Feasibility of a Passenger Rail Travel System between Cranbrook and Golden BC

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Abstract

This paper assesses the feasibility and public value of introducing passenger rail service between Golden and Cranbrook in the British Columbia region, a 300-km corridor broadly aligned with Highway 95 and today served only by highway and freight rail. The study plans to integrate multi-layer demand modeling with network, operations, and equity analysis to answer the questions: (1) What is the potential ridership across tourism and essential travel segments? (2) Under what operating concepts can passenger and freight traffic coexist on shared infrastructure without degrading freight performance? (3) What station, timetable and service design choices maximize benefits relative to cost and risk?

The study estimates demand with a seven-zone origin-destination model, generalized cost summaries of time, monetary cost, access, and reliability, and segmentation of trips into tourism and essential travel. It tests the freight and passenger coexistence through slot planning, scheduled meets, and targeted upgrades to passing sidings across several service designs, including one to four daily round trips using diesel multiple units or locomotive-hauled trains. Preliminary results indicate that coexistence is plausible with disciplined timetables, that ridership is driven by summer tourism and steady regional trips, and that access improves most in communities with few alternatives to private cars. The study provides reusable data templates to support subsequent engineering, cost-benefit, and policy analysis.

INTRODUCTION

Communities along the Golden–Cranbrook corridor rely primarily on Highway 95 for regional mobility. Seasonal congestion, weather-related unreliability, and limited non-auto options constrain access to jobs, education, health services, and tourism assets (national parks, hot springs, and resort towns). Although an active freight railway parallels parts of the route, there is no scheduled intercity passenger rail. Provincial and local stakeholders have periodically explored whether rail could (1) diversify the mobility portfolio, (2) support sustainable tourism, and (3) strengthen economic resilience provided that passenger service can coexist with freight and deliver value relative to cost.

Objective and Area of Focus

This study focuses on evaluating the feasibility of establishing a passenger rail corridor between Cranbrook and Golden through a comprehensive analysis of station placement, travel demand, tourism flow, and socioeconomic impact. The analysis will assess integration opportunities with existing transport networks and identify data-driven recommendations for infrastructure investment and service design.

The key objectives of this study are:

- To identify optimal station locations based on accessibility, population density, tourism hubs, and land use patterns.
- To estimate passenger demand using tourism data, census demographics, and regional mobility patterns.
- To model the economic impact on local businesses and tourism-driven employment.
- To evaluate environmental and transportation equity outcomes of the proposed corridor.

LITERATURE REVIEW

Recent method papers and syntheses emphasize pairing practical forecasting with defensible theory. A TRB synthesis catalogues the state of practice in transit ridership forecasting inputs, models, and validation so practitioners can align methods to data realities. Virginia's VTRC work quantifies elasticities at the stop level, guiding scenario tests. For trip distribution, Cordera et al. show that doubly-constrained gravity models with spatial effects fit rail OD patterns better and simulate station openings and cost changes credibly; they recommend production/attraction constraints and contiguity terms. A modern formulation ties classic gravity deterrence (exponential/power) to generalized linear models and cross-entropy, offering an efficient estimation view; it also motivates ML extensions. Conversely, a recent railway study cautions that gravity performs poorly for predicting flows on individual OD pairs, so planners should avoid over-granular uses.

Determinants of demand consistently center on accessibility, service quality, and land use. A 2025 study disentangles network vs. station accessibility, finding both materially shape the station-area ridership and that local station access significantly affects boardings. A broader review of how to grow ridership highlights internal levers (service, reliability, fare policy) and external ones like land use, parking pricing, echoing agency priorities like network expansion and frequency. A light-rail ridership survey compiles influential variables frequency, reliability, costs, and perceived service quality and how passengers attitudes are measured. At the system level, a DEA-based comparison argues that coordinating rail and road improves overall performance, supporting multimodal integration.

Case and corridor studies translate these ideas into design choices. The Cocoa Intermodal Station study defines a 45 minute driveshed, counts around 1.5 million residents within catchment, and uses 2023 Replica activity-based data to size intercity markets and potential mode shift an explicit, reproducible catchment and the OD approach. The Lehigh Valley Passenger Rail Study lays out feasible service patterns and travel-time targets for New York or Philadelphia markets, providing a template for option screening. The NCRR Commuter Rail Market Study quantifies fare-sensitivity (like lowering fares notably lifts non-work trips) and shows that integrated regional tickets and RTP interlining can materially shift ridership. The Northern Tier Passenger Rail (2024) frames goals like mobility, equity, freight coexistence and evaluates shared-corridor constraints single vs. double track, interlocking spacing, speed differentials so timetables can minimize freight impacts while remaining competitive.

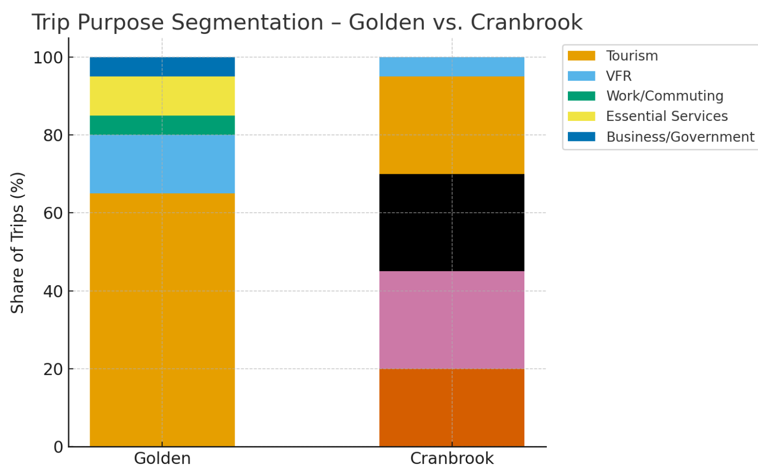
Operationally, shared-use research formalizes dispatching or timetabling as a bi-objective problem, showing that precise meets, siding placement, and disciplined timetables can deliver jointly acceptable performance for freight and passenger. On the benefits side, Canada-wide evidence finds monetized safety, operating-cost, and pollution savings alone exceed annual net costs, with broader jobs impacts when multiple-account evaluation is used. Rail Passengers Association's compiled reports similarly link ridership to visitor spending, VMT, emissions, and IMPLAN-traced multiplier effects especially salient for rural stations that often punch above their population weight.

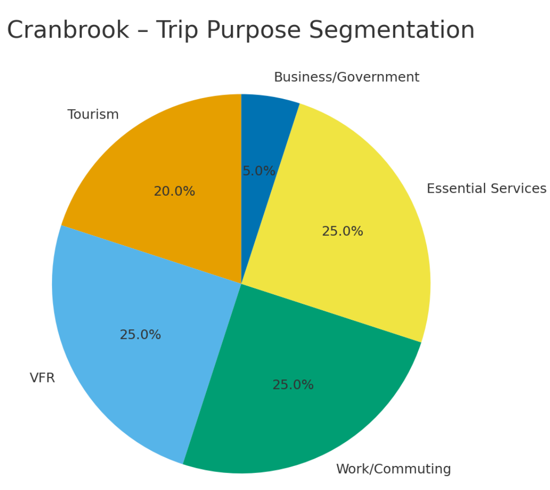
METHODOLOGY

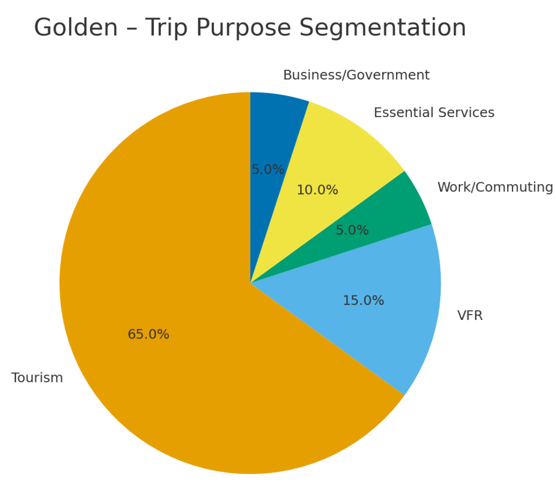
Demand Analysis

The corridor comprises seven communities in a linear sequence from Golden to Cranbrook through Radium Hot Springs, Invermere, Fairmont Hot Springs, Canal Flats, and Kimberley. Trip purpose evidence indicates that Golden is dominated by tourism with a smaller share of visiting friends and relatives, essential services, work or commuting, and business or government travel. Cranbrook shows a balanced mix across those same categories, which points to a steadier year-round base of essential and commuting trips with additional tourism demand during peak seasons.

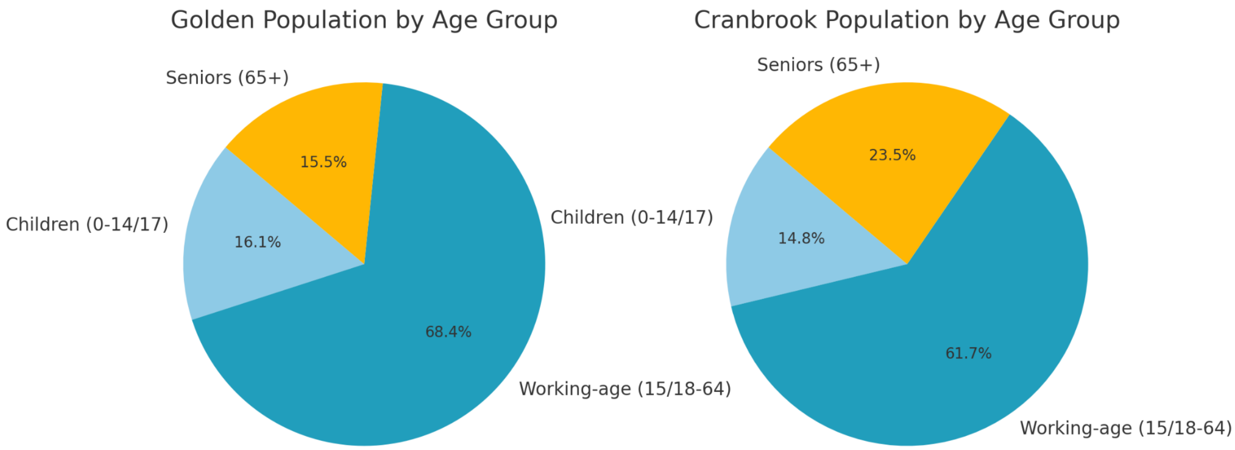
The below charts show the comparison of the purpose of trips between Golden and Cranbrook.

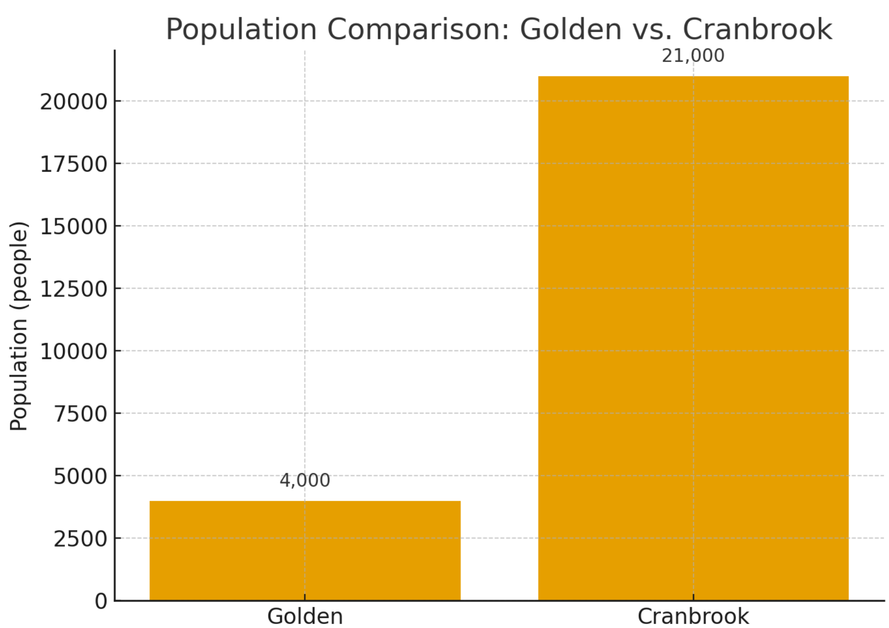






Population context sets overall market size. Golden is a small population center, while Cranbrook is several times larger with a strong working age cohort and a sizable senior population that generates health access and administrative travel.
The charts below show the population comparisons: Overall and between the different age categories.





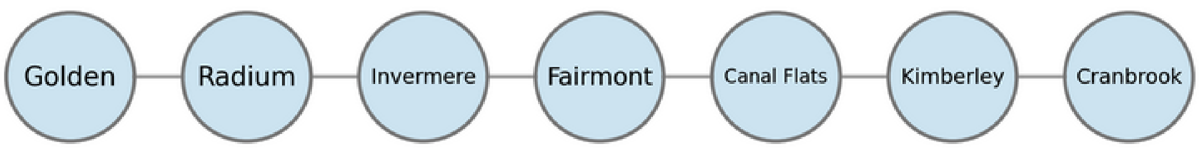
Interplace spacing shapes feasible stop patterns and service spans. Distances are longest between Golden and Radium Hot Springs and between Canal Flats and Kimberley with shorter links among the valley communities between Radium Hot Springs, Invermere, Fairmont Hot Springs, and Canal Flats, and a modest link from Kimberley to Cranbrook. This pattern supports a limited stop regional service that pairs selected station stops with through movements, while local bus connections address short hops.

Ridership Prediction Model

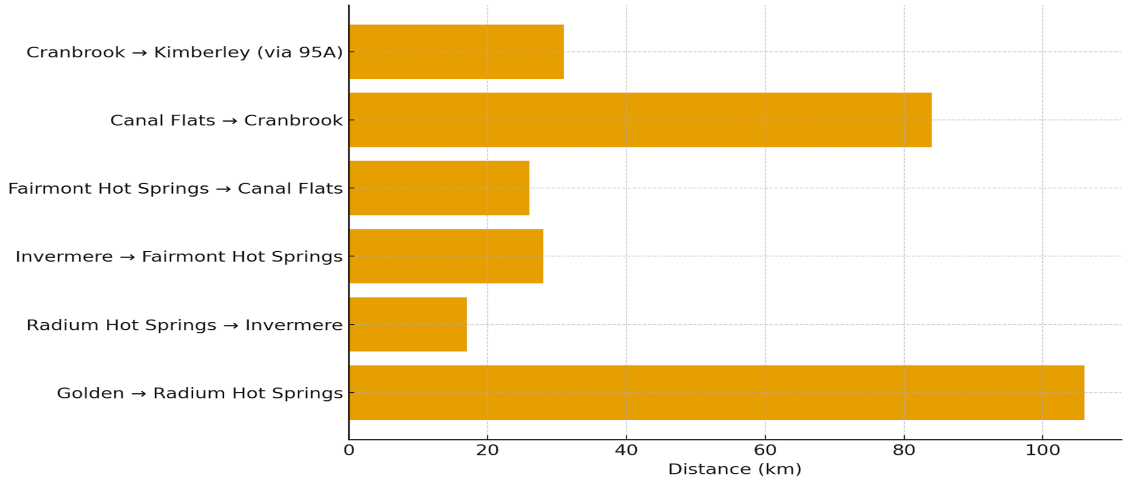
The model delivers corridor ridership as ranges for each service concept. Results are broken down by station pair, by trip purpose, by season, by time of day, and by direction. For each scenario, the model also reports key performance indicators that decision makers actually compare: total annual boardings, peak hour loads on the most constrained segment, seat utilization by train, access time share in total generalized cost, and the change in auto and bus market shares.

Workflow Steps:

1. Define zones and stations
   The seven communities form the base zones. Each candidate station is assigned a walk catchment and a drive catchment. Station access assumptions include typical walk times in town centers and typical drive plus park times in lower density areas.



2. Build seed productions and attractions
   Base year productions and attractions are constructed from population, employment, visitor nights, school enrollment, and health service draws.
3. Calibrate the trip distribution stage
   A doubly constrained gravity based distribution is calibrated so that modeled flows match current road based interactions. Deterrence is based on door to door travel time and out of pocket cost. A spatial term gives more weight to adjacent zones, which matters in a narrow valley where neighboring towns share services.



The distances between each identified location in the Golden Cranbrook route is shown in the table below:

corridor_od_km

	Golden	Radium Hot Springs	Invermere	Fairmont Hot Springs	Canal Flats	Kimberley	Cranbrook
Golden	0.0	103.0	120.0	147.0	174.0	244.0	274.3
Radium Hot Springs	103.0	0.0	17.0	44.0	71.0	141.0	171.3
Invermere	120.0	17.0	0.0	27.0	54.0	124.0	154.3
Fairmont Hot Springs	147.0	44.0	27.0	0.0	27.0	97.0	127.3
Canal Flats	174.0	71.0	54.0	27.0	0.0	70.0	100.3
Kimberley	244.0	141.0	124.0	97.0	70.0	0.0	30.3
Cranbrook	274.3	171.3	154.3	127.3	100.3	30.3	0.0

4. Construct generalized costs by mode
   For personal travel modes, the generalized cost includes in vehicle time on typical days, expected delay in winter, access and egress time for parking, and direct costs for fuel and wear. For existing buses, the cost includes scheduled time, average wait from the headway, transfer penalties where needed, and fares. For rail, the cost includes running time by segment, dwell at stations, expected access time to the station by walk or bus or car, scheduled headway or planned departures, and the proposed fare.
5. Calibrate the mode and service choice stage
   Coefficients are tuned so that the model reproduces current shares between auto and existing bus in the base case. The new rail alternative is then added using the proposed timetable and station set. The mode split responds to changes in speed, frequency, access, cost, and reliability.
6. Seasonalize and segment
   Seasonal profiles use the Golden and Cranbrook tourism and travel patterns. This

produces monthly ridership and shows how many trains (approximate value) should run in summer versus shoulder seasons.

7. Validate and iterate
   The distribution fit is checked against observed interplace interactions, and the mode share fit is checked against any available counts or ticket data. If the model over or under predicts specific flows, deterrence and access inputs are refined. The process repeats until reasonable fit is reached without overfitting.
8. Operational feasibility Screening
   Each scenario is tested against simple capacity rules for the shared corridor.

Environmental Impacts

Seasonal Ridership Analysis

On the Golden-Cranbrook corridor, road usually carries the larger share because it offers door to door access and flexible timing, but rail gains ground wherever generalized cost is closer or lower, especially on the longer OD pairs like Golden to Cranbrook where in-vehicle comfort and steady speeds matter. Winter favors rail in shared terms since snow and variability raise road time and reliability penalties, while rail's schedule is steadier even with small slow-order buffers. Summer still shows more absolute road and rail trips overall due to tourism, yet rail's competitive edge improves when stations have good shuttles or walk access, headways under 90 minutes, and fares that beat per person road cost once car occupancy is accounted for. Road dominates short, local movements and trips with poor station access, while rail performs best for intertown travel with predictable timing and limited parking at destinations. In practice the corridor tilts toward the road today, but targeted rail improvements in access, frequency, and pricing can shift a meaningful slice of longer trips to rail without needing major changes to traveler behavior.

Summer dominates ridership on the Golden-Cranbrook corridor, with June to August totaling about 121.2 index points versus 65.95 in December to February, so summer is roughly 1.84 times winter. July is the peak month, then August and June, while January and February are the lowest. Tourism-heavy zones like Golden, Radium, Invermere, and Fairmont surge most in summer, whereas Kimberley and Cranbrook hold a steadier base from work and essential trips. Winter road slowdowns make rail relatively more attractive on longer pairs, yet absolute riders remain higher in summer because the overall trip base is larger. Operationally this suggests adding capacity, shuttles, and resort partnerships in summer while emphasizing reliability and access in winter.

Engineering corridor analysis

The engineering analysis systematically characterizes the physical and operational features of the existing rail corridor that affect its suitability for passenger services.

First, geometric data on the rail alignment are compiled from public mapping and elevation sources. The line is divided into short segments and for each segment approximate gradient, cumulative elevation change, and curve tightness are estimated. Segments are grouped into broad classes that describe whether they are valley floor, river bank, or side hill, and whether curvature is gentle or sharp.

Second, an operational view is added. The pattern of sidings, siding length, and likely control system is documented to understand how trains meet and overtake today. Based on typical Canadian track safety rules and public information about similar CPKC subdivisions, an indicative track class is assigned for the line. This provides likely maximum speeds for freight and passenger trains. Combined with gradient and curvature, this allows each segment to be classified by its engineering difficulty and plausible passenger speed range.

Third, the analysis identifies engineering sweet spots. These are segments that have gentle gradients, moderate or tangent track, reasonable proximity to Highway 95 and community access roads, and enough length to host stations or sidings. They form a candidate set of locations for new passenger infrastructure because they offer capacity and speed benefits at comparatively low geometric cost.

Habitat and wildlife analysis

The habitat and wildlife component overlays ecological information on the same rail and highway segments. The focus is on the Columbia River Wetlands and associated conservation and connectivity initiatives that run along the corridor.

Wetland and habitat designations are mapped, including the Columbia Wetlands Wildlife Management Area, the Columbia National Wildlife Area units, and the Ramsar site boundaries. Kootenay Connect focal areas, such as the Columbia Wetlands north of Radium, the Columbia Lake wetlands, and the Wycliffe corridor between Kimberley and Cranbrook, are added as key wildlife movement zones. These layers identify where the transport corridor overlaps wetlands of international importance and where cross valley and longitudinal wildlife movement is most critical.

Next, evidence on wildlife vehicle collisions and mitigation is incorporated for Highway 93 and 95. This includes collision rates and herd trends for bighorn sheep near Radium, the location and design of the new wildlife overpass and fencing on Mile Hill, and culvert projects for species such as badgers near Edgewater. Experience from the fenced and bridged sections of the Trans Canada Highway in Banff and Kootenay National Parks is used to calibrate the potential effect of crossings and fencing on collision reduction.

CONCLUSION

The corridor shows clear potential for limited stop regional rail that complements the highway and existing bus network. Demand is anchored by steady essential and commuting trips around Cranbrook and Kimberley, with strong seasonal surges tied to tourism between Golden, Radium Hot Springs, and Invermere. Station spacing and the linear geography support a timetable with a small number of well chosen stops, while local bus links and basic park and ride make short access times achievable for most catchments.

Ridership outcomes are most sensitive to frequency, station access, and disciplined operations. Regular departures and timed local connections reduce waiting and transfer costs, which shifts trips even when rail is only moderately faster than uncongested highway. Dwell discipline, targeted passing capacity, and predictable meets produce the reliability needed to hold market share through winter conditions and peak seasons.

A practical delivery path begins with an operationally feasible base service that passes capacity screens, followed by seasonal boosts aligned to tourism peaks. Early investments should focus on short access times at key stations, one or two passing capacity upgrades at known pinch points, and clear passenger information. As ridership builds, additional frequency or longer consists can be phased in where load profiles indicate recurring constraints. Continued data collection on access times, observed loads, and seasonal patterns will tighten the confidence bands on forecasts and allow timely adjustments to timetables and bus coordination.

Corridor profiling indicates that the existing freight line is physically capable of hosting passenger trains at regional speeds, although geometry and capacity constraints vary by segment. Long valley floor stretches offer gentle grades and moderate curvature, whereas narrower sections near Golden and between Canal Flats and Kimberley impose higher compensated grades and sharper curves that limit speed and timetable flexibility. These findings support a strategy that concentrates new passenger infrastructure in engineering “sweet spots” where tangent track, mild grades, and good road access coincide.

At the same time, the rail and highway corridor passes through a wetland and wildlife system of international significance. The Columbia Wetlands, Columbia Lake wetlands, and Wycliffe corridor play an important role in regional connectivity, and the record of severe wildlife vehicle collisions near Radium and Edgewater shows that transport infrastructure can impose high mortality and fragmentation costs if unmanaged. Experience from Banff, Kootenay, and the current Radium overpass project also shows that well designed crossings and fencing can cut collisions by more than eighty percent and restore permeability.

FUTURE ANALYSIS

Future analysis will apply spatial analysis with GIS to identify potential station zones near key demand generators and underserved areas, followed by cost–benefit modeling that compares capital outlays, travel time savings, and local economic gains. An equity analysis will overlay demographic and socioeconomic data to assess distribution of benefits across vulnerable groups, including rural, Indigenous, and low-income communities. Integration mapping will pinpoint opportunities to link proposed stations with community shuttles, intercity buses, and active transport, informing a station placement strategy that ranks two to three optimal locations using a composite of accessibility, demand, and integration potential. The plan will include tourism-driven service scheduling that aligns frequency and timing with peak visitor inflows, and an intermodal connectivity framework detailing last-mile solutions through existing services and targeted new links.

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