

Content Providers, Consumer Choice, and the eGoods Supply Chain

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Burning Questions

Once the last of the new Star Wars trilogy is ready for release, will I have the option of avoiding opening day lines at the theater and instead downloading the movie in real-time to my HDTV set?

Why hasn't TiVo become the craze?

Did you see that NSinc concert last spring on-line?

Do you agree: The rise (and fall) of Napster was the bellwether of future e-proletariat uprisings in the 21st century.

eGoods?

Transferred, copyrighted digital media that can be either *perishable* or *non-perishable*.

By non-perishable it is meant that, once downloaded, files can be accessed on the receiving computer indefinitely.

There are various degrees of perishability:

Digital files may come with a timestamp, indicating the expiration date.

When the expiration date is the same as the time of arrival, the data transmission is said to be *real-time*.

eGoods

What factors govern the proliferation and delivery of content over the web?

eGoods Supply Chain: The Players

- Content Developers - those who create the goods
{examples: reporters, photographers, writers, singers, secrete agents}
- Content Owners - those having (exclusive) rights to digital assets
{examples: Boston Globe, CNN, Sony, Walt Disney/Pixar}
- Content Providers - those having (exclusive) licensed agreements to distribute content *on the web*
{examples: boston.com, CDNow/Listen.com/Music Match, iFilms}
- Consumers - you and me

eGoods Supply Chain: More Players

- Web Hosters - third party, Internet-related, IT outsourcing service. High security/reliability. Service-level agreements/QoS guarantees. {examples: Inflow, VideoBookmark.com }
- Application Service Providers (ASP) - lease software
- Internet Service Providers (ISP) and owners of Internet backbone
- Meta-content Providers - provide information about content, consumer advocates {AdCritic.com, etc...}
- Outsiders - direct consumers to content {Yahoo!, Napster}

Part I: The Supply Chain

- A. Supply Chain Players
- B. My Version of Consumer Choice
- C. Players' Concerns
- D. Supply Chain Contentions
- E. Video-on-Demand

Part II: A Content-on-Demand Scenario

- A. Data-Streaming
- B. Peak Rate Pricing
- C. Inventory Theory: Newsvendor
- D. Variability is not All Bad
- E. Inducing Randomness

A. Parallels with Tradition Supply Chains

Traditional Supply Chain		eGoods Supply Chain	
Supplier/Manufacturer	Intel	Content Creators	Singer
Manufacturer/Distributer	XBox(Microsoft)	Content Owner	Sony
Distributor/Retailer	Circuit City	Content Provider	Listen.com

B. Consumer Choice

Consumer choice includes the following issues relating eGoods and their availability to consumers over the Web.

- What items are available on the web?
- When are the items made available?
- Through what channels are the digital assets delivered?
- How many goods are available at a time?
- Who among the consumers gets the largest selection?

C. Concerns throughout the Supply Chain

In a broad sense, every player in the supply chain is concerned with *ownership*. For instance, consider the ownership over

- **turf** - one's core role in the supply chain,
- **growth** an expanded role in the supply chain,
- **PR** - one's image to the outside world,
- **security** - assets at one's disposal.

C. The Players's Concerns: Web Hosters

Web Hosters often forge relationships with ISPs and owners of the Internet backbone in order to ensure redundancy of fast, transmission paths from their site to end-users.

They exist, not only because companies would like to out-source their web-related operations, but also because they can provide levels of reliability to pooled clients that the clients individually cannot afford.

Parallels can be drawn with Call Centers, Distributions Centers, and the postponement of product-specialization.

In all three, there are **statistical economies of scale** enjoyed from pooling resources.

C. The Players' Concerns: Content Providers

Content Providers are representatives of the owners. As such, they have to aspire to the image of the owner while protecting the owners' assets.

Providers are concerned with what are the best ways to service owners' and consumers' needs while reaping high margins.

C. The Players' Concerns: Content Developers

In traditional settings, **Content Developers** (e.g. artists) often require the services of **Owners** because of high barriers to ownership.

Such barriers include studio time, support personnel, organization, investments, marketing and distribution.

Developers see the Internet as a means to ownership of the content they create.

C. The Players' Concerns: Content Owners

Content Owners possess the lion's share of control in the traditional entertainment supply chain. They would like to keep it that way in the e-goods supply chain.

The owners also have to decide among potential Internet distributors, if not their traditional partners.

The owners would like to keep their copyrighted material under wraps.

D. Intra- and Inter-Supply Chain Contentions

Roles evolve and players feel their ownership is threatened. Interactions between players can be territorial.

Outsiders try to disrupt the chain.

D. Turf Battles I: Napster vs. Music Industry Owners

Napster infiltrated the chain by facilitating a disruption of the Content Owner/Content Provider relationship.

Consumers, without regards to the rights of the Owner, took over the role of Provider.

D. Turf Battles II: Tiger vs. The PGA

It may have seemed petty at the time, but Tiger Woods fought (and won) a battle with the PGA over his image.

He wanted to make sure that he had control over his web presence, a very lucrative prospect.

D. Turf Battles III: Blockbuster/Pay-Per-View vs. ??

Who will Hollywood choose to Distribute movies over the web?

Is it that big of an issue?

IV. Video-on-Demand Consumers want to know....

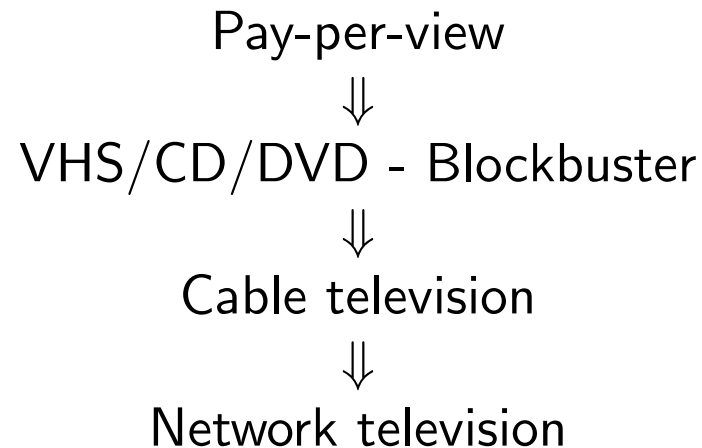
Will we really have true video-on-demand?

When should movies be released?

How long will movies remain “released?”

D. Traditional Release Sequence of Movies

Once a movie has run its course at the theaters, typically the movie is released through progressively less lucrative outlets.



D. Traditional Release Sequence of Movies

Law #1: Typically, the longer the wait for access to a good, the less a consumer is willing to pay for it.

Law #2: Consumers are willing to pay more for exercising flexibility while viewing/listening.

Law #3: As time passes consumer are less anxious to view movies at their discretion.

D. Traditional Release Sequence of Movies

Arguably, movies should be “released” on the web prior to pay-per-view and home/rental video releases.

Not only are the Blockbusters upset for not being able to distribute on-line, their profit margins are being invaded.

What about online release coinciding with the physical release?

How long should a movie stay available on the Web?

Part II: An Example

Consumer Choice, Data-Streaming and Content-on-Demand

Data Streaming is a technology for transferring large data files (typically from movies or music) at a relatively constant speed.

Behavior under data streaming is more predictable and tractable than under standard Internet traffic assumptions.

The Relevant Players

Consumers - crawling over themselves, eager to access the content

Content Provider - weary of costs and somewhat green

Web Hosters - torn between providing reliable service, promoting increases in traffic, and promoting “smooth” traffic

Setting

Consider a Content Provider who uses a Web Hosting service primarily for data storage/retrieval and network access.

The WH has contracted with Internet Service Providers (ISPs) and owners of the Internet backbone for fast reliable connections.

The provider is considering selling subscriptions for access to its digital inventory to Consumers.

Once under subscription, consumers will view the files on a content-on-demand basis.

CP and WH interaction

Paying for Network Access

There are two network access pricing schemes available for customers involved in data streaming:

Payments are directly proportional to the total data sent over the course of, say, one month.

Payments are based on the peak transmission rate and a reservation value made by the CP.

The latter scheme is an attempt by the WH to “smooth” website load through penalizing unbalanced traffic patterns.

CP and WH interaction Peak rate Pricing Model

Prior to usage, the CP *commits* to a target *peak rate* y .

Traffic is experienced over the course of a month and the actual peak, X , is calculated.

The CP pays

$$c_n y + c_p (X - y)^+,$$

c_n is the “normal” price and

c_p is the “premium” or “penalty” price

Rationale behind the Scheme

WH can adjust to anticipated increases in traffic loads.

CP are encouraged to control their traffic patterns.

Effectively, there is a penalty for exceeding the committed value y .

Think cell phones.

Peak Rate Pricing Scheme: Parallels with Inventory Theory and Roses

This commitment/reservation problem is similar to one-shot inventory decisions. Commitments to inventory are made. Demand is experienced and the commitment was either too much or too little.

Take, for instance, a florist around Valetine's Day:

- Before the large holiday rush, the dealer purchases a large portion y of flowers (at c_n per flower) in anticipation of demand D .
- Demand D is realized and $\min(y, D)$ flowers are sold for c_p dollars each
- Leftover flowers are sold for potpourri at an insignificant lower price.

Peak Rate Pricing Scheme: Optimal Inventory Decision

The expected profit maximizing procedure is to purchase enough roses y so that

$$P(D > y) = \frac{c_n}{c_p},$$

where

c_n is the unit cost for over-ordering,

$c_p - c_n$ is the unit opportunity cost for under-ordering, and

$P(D > y)$ is the probability the demand exceeds inventory.

Peak Rate Pricing Scheme: Parallels with Inventory Theory and Roses

	Cost structure	
Setting	Overage Cost	Underage Cost
Internet	c_n	$c_p - c_n$
Roses	c_n	$c_p - c_n$

The two problems are equivalent.

What is this so-called PEAK?

Track the data transfer rate from the website as a function of time, $R(t)$.

Let T be the length of the time horizon. That is, traffic is evaluated over the time interval $[0, T]$.

The peak is the .05-quantile of process $R(t)$ over the horizon $[0, T]$.

$$X = r^*(R, T, .05) = \sup \left\{ r \geq 0 : \frac{1}{T} \int_0^T 1_{\{R(t) \geq r\}} dt \geq .05 \right\}.$$

Research question: What are the effects of changing T or $\alpha = .05$?

Controlling Traffic: Two Scenarios

Consider two Content Providers, each with rules regarding subscribers' behavior.

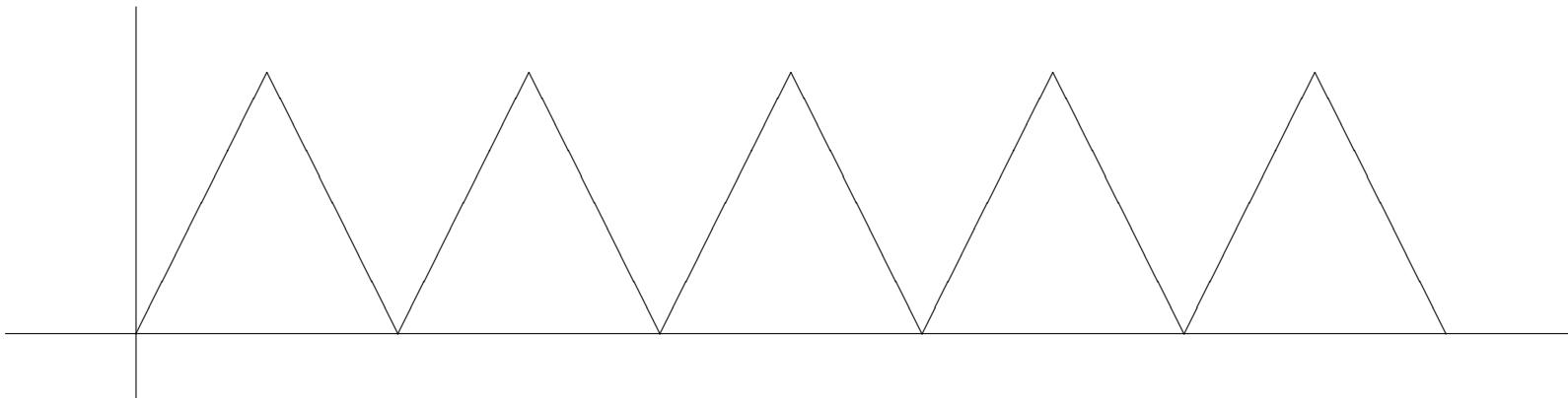
CP1 dictates that users may log on and download music for at most 4 hours each day.

CP2 allots each subscriber a total of 120 hours of downloading time during the month.

The rationale for CP1's restriction is to achieve better performance through tighter controls on user behavior.

Two Scenarios: The Traffic Pattern

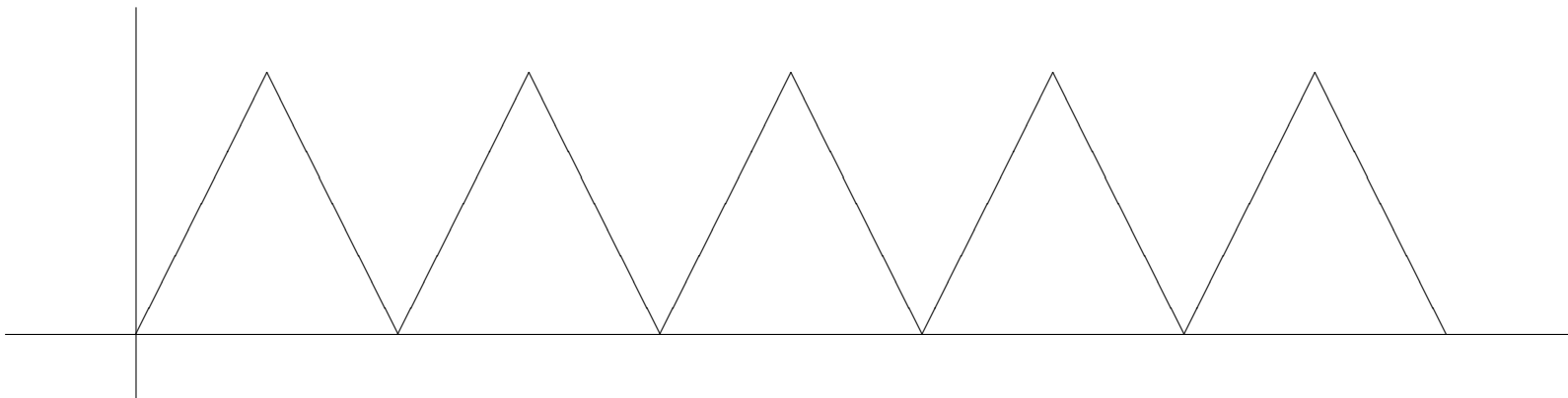
Suppose both providers face the same traffic pattern of arrival of downloading subscribers:



Induced User Behavior

Under the CP1's scheme, suppose users always log on for 4 hours a day.

Under the CP2's scheme, perhaps users log on 0 or 8 hours, arbitrarily.

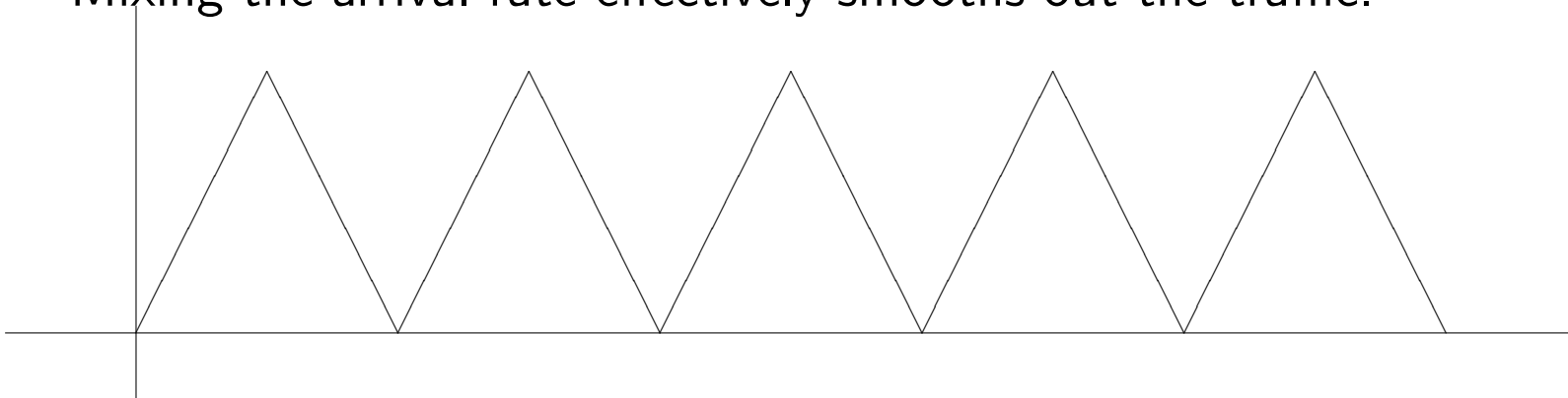


Induced User Behavior

Under the strict scheme, the departure rate of users from the system is the same as the arrival rate exactly 4 hours ago.

Under the flexible scheme, the departure rate of users now is a mixture of the arrival rate over the last 8 hours.

Mixing the arrival rate effectively smooths out the traffic.



Variability is not All Bad!

Conventional wisdom in queueing systems is that variability causes a degradation in performance.

Under our scenarios, randomness on the part of users once they are on the system helps to dampen the variability in which they arrived to the system.

End-of-month effects, can be mitigated via different billing cycles and/or leaky bucket-inspired login protocols.

There is the danger that an important event happens one day and all subscribers flock to the website for simultaneous updates.

Inducing More Randomness

If viewers only have one movie to select, they will all be logged on for exactly the same amount of time.

In addition to removing restrictions from subscribers behavior, Content Providers may opt to provide more viewing options.

The increase in subscribers is probably a welcomed event, even if it is accompanied by increases in load.

Smoothing the Load

Of course, distribution of user download time is perhaps secondary to a more direct method of smoothing the system load:

traffic engineering/website management/dynamic pricing

Perhaps during peak hours of the day, fewer, more expensive movies are available.

Late Night Oldies/Alternative broadcasting/Secondary markets

Comments

Consumer Choice may very well be secondary in the minds of the powers-that-be. However, the primary concerns often have consumer choice ramifications.

“Randomizing” customer behavior means more customer flexibility.

Broadcast events may be more cost-effective than point-to-point transmissions. Hence, true content-on-demand may not be fully realized for a long time.

The eGoods supply chain experiences the same vertical integration pressures as traditional supply chain. Players will continue to spread their influence.

Comments

Expect more battles as players in the traditional supply chain attempt to transcend their physical environment.

Although the Internet allows small content creators to retain more ownership than before, there are still pooling efficiency advantages for large players. Expect a new breed of sophisticated, independents-founded, Content Provider to shorten the gap between artists and consumers.

Traditional owners will also reap the benefit of technological advance. In many cases they will be the source of the advances.

As digital technology improves, so will the speed in the delivery of the content to consumers.