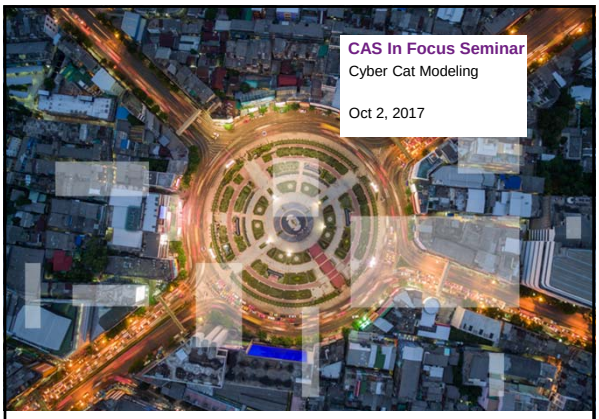


CAS In Focus Seminar
Cyber Cat Modeling

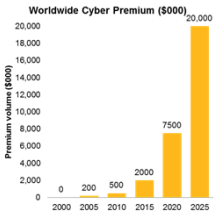
Oct 2, 2017

WillisRe

Cyber – opportunity or threat?

Fastest growing insurance market segment

- However, little available claims data to help determine cyber pricing
- Despite some headline data breach losses in recent years, cyber appears to be a profitable line
- ULRs ratios in 40-60% range depending on composition of book
- This is based largely on data breach experience and exposures are changing rapidly
- Yesterday's claims may therefore be a poor guide for the claims of tomorrow



Source: Various, incl. Willis, Advisen, PWC, Allianz

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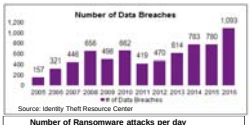
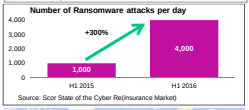
Cyber – a moving target

- Data breach is on the increase
- However, there is a rapid and fundamental shift in loss dynamics from individual breaches to systemic attacks
  - Analogous to fire vs wind or risk vs cat
  - Whole world is one cyber "cat zone"
- Lloyd's/Cyence "Counting the cost" report focused on plausible large loss scenarios for *direct* cyber
  - Largest extreme loss event was hacking of a cloud service provider
  - $53 billion economic/$8 billion insured loss
  - All contingent business interruption
- Cyber attacks such as "Wannacry" and "NotPetya" illustrate potential exposure to business interruption
  - "NotPetya" impacted companies as diverse as
    - Merck: Pharmaceuticals
    - Maersk: Shipping
    - DLA Piper: Legal
- Given wide range of potentially impacted lines, ***silent*** cyber potentially even more of an issue than direct cyber



Source: Identity Theft Resource Center



Source: Scor State of the Cyber Re(insurance Market)

Source: RMS depiction of Amazon Web Services infrastructure

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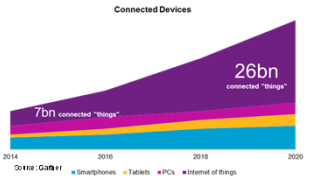
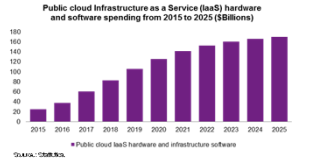
Exposures are only going to grow

- Number of connected devices will more than triple by 2020
- Expenditure on "cloud" infrastructure will quadruple by 2020 and continue to grow rapidly thereafter
- Helps explain dramatic growth in cyber insurance premium projections
- Business interruption exposure from both direct and silent cyber likely to become more acute
- Major implications for aggregation and "Cat" loss potential





Direct vs. silent cyber

Direct cyber

- Standalone cyber policies
- Endorsement on traditional policies

Examples: Privacy liability; Network security liability; Media liability

Silent cyber

- Implicit cyber coverage from non-cyber policies
- Policy gaps in existing cyber exclusions

Examples: Homeowners property; Accident and travel; Personal umbrella

Risk quantification — challenges

- Most models generally more advanced in individual risk scoring / pricing
  - Generally limited by the dearth of historical information
  - Predictive ability constrained by emerging threat vectors
- All models are generally less advanced in assessing correlation, and therefore identifying and quantifying accumulation
  - Currently a heavy emphasis on clouds as respects direct cyber and blackout scenarios (power) across all P&C lines – viewed as the equivalent of peak cat zones
  - Recent Malware and Ransomware scenarios identify operating systems as another significant source of accumulation
- Similar to early-day Property Cat modelling, notwithstanding current limitations of today's cyber models, significant insight and consistency of approach to be gained by adopting a risk management framework informed by modeling
  - Approach endorsed by rating agencies and regulators

Conventional arguments for not modeling Cyber risk

"Not measuring cyber catastrophe risk protects underwriting flexibility"	A company cannot effectively manage its enterprise risk without being able to quantify its cyber accumulation
"The data doesn't exist yet, we will model cyber when the data gets better"	There are many third-party cyber incident and cybersecurity assessment data providers
"Prior events such as cloud provider outages and zero day vulnerabilities had minimal insurance impact so far"	Without actually quantifying the accumulation risk potential of these events across all lines, it's impossible to conclude the insurance impact is minimal

Evolution of cyber modeling

- Early cyber models have been around for several years but the last 12-24 months has seen "analytics arms race" as focus has shifted

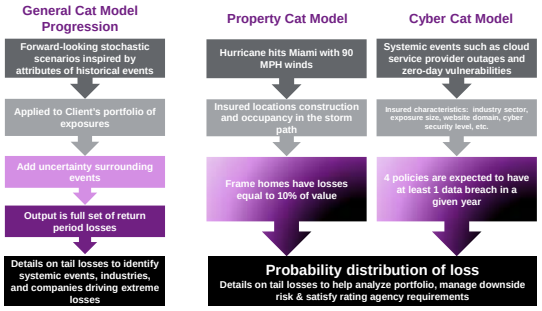
- Stochastic models
  - Willis Re's **PRISM-Re** quantifies downside potential for data breach and business interruption
  - **Cyence** and **Symantec** are scenario based models that focus on the systemic potential
- Deterministic models
  - Willis Re's **eNTAIL**, **RMS** and **AIR** examine the potential severity from specific event characteristics
- **FICO**, **BitSight**, **SecurityScorecard**, **Advisen**, **Corax**, **PivotPoint**, etc. all have models in development

Framework for measuring risk

- Cyber business warrants a Group-level approach given its potential to span the spectrum of P&C lines
  - Requires a framework for measuring direct and indirect exposure in order to establish risk tolerance
  - Fundamental approach is akin to property cat modeling – exposure-based framework required to quantify tail risk
- Multi-model view is essential
  - Cyber modeling is in its infancy with many different approaches to quantifying risk, some of them providing partial answers (eg. cat vs. attritional)
  - Multiple perspectives necessary to begin to build framework for analyzing portfolio and developing strategy
- Focus on calculating PML as a more practical measure of risk quantification than absolute max downside (TIV or TEAL*)

An example of cyber cat model

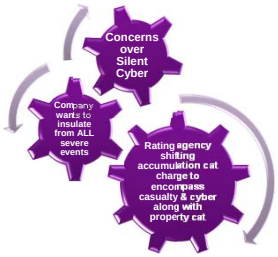
Simulation methodology parallels development of property cat models



Case Study – Large global company - historical view of risk

Cyber never quantified or contemplated in reinsurance purchasing goals or ERM framework

Case Study – Large global company – shift in viewpoint



Client is leveraging external vendor models, benchmarking and expertise to create a more robust view of risk and ERM framework; Satisfying regulatory requirements while insulating capital in severe return periods

Summary

- Cyber is <0.16% of global non-life premium but its impact on (re)insurer oversight and risk management is out of all proportion
  - (Re)insurers want the premium growth but are struggling with risk quantification, especially as it relates to cat risk
- Modelling will help generate market confidence/liquidity over time (much as it did with Property Cat) but there are unique challenges
  - Lack of historical data, changing threats, rapidly growing exposures, business interruption "conundrum" etc
- Silent cyber probably the market's biggest challenge
  - Significant indirect cyber exposure is inherent in all P&C portfolios
  - Development of framework for measurement of exposures
  - Creation of reinsurance alternatives to address net exposures
- Long term goals of cyber models:
  - Moving towards full probabilistic framework
  - Keeping up with the continued evolution of cyber coverage (most recently – CBI, Systems Failure, etc.)

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