on market development * – **delayed 1 year**

* Market development is measured by time taken for the market to reach 5 billion MB/year of 3G data, typically around 2013.
Note: all percentages rounded to nearest 5%

Figure 5. Public interest outcomes are generally neutral or negative, in all combinations of the major uncertainties

Digging into the causes of the results, one fundamental cause was market and user base fragmentation. With two different ensembles of technologies (the GSM path and the CDMA path), developers will have a harder time creating applications for two different technology infrastructures, and thus for the same potential market develop applications less rapidly—they are developing not only for multiple operators (with, e.g., different billing systems and business arrangements), but also to work with different sets of handsets vendors, handset operating systems and user interfaces, coding and internal communication and controls. In addition, some applications will depend on communicating with other users with a similar application (like instant messaging in the past, and video teleconferencing in the future). With CDMA technology in play, which is likely to be incompatible at first with GSM, the initial groups of interoperating users will each be smaller, the applications less useful, and market acceptance slower. (Such incompatibilities were one factor behind the relative unpopularity of instant messaging in the US, by comparison to Europe, Japan or South Korea.)

The insensitivity of the regulatory impact to many assumptions will not be a surprise to System Dynamics modellers. The behavioural characteristics of feedback systems are often surprisingly insensitive to most parameter changes. For example, room temperature controlled by feedback through a thermostat and a furnace is not terribly sensitive to insulation, fan speed and so on. The temperature stays close to the thermostat's setting. Similarly, in classic static economic analysis, price is controlled by feedback through both supply and demand. If, for example, some outside change lowers the demand curve by 10%, price drops, this somewhat stimulates demand all other things being equal, so the actual demand drop will be less than 10%.

Optimisation in effect adds new feedback loops capable of creating further reducing many sensitivities of outcomes to model assumptions. In addition to feedback effects propagating through time to negate the impact of an assumption or scenario change, optimisation in effect allows a firm to look forward at future alternatives, and change its strategy to compensate for different parameter values and economic or regulatory scenarios. This is like feedback from the future. For example, when there are more competitors, conventional economics says prices will be lower. But the eventual market share, cash flows and contribution to value will be smaller, so there is less incentive to lower prices to "fight for a piece of the pie". So prices tended not to be all that much lower when a new competitor enters the market, at least in the Hong Kong case.

OFTA had hired consultants who undertook to look at economic viability of competitors, under various scenarios of market size, share, and pricing. PA was able to use the simulation model to "back out" the assumptions needed to create the OFTA consultants' scenarios, and evaluate the practical likelihood of each of their scenarios, which added an increment of clarity to that analysis as well.

Conclusion: A mostly win-win outcome

After due consideration of the arguments and evidence, OFTA changed its much of its position on the matter, from:

> The TA sees opportunity to allocate 2 x 10 MHz in the 800 MHz band vacated from the current CDMA and TDMA licences for issuing one new licence.
>
> —OFTA statement of 19 March 2004

to:

> … the Government considers that there is no urgency in introducing a new mobile system using the spectrum vacated by the existing CDMA system.
>
> —OFTA statement of 13 December 2004

OFTA decided to not renew the license for the entire spectrum for Hutchison's 2G CDMA service. They will take back some if it, but will leave enough spectrum for existing subscribers to continue, for at least another three years. (As mentioned earlier, Hutchison's 2G GSM service and spectrum were not in question.) OFTA postponed major spectrum planning for at least three years.

OFTA's change of position marks at least the second time dynamic simulation has been applied to telecoms regulation. Both times have successfully demonstrated a true proposition that was difficult and risky to argue with "weight of evidence" adversarial arguments and conventional economic standards. Numerous antitrust cases in the US and around the world indicate just how uncertain (and controversial) the results of that standard process can be.

Two features of the analyses stand out as critical success factors, and stand in sharp contrast to the standard argumentation approaches.

First, the analysis was even-handed. It started with qualitative modelling and diagramming that encompassed multiple (and often seemingly opposed) stakeholder views. So the later quantitative validation and testing was explicitly taking into account the facts and viewpoints from all parties to the dispute. The model explicitly showed the cause and effect relationships that each stakeholder believed to be important in the outcome. Simulation experiments showed whether or not those relationships in fact dominated the outcome. This is the function of validation and testing.

An additional contribution to the even-handedness came from the non-model based research. Closer examination of the Japanese and South Korean wireless data markets revealed a set of success factors quite different from the regulator's original perceptions. And in the process, the research suggested opportunities for constructive actions to improve Hong Kong's performance. Hutchison was helping, not opposing, the regulator in trying to improve the well being of Hong Kong's consumers.

Second, the analysis was quantitative and end-to-end. Changes in regulatory decisions at one end of the system were translated by sophisticated but strictly mechanical simulation and optimization into measures of the public's well being at the other end of the system. The assumptions were explicit and validated and revalidated, and the results follow in an auditable, understandable way from the assumptions. This form of analysis sets a very high standard for quality of analysis, then meets it, and requires any challenges to be of a similarly high calibre.

In the end, a more convincing argument was made, and OFTA modified its position. The Hutchison team could assure its management, owners and customers that it had obtained a mostly favourable result. OFTA could likewise assure its stakeholders (its parent government agency, consumers and consumer groups) that it too had done the right thing for them—mostly a "win-win" resolution.

Readings

For readers wishing to go deeper than this case study presentation, details and substantiating references can be found in these readings:

Official submissions on this work: http://www.ofta.gov.hk/ >"English" > “Industry focus” > “Mobile Network / Services” > “Consultation Papers & Submissions” >"Submissions" >"2 July 2004" > “Submissions on Consultation Paper for ‘Licensing of Mobile Services on Expiry of Existing Licenses for Second Generation Mobile Services’ - Analysis of Comments Received, Preliminary Conclusions and Further Consultation" >#60 "Hutchison Telephone Company Limited & Hutchison 3G (HK) Limited". This gives the classic economics discussion, the analysis of Japanese and South Korean wireless data services markets, and a report on the simulation modelling, which is the publicly-available executive summary of PA’s full report to Hutchison.

Issues in standard regulatory economics: Graham, Alan K. and Donna D. Mayo. “Deregulation: New understandings, new responsibilities”. *Proceedings of the 2004 International System Dynamics Society,* Oxford, UK. System Dynamics Conference proceedings are available through the System Dynamics website, http://www.albany.edu/cpr/sds/

Criteria for legal admissibility of arguments: Craig A. Stephens, Alan K. Graham and James M. Lyneis, **“**System Dynamics modeling in the legal arena: Special challenges of the expert witness Role. *Proceedings of the 2002 International System Dynamics Society,* Palermo, Italy.

Interviewing, group modelling and consensus building: Sterman, John D. *Business Dynamics: Systems Thinking for a Complex World*. Irwin/McGraw-Hill. 2000.

Brief descriptions of related wireless models: Ariza, Carlos A. and Alan K. Graham, “Quick and rigorous, strategic and participative: 12 ways to improve the expected tradeoffs”, *Proceedings of the 2002 International System Dynamics Conference,* Palermo, Italy. Also Graham, Alan K. Determining the optimum time to launch Push-to-Talk to maximize ROI: The importance of being infectious, in *Proceedings of the 2004 IIR PTT Summit, Lisbon, Portugal.* London, UK: IIR Ltd.

Calibration based on partial information about variables: Appendix of Graham, Alan K., “On positioning System Dynamics as an applied science of strategy, or: SD is scientific. We haven’t said so explicitly, and we should.” *Proceedings of the 2002 International System Dynamics Society,* Palermo, Italy.

Discussion of role of optimization in System Dynamics: Graham, Alan K. and Carlos A. Ariza. “Dynamic, hard and strategic questions: Using optimization to answer a marketing resource allocation question”. *System Dynamics Review* 19(1), pp. 27-46, 2003.

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