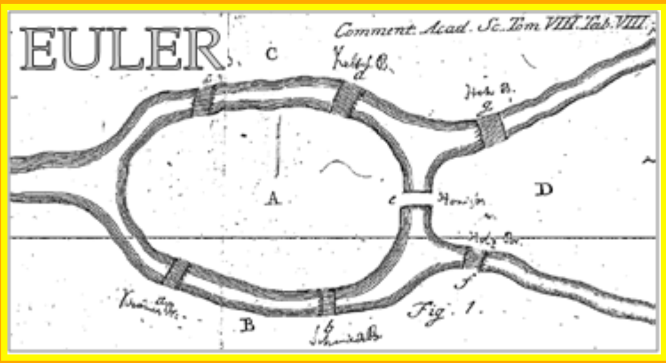


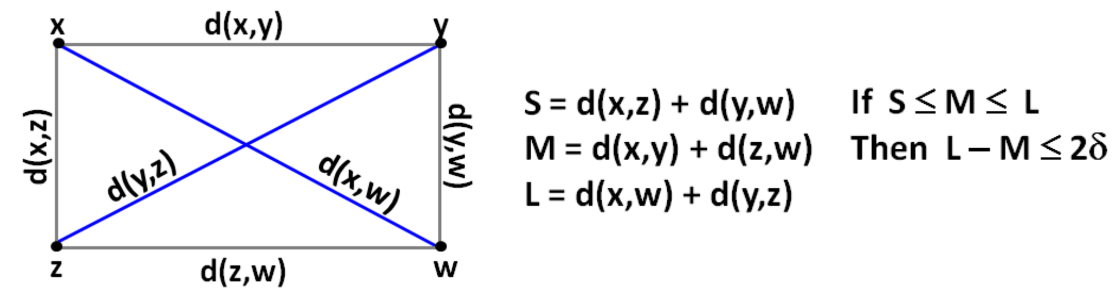
EULER

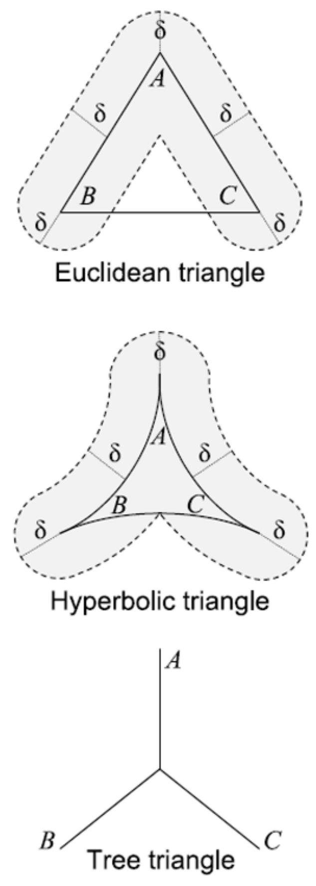
Objectives

- **Unification** of robust **routing** (quasi-geodesic) and **localization** process (mobile content retrieval) while preserving from "reverse path discovery" problem of NDN
- Exploit **geometric properties** of the topology: assign geo-locators to content host (principle "addressing follows topology") without overlay mapping system
- **Multipath route** selection process
  - Not exclusively determined by naming/addressing (compared to mapping systems and NDN)
  - Policing: relies on multi-dimensional parameter space (within certain bounds) for next-hop/routing path selection

Gromov δ-hyperbolic space

- Graph G = (V,E) with distance d_G is **δ-hyperbolic** if metric space (V,d_G) satisfies 4-points condition
  - ∀ w,x,y,z the two larger of d(x,z) + d(y,w), d(x,y) + d(z,w), d(x,w) + d(y,z) differ by at most 2δ ≥ 0

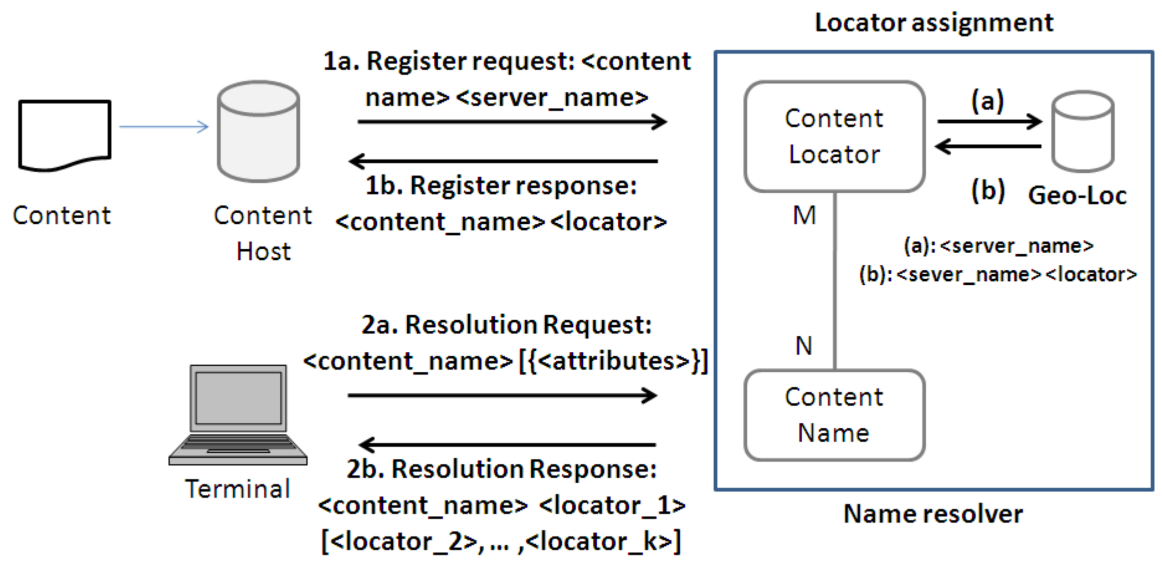




- Intuitively, δ ~ deviation of G from tree-likeness (δ = 0)
- Fundamental relationships
  - Finite graph G: δ ≤ Diameter(G)/2
  - Underlying space curvature κ (≤ 0): δ = ln(1+√2)/ √-κ

Principles

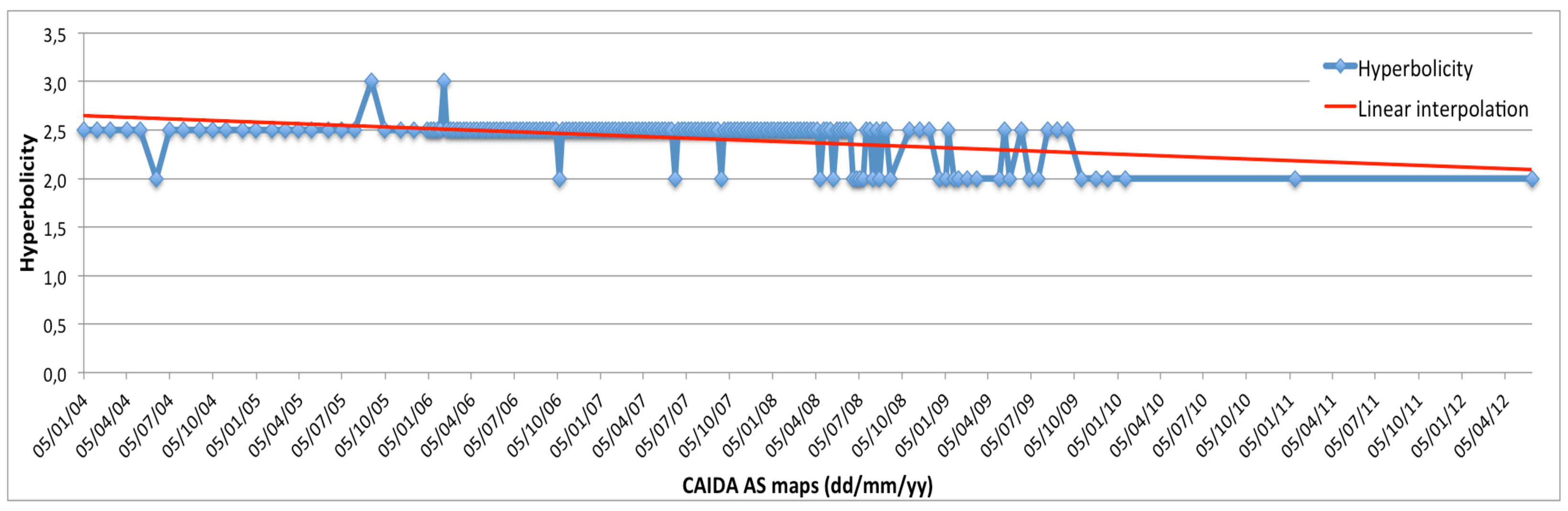
- Associate geo-locator x ∈ X (geodesic space) to content host (server/router)
- Distributed name-to-geolocator registration and resolution process



- Associate distance metric (d) ⟶ geodesic metric space (X,d)
  - From locator x, source y can determine hyperbolic distance d(x,y)
  - Reverse relationship applies from x to y (selection of reverse path)
- **Geometric routing** : end-to-end decision on geo-locators (along geodesic path) while avoiding name-to-locator resolution by intermediate nodes

Internet topology : geometric properties

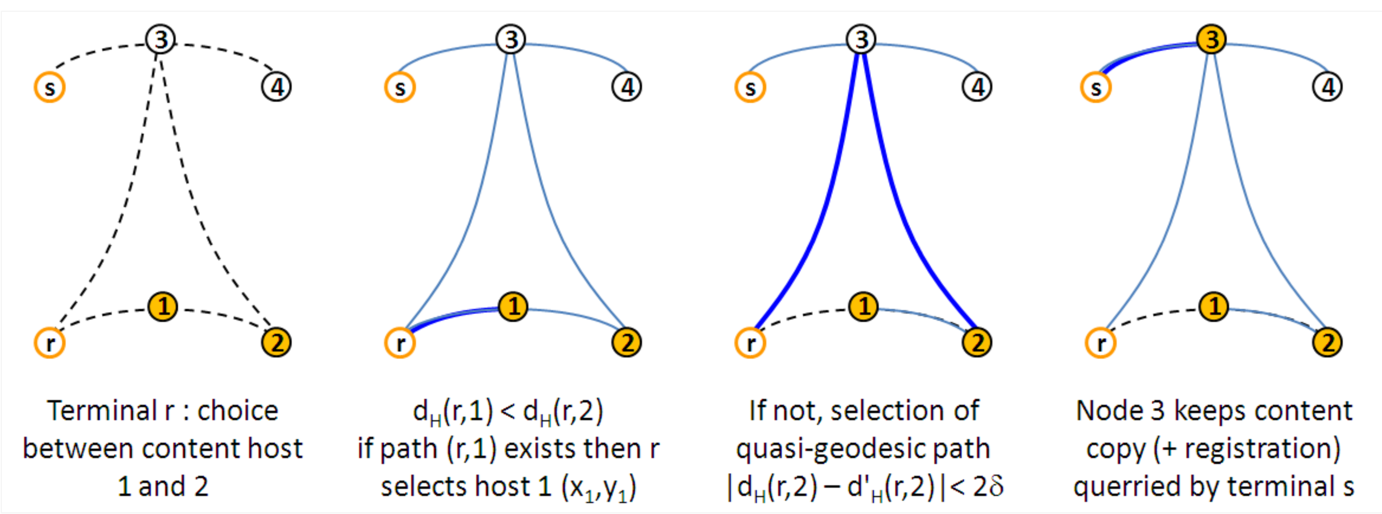
- Graphs underlying Autonomous System (AS)-topology and web graph define metric spaces (X_G,d) with properties
  - **Hyperbolic** ⟶ quasi-geodesics closely follow geodesics
  - δ –hyperbolicity in function of network size (n) ⟶ **quasi-isometric to tree**



- **Routing algorithmic** consequences
  - Geometric routing along local geodesic path (modified distance vector routing)
  - Robust routing along quasi-geodesics with additive stretch up to 2δ
  - Memory space (store routing table entries) ~ √n . succinctness(n)

Geometric routing and Content locators

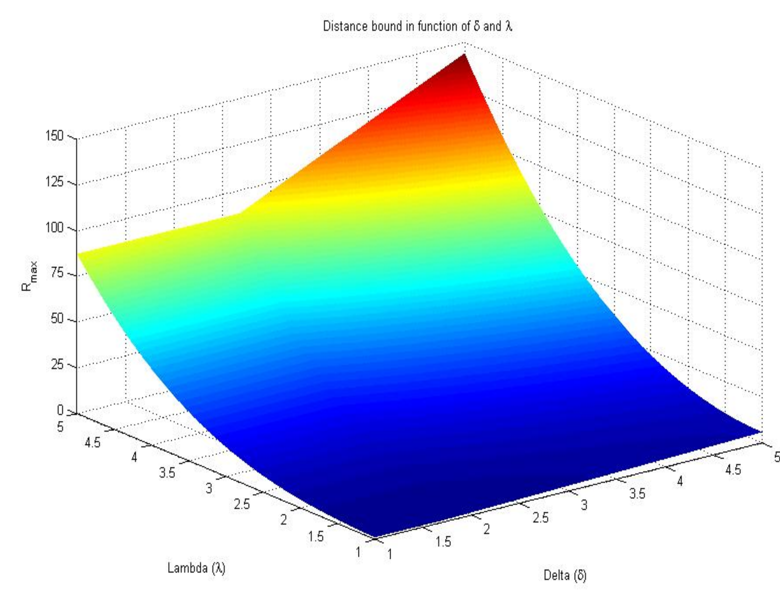
- Content locators substitute to network locators: geometric routing function performs on content locators

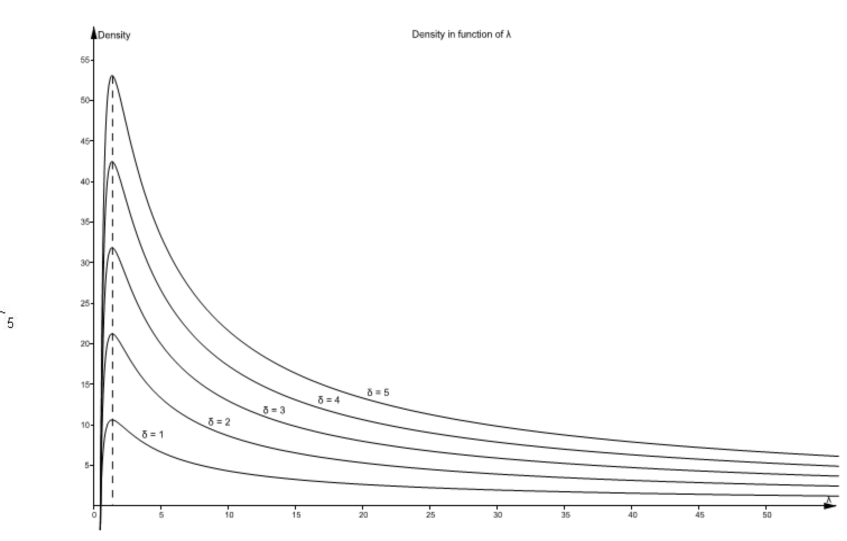


- Content caching: no distinction between server and cache locators (generic application of registration) ⟶ requestor could receive content locator associated to an intermediate node

Exploiting (quasi-)geodesic property

Quasi-geodesic distance bound





Density of quasi-geodesics per unit length

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PROJECT DATA

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- Funding: 3.150 M€

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SEVENTH FRAMEWORK PROGRAMME

Future Internet Research and Experimentation – FIRE
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